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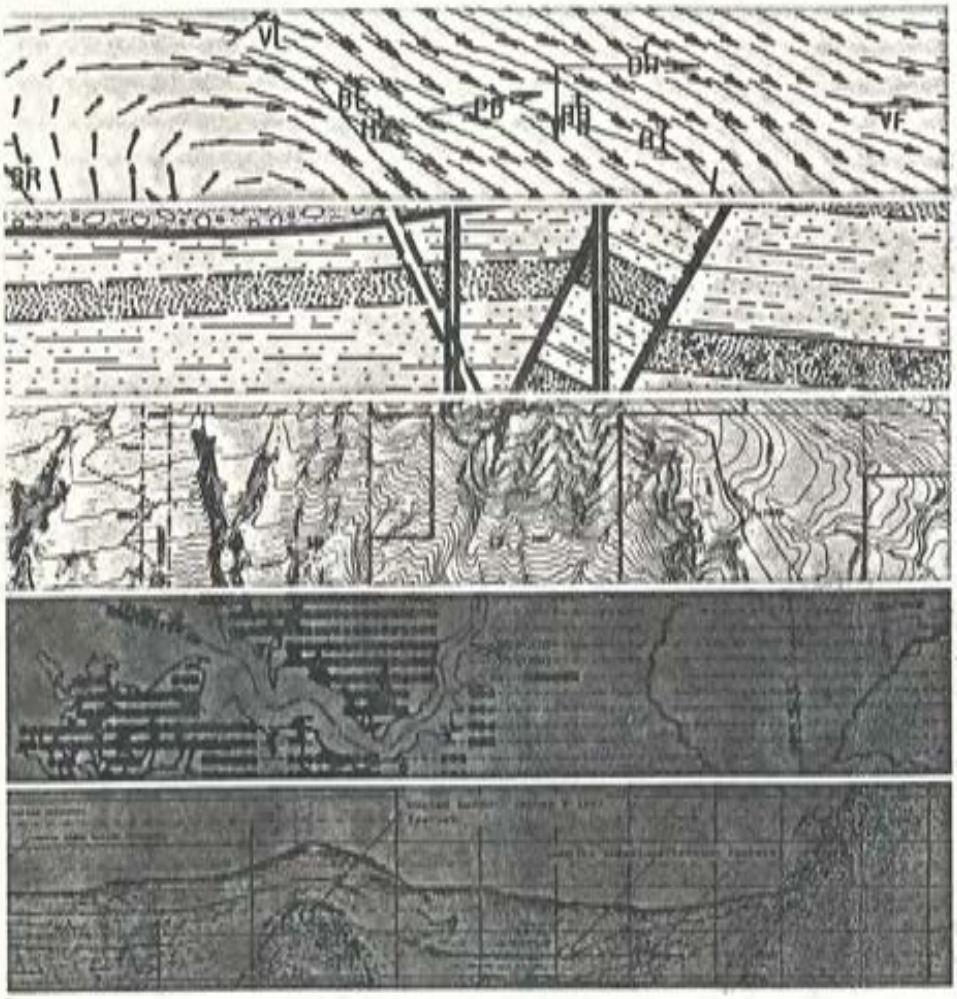

PRESIDIO OF SAN FRANCISCO
STORM WATER MANAGEMENT PLAN
PREPARED FOR THE NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
CONTRACT NO. 1443CX200092035
TASK ORDER NO. 13

Job No. 02050-155-038
October 1994

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I. HydroCAD™ Model Input and Output with Diskette of the Computer Model
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LIST OF ACRONYMS

BMP	Best Management Practices
BOD	Biological Oxygen Demand
c	rational runoff coefficient
CCSF	City and County of San Francisco
CDFG	California Department of Fish and Game
CDROM	Compact Disc Read Only Memory
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
cfs	cubic feet per second
CN	Curve Number
COD	Chemical Oxygen Demand
CWA	Clean Water Act
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EMC	Event Mean Concentration
EPA	Environmental Protection Agency
GGNRA	Golden Gate National Recreation Area
GMPA	General Management Plan Amendment
HMC	Hazardous Material Coordinator
ISCP	Installation Spill Contingency Plan
MCL	Maximum Contaminant Level
mgd	million gallons per day
MHHW	Mean Higher High Water
MPN	Most Probable Number
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NPDES	National Discharge Elimination System Permit
NPS	National Park Service
NURP	Nationwide Urban Runoff Program
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PHSH	Public Health Service Hospital
POL	Petroleum, Oil and Lubricants
POTW	Publicly Owned Treatment Works
PSF	Presidio of San Francisco
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RI	Remedial Investigation
RTP	Richmond Transport Project
RWQCB	Regional Water Quality Control Board

SAP	Sampling and Analysis Plan
SCS	Soil Conservation Service
SIC	Standard Industrial Codes
SRT	Spill Response Team
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
TKN	Total Kjeldahl Nitrogen
TSD	Treatment, Storage or Disposal (facilities)
TSS	Total Suspended Solids
USACE	United States Army Corps of Engineers
WTP	Water Treatment Plant

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION, PURPOSE, AND SCOPE

The National Park Service (NPS), through the Golden Gate National Recreation Area (GGNRA), has prepared a General Management Plan Amendment (GMPA) to guide the transformation of the Presidio of San Francisco from military to civilian use. The GMPA identifies site resources, current land uses, future land use planning issues, parkwide principles and concepts, and strategies for transportation, resource management, and sustainable design. The GMPA also discusses the strategy for managing the Presidio's infrastructure, including the storm water drainage system. At the time this Storm Water Management Plan (SWMP) was prepared, the Draft GMPA was available and is herein referred to as the "GMPA."

This SWMP was developed to assist the NPS in planning and managing storm water facilities at the Presidio. The goal of the plan is to establish a framework for improvement in operation, and maintenance of the storm water drainage system in conformance with federal, state, and local laws and regulations. In addition, the plan was developed in conformance with the requirements of NPS Management Policies (1988) Chapter 4, Water Management, Protection of Surface and Groundwaters, and NPS and Natural Resource Management Guidelines (NPS-77, 1991), Chapter 2, Freshwater Resources. Specifically, the SWMP was developed to assist the NPS in complying with National Pollutant Discharge Elimination System (NPDES) storm water permit requirements set forth in the Clean Water Act, and state regulations. The objectives of the SWMP are as follows:

- Identify drainage (conveyance) system components that are deficient in either capacity or condition and make recommendations for improvement of the system;
- Identify operational procedures and storm water system improvements that will reduce pollutant sources and pollutant concentrations in storm water runoff;
- Provide cost estimates for development of operational, maintenance, regulatory compliance and capital improvement budgets;
- Provide information and guidance for submittal to the RWQCB and guidance for application for National Pollution Discharge Elimination System (NPDES) Permits;

- Provide for the protection and preservation of the natural, cultural, and aesthetic resources of the Presidio, wherever feasible; and

- Perform an evaluation of the existing drainage system using the following criteria:

  - 10-year, 25-year, and 100-year; 30-minute; and 1-hour precipitation for pipes and open channels;

  - 25-year, 30-minute, and 1-hour precipitation for low points in major roads;

  - 100-year, 30-minute, and 1-hour precipitation for major open channels along Tennessee Hollow; and

  - Average annual precipitation for pollutant load estimates.

Several federal, state, and local agencies have jurisdiction over certain construction activities or other operational aspects related to construction and maintenance of the Presidio storm drainage system. The United States Army Corps of Engineers, the United States Fish and Wildlife Service, and the National Marine Fisheries Department have the authority to regulate and permit alteration of navigable waters and the discharge of dredged material or fill into waters of the United States. The California State Historic Preservation Office, Department of Fish and Game, Lands Commission, Department of Transportation, and Water Resources Control Board (through the Regional Water Quality Control Board) regulate activities affecting navigable waters, fish and wildlife habitat, discharges of waste water and storm water to waters of the state, and encroachment within the state highway right-of-way. Two local agencies have the authority to issue development permits associated with development or construction taking place in or near San Francisco Bay and the Pacific Ocean: the San Francisco Bay Conservation and Development Commission and the California Coastal Commission.

The Presidio is not currently required to obtain an NPDES permit for storm water discharges as a municipality or urbanized area; however, this may change if the United States Congress changes the definition of urbanized areas. The San Francisco Regional Water Quality Control Board (RWQCB) has indicated it may request a SWMP for the Presidio. Under state guidance for municipal SWMPs, such a plan typically includes municipal pollution prevention activities, an illicit connection inspection program, controls on new development with regard to storm

water discharges and facilities, public education programs, and designation of those responsible for implementing and enforcing the elements of the plan.

Several individual existing facilities or land uses may require separate NPDES storm water discharge permits (permit for discharge of storm water associated with industrial activities). A Notice of Intent (NOI) to comply with the terms of the state's general permit for industrial dischargers should be filed with the San Francisco RWQCB. In addition, for construction projects involving disturbance of more than five acres, coverage under the state's general permit for discharge of storm water associated with construction activities must be obtained.

1.2 EVALUATION OF EXISTING STORM WATER FACILITIES

Native soils underlying much of the Presidio are sandy, affording good to excellent drainage, relatively low runoff rates, and moderate to high erosion potential where exposed. Historical development at the site has covered substantial areas with paving, buildings, and imported topsoil, disrupting the natural hydrologic regime.

There are three primary watershed basins at the Presidio. The first comprises approximately 210 acres along the western edge of the site parallel to Lincoln Boulevard and is tributary to the Pacific Ocean. The second consists of approximately 875 acres which drain to San Francisco Bay via storm drains in urbanized northern and central portions of the site. The third primary watershed consists of approximately 275 acres tributary to Lobos Creek. The Lobos Creek watershed includes the golf course and most of the southern portion of the site. The latter two watersheds were emphasized because they contain urbanized land uses and associated drainage facilities. In comparison, the western Pacific Ocean watershed is planned as an open space area with minor drainage facilities.

There are over 30 potential hazardous waste sites, including landfills, which have the potential to impact storm water runoff quality. The major sites are generally discussed in Chapter 4. Two sites, one at Crissy Field and one in the Riparian Restoration Corridor area, have the greatest potential to impact some of the components of this SWMP.

The Presidio storm drainage system was constructed piecemeal as land was developed over many decades. Consequently, the system is constructed of various materials and combines open channel flow with piping. The primary storm drain system comprises approximately 37,000 lineal feet of pipe ranging from four to 72 inches in diameter, and approximately 13,400 lineal feet of maintained open channels (lined and unlined). Administration and management of the Presidio storm drainage system has historically been performed by the United States Army; however, responsibility for this system was passed to the NPS in July 1994.

Previous studies of the Presidio storm drain system were reviewed. The purpose of the studies was to assess the adequacy of the system to carry anticipated runoff flows. The assessments included hydraulic modeling of the system and television survey of storm drains to document their physical integrity. The first study (prepared by CH2M Hill) recommended replacement of approximately 15,000 lineal feet to accommodate 10-year design flows. The second study (by Nolte & Associates) validated the modeling results of the previous study. In addition to recommending replacement of the under capacity pipes, the second study identified approximately 2,000 lineal feet of severely damaged pipe.

Dames & Moore completed a detailed hydrologic and hydraulic analysis of the existing Presidio storm drain system to evaluate pipeline capacity, and the potential for attenuation of peak flows through existing and potential future ponds, pipes, and open channels. The HydroCAD program by Applied Microsystems was selected for this portion of the study.

The Presidio was divided into 18 major drainage basins comprising 79 subbasins using topographic and storm sewer maps. Rainfall distributions were developed for several events with varying frequency and duration. A modified version of the Soil Conservation Service TR-20 method was used to generate runoff hydrographs. System physical constraints (pipe diameter, friction loss coefficients, and reach geometry) were considered and the model was calibrated using existing topography and soil types, as well as proposed future conditions described in the GMPA. The hydrologic modeling effort generated peak runoff rates for each modelled event and each subbasin.

The hydraulic analysis included an evaluation of existing pipe capacities, identification of capacity deficiencies, determination of required replacement sizes, evaluation of existing inlet capacities, and evaluation of the potential for detention basins to sufficiently reduce flows in under capacity pipe sufficiently to obviate the need for replacement.

The model indicates that approximately 10,000 lineal feet of storm drain do not have sufficient capacity to handle the 10-year design event, approximately 5,000 lineal feet less than indicated by previous studies by CH2M Hill and Nolte & Associates. This is largely attributable to the use of lower runoff coefficients for open space areas (justified by field observations and observations of Army operations and maintenance personnel). Pipes that exhibited 90 to 99 percent of the estimated design flow were considered to have marginal but acceptable flow capacity, and replacement of these pipes was therefore not considered.

Detention basins were considered as a possible means to reduce peak flows, thereby reducing the need to replace under capacity pipes. Of seven drainage subbasins considered most likely to benefit from detention basins, the use of a detention basin appears feasible in only one subbasin. This subbasin, G.4, is located in the central portion of Crissy Field, and the detention basin would be located west of Building 610 and south of Old Mason Street. A detention basin located in this area could potentially be integrated into the wetlands restoration plan, and could potentially accept and treat runoff from approximately 2,200 lineal feet of Doyle Drive prior to discharge into the wetland restoration area. The feasibility of routing Doyle Drive runoff through the wetland restoration would depend on Caltrans-implemented Best Management Practices (BMPs) achieving an acceptable water quality.

Subbasin inlet capacities were evaluated for using 10-year peak runoff rates. The study indicates that, of a total of 79 subbasins, thirteen have insufficient inlet capacity, and four have marginal inlet capacity. However, many of the existing inlet structures are in poor condition, and few are equipped with bicycle-safe grates.

Low points of major roadways were also evaluated for potential inlet capacity deficiencies using the 25-year storm event. In general, these low points are not susceptible to flooding due to poor inlet capacity, with the exception of Lincoln Boulevard at Bowley Street and Lincoln Boulevard

at Storey Avenue, Lincoln Boulevard at Montgomery Avenue, and West Pacific Avenue at the Park Presidio overcrossing. In addition to inconvenience, flooding at these intersections could result in accelerated erosion. Two other areas are reported to undergo frequent flooding, the Commissary parking lot and Magazine D at Battery East.

Periods of long, intense precipitation at the Presidio could result in accelerated erosion scour, an increase in sediment loads in runoff, sediment deposition in open channels, localized roadway flooding, and overflow at catchbasins. Because intense precipitation is often accompanied by relatively high wind speeds, these problems could be exacerbated by vegetative litter and downed branches which would further obstruct inlets, pipes, and open channels.

1.3 STORM WATER RUNOFF QUALITY

In general, urban runoff pollutant loads vary with time in two distinct ways. The first storms of the rainy season should generate the highest concentrations of pollutants due to accumulation of atmospheric deposition and the activities of man during the extended dry season. Also, runoff generated during the "first flush" of each storm event carries higher pollutant loads for the same reason. In addition, certain land uses generally contribute the majority of pollutants. Industrial, commercial, and major roads are usually the biggest contributors to poor runoff quality.

During the rainy season of 1993-94, Dames & Moore performed a limited assessment of storm water quality at the Presidio. Although not required at this time, the program was developed in accordance with NPDES storm water permit requirements for municipalities. The purpose of the assessment was to develop a basic understanding of pollutant concentrations, identify areas or land uses contributing disproportionate quantities of storm water pollutants, and to provide a baseline evaluation of runoff water quality which can be used to assess the effectiveness of future storm water BMPs. The storm water analytical data were used in conjunction with site-specific precipitation and runoff characteristics to prepare annual pollutant load estimates for the Presidio.

1.3.1 Previous Water Quality Studies

Chapter 6 presents a review of previous water quality studies prepared for the Presidio. Two primary runoff water quality issues are identified. Lobos Creek water tends to contain manganese in excess of the secondary Maximum Contaminant Level (MCL), relatively high concentrations of nitrate (although not in excess of the primary MCL), and high levels of coliform bacteria. Also, studies by the City and County of San Francisco, San Francisco Baykeeper, National Park Service, and the Army indicate an ongoing but diminishing frequency of water quality violations with respect to coliform bacteria in onsite storm drains and in the vicinity of the San Francisco Bay outfalls.

1.3.2 Winter 1993-94 Runoff Monitoring Program

The storm water sampling and analysis program conducted by Dames & Moore for this SWMP focused on overall runoff quality, with particular attention to runoff generated by specific land use types. Six sampling locations were selected as representative of current and planned future land uses at the Presidio. The sampling locations included areas where the primary tributary land use was either industrial, major roads, commercial or institutional, residential, open space, or recreational (the golf course).

Runoff samples were collected from each selected sampling location for a total of three storm events in January and February 1994. Grab samples representative of the first flush were obtained from all locations. Composite samples representative of the overall storm discharge were also collected on a rotating basis in four locations. Samples were submitted to a licensed analytical laboratory for analysis of constituents of concern identified by the State Water Resources Control Board: Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Kjeldahl Nitrogen (TKN), phosphate, oil and grease, the 13 priority pollutant metals identified by the U.S. Environmental Protection Agency (EPA), and coliform bacteria.

The analytical data indicate that runoff generated at the Presidio is remarkably similar to median Event Mean Concentrations (EMCs) calculated by the U.S. EPA based on an extensive

nationwide study of urban runoff quality. Because sampling was conducted after the first storm of the rainy season, the expected seasonal pollutant load relationship is not apparent. Comparison of grab and composite sample analytical data did not generally support the expected difference between first flush and overall runoff quality, although the expected relationship appears to be present for some constituents (COD and TSS).

As expected, oil and grease were consistently detected in samples from the industrial and major road areas. They were also detected in one sample from the commercial area sampling location. TKN was consistently detected in all samples, with the highest concentrations from industrial areas and major roads. Of the thirteen priority pollutant metals, seven were consistently not detected. Chromium, copper, nickel, arsenic, mercury, and zinc were detected, and appear to be primarily associated with industrial areas and roads.

Coliform organisms are rod-shaped bacteria found in the intestinal tract of humans and animals. Escherichia coli (E. coli) is a pathogenic bacteria found in fecal coliform. Coliform bacteria were consistently found in first flush grab samples from every sampling location; however, E. coli counts were significantly lower than total coliform counts for golf course, open space, and major roads samples. Fecal counts in samples from the industrial and commercial areas were highest, ranging up to 300,000 MPN/100mL. Fecal counts from the residential sampling location ranged from 2,400 to 5,000 MPN/100mL. By comparison, the median EMC for fecal coliform is 1,000 MPN/100mL (cold weather) and 21,000 MPN/100mL (warm weather).

1.3.3 Baseline Pollutant Load Estimates

Two baseline pollutant load estimates were prepared: one using U.S. EPA median EMCs, and one using the water quality data generated from the storm water sampling and analysis program. Due to the similarity between the site-specific water quality data and values published by the U.S. EPA, the two baseline pollutant load estimates are similar. However, it should be noted that the estimated annual load for lead using site-specific data is substantially lower than predicted by the U.S. EPA data.

The primary pollutants predicted by the baseline estimates are BOD (approximately 9,000 pounds per year), COD (approximately 60,000 pounds per year), TSS (approximately 80,000 pounds per year), oil and grease (approximately 4,000 pounds per year), and TKN (approximately 1,500 pounds per year). Probable sources of BOD are sewage, oil & grease, and other organic (plant) matter. COD includes all oxidizable materials, such as BOD, metals, and other chemicals. TSS is likely a combination of soil and particulate produced by the activities of man.

1.4 PROBLEM DEFINITION

Based on recent studies of the Presidio storm drain physical system and runoff water quality performed by Dames & Moore and others, the following problems or concerns were identified:

- Segments of the piping and open channel storm drain system are under capacity and/or in poor condition;
- Many catchbasin inlets and manhole structures are potentially hazardous to pedestrians and bicyclists;
- Without adequate screening and compliance review, implementation of some parts of the SWMP could potentially affect sensitive habitats that are home to threatened and endangered species or other natural or cultural resources;
- Several autonomous agencies have control over various portions of the system;
- Many areas exhibit existing erosion problems, and soil type, condition, and terrain suggest that erosion potential in many areas is high;
- The storm drain system is constructed of a variety of materials, and was designed piecemeal without benefit of a master plan; and
- In spite of recent efforts to separate storm and sanitary sewers, there is evidence that some connections may not have been detected.

1.5 CAPITAL IMPROVEMENTS PLAN

A capital improvements plan was developed in accordance with future land uses identified in the GMPA and regulations expected to be implemented under the NPDES permit program. The plan presumes that the planned restoration of the Tennessee Hollow riparian corridor and wetlands along Crissy Field will be implemented.

1.5.1 Wetlands and Riparian Restoration Projects

The primary objective of the wetland and riparian restoration project is to emulate natural systems and to benefit aquatic and terrestrial wildlife. Planned riparian and wetlands restoration programs, although not specifically planned for the purpose, can be expected to provide storm water management benefits. Recommended design concepts to enhance storm water management in conjunction with habitat restoration include:

- Designing the Tennessee Hollow channel to carry the 10-year storm flow and to provide a flood plain for the 100-year event; and
- In addition to the Tennessee Hollow drainage basin, routing up to five additional drainage basins through the Crissy Field wetlands to provide additional runoff treatment and reduce costs associated with replacement of under capacity and poor condition piping and outfall systems. This procedure could result in the elimination of as many as six existing outfalls to San Francisco Bay.

Recommendations are made regarding structural best management practices to address water quality concerns, as well as improvements to address identified condition and capacity problems. An alternative, diversion of runoff to the CCSF system for treatment and disposal, is also presented along with estimated costs.

During design or redesign of storm water drainage systems that discharge into the riparian and wetland restoration areas, structural and operational BMPs should be implemented to reduce potential impacts on water quality that could adversely affect aquatic and terrestrial habitat.

Alternatives to routing storm water through the riparian and wetland restoration area were considered and found to be infeasible due to capital cost or incompatibility with the GMPA. These alternatives included:

- Construction of a low-flow interceptor system from the existing U.S. Coast Guard station to near the existing U.S. Army Department of Engineering and Housing complex. The interceptor system would convey runoff to the CCSF combined sewer system for treatment and disposal; and
- Construction of a new outfall(s) system(s) to convey runoff around the wetland restoration area to San Francisco Bay.

1.5.2 Structural Best Management Practices

The purpose of structural BMPs is to reduce pollutant loads in storm water discharges to waters of the state, either directly through pretreatment, or indirectly through alternate disposal means. The proposed BMPs presented in the SWMP are based upon the California Best Management Practices Handbook, which identifies cost-effective methods to reduce storm water pollutant loads. Several general BMP types were evaluated for use at the Presidio. The evaluation considered future land uses, technology limitations, site physical constraints, aesthetics, operation and maintenance requirements, and cost-effectiveness. Five general categories of structural improvements are proposed for the Presidio.

The first category consists of improvements to address runoff from Doyle Drive, which is expected to contribute the greatest pollutant load per square foot. The California State Department of Transportation (Caltrans) is responsible for developing BMPs for this corridor, as well as other state-owned roadways. It is recommended that the NPS coordinate implementation of BMPs for Doyle Drive with Caltrans consistent with limited right-of-way widths and other proposed Presidio facilities. The proposed BMP consists of lined filtration channels parallel to the north side of the freeway. The channels would be designed to convey runoff to a proposed wetland polishing basin and then to the Crissy Field restored wetlands, while removing settleable solids, oil, grease, heavy metals, and some nutrients.

The second category of structural BMPs addresses runoff from planned new parking facilities. Specific BMPs are proposed for each new parking facility described in the GMPA. Biofiltration and oil/water separators are emphasized to reduce pollutant loads, and onsite infiltration is proposed to reduce direct discharges where practical and cost-effective.

Existing parking facilities will require retrofitting the existing storm water collection system to achieve the storm water pollution reduction objectives of this SWMP. This is the third category of structural BMPs. As with new parking facilities, biofilters and oil/water separators could be implemented to pretreat storm water runoff. Various BMPs are proposed for each existing parking facility which is to remain in place. These practices are discussed in Chapter 8.

The fourth category of structural BMPs consists of improvements to pretreat runoff entering Mountain Lake from the golf course. Two constructed wetlands at the northern and northeastern shores of the lake are proposed. The purpose of these wetlands is to allow settlement of particulate and provide polishing treatment of degradable organics.

For certain types of facilities, diversion of storm water runoff to a sanitary sewer is the most cost-effective means of addressing pollutant loads in runoff. The fifth category of structural BMPs focuses on selected facilities characterized by relatively high BOD/COD loads and relatively low flows. Diversion to the sanitary sewer is proposed for golf course equipment washing facilities, maintenance facilities equipment washing areas, commercial and industrial waste and material storage areas, Letterman Army Research Institute roof drains, the equestrian facilities (paddocks and stables), and major roads that drain into the Lobos Creek Watershed.

Optional dry wells or cisterns could also be used to address runoff from the rooftops of smaller buildings. Dry wells would allow infiltration of runoff, whereas cisterns would be designed to store it for beneficial reuse.

Structural BMPs, including biofilters, oil/water separators, infiltration trenches, basins, and swales and wetland polishing basins are all dependent upon regular maintenance and upkeep to ensure their effectiveness, reliability, and useful life expectancy.

1.5.3 Proposed Capacity and Condition Improvements

Storm drain capacity and condition improvements are shown on Figure 10. These improvements are proposed based on the results of hydraulic modeling and previous television surveys of the storm drain system. Where practicable, detention basins and wetland facilities were proposed in preference to reconstruction of outfall systems or construction of systems to route runoff around the wetland restoration. Alterations in piping configuration are proposed in the vicinity of Montgomery Street and the Main Parade Grounds and Sheridan Avenue; Gorgas Avenue at Highway 101; the U.S. Coast Guard Station; and other miscellaneous areas. The proposed improvements include replacement of pipe in poor condition, replacement of under-capacity pipes, construction of new piping systems, and structural BMPs.

1.5.4 Diversion to the CCSF Combined Sewer System

The potential to divert storm water to the City and County of San Francisco (CCSF) combined sanitary and storm sewer system was considered during preparation of this SWMP. In general, three basic diversions were considered: (1) diversion of runoff from the watershed draining to the San Francisco Bay by constructing a low-flow interceptor system along Crissy Field; (2) diversion of runoff from the southern portion of the Presidio (along Lobos Creek) by converting an existing (to be abandoned) 66-inch-diameter combined sewer overflow pipe into an in-line storage facility connected to the CCSF's Richmond Transport Project (RTP); and (3) diversion of several isolated areas which exhibit a high potential for storm water contamination (i.e., loading docks, the horse stables, and paddock area).

After due consideration of these three options, the NPS determined that two options would be recommended as part of this SWMP. The recommended options are the diversion of runoff from the southern portion of Presidio to the RTP, and the diversion of isolated areas which exhibit a high potential for storm water contamination. A detailed discussion of the potential connections considered, and the rationale for the conclusions reached, is provided in Section 8.5 of this plan.

1.5.5 Cost Estimates for Structural BMPs and Conveyance Improvements

Class C cost estimates were developed for structural BMPs and conveyance system improvements based on the proposed program of improvements. Capital costs for construction of the proposed structural BMPs total approximately $1.5 million.

Capital costs for conveyance system improvements were estimated for two scenarios: proposed improvements (including those associated with proposed BMPs), and alternative improvements (those required to bring the existing system up to its 10-year design capacity).

Capital costs for the proposed conveyance improvements would be about $1.2 million which would include installation of new conveyance systems to replace under capacity and poor condition piping and outfalls and replacement of pipe in poor condition (excluding that which will no longer be needed).

The capital cost for the alternative conveyance improvements scenario would be about $2.4 million and include:

- Replacement of pipes in poor condition without upgrading capacity as indicated by the hydraulic model is estimated to cost $600,000;
- Replacement of pipes in poor condition while upgrading capacity as needed would add approximately $20,000 to the cost; and
- Miscellaneous capacity improvements based on the hydraulic model are estimated to cost approximately $1.8 million.

Recommended catchbasin safety retrofitting is estimated to cost $750 to $1,000 per catchbasin for approximately 650 affected structures. This could amount to about $600,000.

Total estimated capital costs for the proposed structural BMPs, conveyance, and catchbasin grate improvements is therefore $3.3 million.

1.6 OPERATIONAL IMPROVEMENTS PLAN

A storm water system Operational Improvements Plan was developed for the Presidio site. The plan contains recommendations for storm water system inspection and maintenance, maintenance of roads and other paved areas, spill prevention and control, turf and landscape chemical management, erosion control, and storm water quality monitoring.

1.7 BMP VALUE ANALYSIS WORKSHOP

Following submittal of the 90% review document for the SWMP, the NPS held a value analysis workshop to evaluate the proposed improvements and develop a plan for finalizing the SWMP. A storm water management concept matrix was developed to identify concepts selected for each drainage basin based on a round table discussion of concerns. Specific management concepts and preferred BMPs for each unique land use type and a few special areas were developed. In general, the value analysis team concurred with the proposed BMPs and concepts presented in the draft plan. Specifically, pavement and industrial/commercial areas are to be targeted for structural BMPs. The plan was however modified to include constructed pretreatment basins (constructed wetlands) at Mountain Lake and expanded diversion of selected runoff areas to the CCSF sewer system.

Decision Criteria were developed and ranked. The Decision Criteria were then used to generate an analysis matrix for evaluation of one of the more significant issues facing the team: whether to reconstruct four existing outfall systems to divert runoff around the wetland restoration area or to allow runoff to flow through the restored Crissy Field wetlands. The analysis indicated that diverting the flows through the wetlands is preferable to reconstructing the existing outfall system.

Analysis matrices were not developed for every component of the SWMP; however, the feedback was used to develop new plan elements and BMPs and to refine other concepts proposed in the draft SWMP. The value analysis workshop also generated a list of priorities for NPS staff.

1.8 PERMITTING FOR STORM WATER SYSTEM IMPROVEMENTS

Various federal, state, and local agencies have jurisdiction over construction and/or operation and maintenance activities associated with the existing storm drain system, proposed conveyance improvements, and proposed BMPs. Permitting agencies, regulated activities, and permits are tabulated for use in planning.

1.9 STORM WATER POLLUTION PREVENTION PLAN

A Storm Water Pollution Prevention Plan (SWPPP) was developed for the Presidio based on all other elements of the SWMP. The SWPPP outlines specific runoff water quality objectives, and structural BMP concepts, locations, and design criteria. Operational BMPs are discussed in greater detail, including erosion control practices and policies, storm water structure maintenance, pipeline maintenance, storm related maintenance, maintenance of onsite treatment systems, spill prevention and control, an illicit discharge elimination program, an educational program and a program for on-going storm water runoff quality monitoring.

1.9.1 Post-BMP Implementation Pollutant Load Estimate

Significant pollutant load reduction can be realized through implementation of operational and structural BMPs, based on a second pollutant load estimate prepared to predict the pollutant reduction benefits of implementing a strong, consistent BMP program at the Presidio.

1.9.2 New Development and Tenant Controls

In order to assist the NPS in achieving storm water pollutant load reduction objectives, it is recommended that structural and operational BMPs be evaluated and incorporated into the design of each new facility at the Presidio during the planning and project approval phase. Policies and guidance for land use planners and designers should specify minimum structural and operational BMPs, and could also suggest optional BMPs. Specific recommendations for minimum structural and operational BMPs are described as are design criteria for the various components.

2.0 INTRODUCTION

The Presidio of San Francisco is a 1,400-acre military reserve located on the northwestern-most point of the San Francisco peninsula. Figure 1 shows the regional location of the Presidio of San Francisco.

The facility has a military and civilian history that extends back 213 years, and it has been under the control of the U.S. Army since the 1840s. On October 1, 1994, the Presidio will be transferred from the Department of Defense to the Department of the Interior, at which time the National Park Service will become the caretaker of the entire facility. On July 1, 1994, responsibility for operation and maintenance of the storm sewer system was turned over to the National Park Service.

The National Park Service, through the Golden Gate National Recreation Area (GGNRA), has prepared a General Management Plan Amendment (GMPA) that outlines the vision for the transformation of the Presidio from military to civilian use. The GMPA identifies cultural, natural, and recreational resources, planning issues and concerns, land uses, parkwide principles and concepts, and strategies for transportation, resource management, community service and stewardship, and sustainable design. The GMPA discusses the disposition and strategy for managing the numerous buildings, roadways and appurtenant infrastructure, including storm water drainage facilities, which have been constructed throughout the history of the Presidio on an as needed basis. The construction of these facilities has necessarily altered the topography, vegetation and wildlife habitats. These alterations have resulted in an increase in impermeable surface area and alterations in the natural drainage patterns. The cumulative effect is an increase in the rate and volume of storm water runoff and a degradation in the water quality of runoff.

The Presidio storm water drainage facilities are typical of extensive storm water drainage system developed over long time spans in the absence of a master plan for management and construction of capital improvements. Numerous pipes are in poor repair or may have capacity deficiencies or excess capacity. Furthermore, the regulatory environment for storm water has become much more stringent. Until as recently as the 1990 modifications of the Clean Water Act, regulation of storm water was minimal or non-existent.

2.0 Introduction

The National Park Service, as future caretakers of the Presidio, have determined that development of a Storm Water Management Plan (SWMP) is in the best interest of the facility. This SWMP has been developed for the National Park Service under Indefinite Quantity Contract No. 1443CX200092035, Task Order No. 13. It was developed to assist the National Park Service in managing the storm water facilities of the Presidio of San Francisco (PSF). The purpose of this SWMP is to provide guidance to NPS administrators and planners and maintenance personnel.

This document addresses the existing conditions, hydrologic and regulatory setting, system capacities and deficiencies, and recommendations for augmentation of capacity, management of water quality and operation and maintenance of the system. For administrators, the plan presents budgetary and permitting information for operation, maintenance, and improvement of the storm water system. For planners, the plan presents information for use during integration of the plan elements into the overall land and facility use plans as described in the GMPA for the Presidio of San Francisco. For maintenance personnel, the plan presents information on required equipment, estimated man-hours, maintenance tasks, and task frequency.

This SWMP was developed in accordance with the goals and objectives as described in the draft GMPA. The goal of the SWMP is the establishment of a framework for improvement, operation, and maintenance storm water drainage system in conformance with federal, state, and local laws and regulations, the identification of pertinent permit requirements and compliance with the water quality goals set forth by the San Francisco Bay Regional Water Quality Control Board (RWQCB). The primary objectives of this SWMP are summarized below:

- Identify drainage (conveyance) system components that are deficient in either capacity or condition and make recommendations for improvement of the system;
- Identify operational procedures and storm water system improvements that will reduce pollutant sources and pollutant concentrations in storm water runoff;
- Provide cost estimates for development of operational, maintenance, regulatory compliance and capital improvement budgets;

- Provide information and guidance for submittal to the RWQCB and guidance for application for National Pollution Discharge Elimination System (NPDES) Permits;

- Provide for the protection and preservation of the natural, cultural and aesthetic resources of the Presidio, wherever feasible; and

- Perform an evaluation of the existing drainage system using the following criteria:

    - 10-year, 25-year, and 100-year; 30-minute; and 1-hour precipitation for pipes and open channels;

    - 25-year, 30-minute, and 1-hour precipitation for low points in major roads;

    - 100-year, 30-minute, and 1-hour precipitation for major open channels along Tennessee Hollow; and

    - Average annual precipitation for pollutant load estimates.

3.0 REGULATORY SETTING

Several agencies have jurisdictional authority over activities recommended within this SWMP that may affect surface waters (including wetlands), streams and wildlife habitats, plant and animal communities (including threatened and endangered species), and cultural resources within and around the Presidio of San Francisco. These agencies include, among others, the U.S. Army Corps of Engineers (USACE), the California Department of Fish and Game, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the Coastal Commission, the San Francisco Bay Conservation and Development Commission, and the State Water Quality Control Board.

Authority to regulate storm water or activities that affect surface water quality is granted under the Clean Water Act (CWA) of 1987, the State Porter-Cologne Act, the California Coastal Nonpoint Pollution Control Program, the National Estuary Program, and various hazardous material/waste control programs. A summary of regulatory agencies and their jurisdictions is presented in the tables on pages 3-2 and 3-3.

Foremost among storm water regulations are the 1990 amendments to the CWA, Section 402(p), which establish the framework for regulating municipal, industrial, and construction storm water discharges under the National Pollution Discharge Elimination System (NPDES) program.

In addition, NPS Natural Resources Management (NPS-77) contains policies regarding aquatic resources management. Broadly stated, these policies require management of natural resources of the National Park System to maintain, rehabilitate, and perpetuate the inherent integrity of water resources and aquatic ecosystems. Specific management policies provide for protection of quality and quantity of surface water and groundwater (4:15-16); preservation of floodplains and wetlands (4:16-17); maintaining, protecting, and securing water rights (4:17); and protection of aquatic biological resources (4.5-15). Program objectives and specific guidance regarding these goals are presented in Program Guidance in NPS-77.

Once the plan is completed, it will also be subject to environmental review pursuant to the requirements of the National Environmental Policy Act (NEPA) and NPS-12. As with all

projects at the Presidio, the SWMP will be reviewed by the GGNRA Environmental Compliance Committee.

The NPS has decided to prepare a programmatic Environmental Assessment (EA) in order to identify potential significant adverse impacts which may occur as a result of implementation of the SWMP. The purpose of the EA is to provide an overall environmental assessment of the SWMP. Additional environmental review will be required during the design-specific stages of SWMP implementation.

The remainder of this section presents an overview of the regulatory setting for implementation of the 1990 CWA amendments, an overview of the permit process, and the present permit requirements and how they may be applied to the Presidio of San Francisco.

100,000 people, as entities that must obtain an NPDES storm water permit. Also, the RWQCBs may impose requirements on other areas if conditions warrant storm water regulation.

With respect to the Presidio of San Francisco, the San Francisco RWQCB is responsible for developing and implementing the storm water control requirements under the USEPA's final regulations, the State Porter-Cologne Act, California Coastal Nonpoint Pollution Control Program, and the National Estuary Program. Other agencies such as the USEPA, the Coastal Commission, and the California Environmental Protection Agency would likely exercise their authority through the RWQCB.

3.2 PERMIT OVERVIEW

The state and federal storm water NPDES permit requirements are essentially the same when applied to municipalities with populations greater than 100,000. The permit application is divided into two parts:

- Part 1 requires presentation of existing information regarding storm water discharges, receiving waters, management programs, fiscal resources, and associated elements; and
- Part 2 requires development and implementation of a storm water management program designed to reduce the discharge of pollutants to the maximum extent practicable.

The typical terms of an NPDES permit range from three to five years, depending upon specific permit requirements which may include, among others, flow monitoring, sampling, and reporting.

Figure 2 presents a summary of Part 1 and Part 2 municipality permit application requirements.

Industrial activities covered by the 1987 amendments and the USEPA regulations include:

- All facilities presently subject to national effluent limitation guidelines, new source performance standards, or toxic pollutant effluent standards;

- Facilities classified as the following SIC codes: 24 (except 2434), 26 (except 265 and 267), 28 (except 283), 33, 344, and 373 (see Appendix A for a listing of SIC codes);
- Facilities classified as SIC 10 through 14, including active or inactive mining operations;
- SIC classifications 20 through 39, which are not included above, where materials are exposed to storm water;
- Hazardous waste treatment, storage, or disposal (TSD) facilities;
- Landfills, land application sites, and open dumps that receive industrial wastes;
- Recycling facilities classified as SIC 5015 and 5093 — these include metal scrapyards, automobile junkyards, and others;
- Steam electric power generating facilities;
- Vehicle maintenance, equipment cleaning, or airport de-icing areas; railroad, mass transit, school bus, trucking and courier services; postal service, water transportation, and airport facilities; and petroleum bulk stations (SIC classifications 40 through 45 and 5171);
- Treatment works treating domestic sewage with a design flow of 1.0 million gallons per day (mgd) or greater; and
- Construction activities disturbing five acres or more.

Areas located on plant lands, separate from the industrial activities, may be excluded, provided that the storm waters of the excluded area do not mix with the runoff from the areas with industrial activity. A detailed list of affected SIC classifications is included in Appendix A.

On November 19, 1991, the State Water Board adopted the General Industrial Storm Water Permit program to implement the federal requirements for all regulated industries. The state requires that each industrial facility submit a Notice of Intent (NOI), Storm Water Pollution Prevention Plan (SWPPP), and a Monitoring Program. The NOIs collect background information and are analogous to the municipal Part 1 application. The SWPPP and monitoring

ACTIVITIES AND PERMITS REGULATED BY FEDERAL AND STATE AGENCIES		
Agency Name	**Jurisdictional Authority/Permit**	**Regulated Activities[1]**
U.S. Army Corps of Engineers (USACE)	Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)[3]	Prohibits the obstruction or alteration of navigable waters[2] of the U.S. without a permit.
USACE	Clean Water Act Section 404 (U.S.C. 1344)[3]	Section 301 of this act prohibits the discharge of dredged or fill material into the waters of the U.S.[4] without a permit
U.S. Fish and Wildlife Service	Section 10/404 Permits	Same as above.
National Marine Fisheries	Section 10/404 Permits	Same as above.
State Historic Preservation Office	Section 10/404 Permits	Same as above.
California Department of Fish and Game (CDFG)	Stream Bed Alteration Agreement	Protection of fish and wildlife habitat from activities within lakes and channels, streams and crossings.
CDFG	Standards for Special Suction Dredging Permits	Dredging activities.
State Lands Commission	Lake Use Lease	Encroachments, docks, and crossing on tide and submerged lands
State Water Resources Control Board, Regional Board	National Pollutant Discharge Elimination System Permit	Waste discharge requirements for discharges to surface waters
California Department of Transportation (Caltrans)	Encroachment Permit	Encroachment on or across a state highway (right-of-way)

Source: USACE, 1985

1. Activities include placement or alteration of structures (piers, wharfs, bulkheads, jetties, etc), and work (which includes dredging, disposal of dredged material, filling, excavation or other modification of navigable water of the U.S. or waters of the U.S.

2. Navigable waters of the U.S. are those waters of the U.S. that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are, have been, or may be, used to transport interstate or foreign commerce.

3. Other laws that may affect the processing of USACE permits for work or activities at the Presidio of San Francisco include the National Environmental Policy Act, the Coastal Zone Management Act, the Fish and Wildlife Coordination Act, The Endangered Species Act, The National Historic Preservation Act, the Deep-Marine Mammal Protection Act, and the National Fishing Enhancement Act of 1984.

4. Waters of the U.S. is a broader term than navigable waters of the U.S as defined above. Included are adjacent wetland and tributaries to navigable waters where the degradation or destruction of which could affect interstate or foreign commerce.

Other local agencies with regulatory jurisdiction over all activities within the limit of these jurisdictions include:

ACTIVITIES AND PERMITS REGULATED BY LOCAL AGENCIES		
Agency	**Permit**	**Jurisdictional Area**
San Francisco Bay Conservation and Development Commission	Development Permit	San Francisco Bay from high water to 100 feet inland
Coastal Commission	Coastal Development Permit	From 3 miles offshore to 1,000 yards inland

3.1 BACKGROUND

On November 16, 1990, the United States Environmental Protection Agency (USEPA) promulgated the final regulations pursuant to the 1987 CWA amendments. These regulations established storm water discharge permit requirements for: municipalities with populations greater than 100,000, certain industrial activities as defined by Standard Industrial Codes (SIC) Classifications, and construction activities on areas greater than five acres. Currently the United States Congress is considering Phase II of the storm water permit requirements. When implemented, Phase II will either lower the population threshold below 100,000, or redefine the criteria for urbanized areas that require storm water permits. Implementation of Phase II is anticipated to occur in the next two to three years.

In California, the Porter-Cologne Act requires the development of Basin Plans to protect the water quality within the various watersheds. These plans are used to regulate specific discharges. Implementation of the plans is through the NPDES program as administered by the State Water Quality Control Board (State Water Board) through nine RWQCBs.

The State Water Board has implemented the USEPA storm water regulations by requiring industries and construction activities to apply for a statewide general permit, and municipalities greater than 100,000 to apply for individual NPDES storm water permits. In addition, the State Water Board has designated certain urbanized counties, with numerous municipalities of less than

program address the detailed issues of preventing and monitoring storm water pollution. The submittal due date for NOIs was March 30, 1992, and the SWPPPs and Monitoring Programs were to be submitted by August 1, 1992. Based on communications with the San Francisco RWQCB, a NOI has not been filed for any industrial facilities within the Presidio of San Francisco boundaries.

3.3 PERMIT REQUIREMENTS

The San Francisco RWQCB was contacted to ascertain the status of the NPDES program as it pertains to the Presidio of San Francisco. Based upon communications with the San Francisco RWQCB, the Presidio of San Francisco would not require a storm water NPDES permit as a municipality or urbanized area (Bruhns, 1993). Further, it is likely that the Presidio would be exempt from the requirement to obtain an NPDES storm water permit if Congress decides to revise the 100,000 municipal population standard downward. If, however, Congress opts to implement a refined definition of urbanized areas, it is probable that the Presidio of San Francisco would be required to obtain an NPDES storm water permit.

The State Water Board has required that the south bay counties (Santa Clara, San Mateo, Alameda, and Contra Costa) obtain NPDES storm water permits since these areas are highly urbanized and have numerous cities with populations below 100,000. North Bay counties, however, have not been required to obtain NPDES permits, although the San Francisco RWQCB has requested that the North Bay counties submit storm water management plans and annual reports of their progress.

The San Francisco RWQCB has indicated that the Presidio would be viewed as a North Bay county. Therefore, at a minimum, the Presidio of San Francisco may be asked to prepare an SWMP and could, depending upon the actions of Congress, be required to obtain an NPDES permit. Components of an SWMP typically include:

- Public education program;
- Municipal pollution prevention activities to be implemented (such as street sweeping);

- Illicit connection inspection program;
- New development controls; and
- Designation of the authority to implement and enforce these programs.

Based upon the proposed facilities and land uses described in the General Management Plan Amendment, the following industrial facilities or activities within the Presidio may require an NPDES storm water permit:

- Maintenance facilities;
- Paint shops;
- Hangars and warehouses;
- Hazardous materials storage areas;
- Landfills (closed); and
- Steam generation plant.

Pending finalization of detailed development and facility use plans, NOIs for qualifying industrial facilities within the Presidio should be submitted to the San Francisco RWQCB. In addition, a General Construction Permit will be required when construction activities disturb more than five acres.

The implementation of this SWMP should satisfy the RWQCB requirement for North Bay counties and provide the basis for a NPDES permit application should Congress revise the definition of urban areas.

4.0 EXISTING FACILITIES

4.1 EXTENT AND CONDITION

The Presidio of San Francisco encompasses an area of approximately 1,400 acres. It is vegetated with a variety of native and non-native species and has an abundance of wildlife habitats. Existing land uses at the Presidio range from vast open space areas to densely developed urban areas.

Open space areas are drained primarily by overland flow and open channels. These drainage mechanisms promote the growth of riparian vegetation. Open areas at the Presidio are vegetated with a diversity of plant life which provides wildlife habitat, promotes infiltration of precipitation and also filters contaminants which accumulate through atmospheric deposition. Runoff from the open spaces is generally slow. The majority of the open space at the Presidio is located in the southern half of the facility. Encompassed within the open space areas are El Polin Spring, Mountain Lake, Baker Beach, the Lobos Creek Drainage Basin, and other areas. Open space areas account for approximately 1,000 acres of the Presidio.

In contrast, urban areas are drained mostly by pipes with some open channels along roadways. Plant diversity and wildlife habitat are minimal and paved areas and other impermeable surfaces such as roofs cause rapid runoff. Atmospherically deposited pollutants as well as pollutants from operation and wear of automobiles and other human activities are easily washed from the impermeable surfaces, conveyed to storm drains and ultimately discharged to receiving waters.

The facility has a military and civilian history which extends back 213 years, and it has been under the control of the U.S. Army since the 1840s. The drainage system was constructed primarily under the direction of the U.S. Army. Materials used to construct the system include wood, concrete, clay, brick, stone, corrugated metal and steel. The only remaining natural creek at the Presidio is Lobos Creek, which is located along the southern boundary of the Presidio. Normal flows in Lobos Creek are diverted to the Presidio Water Treatment Plant; however, a bypass system allows Lobos Creek to discharge to the Pacific Ocean and storm flows can and often are directed to the Pacific Ocean. In addition, the City and County of San Francisco maintain a combined sewer overflow system along the Lobos Creek valley which

discharges to Lobos Creek downstream of the Water Treatment Plant and flows to the Pacific Ocean. The CCSF is currently in the process of constructing a new combined sewer system to replace the existing overflow system. The new system will discharge into the Richmond Transport Tunnel which will convey the discharge to the CCSF wastewater treatment plant. The Lobos Creek drainage and the City and County of San Francisco combined sewer overflow system are discussed in more detail in the Watershed Sanitary Survey for Lobos Creek (Dames & Moore, 1993a).

The primary drainage system is comprised of approximately 37,000 lineal feet of gravity pipe ranging in size from 4 inches to 72 inches in diameter. In addition, numerous concrete, rock, brick and earth lined open channels assist in the conveyance of drainage. Approximately 13,400 feet of open drainages are maintained within the Presidio (U.S. Army, 1993a).

Gravity piping predominates within urban land use areas which include, among others, the East Housing area, the Letterman Complex, the Main Post, the vicinity of the National Cemetery and the Cavalry Stables, Fort Scott, the Public Health Service Hospital, as well as along paved roadways, parking lots, Doyle Drive and Highway 1.

Of the open channels, some are lined and some are unlined. Lined channels are constructed of concrete, brick, and stone or a combination of these materials. Unlined channels include natural drainages such as Lobos Creek, and constructed drainages along roadways and in open areas, such as the Golf Course.

Lined open channels along roadways are typically located on the uphill side and adjacent to the roadway, except at some locations, such as along Doyle Drive, where channels parallel to the roadway collect elevated deck runoff and convey it to storm sewer piping. The dimensions of the open channels vary from one location to the next, but in general most channels are no more than one to two feet deep and between two and three feet wide at the top.

Many parts of the drainage system could be potential cultural resources including brick-lined open channels adjacent to roadways and rubble-lined open channels such as that through Tennessee Hollow.

4.2 BACKGROUND

4.2.1 Previous Studies

Two previous studies addressing the storm water drainage system were reviewed as part of this report. The first was prepared by CH2M Hill for the U.S. Army under the direction of the U.S. Army Corps of Engineers and is dated March 1989. The second was prepared by Nolte & Associates for the National Park Service and is dated October 1991.

CH2M Hill

CH2M Hill prepared an evaluation of the capacity of the existing storm sewer system. The evaluation included recommendations for improvements to the piping system. The capacity of pipes 18 inches in diameter and larger were studied. Runoff rates were computed for 2-year and 10-year design storms. Scour potential at storm sewer outfalls was evaluated using the computed 2-year runoff rates and pipe conveyance capacity was evaluated using the computed 10-year runoff rates flowing against a Mean Higher High Water (MHHW) elevation of 5.7 feet.

The CH2M Hill study used the Modified Rational Method to evaluate peak rates of runoff entering and traveling throughout the storm drainage system. The CH2M Hill study considered an initial precipitation loss between 0.1 to 0.2 inch on unpaved areas. Subbasin delineation was performed using 1″ = 400′ topographic maps and 1″ = 100′ General Storm Sewer System maps on file with the U.S. Army, and additional information was provided from construction plans for recent projects. Limited field verification of the pipe system data was performed, and in some locations it was necessary for CH2M Hill to assume or extrapolate pipe invert elevations from existing data.

The study found that approximately 14,860 lineal feet of pipe were under-capacity for the 10-year storm flowing against a MHHW elevation of 5.7 feet. It was recommended that under-capacity pipes be replaced.

Nolte & Associates

Nolte & Associates reviewed the methodology and findings of the CH2M Hill study for the National Park Service. The review was performed to validate the findings of the CH2M Hill study. Hydrologic and hydraulic assumptions were evaluated and spot checks of the system capacity to convey the 10-year rate of runoff against the MHHW tidal elevation were made. The Nolte study concluded that the methods and results of the CH2M Hill study were valid. The Nolte study also recommended the replacement of an additional 2,090 lineal feet of pipe due to the reported deteriorated condition of the pipe as indicated by the 1985 television survey.

Dames & Moore

In 1992, a television survey of the storm sewer system was performed for the U.S. Army by ABC Service of Sacramento, California. Dames & Moore performed a review of the logs of the 1992 television survey. The logs indicate numerous locations where camera access to the piping system was not possible due to concrete in the pipe joints. In addition, many cracked, broken and collapsed pipes were noted. A tabulation of the defective piping noted in the 1992 television survey is presented in Table 4.1. Figure 3 shows the locations of the defective pipes.

4.2.2 Hydrologic Setting

Several factors contribute to the hydrologic setting. These include the amount and intensity of precipitation and other climatic factors, soil types and land uses, the amount of impermeable surface area, the type and density of vegetative cover, the slope of the terrain, the extent of storm sewer piping and open channels, the presence of base flows in natural waterways and the tidal cycle. Section 5.0 presents additional discussion of these hydrologic parameters and the methods employed to evaluate the watershed drainage basins.

Precipitation Amount and Intensity

The amount of precipitation varies depending upon the duration and frequency of the event. Shorter duration events have less total precipitation than longer duration events, and more

frequent events have less total precipitation than infrequent events. Table 4.2 provides the mean annual precipitation rates (by month) for the Presidio.

Precipitation intensity is the amount of precipitation occurring over a given period of time. Intensity is commonly expressed in inches of precipitation per hour. In general, storm events can be thought of as a series of short precipitation events of differing precipitation intensities, that occur one right after another. The highest intensity of precipitation occurs over short time intervals; as the time interval lengthens, the intensity of precipitation decreases.

The rate of runoff from a watershed is affected by both the amount of precipitation and the intensity of precipitation. Peak rates of runoff from a watershed with a short time of concentration would be generated by (higher intensity) storms with (short) durations approximating the time of concentration of the watershed. Conversely, peak rates of runoff from watersheds with longer times of concentration would generated by longer duration (lower intensity) events. Precipitation amounts and intensities are discussed further in Section 5.0.

Time of Concentrations

The time of concentration of a watershed is the amount of time required for precipitation to run off and travel through the watershed. This time is typically measured along the most hydraulically remote path. Travel time through a watershed is dependent upon the slope of the terrain, vegetative cover, and impermeable surface areas. Runoff travels slower on flat vegetated slopes and faster on paved surfaces or naturally occurring surfaces with steeper slopes. Times of concentration at the Presidio vary from several minutes to about one hour depending upon the size or location of the watershed or subbasin area of interest.

Climate

San Francisco has a relatively temperate climate, which is directly influenced by its proximity to the Pacific Ocean and the San Francisco Bay. Located in a region of Mediterranean climate, cool, wet winters are typical. The constant influence of surrounding water bodies, however, keeps summer temperatures substantially cooler than those of the surrounding areas.

Climatic data on San Francisco were compiled over a 40-year period (1948-1988) by the U.S. Department of Agriculture Soil Conservation Service (SCS). These data indicate that the average daily temperature for that period was 57 degrees F, with the average daily maximum and average daily minimum representing only a 11.9 degree differential (62.9 degrees F versus 51.0 degrees F, respectively). Common seasonal temperatures include mid- to low-50's in the winter, and high-50's to low-60's in the summer. The annual precipitation over the 40-year period averaged about 22 inches, the majority of which was received in December, January and February. Other wet months were November and March. From May through September, the total precipitation is typically less than 1 inch.

Soils and Land Use

Soils at the Presidio are characteristic of coastal areas. Outcroppings of rock and cliffs separating upland areas from coastal beaches occur along the Pacific Ocean coastline. Along the San Francisco shoreline, soils are more variable in areas that were once part of the Bay (in the Crissy Field area). Soils in the upland areas of the Presidio consist primarily of Sirdrak Sands and Typic Argiustolls. Sirdrak Soils are formed on coastal dunes and exhibit rapid permeability and runoff is very slow. Typic Argiustolls are formed on alluvium and permeability is moderately slow or slow. Figure 4 shows the SCS soil types within the Presidio. A more complete description of the soil types is presented in Appendix B.

The types of soils within the Presidio affect the hydrologic responses of the watersheds. The sandy soils typical of much of the Presidio prior to development of the existing facilities have a high permeability. Precipitation infiltrates into the soil easily and runoff rates are relatively slow. Construction of roads, buildings, and other facilities, including the Golf Course, has altered the soil structure. A common example is the development of a layer of top soil during establishment of turf; at the Presidio, this would result in a layer of soil with a comparatively high available water capacity, which, when saturated, would slow the rate of infiltration and result in more runoff than native soils.

The land use information presented in this SWMP was derived from the General Management Plan Amendment Draft Environmental Impact Statement for the Presidio of San Francisco

(DEIS). The Proposed Project presented in the DEIS forms the basis for the land use assumptions incorporated into the hydrologic model discussed in Section 5.0. The proposed land uses at the Presidio are shown in Figure 5. Land uses indicated on the figure include open space, residential, commercial/office, institutional, industrial and special uses (cemeteries and roads). The land use information can be used as a guide to areas where the native soil structure has been altered.

Impermeable Surface Areas

Impermeable surfaces generate the highest rate and volume of runoff. These surfaces are comprised of roof tops and paved surfaces such as sidewalks, roadways, parking lots, or recreational facilities such as tennis courts or outdoor basketball courts. At the Presidio, the dominant impermeable surfaces areas are roof tops and pavement.

There are also naturally occurring impermeable surfaces which include some types of rock outcroppings and other geologic formations and water bodies such as lakes or wetlands. Water bodies are categorized as impermeable because 100 percent of precipitation falling on the body contributes (runoff) to the total volume of the waterbody. In comparison, only 80 to 90 percent of precipitation falling rooftops or pavement results in runoff. The difference is due to the amount of precipitation required to "wet" the surface.

The amount of impervious surface area at the Presidio varies depending upon the location, land use, and size of the watershed or subbasin area of interest. Impervious surface areas for the various watersheds at the Presidio are discussed further in Section 5.0.

Type and Density of Vegetation

Vegetation type and density can affect the rate and volume of runoff. Plants with many leaves, such as trees, have large areas that must become wet before runoff is generated. Plants also take up soil moisture through their root systems, which provide pathways for water to enter the soil matrix thereby increasing the infiltration capacity of the soil. Dense ground vegetation, slows

runoff and increases travel time through the watershed by holding soils in place thereby promoting overland sheet flow versus channelized flows, which result when soils are eroded.

By comparison, areas that are not vegetated are susceptible to erosion and channelization, and if the area is subjected to pedestrian or vehicular traffic, the soils may become compacted; thee factors can result in faster runoff and lower soil infiltration.

Tidal Cycles

The impact of the tidal cycle on drainage facilities is limited to outfall systems flowing to San Francisco Bay. Along the Pacific Ocean there are no drainage facilities of interest that are within the tidal zone. Along San Francisco Bay, existing outfall systems are within the tidal zone. The capacity of these systems is lowest during high tides and higher during low tides due to sea water entering and backing up through the storm sewer system during high tides and flowing out during low tides.

4.3 RECEIVING WATERS

The Presidio has three major watersheds each comprised of drainage basins which are further divided into subbasin areas as shown on Figure 3. The first drains to the Pacific Ocean and is directly located along the western edge of the Presidio roughly parallel to Lincoln Boulevard and extending from Lobos Creek north to the Golden Gate Bridge. Approximately 210 acres of the Presidio drain directly to the Pacific Ocean. A high ridge line separates this watershed from the portion of the Presidio that drains to San Francisco Bay and less pronounced topography separates it from the Lobos Creek Valley.

The second watershed drains to San Francisco Bay. Runoff flows in a northerly direction first from open space areas and then into storm drains systems located within urbanized areas. Fourteen separate drainage basins discharge through a system of piping to fourteen outfalls located along the bay. Approximately 875 acres of the Presidio drain to the bay through the piping and outfall system.

The third watershed drains to Lobos Creek. This watershed collects runoff from the Golf Course, the Lobos Creek Valley and from the area located south of the Wherry Housing area and terminating approximately at the southern boundary of the Presidio. Runoff from the Golf Course and portions of State Highway 1 discharges into Mountain Lake. An overflow outlet from the lake routes flows into the City and County of San Francisco combined sewer overflow system which discharges into the Lobos Creek valley downstream of the Presidio Water Treatment Plant at Baker Beach. Approximately 275 acres of the Presidio drain to the Pacific Ocean through the Lobos Creek Valley. The Public Health Service Hospital and other less significant areas comprising a total of 40 acres of the Presidio drain directly to the City and County of San Francisco combined sewer system.

4.4 SUMMARY OF HAZARDOUS WASTE SITES

Two Remedial Investigation Reports were prepared for the Presidio of San Francisco; one for the Public Health Service Hospital, and one for the remainder of the Presidio, "the Main Installation." These reports identified and analyzed over 30 potentially hazardous waste sites, including landfills and buildings. Data gathered during preparation of these reports were used to develop Feasibility Study Reports, which propose and prioritize remedial alternatives for selected sites. The sites analyzed in the Feasibility Studies were selected based on the risk they pose to human health and the environment.

Although the Feasibility Study Reports are in different stages of review (a Remedial Action Plan for the Public Health Service Hospital is under public review and the Main Installation Feasibility Study is under Agency review), both identified several sites of concern and should be referred to for specific information on contaminants and proposed remedial actions. General information relevant to identified landfills at the Presidio is given in the following table.

Depending upon the findings of the remedial investigations, these sites may require specific runon and runoff controls which would be addressed during development of specific site closure plans. Figure 6 shows the locations of the landfill sites.

POTENTIAL HAZARDOUS WASTE SITES	
SITE NAME	**GENERAL SITE INFORMATION**
Public Health Service Hospital	
Landfill 8	Landfill 8 has an engineered cover and debris is visible from surface.
Landfill 10 Graded Area	Landfill 10 graded area is partially capped (by a parking lot and helipad), however, potential for runoff to reach Lobos Creek is of concern.
Main Installation	
Fill Site 1 (Landfill 1)	Fill Site 1 accepted debris from approximately 1948-73, and is located in a topographic low.
Landfill 2	Landfill 2 contains both landfill and debris fill materials.
Transfer Station (Landfill 3)	Landfill 3 is currently under operation as a solid waste transfer station.
Landfill 4	Landfill 4 is located in a valley bottom, and stopped accepting landfill material and debris fill in 1981.
Fill Site 5 (Landfill 5)	There is currently a building located on Fill Site 5, and debris was formerly deposited in a ravine.
Fill Site 6 (Landfill 6)	Fill Site 6 contains construction debris from a building demolished onsite.
Graded Area 9 (Landfill 9)	Graded Area 9 contains clean fill, which was used to level area for recreation use.
Landfill E (Disturbed Area E)	Landfill E contains landfill material and debris fill in low drainage, and ceased operation in 1965.

Sources: USACE, 1992 and 1993; U.S. Army 1993b and 1993c.

In addition to the above fill and landfill sites, several other potentially hazardous sites have been identified throughout the Presidio. These sites are most commonly associated with buildings (i.e., pesticide mixing and storage facilities, gasoline stations, etc.). For a complete list of these sites, including their locations, contaminants detected, sampling methodology, and proposed and/or planned remedial actions, see the following documents:

- Remedial Investigation Report for the Former U.S. Public Health Service Hospital (USACE, 1992);
- Remedial Investigation Report for Presidio Main Installation (USACE, 1993);
- Remedial Action Plan for the Former U.S. Public Health Service Hospital (U.S. Army, 1993b); and
- Final Feasibility Study Report Presidio Main Installation (U.S. Army, 1993c).

Implementation of the various components of this SWMP should be coordinated with the findings of the Remedial Investigation (RI) and Remedial Action Plan (RAP). Of the listed potential hazardous waste sites, those most likely to conflict with elements of this SWMP are Fill Site 7 (along Crissy Field) and Landfill E, located within the Riparian Restoration Corridor.

4.5 CURRENT MANAGEMENT PRACTICES

Administration and management of the storm sewer system has, in the past, been performed by the U.S. Army through the Presidio of San Francisco Public Works Department. Responsibility for the storm sewer system was passed to the National Park Service on July 1, 1994. The information presented below is a summary of the management and administrative systems which have historically been provided by the U.S. Army. With the transfer of responsibility for the storm sewer system, the National Park Service will need to assume these management and administrative responsibilities. This Storm Water Management Plan presents additional management and administrative responsibilities beyond those discussed below. The additional responsibilities are developed further and discussed in Sections 8.0, 9.0, 10.0, 11.0, and 12.0.

Administrative tasks performed by the Army included planning budgets for staffing, equipment and contracted services, purchase and acquisition of equipment, supervision of staff, and administration of contracts for outside services.

Other programs implemented by the Army and relevant to the storm drainage system include a spill prevention and emergency response plan to control accidental discharges of hazardous materials and a post storm inspection program to clean up and repair damage due to storms.

In addition, the Army has maintained an engineering staff which performed technical analysis and preparation of contract documents for repair and improvement of the drainage system, among other tasks.

Operation and maintenance of the storm drainage system has focused primarily on inspection, cleaning and repair of storm damage. For fiscal year 1994, the Army budgeted $32,000 to inspect and clean open drainage ditches, catchbasins, and manholes, and about $10,000 to clean clogged pipelines. Typical tasks include inspection of manholes, checking frames, rings covers, and ladders for rust, poor fit, loose fittings, and physical damage; checking manholes and catchbasins for blockage, clogging, and concentration of suspended solids; checking for gasoline or oil residue; removal of sediments and debris; and cleaning catchbasins and manholes.

In addition to these funds, about $39,000 was budgeted to perform emergency repairs on the storm drainage system and other facilities due to storm damage. Typical tasks include debris removal, disposal of fallen tree limbs and other blown debris; repairs to external electrical components and structures including damaged roofs and windows caused by falling trees and other storm-related events; and emergency repairs to piping, storm drains, flues, and gutters.

4.6 LEGAL AUTHORITY

Authority to regulate activities at the Presidio, including entering into and terminating tenant leases, approval of development projects, and enforcement of local, state, and federal laws and regulations and enforcement of the provisions of the Storm Water Management Plan is granted to the National Park Service by U.S.C. Title 16, Section 3. Local, state and federal laws are

enforced primarily by NPS Law Enforcement division. Tenant agreements, leases and development projects are regulated by the GGNRA Real Estate Office. Enforcement of the various provisions of this storm water management plan will be accomplished by the following entities:

• GGNRA Technical Support	Review of Development Projects, incorporated BMPs and temporary erosion control measures;
• NPS Law Enforcement	Discharge of illicit substances into the storm sewer;
• NPS Law Enforcement	Unauthorized off-trail use of sensitive areas;
• GGNRA Safety Office	Handling and storage of hazardous materials;
• GGNRA Technical Support	Hazardous waste handling; and
• Resource Management	Monitoring of chemical application controls and irrigation system operation at the golf course.
• NPS Compliance	NEPA Compliance (NPS-12) for development projects.
• NPS Compliance	GGNRA Standard Operating Procedures (SOP 601) for Project Review and Environmental Compliance

5.0 HYDROLOGIC AND HYDRAULIC ANALYSES

5.1 HYDROLOGIC ANALYSIS

The purpose of the hydrologic and hydraulic analyses performed during preparation of the SWMP was to develop detailed information on peak flow rates and volumes, to evaluate the capacity of small and large pipelines and to evaluate the potential for attenuation of peak rates of flow by routing flows through existing and potential ponds, pipes and open channel system. This evaluation included delineation of runoff subbasin areas corresponding to small branch piping systems, a review of proposed land use and soil types, and a computation of existing pipe and inlet capacities.

Previous analysis prepared by CH2M Hill (discussed above in Section 4.0) was used as a reference for missing information and for overall reasonableness within the context of identifying runoff rates, volumes and capacity deficiencies. However, because of the need for more detailed level information, it was necessary to independently develop a runoff model for use in analyzing pipe system capacities, and potential capital improvements.

Model Selection and Limitations

The HydroCAD™ computer program by Applied Microcomputer Systems, Inc. was selected for hydrologic modeling and hydraulic analysis of the drainage system components. This program was selected because of its simplicity, particularly with respect to analyzing alternatives to proposed deficiencies. A screen interface is used for all data entry and a computation diagram controls the order in which runoff from subbasin areas is routed through reaches or ponds. The program allows runoff to be computed using either the rational method or the SCS TR-20 method with options for modifying rainfall distribution tables and unit hydrographs as appropriate for any particular application. Both the rational method and the SCS TR-20 method are commonly used to design storm water drainage systems and evaluate watershed responses. The SCS TR-20 model was developed by U.S. Department of Agriculture and is a reliable tool for predicting the rate and volume of runoff.

The HydroCAD™ model is a proprietary model. The source code is not available from the author and software support is provided solely by Applied Microcomputer Systems, Inc. The model does not include parameters for initial abstractions or losses; these are accounted for within the SCS curve number tables as discussed below. In addition, the TR-20 modeling option is designed for evaluation of 24-hour storms and required modification of the rainfall distribution table and interpretation of the runoff curve tables to evaluate shorter duration storms. The ease of use of the model and its flexibility with regard to modifying the location and arrangement of the drainage system elements outweighed these disadvantages.

The accuracy of the model predictions is dependent upon the accuracy and precision of model input including the time of concentration, basin area, precipitation data, soil conditions, and other hydrologic parameters which are discussed further in the following sections.

5.1.1 Methodology

Soil-Complex Method

Runoff rates and volumes for the Presidio were developed using a modified application of the SCS TR-20 method to generate and route runoff hydrographs through the existing drainage system. The TR-20 method applies the soil-cover complex method which considers land use, ground cover, and the hydrologic soil group to determine a composite runoff curve number (CN) representing the soil-cover complex. This method uses a non-linear relationship between the amount of precipitation and runoff from a watershed and the type of soils, vegetative cover and impervious surface area. A high CN corresponds to a high potential for direct runoff with impervious surface areas and open water surfaces represented by a CN of 100; all precipitation results in direct runoff. Soil type and vegetative cover reduce the amount of precipitation that contributes to direct runoff; these reductions are known as losses or abstractions. As losses or abstractions increase, the CN goes down. A complete discussion of the soil-complex method can be found in the National Engineering Handbook, Section 4, Chapters 7 through 10 (Soil Conservation Service, 1985). Typical parameters used to represent watershed subareas in the TR-20 method include time of concentration, precipitation amount, and the composite curve number.

Modified TR-20 Method

The TR-20 method is generally used to analyze runoff from relatively long-duration, low-frequency events. It was necessary to modify the standard application of this program to account for the short time of concentrations typical of the small subbasin areas at the Presidio. The precipitation/runoff relationship was developed by considering the various soil types and slopes, and by applying the rational method and back calculating the corresponding CN values. CN values obtained in this fashion were used in the model. The relationship between rational runoff coefficients (c), curve numbers (CN), and the amount of precipitation are shown in Table 5.1 and on Figure 7. The relationships shown in Table 5.1 and on Figure 7 are only applicable at the Presidio for short-duration, high-intensity events, preceded by a prolonged period of precipitation. Table 5.1 demonstrates that using a relatively high CN of 89, with 30- and 60-minute precipitation amounts, only 15 percent of the precipitation would run off.

Subbasin Delineation

Runoff area delineations were developed using 1″ = 100′ topographic mapping developed by Aelutek, Inc. This topographic mapping was provided to Dames & Moore in paper and in AutoCad digital formats. Also used were General Storm Drainage Maps prepared by the U.S. Army at a scale of 1″ = 100′. These maps show the locations and sizes of many of the storm sewer pipes throughout the Presidio; however these maps are incomplete in some areas and the need exists to verify and upgrade the information on the maps. Subbasin boundaries were generally chosen to correspond to drainage areas entering specific pipe systems. This approach was used to develop detailed runoff hydrographs for use in evaluating the capacities of pipes within the major drainage systems. These hydrographs were also used to evaluate the catchbasin inlet capacity within each subbasin.

Time of Concentration

Each subbasin was evaluated to determine the subbasin time of concentration. The time of concentration is the travel time required for precipitation, falling on the most hydraulically remote spot in the subbasin, to reach the downstream end (discharge outlet) of the subbasin.

The Overland flow method was employed to compute the time of concentration. Parameters considered include the slope of the terrain; vegetative cover; impermeable areas; channelization and piping; channel and pipe sizes, materials, and slopes; and the length of the flow path.

Precipitation Data

Rainfall distributions were developed for the 2-, 10-, 25- and 100-year frequency storms with 30- and 60-minute precipitation durations. The precipitation durations of 30 and 60 minutes were selected because they correspond to the time of concentration of the individual subbasins as well as the cumulative time of concentration for the watershed basins. The rainfall distributions correspond to high-intensity, short-duration storms. Typically, these storms would occur as part of a frontal system.

Storm water drainage piping and open channels were evaluated for capacity using the 10-year frequency event. Low points along major roadways were evaluated using the 25-year frequency event and the impact of prolonged intense precipitation was evaluated using the 100-year frequency event. A 10-year event corresponds to a precipitation event that has a 1 in 10 chance of occurring in any given year. A 100-year frequency event has a 1 in 100 chance of occurring in any given year. Rainfall distributions for the various duration and return frequency events are presented in Table 5.2. The rainfall distributions were developed to generate a peak rate of runoff from relatively small watershed areas with short times of concentration. The distributions would be representative of precipitation from a storm that is "nested" within a frontal system delivering a period of prolonged precipitation.

Storage-Indication Routing

The model utilized storage-indication routing to attenuate the peak rate of flow through pipes, open channels and surface ponds. Friction loss coefficients and reach geometrics were used to compute travel times through each reach. At several locations low areas define storage ponds. These areas were incorporated into the model as ponds with stage-storage-discharge relationships. The storage-indication method accounts for the volume of runoff as well as the

rate of runoff entering and leaving each pipe, open channel reach, or pond. Manning's n friction factors used in the model are presented in Table 5.3.

Model Calibration

Dames & Moore calibrated the model using existing information on topography, soil conditions and proposed conditions described in the Draft GMPA. The calibration considered areas proposed for pavement installation and removal as well as removal or construction of buildings. In addition, a detailed analysis of the relationship between runoff coefficients and SCS curve numbers for soils conditions at the Presidio was performed. The calibration of the model using existing information should provide a reasonable range of results for use in evaluating runoff rates and volumes and pipe conveyance capacities for the storm frequencies and durations studied.

Precipitation and Runoff Monitoring

As part of the Storm Water Sampling and Analysis Program, simultaneous measurements of precipitation and runoff were made. A portion of the El Polin Spring drainage basin comprised primarily of open space and soil types representative of a majority of the open space at the Presidio was chosen for this exercise. An automatic bubbler flow meter and tipping bucket precipitation gage was installed at the masonry headwall of the western drainage of the El Polin Spring drainage basin.

Data representing the storm of February 16 and 17 are presented in Table 5.4. The data depict an average storm with precipitation totaling about 0.3 inch. Precipitation occurred over a time span of 8 to 9 hours beginning late on February 16 and ending early February 17. Approximately two-thirds of the precipitation occurred over a 2-hour interval during the mid-point of the storm. The average intensity during this period was about 0.11 inch per hour. The data for the measured area show that less than one percent of the precipitation volume was runoff. Section 6.6.1 presents a discussion of average annual precipitation. The recorded event falls within the range of precipitation amount and intensity typical of an average winter storm.

Therefore, as expected, open space areas at the Presidio can be expected to generate little, if any, runoff during the average winter storm.

5.1.2 Results

The data used in evaluation of the piping system and hydrologic regime, along with data generated by the hydrologic modeling, are presented in Tables 5.5, 5.6, and 5.7. Table 5.5 presents data on the modeled storm sewer system pipe sizes, materials, invert elevations, slope and Manning's n. The subbasin areas and pipe numbers shown in this table are also shown on Figure 3. Table 5.6 presents data on the subbasins which comprise the Presidio. The table includes the subbasin area, time of concentrations, pervious, impervious and total areas, and their respective SCS curve numbers. The estimated runoff rate for the 2-, 10-, 25-, and 100-year storm events along with the estimated runoff volume for each basin are shown in Table 5.7.

Of the three major watersheds in the Presidio, the western watershed which comprises 210 acres and drains to the Pacific Ocean (see Figure 3) was not included in the model. The hydrologic model was based on information provided in the GMPA. The GMPA indicates that the western watershed will be designated primarily as open space/recreational uses, and therefore does not require the same level of analysis (as provided for the other, developed watershed areas in the Presidio). The following runoff rates for the western watershed are provided as background information for the reader.

The primary source of existing development in the western watershed is the 1500 buildings (the Wherry Housing Area). Pursuant to the GMPA, these buildings will be removed and the landscape will be returned to a natural state. Currently, a portion of the runoff from this area is collected and diverted to the CCSF combined sanitary and storm sewer system. The runoff not captured and conveyed to the CCSF system is discharged through two main catchment basins, and is eventually discharged to Baker Beach via the Battery Chamberlin. This runoff, which includes runoff from the open space area between the Wherry Housing Area and the Battery Chamberlin, is estimated at 41 cubic feet per second (cfs) (for the 46.8-acre area).

After demolition of the Wherry Housing Area and establishment of open space recreation landuse, the expected range in runoff rates for the western watershed will be approximately 0.14 to 0.29 cfs/acre or about 30-61 cfs for the watershed, of which about 6.6 to 13.6 cfs would come from the Wherry Housing Area.

5.2 HYDRAULIC ANALYSIS

The hydraulic analysis performed included an evaluation of existing pipe capacities, identification of pipe capacity deficiencies, determination of required replacement pipe sizes, an evaluation of existing inlet capacities, and an evaluation of detention basins to reduce the number of lineal feet of pipe that would need to be replaced.

5.2.1 Existing Pipe Capacities

Existing pipe capacities were evaluated by computing the full pipe flow based upon pipe material, size and slope. The computed values were compared to values presented in the CH2M Hill study. Our analysis yielded essentially the same flow capacities as the CH2M Hill study. In a few instances, our results were modified to incorporate additional information on invert elevations that was provided in the CH2M Hill study but was not included on the available reference maps of the drainage system. Table 5.8 presents the existing pipe capacities and estimated runoff rates conveyed through each modeled pipe segment.

5.2.2 Pipe Capacity Deficiencies

Deficient pipe capacities were identified and the auto-sizing routine of the HydroCAD™ computer program was used to estimate the required replacement pipe sizes. The pipe sizes determined by the program were spot checked and evaluated to determine their ability to convey the 10-year rate of flow against an MHHW elevation of 5.7 feet. Hydraulic grade lines were computed beginning at the bay and extending upstream reach by reach to confirm that the grade line did not rise above the surface of the ground.

Existing pipes were identified for replacement if the design flow exceeded the existing full pipe capacity by ten percent or more. The replacement pipe sizes are shown in Table 5.8 along with their respective lengths.

For the 10-year event, 9,970 lineal feet of piping ranging in size from 12 to 42 inches in diameter would need to be replaced. The portion of drainage basin F beginning at the south end of the Parade Grounds and extending to the bay contains 1,690 lineal feet of under-capacity piping. Drainage basin J contains 2,260 lineal feet of under-capacity piping from just south of Highway 101 and extending to the bay. The majority of the remaining under-capacity pipe occurs in various outfall systems extending from Doyle Drive toward the bay through the Crissy Field area.

The results of the model indicate approximately 4,890 fewer feet of piping are under capacity than indicated in the CH2M Hill study. The differences are likely attributable to one or more of the following:

- The Dames & Moore model considered more refined subbasin areas and an increased number of pipe segments which would be expected to result in a more accurate estimate of the rate and volume of runoff;

- The Dames & Moore model used the SCS runoff hydrograph routines of the HydroCAD™ model to determine the volume of runoff. The SCS method generates a more reasonable estimation of the rate of runoff and the variation of rate with time. It should also provide a better estimate of runoff volume;

- The Dames & Moore model used somewhat lower runoff coefficients for open space areas. The use of the lower runoff coefficients was justified by field investigations, literature reviews, and interviews with Army operations and maintenance personnel during which few observed capacity deficiencies were noted; and, most significantly,

- Pipes with capacity to convey at least 90 percent of the estimated design flow were considered to have marginal but acceptable flow capacity. Therefore, replacement was considered unnecessary.

5.2.3 Detention Basins

Detention basins were considered as a possible means to reduce the peak rate of flow in various segments of the drainage system, thereby reducing the need to replace existing piping due to capacity deficiencies.

The location of the evaluated detention basins was determined from a review of topographic mapping and storm drainage piping. In general, sites were chosen that appeared to have the greatest potential for interception and storage of runoff with the least impact on existing trees, habitat and other facilities. Drainage subbasin areas B.2, B.3, D.10, G.4, J.10, J.11, and J.12 were evaluated. Criteria for evaluation of detention basins included the following:

- Ability to control the rate of discharge from the detention basin commensurate with the existing down stream piping system capacity; and
- Ability to safely store and convey the rate and volume of runoff generated by a 100-year, 24-hour storm; and
- Compatibility with the goals and objectives of the GMPA.

Of the detention basins evaluated, only one, located in Subbasin G.4, appeared feasible to implement from a storm routing perspective. This detention basin would eliminate the need to replace the under-capacity outfall system for drainage basin G. In addition, the detention basin could potentially be integrated into the wetlands restoration plan, and, in combination with other BMPs identified in Section 9.0, provide treatment of runoff from about 2,200 lineal feet of Doyle Drive. It could also provide treatment for roadways within basin G south of Doyle Drive, and, depending upon the final configuration of the wetland restoration project, could provide additional treatment for runoff from Subbasin F.5 from Montgomery Avenue to the west. It should be noted that management of the runoff from Doyle Drive is the responsibility of the California Department of Transportation (see Section 8.5 for additional discussion of this issue).

The use of detention basins in the following subbasins was found to be infeasible for the following reasons:

- The detention basin in B.2 would not provide a sufficient level of flow rate reduction to meet the first evaluation criterion discussed above;

- The detention basin in B.3 would require extensive regrading and reconstruction of the parking lot at the Letterman complex. This concept was dismissed because of potential inconvenience to patrons from water accumulating in the parking lot;

- The detention basin in D.10 would be coincident with the riparian corridor restoration project, however, no benefit to downstream piping would be realized as the existing piping already has sufficient capacity;

- The detention basin in J.7 would require extensive regrading and the removal of trees within the Presidio Forest. This was considered incompatible with the preservation of existing cultural and natural resources;

- The detention basins in J.10 and J.11 would not satisfy the second evaluation criterion without excessively deep excavations, potential impact on natural and cultural resources, and conflicts with the proposed horse paddock area; and

- Insufficient surface area exists for an adequate detention basin in J.12. This detention basin could potentially be implemented in conjunction with detention basins in J.10 and/or J.11 which, in combination, would provide adequate storage. However, deep excavations and potential tree and horse paddock impacts would likely be unacceptable.

5.2.4 Inlet Capacities

Subbasin inlet capacities were evaluated using 10-year peak rates of runoff generated by each subbasin area. An inventory of the inlets was performed through a combination of field observation and review of the General Storm Drainage Maps and Cadd files. Although several different types of inlet grates exist at the Presidio, the predominant type was approximately 18 to 20 inches square with approximately 1.2 to 1.3 feet of open area. To simplify the evaluation, a general inlet grate type was selected based upon the above observations.

The capacity of an inlet grate is dependent upon the open area of the grate, the presence or absence of a curb inlet, the transverse gutter slope and the longitudinal slope of the gutter. Curb inlets were neglected in the analysis because at the Presidio, they are the exception rather than

the rule. The first step in evaluating inlet capacity was to select an equivalent grate conforming to the parameters of our assumed "general inlet grate type." A manufacturers' catalog was used and the Neenah model R-1879 A3 was chosen. This grate has an open area of 1.3 feet and a configuration similar to many of the observed grates. A range of inlet capacities was evaluated using the flow rate information in the manufacturers' literature. A transverse cross slope of 2 percent was assumed for all inlets. Three ranges of longitudinal slopes were evaluated, 0 to 1 percent (flat), 2 to 4 percent (mild), and 5 and greater percent (steep). Table 5.9 presents the inlet capacity evaluation. The table indicates that most subbasins have sufficient inlet capacity for the 10-year rate of runoff.

In some instances, the evaluation indicates that the existing inlet capacity is marginal or that additional capacity could be needed. Those areas capable of passing at least 90 percent of the 10-year design storm runoff are identified as having acceptable inlet capacity. Those areas with inlet capacity of less than 90 percent of the estimated rate of runoff are identified as needing capacity improvements. In a couple of instances, open channels are the primary means of collecting and conveying runoff within the subbasin. Even though the inlet capacity evaluation indicates a need for improvement, adequate collection and conveyance would be provided by the open channels.

Although the inlet capacity of the existing system should, for the most part, provide adequate surface drainage, the existing inlet structures are generally in poor to very poor condition. Many of the grates and structures are beyond their useful life-cycle; common problems include deterioration from corrosion, poor fit between frame and grate, and damaged grates. In addition, many inlets present potential hazards to pedestrians or bicyclists. Loose, poorly fitting, and damaged grates could cause injury to pedestrians, and with the exception of some structures and grates installed more recently, the majority of the inlet structures are not equipped with modern bicycle safe grates.

5.2.5 Roadway Low Points

Low points along major roadways were evaluated for drainage inlet capacity deficiencies using the 25-year storm event. The intensity of the storm was based on the time of concentration for

each area. The evaluation determined that inlet capacity at low points was not a major concern at most locations. The noted exceptions are at the intersections of Lincoln Boulevard and Bowley Street, and Lincoln Boulevard and Story Avenue.

Lincoln Boulevard at Bowley Street is near the proposed maintenance facility along Lobos Creek at Lincoln Boulevard. Water would accumulate in the roadway and could overtop the curb and flow overland to Lobos Creek. Vegetation is deteriorated and erosion is occurring in this area. During a 25-year storm, erosion would increase and accelerated damage could occur. Additional inlet capacity should be provided in this area, particularly in light of the roof leader disconnection program which would be expected to increase the rate and volume of runoff at this location. New drainage facilities should be designed to prevent runoff from entering Lobos Creek upstream of the Water Treatment Plant diversion structure on Lobos Creek. These could include new catchbasins, curbing and storm sewer piping.

The Lincoln Boulevard and Story Avenue intersection is coincident with the lower end of a natural open channel drainage that originates in the Fort Scott area near the Boy Scout Building. Accumulated water that overtopped the curbs would drain toward and into the natural channel and could cause some minor erosion damage.

5.3 PROLONGED PRECIPITATION

The drainage system at the Presidio is comprised of several elements which work together to direct and convey surface runoff from yards, open space, parking areas, and roadways. Runoff originating in the upper portions of the watershed and from yards and open spaces typically flows overland to roadways or other paved surfaces. Most of the roadways are equipped with open channels or curbs and gutters. Throughout much of the Presidio, shallow open channels along the roadside intercept the runoff and convey it downgradient to catchbasin (inlet) structures. The runoff is conveyed from there to storm drainage piping and may be discharged back into larger open channels or may be conveyed within the storm sewer piping system to the receiving water. Periods of prolonged precipitation, in excess of the design capacity of any one of the components of the drainage system, may result in several consequences that could in some cases be considered inconvenient but in other cases may cause property damage, pose safety

hazards, or require emergency response measures. A qualitative evaluation of prolonged intense precipitation is presented in this section of the SWMP. The objective of the evaluation is to identify the type and range of problems and the likely locations that will be impacted. The evaluation was based upon a synthesis of the hydrologic modeling, hydraulic analysis, soils and erosion mapping, and a review of the site topography.

During long, intense precipitation, the soils within yards and open spaces will become saturated, thereby reducing the rate of infiltration. The rate of runoff will accelerate and sheet flow will concentrate into rivulets which will increase the likelihood of erosion scour in open spaces. Open space areas that are vulnerable to erosion include places where vegetation has been damaged, along authorized and unauthorized trails, unpaved maintenance or service vehicle access roads and along all draws and drainage ways. Erosion within open space areas may result in an increase in the amount of sediment deposited along roadside open channels, depending upon the slope of the roadway and the magnitude of flow within the channels.

Roadside open channels are typically shallow (4 to 8 inches in depth) and are constructed of brick, concrete, asphalt or granite blocks. These channels are the predominant initial component of the drainage system within the Fort Scott, Presidio Hill, Presidio Forest, Golden Gate/Fort Point, and East Housing planning areas. In other parts of the Presidio, curb and gutters comprise the initial component of the drainage system. The shape of the open channels varies from location to location. Some are rectangular in section, others are triangular and a few are parabolic. As the flow capacity of the channels is exceeded, the channels will overtop and water will flow along the edge of the road encroaching into the traffic lane. If conditions permit, runoff will also encroach into the vegetated strip adjacent to the road. This condition would result in erosion scour adjacent to the roadway and particularly at the interface between the paved surface and the adjacent native soils. Sediments will be deposited in areas where the slope of the roadside channel flattens and loses its capacity to maintain the suspended sediment load. Rectangular shaped channels with flat slopes will tend to accumulate sediments more rapidly than the other shapes.

At inlet structures, the rate of runoff may exceed the inlet capacity, water will accumulate at the inlet and will encroach into the roadway. Traffic lanes may be obstructed by standing water.

Flooding can be expected at intersections and at low points along roadways. In some areas the accumulated water may exceed the height of the curbing and flood adjacent yards, open spaces or sidewalks. In other cases runoff may flow past an inlet structure and downgradient to the next inlet structure or to a low point in the roadway. Accumulation of runoff at low points may cause overtopping of the curb and overland flow. This would likely result in localized erosion scour adjacent to the road and extending down slope. Areas of particular concern would be adjacent to roadways along the bottom of valleys, draws and drainage ways where runoff would naturally tend to accumulate and the likelihood of erosion of the roadbed would be greatest.

Long, intense precipitation is also frequently accompanied by high wind which may increase the amount of vegetative litter from trees and other plants. Depending upon the severity of the winds, leaves, twigs, branches, limbs and entire trees may fall. Electrical wires may be knocked down and buildings may be damaged. Fallen litter may be swept by runoff into open channels and inlet structures. Channel conveyance and inlet capacity may be reduced and cause an increased amount of water accumulation on and next to roadways.

With a few exceptions, most of the storm sewer piping system would be operating under pressure. In some locations, this may cause water to bubble up and out of inlet structures. Standing water could accumulate at the inlet or flow overland to lower lying areas. Standing water would draw down as the storm intensity diminished. Existing pipes that are cracked or broken, or pipes with holes could be subjected to accelerated deterioration. In extreme cases pipe failure could occur and the soils surrounding the failed pipe could be swept away; creating an ever growing void space beneath the surface. Under prolonged conditions, a sink hole could develop; the most severe condition would occur as a sudden failure of a paved traveled roadway.

Natural unlined open channels and overland flow paths would be subjected to long duration flow rates in excess of normal channel flow rates. Vegetation could be loosened and fallen branches and tree limbs could obstruct the channels and be washed down stream. In some areas, culvert crossing and open channel transition inlets to storm sewer piping could become partially obstructed. Water would back up behind the culvert or inlet. The water surface would increase in elevation and could flood adjacent areas and flow overland to lower lying areas. If water

accumulated to the point of overtopping roadways, it is likely that erosion of the road banks and damage to the road pavement would occur.

The Presidio's storm water drainage system has not been designed to handle every contingency, as this is neither cost-effective nor standard practice. Modifications and maintenance procedures recommended to enhance the capacity and operation of the system are discussed in Section 12.0.

5.4 INFLOW FROM OTHER SOURCES

One additional source of inflow to the storm sewer system was identified. The steam-generating plant contributes a low-level flow of approximately 5 to 10 gallons per minute. The flow enters the storm sewer system pipe D.16 200. This flow would discharge into the planned riparian corridor and wetlands restoration area, and because it would introduce a high thermal gradient it should be diverted to the sanitary sewer system as part of the illicit discharge elimination program.

6.0 RUNOFF WATER QUALITY

6.1 INTRODUCTION

Pollutant loads in storm water vary greatly from event to event and are dependent upon a variety of factors which include the duration and intensity of precipitation, the elapsed time between storms, land use, vegetative cover, impermeable surface area, population density, vehicle traffic, the age of facilities and many other factors. Accidental spills of hazardous and non-hazardous materials or waste can also impact runoff quality of they occur during a storm or are not promptly and thoroughly cleaned up.

With the implementation of the Clean Water Act, a greater awareness of storm water pollutants led to increased efforts to quantify pollutant loads and typical constituents. Many studies have been implemented to ascertain specific pollutant loads and to search for correlation between the various hydrologic and pollution parameters. On such study published by the EPA, the Nationwide Urban Runoff Program (NURP), was conducted by an assortment of cooperating federal, state, regional and local agencies from across the country. The program was broad and covered a large range of technical and planning issues. The intent of the program was to provide practical information for use in storm water management and planning. The program evaluated the type and extent of pollutant loads and identified appropriate and practical methods to control or mitigate the effects of storm water pollutants. The current NPDES permit requirements for storm water discharges were developed based upon the findings of the NURP study.

6.1.1 Purpose

The NPDES storm water permit application process requires a characterization of runoff water quality. The purpose of characterization is twofold:

- To identify areas or land use types contributing disproportionate quantities of pollutants to storm water discharges, so these areas can be targeted for implementation of BMPs; and

- To provide a baseline evaluation runoff water quality which can be used to assess the effectiveness of storm water BMPs in reducing pollutant loads.

At this time, regulations do not require collection and analysis of site-specific runoff samples; however, it is likely that such a requirement will be implemented in the future. Therefore, in anticipation of this requirement, storm water samples for three storm events during the winter of 1993-94 were collected and analyzed to categorize runoff water quality for each major land use designation at the Presidio. Previous studies of water quality in Lobos Creek, Presidio storm drains, and Presidio storm drain outfalls were also used to assist in identifying problem areas, and to supplement overall understanding of runoff water quality. This section of the Storm Water Management Plan summarizes previous water quality studies, describes the rationale and methods employed in site-specific storm water sampling and analysis, discusses the expected variation in storm water pollutant loads, and presents an estimate of pollutant loads in Presidio storm water.

6.1.2 General Background

Presidio storm water and sanitary sewage have historically been conveyed through a combination of separated and combined sewers. With the implementation of the Clean Water Act, programs were implemented at the Presidio to completely separate the sewer systems. As recently as 1993, the U.S. Army implemented a major retrofit of the sanitary sewer piping and lift station system. This retrofit program disconnected numerous roof drains from the sanitary sewerage system and completed major upgrades to the lift station system. This work was performed to bring the systems up to acceptable standards and to provide effective sewerage service to the Presidio well into the twenty-first century. Specifically, the program was intended to eliminate discharge of untreated sewage into the San Francisco Bay and Pacific Ocean.

Nonetheless, some concerns remain as to the completeness of the effort with regard to disconnection of all sanitary sewerage facilities from the storm drainage system. A description of measures designed to detect and eliminate illicit sanitary sewerage connection is presented in Section 12.0.

The following sections discuss existing surface water runoff water quality.

6.2 REVIEW OF EXISTING WATER QUALITY DATA

This section summarizes the results of recent surface water quality studies. None of the previous studies focused specifically on storm water runoff quality on a sitewide basis; however, the data are useful in locating potential sources of pollutants in storm water runoff. Existing water quality data for Lobos Creek and San Francisco Bay at the Presidio shoreline are discussed separately.

Lobos Creek

In preparing the Watershed Sanitary Survey for the Lobos Creek Watershed (Dames & Moore, 1994a), the following studies were reviewed:

- Presidio Water Treatment Plant annual and quarterly reports prepared by the U.S. Army for 1990, 1992, and 1993. These reports document analytical data for raw (untreated) water samples collected at the water treatment plant intake diversion structure in Lobos Creek.

- Main Installation Remedial Investigation (USACE, 1993). Samples were obtained from five locations along Lobos Creek: three upstream of the water treatment plant, one near the intake, and one downstream of the plant. Samples were collected during the period May through October 1990.

- Presidio of San Francisco Water Supply Evaluation (Nolte & Associates, 1992). Samples were obtained from two locations along Lobos Creek in 1991: one near the intake, and one near 20th Avenue.

In general, the three studies indicate that concentrations of manganese and iron periodically exceeded their respective primary Maximum Contaminant Levels (MCLs). Concentrations of carbon tetrachloride and 1,2-dichloroethane were greater than or equal to the primary MCL. Concentrations of nitrate were consistently high, but not in excess of the primary MCL, and fecal and total coliform bacteria levels were also relatively high. Based on the review of water quality data presented in these three studies, Dames & Moore identified three constituents of concern with respect to Lobos Creek as a drinking water source:

- Manganese, which occasionally exceeded the secondary MCL (taste and odor criterion);

- Nitrate, because levels present in the creek may indicate contamination from leaking sewers; and

- Coliform bacteria, due to their common association with fecal contamination from human or animal sources.

Storm Drains and San Francisco Bay Outfalls

The second group of studies focused on water quality in storm drains discharging to the bay and in the bay near the Presidio storm drain outfalls. These studies, including the Presidio of San Francisco Storm Sewer Outfall Study (Dames & Moore, 1993b), identified a pattern of water quality violations with respect coliform bacteria.

San Francisco BayKeeper, a non-profit organization, analyzed coliform data obtained by the City and County of San Francisco, the U.S. Army, and BayKeeper. Their analysis indicated that consistently high coliform counts were present near the outfalls for drainage basins D, F, and J over the period of monitoring. However, low correlation coefficients indicated no reasonable correlation between precipitation events and elevated coliform counts; this could be interpreted as an indication of illicit sanitary sewer connections.

Dames & Moore used bay water quality data obtained by the CCSF between 1988 and 1993 to evaluate trends in coliform levels. The CCSF data indicated an overall decline in coliform count violations over the past five years in the vicinity of outfalls discharging runoff from drainage areas A, J, K, and L. This decline may be the result of various structural improvements implemented by the U.S. Army in recent years. However, during the winter of 1992-1993, coliform water quality violations were observed in the vicinities of outfalls receiving storm water from drainage areas C, D, E, I, and J.

Dames & Moore's 1993 sampling efforts focused on identifying potential sanitary sewer cross connections or leaks which may be the cause of elevated coliform counts detected in the bay near the storm drain outfalls. Based on limited sampling in onsite storm drains, five areas were identified as potential source areas and were recommended for further study after completion of sanitary sewer repairs by the U.S. Army. The five areas are: the vicinity of Building 650; north

of Building 902 at Mason Street; the vicinity of Building 605; the vicinity of Banks Street at Lincoln Boulevard; and the vicinity bounded roughly by Eddie Road, General Kennedy Avenue, Torney Avenue, Lincoln Boulevard, and Girard Road. The 1993 Dames & Moore report recommended that monitoring be continued to provide a statistically significant database and assess the effectiveness of the Army's sanitary sewer repairs (slip lining and lift station reconstruction) in reducing coliform counts in the storm drain system.

Other water quality data on outfalls B, F, G, H, M, and N were not available.

Storm Drain and Outfall Water Quality

Watkins-Johnson Environmental, Inc. performed sampling and chemical analysis of storm water samples collected from five selected Presidio storm drains at or near their respective outfalls in February 1993. The results were reported in the Marine Ecological Sampling and Analysis Program (Watkins-Johnson Environmental, Inc., 1993). Storm water samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), oil and grease, pesticides and PCBs, herbicides, total metals, total organic carbon (TOC), total suspended solids (TSS), and total dissolved solids (TDS).

VOCs and SVOCs were not detected, with the exception of two common laboratory contaminants which were also detected in the method blank. One herbicide (2,4,5-trichlorophenoxyactetic acid) was detected at concentration up to 0.5 μg/L in each sample, and two pesticides (tetrachlorometaxylene and dibutylchlorendate) were detected at similar concentrations in all samples. Barium, calcium, chromium, copper, iron, potassium, magnesium, manganese, sodium, vanadium, and zinc were detected in all samples. Cadmium was detected in one sample, and lead was detected in two samples.

The reported concentrations of nickel, lead, and zinc exceeded one or more of the numerical water quality objectives of the California Enclosed Bays and Estuaries Plan for surface waters downstream of the Carquinez Strait; however, natural concentrations of nickel in the bay are known to regularly exceed national surface water averages.

6.3 MONITORING AND SAMPLING

A storm water sampling and analysis program was undertaken by Dames & Moore at the Presidio during the winter of 1993-94. This section describes the selection of sampling locations, sample collection methodology. Analytical testing is discussed in Section 6.4, and Section 6.5 presents the analytical results.

6.3.1 Subbasin Selection

Storm water samples were collected from each of six sampling locations within the Presidio. The sampling locations were selected to be representative of anticipated future land uses at the Presidio based on the Proposed Project (Alternative A) described in the General Management Plan Amendment (GMPA) and Draft Environmental Impact Statement (DEIS) for the Presidio of San Francisco.

Subbasins within the eighteen major drainage basins at the Presidio were screened to identify candidate sites for storm water sample collection using the following criteria:

- Subbasins characterized by a single predominant land uses are preferred because runoff quality is expected to vary by land use;
- Areas where future land use is expected to be similar to current land use are preferred;
- Larger subbasins are preferred over smaller ones; and
- Areas having potentially unique runoff characteristics (such as the Golf Course) are preferred.

The following table describes the physical location of each sampling point, the major drainage basin in which it is located, and the corresponding representative land use type. Figure 8 shows the Presidio site drainage basin boundaries, existing land use types, and the selected storm water sampling locations.

STORM WATER SAMPLING LOCATIONS (WINTER 1993-94)			
Sample ID	**Drainage Basin**	**Land Use Type**	**Description of Sample Location**
SL-1	M	Industrial	Parking area northwest of Bldg. 979 (near Long Avenue)
SL-2	F (lower)	Major Roads	North side of Doyle Drive near Bldg. 610
SL-3	F (upper)	Residential	Infantry Terrace near Arguello Blvd.
SL-4	B	Commercial/ Institutional	Eddie Road at O'Reilly Avenue (Letterman Army Institute of Research parking area)
SL-5	D (upper)	Open Space	MacArthur Avenue at El Polin Loop (El Polin Spring)
SL-6	P	Golf Course	West Pacific Avenue beneath Highway 1 (Park Presidio) overpass

The Golf Course was selected for monitoring because of its large geographical area, the fact that it is part of the Mountain Lake watershed, and because special chemical applications are typically required to maintain fairways, tees, and greens.

The El Polin Spring sampling location was selected as being representative of runoff from natural open space areas, including Presidio Hill, Presidio Forest, portions of Fort Scott, and similar undeveloped areas of the Presidio.

6.3.2 Data Collection Methodology

Storm water runoff samples were collected at each of the six sampling locations during three storm events having total precipitation of 0.1 inch or more. The monitored storm events occurred on January 23, February 6, and February 17. One objective of the sampling program was to collect grab samples representative of the first flush, or first half hour of precipitation. However, sampling on January 23 took place approximately two hours after the onset of precipitation. The second objective was to collect composite samples representative of the overall character of runoff water quality.

Each sample was collected in several sample containers. The size, material, and preservative (if used) for each container was selected based on the constituents to be monitored in accordance

with standard water sampling and analysis protocols established by the United States Environmental Protection Agency. Table 6.1 lists the sample container sizes, types, and preservatives used for the Presidio storm water monitoring program.

Two types of runoff samples were collected: grab samples and composite samples. Grab samples were obtained at each sampling location during each storm event. Composite samples were obtained from sampling locations SL-2, SL-3, SL-4, and SL-5 on a rotating basis during the monitoring period. One composite sample was obtained from each location.

Automatic flow monitoring and sampling equipment was used to collect composite samples. The equipment monitored flow elevations and was programmed to initiate sample collection based upon a specified amount of precipitation (0.1 inch in a 2-hour interval) and/or a change in water surface elevation. The automatic samplers were programmed to collect separate one liter samples every five minutes for the first half hour followed by one liter every twenty minutes until a total of three hours had elapsed. The first four sample bottles were combined to create a grab sample representative of the first flush. The remaining bottles were used to create a flow-weighted composite sample for use in estimating average pollutant loads.

6.4 LABORATORY ANALYSIS

Quantitative data were developed through laboratory analysis of grab and composite samples performed by a certified laboratories. Testing methodologies were in accordance with the current edition of "Standard Methods for Examination of Water and Wastewater" (APHA, 1975) or with other EPA-approved testing methods. The purpose of this effort was provide detailed data regarding the water quality constituents discussed below.

Monitored Constituents. Collected storm water samples were tested for:

- Biological Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- Total Suspended Solids (TSS);
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus;

composite samples. However, the general trend for Chemical Oxygen Demand (COD) and Total Suspended Solids (TSS) indicates the expected relationship is present for at least some constituents (i.e., the grab sample results are higher than results for composite samples collected during the same event). Furthermore, the photograph of a series of timed samples in Appendix K visually demonstrates how concentrations of pollutants typically decline as each event progresses.

6.5.2 General Storm Water Quality

The analytical data indicate that Presidio runoff is generally neutral to slightly basic. COD and TSS were consistently detected at concentrations similar to the EPA median Event Mean Concentrations (EMCs) reported in the NURP study. COD and TSS were significantly higher than the EPA median EMCs for the industrial samples (SL-1); however, it should be noted that the EPA's industrial land use category specifically did not include heavy industrial sites. BOD was detected at concentrations similar to the median EMCs in most runoff samples; however, BOD in samples from the industrial area tended to be twice as high as the EPA median EMC.

Oil and grease were consistently detected in samples from the industrial area and roads (SL-1 and SL-2, respectively). Oil and grease were detected in one sample from the commercial area (SL-4), but were not detected in samples from open space areas and the Golf Course (SL-5 and SL-6, respectively). Oil and grease were not monitored for the NURP study, so no comparison is available.

Nitrogen (Total Kjeldahl Nitrogen, TKN) was consistently detected in samples from all areas, with the highest concentrations in samples from industrial areas and roads. The concentrations reported for these samples were remarkably similar to the EPA median EMCs. Phosphates were not detected in any sample.

Of the thirteen priority pollutant metals, seven were consistently not detected in runoff samples from the Presidio: antimony, beryllium, cadmium, lead, selenium, silver, and thallium. Chromium was occasionally detected only in samples from industrial and open space areas; copper was occasionally detected in samples from industrial, road, and residential areas; nickel

- The EPA list of 13 priority pollutants including heavy metals such as cadmium, chromium VI, copper, lead, nickel, and zinc, among others;
- Oil and Grease; and
- Coliform.

In addition, each set of samples was tested for pH during sample collection. Copies of the laboratory reports are presented in Appendix K. The monitored constituents were chosen based on recommendations presented in the California Storm Water Municipal Best Management Practice Handbook (CDM et al., 1993).

6.5 STORM WATER ANALYTICAL RESULTS

This section presents a discussion of the storm water runoff analytical data obtained for three storm events during the 1993-94 storm season. The analytical data are presented in Table 6.2.

6.5.1 Variation of Pollutant Loads with Time

Runoff pollutant loads vary with time. During the late spring, summer and early fall, pollutants are deposited on both pervious and impervious surfaces. The first significant precipitation of the season will wash off greater amounts of accumulated pollutants than subsequent precipitation. This is a seasonal variation in pollutant loads (i.e., higher at the start of the rainy season and lower at the end of the season). Pollutant concentrations also vary during individual storm events. With the onset of precipitation and initial runoff, pollutant concentrations are the highest; this is the "first flush" which occurs during the first 30 minutes of runoff. As the storm progresses, pollutant concentrations diminish.

In general, the data do not reveal the expected trend of reduced pollutant loads as the rainy season progresses; however, it should be noted that the sampling events were clustered near the middle of the rainy season. Therefore, the majority of pollutants accumulated on surfaces during the dry season should have already been flushed through the Presidio storm drain system.

Additionally, the limited grab and composite sample analytical data are not sufficient to demonstrate the expected difference between first flush grab samples and overall storm event

was detected only in samples from the open space area; arsenic was detected twice in the industrial areas only; and mercury was detected once in the residential area only. Zinc was consistently detected in samples from all areas except open space and Golf Course.

The NURP study presented median EMCs for three of the thirteen priority pollutant metals: copper, lead, and zinc. The storm water analytical data for Presidio samples were similar to the median EMCs (i.e., generally on the same order of magnitude).

Pesticides, PCBs, and herbicides were not detected in any samples from the Golf Course. However, it should be noted that these samples are not expected to be fully representative of annual pollutant loads from this area because of the seasonal nature of turf management practices. Specifically, pesticide and herbicide applications are probably most frequent during the active turf growing period (spring through late summer).

One potentially significant apparent trend in the Presidio runoff monitoring data for the rainy season of 1993-94 is that concentrations of BOD, COD, certain metals, and oil & grease were consistently relatively high in samples from the industrial area. This trend was expected, and indeed, storm water quality control programs typically focus on industrial and paved areas as the primary source of runoff pollutants.

6.5.3 Coliform Bacteria

Grab samples of runoff from each sampling location were evaluated for the presence of coliform bacteria. The high levels of E. coli found in samples from industrial and residential areas are not unusual in storm water runoff. However, the high levels of E. coli found at the commercial area (SL-4) indicate the possible presence of raw sewage in this storm drain. This drain corresponds to discharge at outfall B.

6.6 POLLUTANT LOAD ESTIMATE

Estimates of annual pollutant masses in Presidio storm water runoff were made using site specific precipitation and storm water analytical data. Pollutant load estimates were developed for each drainage basin and major land use category at the Presidio. The purpose of the

pollutant load estimates is to provide a basis for selecting cost-effective storm water best management practices. After implementation of these BMPs, the pollutant load estimate can also be used in conjunction with future storm water monitoring data to gauge the effectiveness of the BMPs. Pollutant load estimates were generated for three scenarios:

- Annual pollutant loading based on the USEPA NURP study typical storm water quality data and future land use conditions without BMPs;
- Annual pollutant loading based on site-specific storm water analytical data obtained for the rainy season of 1993-94 and future land use conditions without BMPs; and
- Annual pollutant loading based on site-specific storm water analytical data, incorporating pollutant load reductions anticipated from implementation of proposed BMPs.

6.6.1 Average Annual Precipitation and Runoff

Precipitation data from the National Climatic Data Center (NCDC) for the San Francisco Richmond station were evaluated to determine the average annual precipitation and the average annual amount of precipitation that occurs during storm events that produce 0.1 inch of precipitation or more. The entire period of record from October 1948 through December 1990 was used in the evaluation. One year of data, 1952, was missing and is not available.

The review of the data indicate that, on average, about 22 inches of precipitation can be expected annually. In order to estimate the pollutant load, an evaluation was performed to determine the average amount of precipitation that could be expected to generate runoff. Some precipitation events do not provide enough rainfall to overcome the initial losses and generate runoff. For the purpose of this estimation, rainfall events with less than 0.1 inch of precipitation were excluded. It is reasonable to expect that 0.1 inch of precipitation would only wet impervious areas and would not result in significant runoff. This is also consistent with the current 0.1-inch precipitation threshold for collection of runoff samples by industrial NPDES permit holders.

Storm event data were accessed through the compact disc read only memory (CDROM) data base program for NCDC hourly and 15-minute precipitation published by EarthInfo, Inc. The data were sorted to exclude events with less than 0.1 inch of precipitation. The average amount of precipitation per event was found to be 0.17 inches, a cumulative total of about 10.7 inches (about 50 percent) of the average annual precipitation could be expected to generate runoff.

6.6.2 Baseline Pollutant Load Estimates

An estimation of the pollutant loads was made for the annual runoff from the Presidio for the future land use condition as presented in the GMPA. The estimate is based on site-specific storm water runoff data and analytical data compiled by the United States Environmental Protection Agency for the Nationwide Urban Runoff Program (U.S. EPA, 1983). Annual mass loading was estimated for each drainage basin for each of the following constituents:

- Biological Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- Total Suspended Solids (TSS);
- Total Lead;
- Total Copper;
- Total Zinc;
- Total Kjeldahl Nitrogen (TKN);
- Nitrate-Nitrite as Nitrogen (Nitrate/Nitrite);
- Total Phosphorus; and
- Soluble Phosphorus.

The six land use categories defined in the DEIS were used in conjunction with typical land-use-based runoff coefficients to estimate the total annual runoff volumes and pollutant loads. Table 6.3 describes the percentage of each land use category occurring within each drainage basin.

For each drainage basin area, the total annual runoff volume was determined. The average annual runoff-generating precipitation amount (10.7 inches), as discussed above, was used to estimate the runoff volume. Composite runoff coefficients were determined for each drainage basin. Table 6.4 presents the composite runoff coefficients for each drainage basin. The product of the runoff coefficients and the drainage basin area were multiplied by the amount of runoff generating precipitation to determine the volume of runoff on an average annual basis.

The following sections describe two separate baseline pollutant load estimates prepared for this storm water management plan: one using NURP study data, and one using site-specific storm water monitoring data.

6.6.2.1 NURP-Based Pollutant Load Estimate

Median Event Mean Concentrations (EMCs) were calculated by the EPA from storm water analytical data collected from 81 urban locations nationwide during several hundred storm events for the Nationwide Urban Runoff Program. Median EMCs for various EPA-defined land use categories are presented in Table 6.5. Corresponding Presidio land use categories are also shown. Due to the observed variability of pollutant concentrations with runoff volume (i.e., most pollutants are transported during the early stages of a storm, and each successive event tends to generate lower pollutant concentrations), the EPA recommends that the median EMCs be used in conjunction with site-specific precipitation and runoff data to estimate pollutant loading.

The annual pollutant mass loading by drainage area for each listed constituent was estimated as the sum of the median EMCs multiplied by their respective runoff volumes. Estimated pollutant mass loadings and weighted mean runoff coefficients for each drainage basin are summarized in Table 6.6.

6.6.2.2 Site-Specific Data Pollutant Load Estimate

The second annual pollutant load estimate was prepared in the same manner as the NURP pollutant load estimate, substituting analytical data from the 1993-94 rainy season storm water monitoring performed by Dames & Moore. Mean runoff concentrations used in the estimate are summarized in Table 6.7. As indicated in the table, mean concentrations were generally estimated as the mean of the mean concentration detected and the corresponding EPA median EMC. This method was selected due the similarity of the site-specific data and the median EMCs. For constituents that were sporadically detected in site runoff samples, the mean runoff concentration was calculated as the mean of detections, substituting one-half the detection limit for samples where the constituent was not detected. In general, the composite data were not

used, except in specific cases where composite data were considered reliable indicators of overall concentrations. The results of the site-specific data pollutant load estimate are presented in Table 6.8.

6.6.2.3 Comparison of Baseline Pollutant Load Estimates

In general the two methods of estimating annual storm water pollutant loads generated similar results.

The amount of open space and the varied land uses within each drainage area result in a somewhat narrow range of runoff coefficients, ranging from 0.26 to 0.52. The range of runoff coefficients, when combined with the relatively low variability of constituent EMCs for different land use categories, results in estimated annual pollutant mass loadings roughly proportional to the drainage basin areas. For instance, drainage basins D and J comprise approximately 38 percent of the Presidio site. Using the method described above to estimate annual pollutant mass loading, these two basins were estimated to contribute 38% of the annual BOD mass, 39% of the COD mass, 39% of the TSS mass, and 38% of the combined metals.

The following table presents a comparison of the two estimating methods.

COMPARISON OF POLLUTANT LOAD ESTIMATES		
Constituent	**NURP Estimate (pounds per year)**	**Site-Specific Data Estimate (pounds per year)**
BOD	9,600	9,200
COD	58,000	70,000
TSS	76,000	85,000
Oil & Grease	NA	4,300
Arsenic	NA	10
Chromium	NA	30
Lead	90	0
Copper	31	10
Zinc	190	130
TKN	1,300	1,500

7.0 PROBLEM DEFINITION

The Presidio's storm water drainage system is an extensive facility of pipes, lined and unlined open channels, and inlet structures. Managing, operating and maintaining the system within the context of current regulatory standards is complicated by the extent and variety of pipe materials and sizes. An additional consideration is that the system was developed over a prolonged period of time, predating the current trend toward runoff water quality management, and consequently none of the existing components was designed to minimize or reduce pollutant loads. In addition, the density and proximity of buildings, sanitary sewers, and storm sewers increase the potential of sanitary sewage flowing to the storm drain system even though previous programs have been implemented to remove these connections, and that identification of remaining connections (if any) could be time consuming.

The previous sections of this SWMP outlined the regulatory setting for managing the storm water systems, assessed the capacity and condition of the existing system, and presented an estimate of the amount and types runoff pollutants originating from the Presidio. This section of the SWMP states identified problems associated with management and operation of the drainage system in accordance with the requirement and water quality objectives of the NPDES municipal discharge permit. The range of problems includes the following:

- Segments of the piping and open channel system are either under capacity or are in poor condition;
- Numerous catchbasin inlets and several manhole structures are potentially hazardous to pedestrians and bicyclists;
- Many areas have sensitive habitats and threatened and endangered species;
- Various components of the system are controlled by autonomous agencies (the National Park Service, the California Department of Transportation and the Golden Gate Bridge Maintenance District) with responsibility for construction and operation of portions of the drainage system within the Presidio;
- Many areas have existing erosion problems, and there is a preponderance of soils and sensitive habitats that are susceptible to damage and erosion, as shown on Figure 9;

- The system was constructed of a variety of pipe materials and system components constructed in an uncoordinated fashion, without the benefit of a comprehensive plan to guide design and construction and without concern for water mitigation of runoff water quality degradation;

- The extended time line during which the system was developed, combined with the close proximity of numerous buildings and sanitary sewer facilities, increases the probability that some sanitary sewerage connections were not detected and disconnected from the storm sewer system during the numerous projects implemented to separate the sewer systems;

- Recent storm water monitoring and monitoring near the Presidio's San Francisco Bay outfalls indicates ongoing sources of fecal coliform bacteria within the storm drain system; and

- Loads of other pollutants in runoff from the Presidio, such as BOD, COD, TSS, oil and grease, and metals, can be cost-effectively reduced to preserve the beneficial uses of the receiving waters.

The following sections of the SWMP attempt to address the above identified problems and to establish a framework for adapting, operating and managing the system to meet the NPDES municipal discharge permit requirements. The following sections of this SWMP:

- Outline a maintenance and inspection program that will identify broken, damaged or improperly functioning components and that will implement repairs or maintenance to address the identified problems;

- Present a plan for inspection and monitoring of areas subject to erosion and implementation of controls to prohibit or control pedestrian and bicycle access, to implement corrective measures including repairs and revegetation;

- Provide guidance for the future improvement of the system in a coordinated fashion that reduces the overall pollutant load originating from the Presidio;

- Provide a basis for coordination of the responsibilities of autonomous agencies each separately responsible for construction, operation and maintenance of drainage facilities located within the Presidio; specifically, Caltrans, the Golden Gate Bridge District, and National Park Service; and

- Outline a plan to identify and eliminate illicit connections of sanitary sewers.

8.0 CAPITAL IMPROVEMENTS PLAN

The plan for capital improvements, as outlined in this section, has been developed within the context of a larger framework for capital improvements associated with the restoration of the riparian corridor along Tennessee Hollow, restoration of a wetland along Crissy Field, and planned improvements to Doyle Drive as well as overall improvement of the various facilities at the Presidio. This section presents an overview discussion of the riparian and wetlands restoration projects within the context of storm water management; a discussion of proposed water quality improvements; a discussion of capacity and condition improvements; a review of the potential for diversion of runoff to the City and County of San Francisco combined sewer system; and a presentation of cost estimates for construction of the proposed water quality and conveyance system improvements. Proposed improvements are shown on Figures 10 through 18.

The term "restoration," as used in the following sections of this SWMP, refers to the natural resource or ecological concept of re-establishing a more natural and native habitat. This is in contrast to the cultural meaning of recreating or refurbishing a system to its historically correct condition.

8.1 RIPARIAN RESTORATION

Restoration of the riparian corridors in Tennessee Hollow will reestablish a more natural and native habitat, and will also provide storm water management benefits. The existing piped and lined open channel storm water system will be replaced with a natural open channel system. The channel should be designed to provide capacity for the 10-year storm and overflow capacity on the flood plain for the 100-year storm. The table below presents a summary of the estimated 10-year and 100-year design flow rates, channel slopes, and cross-sectional flow areas along various segments of the corridor. Figure 11 shows a profile of the stream corridor.

Although the corridors are not planned with water quality improvements as an objective, the channels will slow the flow of water and trap some suspended sediments. Riparian vegetation planted along the corridors will also remove some nutrients. The restoration of the riparian corridor is discussed in more detail in the Wetland and Riparian Corridor Restoration Feasibility

Study (Dames & Moore, 1994b). Estimated costs for restoration of the corridor are presented in the feasibility study.

TENNESSEE HOLLOW CHANNEL DESIGN DATA						
			10-year Design		100-Year Design	
Reach	Description	Channel Slope (Percent)	Flow (cfs)	Channel Cross-Sectional Area (sq. ft.)	Flow (cfs)	Channel Cross-Sectional Area (sq. ft.)
1	El Polin to Bld. 857	3.0	23.0	5.0	32.1	6.0
2	Bdg. 857 to Fernandez Ave.	0.74	29.4	10.0	40.9	12.0
3	Fernandez to Presidio Blvd.	0.43	95.4	28.5	120.2	33.0
4	Presidio Blvd. to 101 Undercrossing	1.8	101.2	18.1	136.3	22.2

8.2 WETLAND RESTORATION

Restoration of the historic wetlands at Crissy Field will provide an opportunity for improved storm water management. Although improvement of stormwater management is not the restoration objective, the incidental storm water management benefits could be significant. Storm water runoff from the Tennessee Hollow (Basin D) area will discharge into the wetlands at Crissy Field and then overflow to San Francisco Bay through a new open channel system. Runoff from drainage basins B, C, E, F, and G (which at one time naturally flowed to the historic wetland) could also be routed through the wetland restoration, thereby eliminating the need to replace under-capacity and poor-condition outfall systems servicing these drainage basins. The capacity of the wetland overflow system would be greater than the existing pipe

outfalls and should be designed and maintained to reduce the impact of sand accumulation that could restrict the outflow capacity.

The wetlands will also provide an opportunity to improve the quality of storm water discharged to San Francisco Bay. Although the wetland will not be designed with water treatment as an objective, the wetland will improve the water quality of storm water that flows through it. Suspended sediment not removed by other BMPs implemented in the upper watersheds would be trapped in the pretreatment basins(s) on the south side of Old Mason Street by removing some nutrients and other potential pollutants.

The upper watershed BMPs (discussed below) and the pretreatment basins south of Old Mason Street should improve runoff water quality sufficiently to allow these flows to enter the wetland restoration area. The wetland restoration (including expected water quality) is discussed in more detail in the Wetland and Riparian Corridor Restoration Feasibility Study. Cost estimates for restoration of the wetland are presented in the feasibility study.

8.3 STRUCTURAL BMPs

8.3.1 Selection Criteria

The structural BMPs were screened to select those that can reduce storm water pollutant loads yet still be practicably applied at the Presidio within the context of the existing and proposed facilities.

The criteria used to evaluate and select the specific BMPs proposed for implementation include the following:

- Slope: Certain BMPs cannot be placed on or near slopes as the ponding of the water or velocity of flow may cause instability or excess erosion;
- Required Area: Certain BMPs require an area that limits their applicability to specific locations;

- Soil: Infiltration systems require a well-drained soil; vegetation-dependent BMPs must have soils suitable to sustain the vegetation; wet ponds require a permanent water table or must have impermeable soils liners to prevent excessive loss of water into the soils;

- Pollution Treatment Capability: pollutant constituents targeted for removal are a primary consideration in the selection of the BMP or combination of BMPs selected to meet the removal objective; and

- Aesthetics: The selected BMP should be compatible with other planned uses in the area and should not diminish the aesthetics of the adjacent environment.

8.3.2 Proposed Structural BMPs

Six general categories of structural BMPs are proposed for the Presidio:

- Improvements to address runoff from Doyle Drive/Highway 101 and Highway 1 (to be implemented by Caltrans);
- Improvements to address runoff associated with planned new parking facilities;
- Retrofitting existing parking facilities;
- Improvements to address runoff entering Mountain Lake from the Golf Course;
- Diversion of runoff from selected high pollutant load areas to the sanitary sewer system; and
- Porous pavement (optional).

Proposed locations for each category of improvements are shown on Figure 10; and conceptual designs for various components are presented on Figures 12 through 18. More detailed information on water quality objectives, BMP selection and implementation priorities is presented in Section 12.0.

<u>Doyle Drive</u>

The planning process for the improvement of Doyle Drive/Highway 101 is currently underway. This effort is being lead by Caltrans in cooperation with the City and County of San Francisco.

Planned improvements will, in general, increase the extent of impervious pavement.

The Doyle Drive/Highway 101 and Highway 1 corridors will contribute the greatest pollutant load per square foot of impermeable surface area. Runoff will contain pollutants with relatively high concentrations of oil, grease and heavy metals. Caltrans is in the process of applying for an NPDES permit on a statewide basis and is ultimately responsible for developing effective BMPs for these roadway corridors.

Accordingly, any specific BMPS for Caltrans facilities discussed in this SWMP are presented as possible methods to mitigate pollutant loads from Caltrans facilities. It will be the duty of Caltrans to select and implement any future improvements relating to both Doyle Drive and Highway 1. The purpose for discussing these areas in this SWMP is to identify and address these potentially significant pollutant sources within the Presidio. The NPS will work with Caltrans to develop effective solutions for the long-term maintenance of these areas.

There are several unique constraints at the Presidio which should be considered. These constraints include a limited right-of way width and grade change transitions to the south end of the Golden Gate Bridge and through the MacArthur Tunnel. The SWMP proposes a BMP along Doyle Drive from Highway 101 at Battery Blaney Road west to near the Palace of Fine Arts (as shown on Figure 10). The BMP is compatible with other proposed facilities at the Presidio and is adaptable to any of the various alternatives being considered for improving Doyle Drive/Highway 101.

The proposed BMP consists of lined filtration channels that would collect, filter and convey runoff to a proposed detention basin located west of the Commissary or to the riparian restoration corridor. Both the detention basin and the riparian restoration corridor would convey the filtered runoff to the wetland restoration area. The lined filtration channel would accomplish filtration by directing runoff from the highway through a gravel and sand soil matrix. The soil matrix would remove settleable solids, oil, grease, heavy metals, and some nutrients. The third option is diversion to the CCSF combined system.

The NPS recognizes that Caltrans may propose to implement any number of alternative BMPs which may or may not include the BMP presented in this SWMP. However, the NPS also places a high priority on the effectiveness of any BMP employed to treat runoff prior to discharge into the wetland restoration area. Storm water discharged from BMPs implemented by Caltrans will be monitored to determine whether the storm water quality is acceptable for discharge into the wetland restoration area. Areas of particular concern will be the removal of oils, grease, heavy metals. Further, if the NPS determines the storm water quality to be unacceptable, the NPS will require that the runoff be further treated or directed to the CCSF combined sewer system for treatment and disposal.

New Parking

Parking facilities proposed for construction provide the greatest degree of flexibility for integration of BMPs. Three BMPs are proposed for implementation at new parking facilities. The BMPs will be implemented in combination and include biofiltration followed by oil/water separation and/or infiltration. Figures 14 and 15 show two proposed combinations of a biofilter, infiltration trench, and oil/water separator (skimmer tee).

Existing Parking

Facilities that are not proposed to be replaced or removed can be retrofitted with BMPs designed to capture the runoff for onsite treatment and removal of oils and grease, and particulates. The proposed BMPs include one or a combination of the following:

- redirecting runoff through a biofilter/swale prior to discharge to the storm sewer system;
- retrofitting catchbasin inlets with biofilters;
- retrofitting the catchbasins with a skimmer tee; and/or
- routing the storm sewer system through a sediment trap or infiltration system.

Golf Course/Mountain Lake

In order to reduce pollutants discharged into Mountain Lake, two pretreatment basins (constructed wetland areas) are proposed to intercept runoff from the Golf Course. The purpose of the pretreatment basins is to remove suspended solids, oil and grease, and degradable organics (BOD and COD). In combination with a structured turf management plan, this BMP would reduce potential pollutant loads entering Mountain Lake.

Two shallow (approximately two feet deep) pretreatment basins would be constructed adjacent to the eastern and northeastern ends of the lake. The pretreatment basins would receive runoff from the Golf Course through engineered inlet structures. The outfalls into Mountain Lake would consist of an overflow weir designed to provide a minimum water depth in the pretreatment basins, filter the overflow into Mountain Lake, and provide a natural appearance. The pretreatment basins would be vegetated with selected plant species.

Highway 1 is an additional source of pollutants entering Mountain Lake. Although the management of runoff from Highway 1 is the responsibility of Caltrans, the NPS considered this runoff during the preparation of the SWMP as it has a high potential for contamination. It was determined that diversion of Highway 1 runoff away from Mountain Lake is precluded by existing topography, and the limited space between Mountain Lake and Highway 1 precludes construction of a settlement basin.

Inlet structures on Highway 1 could be retrofitted, under the direction of Caltrans, with oil-skimming outlets. First flush flows from Highway 1 could possibly be diverted through the pretreatment basins north of Mountain Lake by constructing a diversion pipeline from the low point in Highway 1 to the pretreatment basin. This would, however, require removal of numerous trees that buffer Mountain Lake from Highway 1, and would also require approval of the NPS once water quality testing (as discussed in Section 12.5) confirms that runoff is acceptable to the NPS.

In the event that the runoff is not acceptable to the NPS, one possible alternative would be to route Highway 1 runoff to the CCSF system. This would likely require construction of a

substantial length of new piping due to existing elevations and capacity constraints. In any event, it will be the responsibility of Caltrans to manage this runoff, and the NPS will be available to work with Caltrans to develop an effective and environmentally sound method of management.

Diversion to Sanitary Sewer

For certain facilities, the most cost-effective way to address pollutants in storm water runoff is to divert the flow to a sanitary sewer. Because of the fee-structuring system used by Publicly Owned Treatment Works (POTWs), this approach is most cost-effective for addressing sources with high levels of BOD and/or COD where the discharge is characterized by relatively low flow. There are several facilities at the Presidio that can be expected to generate this type of runoff:

- Golf course equipment washing facilities;
- Maintenance facilities equipment washing and waste and material storage areas;
- Letterman Hospital Complex loading dock and solid waste storage areas;
- Letterman Army Institute of Research roof drains and the loading dock area; and
- Equestrian stables.

At one of these sites, the equestrian stables, there may be an opportunity to install an experimental system to treat runoff organic pollutants with a composting type filter. However, a backup system (such as the recommended sanitary diversion) would be advisable should the experimental system prove unreliable or too costly to operate and maintain. Because of the experimental nature of this type of system, it has not been evaluated further in this SWMP.

An additional advantage offered by diversion to the sanitary sewer for selected facilities is a reduction in the risk that spilled hazardous materials will be discharged via the storm drain system into the bay, ocean, or Lobos Creek, the fresh water source for the Presidio water treatment plant.

Impervious areas that drain into the Lobos Creek watershed include the Public Health Service Hospital (PHSH) tennis courts, the Army Reserve Center (a proposed maintenance facility), and portions of Lincoln Boulevard. Runoff from these areas will be diverted to the CCSF combined sewer system where practical and cost-effective. Runoff from the Army Reserve Center, PHSH and Lincoln Boulevard will be diverted into the existing 78-inch combined sewer overflow pipe. This pipe will be converted to store runoff from these areas after completion of the CCSF Richmond Transport (tunnel) Project. Runoff stored in the 78-inch overflow pipe will be slowly discharged into the Richmond Transport Project near Lincoln Boulevard.

Costs for sanitary sewer diversion will depend on existing sanitary sewer and lift station capacities and locations. Modification of these facilities, if necessary, would be in addition to the cost estimates presented in this SWMP. Areas proposed for sanitary sewer diversion are indicated on Figure 10.

Optional Dry Wells/Cisterns

Dry wells can be constructed to allow infiltration of runoff from roofs. This technique tends to be most cost-effective for residences and other buildings with relatively small footprints. In general, one 8-foot-diameter dry well that is 8 feet deep should have sufficient capacity for runoff from the roofs of two houses. Larger buildings will require larger and/or deeper dry wells to accommodate anticipated flows. Each dry well would be equipped with an overflow pipe to allow excess runoff to bypass the system into the storm sewer. If desired, this concept could be converted to a storage cistern by substituting impermeable walls and base, allowing beneficial reuse of stored runoff. However, the practicability of this could be limited by the amount of storage and cost.

Porous Pavements (Optional)

Porous pavement may be used to reduce surface runoff by allowing storm water to infiltrate through the pavement and seep into the groundwater table. The drawbacks to using porous pavement are that it tends to clog easily and requires frequent sweeping and power washing to

dislodge small particles from the surface of the pavement. It can also be expensive to install.

Areas where porous pavement may be considered include parking pads adjacent to conventionally paved roadways or in overflow parking areas. The use of porous pavement along bike paths and trails was considered and rejected based on the above stated shortcomings. Although in theory the use of porous pavement in open space areas along trails would seem advantageous, the high maintenance costs associated with the upkeep of these extensive linear features make it less feasible.

One promising area for implementation of porous pavement would be along Old Mason Street. When this roadway is reconstructed, concrete curb and gutter with open area block outs in the gutter section could be practicable. The block outs would be backfilled with sand and would allow water in the gutter to pass through and infiltrate into the underlying road bed and soils. An installation similar to this is located along the Great Highway at Ocean Beach in San Francisco.

8.3.3 Structural BMPs Not Selected for Implementation

Structural BMPs that were considered but not selected for implementation include storm water detention basins, extended detention basins, wet ponds and porous pavements.

Storm Water Detention Basins

Storm water detention basins were considered in numerous locations throughout the Presidio and, with the exception of the detention/pretreatment basin at Subbasin G.4, were dropped from further consideration for a number of reasons including aesthetics, preservation of cultural and natural resources, minimal flow reduction benefits, lack of adequate area, and potential inconvenience to park visitors. A more complete discussion of potential storm water detention basins is included in Section 5.2.3 of this SWMP.

Extended Detention Basins and Wet Ponds

These facilities were considered and dropped from further consideration for reasons similar to those discussed above for storm water detention basins.

8.4 PROPOSED CAPACITY AND CONDITION IMPROVEMENTS

Proposed capacity improvements were based upon a review of data on existing condition and the findings of the hydrologic and hydraulic investigations presented in Sections 3.0, 4.0 and 5.0. The proposed improvements area shown on Figures 10 to 18. The proposed piping is configured differently than the existing piping system. The following paragraphs describe the various proposed systems.

Parade Grounds

Along the Main Parade Grounds, several sections of proposed piping would collect excess runoff from the new parking area and direct it to the proposed wetland restoration area. These improvements would provide drainage for the Parade Grounds and new parking facilities. The system would convey runoff to Lincoln Boulevard and then to the area east of the Commissary and discharge into the proposed wetland restoration (expansion area) south of Old Mason Street. Runoff entering the wetland restoration (expansion area) would be of a relatively good quality after pretreatment by the parking facility BMPs. Please note that this area was one of the historical drainages to the proposed wetland restoration area.

Gorgas Avenue at Highway 101

Just south of Highway 101 at Gorgas Avenue, the piping systems draining basins B and C are under capacity. The proposed piping would connect to the existing piping systems and route runoff from areas B and C to the riparian corridor at Highway 101. The proposed pipe would be 48 inches in diameter, and it would eliminate the need to reconstruct the basin B outfall piping system beginning just south of Highway 101 and extending to either San Francisco Bay or the wetland restoration. It would also eliminate the need to reconstruct the basin C outfall

piping system from just south of Highway 101 to the wetlands restoration. The outfall of the proposed piping system (at the location of outfall B) could be obscured by incorporating it into the riparian corridor drainage system crossing at Highway 101.

U.S. Coast Guard Station

Near the U.S. Coast Guard Station at the proposed Airfield, the proposed piping system would collect runoff from drainage basins I, J, and K and combine them into one new outfall system at the location of outfall J, thereby replacing three undercapacity outfall systems as well as piping and outfalls that are in poor condition.

Other Miscellaneous Systems

Other miscellaneous proposed systems are shown along Old Mason Road at various locations, at Battery East, and Fort Point. These are typically small segments of new pipe with a few catchbasin inlets.

8.5 DIVERSION TO THE CCSF COMBINED SEWER SYSTEM

The potential to divert storm runoff to the City and County of San Francisco (CCSF) combined sewer was considered. The following section summarizes the various alternatives considered, and presents a brief synopsis of the conclusions reached by the NPS.

CCSF Public Works Department Proposal

On June 10, 1994, the CCSF Public Works Department submitted a preliminary proposal to the NPS for the connection of the storm water and sanitary sewer system at the Presidio to the CCSF combined system. The following discussion is based on the storm water system component of that proposal.

The two major components of the CCSF's proposal for the storm water system connection are: construction of an interceptor system from the east end of Marine Drive to the western end of

the proposed wetland at Crissy Field; and connection of the southern portion of the Presidio to the Richmond Transport Project (RTP).

The interceptor system along Crissy Field would extend approximately 8,000 feet from west of the U.S. Coast Guard Station to a location near the U.S. Army Department of Engineering and Housing (east of Marine Drive). The purpose of the interceptor would be to contain and divert low flows from the Doyle Drive/Main Post area to the CCSF combined system for treatment at the North Point Treatment Plant. This interceptor would divert low flow and/or first flushes to the CCSF, while the high flows would be directed to the San Francisco Bay through the existing storm water outfalls. Although the construction of this type of interceptor system would eliminate the need for many of the recommended site specific BMPs, existing outfall systems would need to be repaired and maintained (as appropriate).

The conveyance of storm water runoff along the southern portion of the Presidio to the CCSF combined system would be accomplished through a connection to the RTP tunnel (which is currently under construction). This diversion would prevent potential contaminants from entering Lobos Creek, a drinking water source for the Presidio. Sources of storm water with potentially high pollutant loads in this area include runoff from the Public Health Service Hospital, the Army Reserve Center (a proposed park maintenance facility), Lincoln Boulevard, and the Water Treatment Plant. This conveyance of storm water may require the construction of several connector lines; however, it would primarily utilize the existing 66-inch-diameter pipe located along Lobos Creek. This existing pipe currently functions as an overflow device which discharges directly to Baker Beach. The pipe could be converted to an in-line storage facility and be routed directly to the RTP (which discharges to the Oceanside Treatment Plant located in the southwestern portion of San Francisco).

Other Connections to the CCSF System

Several minor diversions of storm water to the sanitary sewer system, which were not discussed in the CCSF's June 10 proposal, are proposed as part of the SWMP. These connections are shown on Figure 10, and include isolated geographic areas where the potential for pollutants to enter storm water is high. The isolated areas including loading docks at several facilities and the horse stable and paddock area.

Conclusions

The main advantages of constructing a diversion interceptor along Crissy Field would be to eliminate the need to implement other structural and non-structural BMPs within the drainage basins discharging into the bay, including the elimination of such components as:

- Structural BMPs at future and existing parking facilities;
- Structural BMPs for runoff from Doyle Drive/Highway 101 (to be implemented by Caltrans);
- Operational BMPs including water quality monitoring, inspection and maintenance of structural BMPs, education and training programs and others as discussed in Sections 9.0 and 12.0; and
- An illicit discharge elimination plan for this area of the Presidio.

The disadvantages of this system are:

- High construction costs, as discussed below;
- Potential conflicts with existing facilities;
- Maintenance of the storage facility, including sediment removal; and
- The annual cost to treat storm water.

The estimated cost for construction of the capital improvements listed in the CCSF's June 10 proposal is $7,200,000. This does not include various associated improvements, regulator structures, and outfall repair. This amount represents $6,500,000 for construction of the interceptor system along Crissy Field, and $700,000 for the conversion of the existing 84-inch-diameter pipeline along Lobos Creek to an in-line storage facility and connection to the RTP. In addition to the construction costs (and associated initial costs), the ongoing operation and maintenance costs were considered, including costs for treatment of the runoff diverted to the North Point Treatment Plant.

The Crissy Field low-flow interceptor system was determined to be infeasible due to high capital and operational costs and, more importantly, incompatibility with the NPS directive of "sustainable design." Alternatively, BMPs recommended in the SWMP can mitigate storm water pollution at lower cost and maintain compatibility with the sustainable design directive. Furthermore, Caltrans-implemented BMPs addressing Doyle Drive runoff quality are expected to result in storm water quality suitable for discharge through the wetland restoration. A final determination on routing Doyle Drive runoff through the wetland restoration will, however, be made by the NPS based upon monitoring the water quality of Doyle Drive runoff after treatment by Caltrans-implemented BMPs.

In the southern part of the Presidio along Lobos Creek, the in-line storage system was found to be feasible. This system would be constructed by converting an existing 84-inch combined sewer overflow pipe, which is being abandoned as part of the Richmond Transport Tunnel project, into an in-line storage system. Diversion of runoff to this system would help protect the water quality and riparian habitat of Lobos Creek (a source of drinking water for the Presidio). Runoff would be diverted to the in-line storage system from the Public Health Service Hospital, the Army Reserve Center (a proposed park maintenance facility), and portions of Lincoln Boulevard.

Storm water runoff would also be diverted to the sanitary sewer system from other isolated areas including the loading docks at the Letterman Hospital Complex, the Officers Club, and the Commissary along with the horse stables and paddock areas. Runoff from these areas could potentially include high levels of pollutants. The diversion system could be as simple as

connecting trench drains at loading docks to the sanitary sewer but, in some instances, storage may be required to regulate the rate at which runoff enters the sanitary sewer system. Existing sanitary sewer and lift station capacity should be assessed on a case-by-case basis to ascertain if storage is necessary.

Institutional Arrangements for Diversion to CCSF Combined Sewer System

In addition, for the construction and operation of the diversion system, various institutional arrangements would have to made. First, the CCSF would have to agree to accept the discharge. This would require entering into a formal agreement with the City that would, among other things, specify:

- The amount of compensation due the City for treatment of runoff; and
- The amount of compensation due the City for retrofitting the treatment plant to accommodate higher flows.

Additionally, an agreement with the Regional Water Quality Control Board may be required. This agreement would "relax" the conditions of the City's current NPDES discharge permit, thereby permitting an increase in the number of allowable discharges/overflows to the bay.

8.6 CAPITAL IMPROVEMENT COST ESTIMATES

Class C cost estimates for capital improvements were prepared for two categories of improvements: 1) water quality improvements (storm water Best Management Practices, or BMPs), and 2) conveyance system improvements (replacement of damaged and/or under-capacity storm drains). The basis and assumptions used in developing the cost estimates are summarized below. Cost estimates for the following improvements are presented in separate spreadsheets included in Appendix C:

- Structural BMPs;
- Conveyance Improvements (new pipe);

- Replacement of Pipes in Poor Condition (with no capacity improvements);
- Replacement of Pipes in Poor Condition (with capacity improvements as indicated by storm water modeling); and
- Sitewide Storm Drain Capacity Improvements.

In general, unit costs for construction were estimated using the Means Construction Cost Data 1994 (R.S. Means Co., Inc., 1994). Unit costs presented in the cost data publication were multiplied by the recommended San Francisco City Cost Index of 1.078. Unit costs for a few specialty items were estimated based on recent Dames & Moore project experience. A 15 percent design contingency was applied to the cost subtotal of each cost estimate to account for variation between the conceptual design and actual engineered design.

Unless otherwise noted, new and replacement storm drain pipe was assumed to be reinforced concrete. Several other materials are available at generally comparable cost, as indicated in Table 8.1.

8.6.1 Structural BMPs

Section 12.0 describes proposed improvements to existing and proposed new facilities designed to reduce the potential for discharge of pollutants into the San Francisco Bay and the ocean. Cost estimates for these BMPs were developed based on conceptual designs for specific facilities, as shown on Figures 10 through 18. Lumped unit costs for common items used in more than one location were developed based on conceptual design sections for use in the Class C cost estimate spreadsheets. The table below lists these items and the work included in the lumped unit cost.

GENERALIZED UNIT COSTS – STRUCTURAL BMPs		
Item Description	**Work Included in Unit Cost**	**Estimating Units**
Lined Filtration Channel	Excavation, concrete channel lining, PVC subdrain pipe, filter fabric, filter material backfill.	Linear Foot (LF)

GENERALIZED UNIT COSTS – STRUCTURAL BMPs		
Item Description	**Work Included in Unit Cost**	**Estimating Units**
Biofilter Infiltration Trench	A. Infiltration Trench: excavation, filter fabric, PVC subdrain pipe, filter material backfill.	Linear Foot (LF)
	B. Biofilter: fine grading, 2 inches new topsoil, bentgrass sod.	Square Yard (SY)
	C. Catchbasins/Manholes: excavation, concrete footing, precast catchbasin with frame and cover (or grate), backfill and compaction.	Each (EA)
	D. Cleanout: PVC pipe and fittings, PVC slip cap.	Each (EA)
Conveyance Pipe (12" and 30")	Excavation, bituminous coated CMP pipe with paved invert, bedding material, native soil backfill, and compaction.	Linear Foot (LF)
Infiltration Bed (Parade Grounds Parking Only)	Excavation, filter fabric, PVC subdrain, crushed rock infiltration bed, native soil backfill, compaction.	Linear Foot (LF)
Catchbasin with Skimmer Tee (Parade Grounds Parking Only)	Excavation, concrete footing, precast catchbasin with frame and inlet grate, PVC tee skimmer. (Backfill and compaction included in infiltration bed unit cost).	Each (EA)
Pavement Removal and Disposal	Pavement saw cutting, removal, loading, 30-mile haul to disposal site, tipping fees.	Square Yard (SY)

For existing facilities, cost estimates reflect work needed to retrofit the facility to achieve the storm water quality improvement objectives, including pavement removal and storm drain structure demolition where applicable. For new facilities, the estimates include costs only for work performed over and above standard construction for a typical similar facility without structural BMPs. For instance, work such as site grading, paving and surfacing, and standard appurtenances were not estimated for new facilities because the work would be required either with or without the BMPs. In all cases, quantities of work were estimated based on the conceptual plan and typical sections shown on Figures 10 through 18. Costs were estimated separately for each facility.

The following table summarizes the location, system type, and estimated cost for proposed structural BMPs by facility.

COST ESTIMATES FOR PROPOSED STRUCTURAL BMPs		
Facility Type and Location	**BMP System**	**Estimated Cost**
Doyle Drive		
Roadway between Battery Blaney Road and Palace of Fine Arts	Lined filtration trench discharging to pretreatment basin	$615,000
New Parking		
Drainage Basin I (Mason Street at Harmon Hall)	Biofilter/Infiltration Trench	10,000
Sternberg Road	Biofilter Swale to Inlet	4,000
Gorgas at Highway 101	Biofilter/Infiltration Trench	22,000
Windsurfer Staging Area	Biofilter/Infiltration Trench	106,000
Old Mason Street	Biofilter/Infiltration Trench	6,000
French Court	Biofilter Swale to Inlet	7,000
Parade Grounds	South: Biofilter Swale w/Infiltration Bed North: Biofilter/Infiltration Trench	280,000 12,000
Sal Street	Biofilter Swale to Inlet	18,000
Bridge Maintenance Facility	Biofilter/Infiltration Trench	34,000
Fort Scott (Lincoln Blvd.)	Biofilter/Infiltration Trench	21,000
Fort Scott (Storey Avenue)	Biofilter Swale to Inlet	7,000
Fort Scott (Ralston Avenue)	Biofilter/Infiltration Trench	10,000
Toll Plaza Visitor Parking (East)	Biofilter Inlets	3,000
Battery East	Biofilter Inlets	3,000
Existing Parking		
Commissary	Biofilter/Infiltration Trench	41,000
Letterman Hospital	Biofilter Inlets	22,000
Sternberg Road	Biofilter Swale to Inlet	8,000
Lincoln Boulevard at Garard	Biofilter Inlets	11,000
Lincoln Boulevard at Halleck	Biofilter Inlets	2,000
Pena Street	Biofilter/Infiltration Trench	12,000
Montgomery Street Visitor Parking	Biofilter Inlets	4,000
Public Health Service Hospital (Small Lot)	Biofilter Inlets	5,000
Public Health Service Hospital (Large Lot)	Biofilter Inlets	12,000
Public Health Service Hospital Tennis Courts	Runoff Diversion	3,000

COST ESTIMATES FOR PROPOSED STRUCTURAL BMPs		
Facility Type and Location	**BMP System**	**Estimated Cost**
Bridge Maintenance Facility	Diversion Biofilter/Open Space	7,000
Other Structural BMPs		
Golf Course parking lot along Arguello Boulevard	Infiltration Basin	19,000
Golf Course/Mountain Lake	Wetlands	150,000
Roof tops	Dry Wells/Cisterns (each)	5,000-10,000
	***TOTAL**	**$1.5 million**

* Total includes the cost of the proposed BMP along Doyle Drive (for which Caltrans would be responsible) but does not include optional dry wells/cisterns.

8.6.2 Storm Water Conveyance System Improvements

The storm water modeling indicated that approximately 10,000 linear feet of existing storm drains have less than 90 percent of the required capacity for the 10-year design event. In addition, the 1992 television survey logs indicate that a total of 6,700 linear feet of storm drain are in poor condition. Cost estimates were prepared for the proposed conveyance system improvements and for three alternative storm drain replacement scenarios:

- Replacement of pipes in poor condition without capacity upgrade;
- Replacement of pipes in poor condition with capacity upgrade (capacity upgrades are needed only for poor condition pipes in drainage basin J); and
- Sitewide storm drain capacity improvements.

Quantity estimates were prepared based on the model results for the 10-year design capacity as indicated in Table 5.8. All existing pipes were assumed to lie under pavement which would have to be removed, disposed, and replaced. All existing catchbasins and manholes would be removed, disposed, and replaced with new structures. All new storm drain pipe was assumed to be reinforced concrete. Generalized unit costs were developed for lumped items of work, as detailed in the following table. Separate cost estimates were prepared for each drainage basin.

GENERALIZED UNIT COSTS – STORM WATER CONVEYANCE SYSTEM IMPROVEMENTS		
Item Description	**Work Included in Unit Cost**	**Estimating Units**
Pavement Cutting and Removal	Saw cutting, removal of existing pavement (assumed to consist of 6 inches of asphaltic concrete).	Square Yard (SY)
Manhole/Catchbasin Removal	Excavation, removal, rough breaking of structures.	Each (EA)
Excavation and Pipe Removal	Trench excavation, removal, rough breaking of storm drain pipe.	Linear Foot (LF)
Debris Disposal	Loading, 30-mile haul to disposal site, tipping fees.	Cubic Yard (CY)
Pipe Replacement and Backfill	Bedding material placement, pipe installation, backfill with excavated soil, compaction.	Linear Foot (LF)
Manhole/Catchbasin Replacement	Poured concrete footing, precast concrete manhole with slab top, frame and cover (or inlet grate), backfill with excavated soil, compaction.	Each (EA)
Pavement Replacement	Base material, asphaltic concrete (6-inch section), compaction.	Square Yard (SY)

8.6.2.1 Proposed Conveyance Improvements

Proposed conveyance improvements in conjunction with the structural BMPs include several networks of new pipe, as discussed in Section 8.4, and require replacement of only 4,300 linear feet of pipe in poor condition. Separate cost estimates were prepared for four new pipe networks and miscellaneous individual pipes. A cost estimate for replacement of pipes in poor condition (excluding those which will no longer be needed) was also prepared. The costs are summarized in the following table.

COST ESTIMATE FOR PROPOSED CONVEYANCE IMPROVEMENTS	
Improvement	**Estimated Cost**
New Pipe	
Montgomery Street/Parade Grounds	$150,000
Gorgas Avenue at Highway 101	130,000
U.S. Coast Guard Station	520,000
Miscellaneous New Pipe	44,000
SUBTOTAL	$840,000
Replacement of Pipe in Poor Condition	
Sitewide (excluding that which will no longer be needed)	380,000
TOTAL	**$1,200,000**

8.6.2.2 Alternative Conveyance System Improvements

An alternative to the proposed conveyance improvements consists of replacing pipes in poor condition and upgrading capacity sitewide as indicated by runoff modeling. Separate cost estimates prepared for this work are summarized in the following table.

COST ESTIMATE FOR ALTERNATIVE CONVEYANCE IMPROVEMENTS	
Improvement	**Estimated Cost**
Replacement of Pipe in Poor Condition	
Without Capacity Improvements (Replacement in Kind)	$580,000
With Capacity Improvements	600,000
Capacity Improvements (10-Year Design Capacity)	
Sitewide (excluding under capacity pipes in poor condition)	1,790,000
TOTAL	**~$2,400,000**

8.6.2.3 Catchbasin Safety Retrofit

The number of catchbasin and drop inlet grates at the Presidio is estimated to exceed 800. Very few of the grates are bicycle safe, and therefore most should be replaced. Rough unit costs for catchbasin retrofitting are estimated to be $750 to $1,000 per catchbasin. This estimate includes removal of existing grate; modifications to the structures' top (such as saw cutting); installation of new frames and bicycle-safe, traffic-rated grates; debris disposal; and pavement repairs. Based on recent site reconnaissance, roughly 80 percent, or about 650, catchbasin grates will need to be replaced. The total cost of this work is expected to range from approximately $0.5 to $0.7 million, depending on the number of structures to be retrofitted and the type of structure. In order to better define the scope and cost for this retrofitting work, a detailed survey of all storm drain structures would need to be done to document structure type, size, and location and select a retrofit frame and grate model for each structure. Costs are also expected to vary depending on the number of units replaced at one time. This is due to cost savings realized through bulk purchase of materials.

8.6.2.4 Other Costs

Costs for engineering design, construction management and monitoring, contractor mobilization, and field engineering (material testing, surveying, and as-built plans) were not included on the cost estimates because costs for these elements are strongly dependent on the quantity of work per contract (i.e., costs as a percentage of the total project cost tend to be higher for smaller projects). Additionally, it is likely that construction of the BMPs for new facilities will occur as part of a larger project, thereby decreasing the impact of these "other" costs for those improvements.

The following table lists approximate NPS costs for these items as a percentage of total construction cost for similar projects of varying size.

OTHER NPS COSTS AS A PERCENTAGE OF TOTAL CONSTRUCTION	
Net construction costs	100%
Construction supervision	15%
WASO contingencies	16%
Advance planning & planning	25%
Total Markup	156%

8.6.3 Summary of Estimated Costs for Capital Improvements

The following table summarizes estimated costs for all capital improvements.

SUMMARY OF ESTIMATED COSTS FOR CAPITAL IMPROVEMENTS	
Improvement	**Capital Cost (Site-wide Total)**
Structural BMPs	
Doyle Drive	$720,000
New Parking Areas	543,000
Existing Parking Areas	127,000
Other	169,000
***Subtotal**	**$1.5 million**

SUMMARY OF ESTIMATED COSTS FOR CAPITAL IMPROVEMENTS	
Improvement	**Capital Cost (Site-wide Total)**
Proposed Conveyance Improvements	
New Pipe	$840,000
Replacement Pipe in Poor Condition	380,000
Subtotal	**$1.2 million**
Alternative Conveyance Improvements	
Replacement Pipe in Poor Condition	$600,000
Capacity Improvements	1,790,000
Subtotal	**$2.4 million**

* Subtotal includes the cost of the proposed BMP along Doyle Drive (for which Caltrans would be responsible).

9.0 OPERATIONAL IMPROVEMENTS PLAN

The operation of the storm water system is a central component of the storm water management plan. Proper operation of the system will result in a reduction and early identification of system deterioration, more reliable operation, effective and rapid response to spills of hazardous and non-hazardous substances and verification of the effectiveness of the various components and operational programs designed to reduce pollutant loads from the Presidio. This section of the SWMP discusses the following general categories of operations activities:

- Storm water system inspection and maintenance;
- Maintenance of roads and other paved areas;
- Operation and maintenance of onsite storm water treatment systems;
- Spill prevention and control;
- Turf and landscape chemical management;
- Erosion control; and
- Storm water quality monitoring.

Specific procedural recommendations are presented in the Storm Water Pollution Prevention Plan (Section 12.0).

9.1 STORM WATER SYSTEM INSPECTION AND MAINTENANCE

Presented herein is an overview of the general inspection and maintenance program for the storm water system at the Presidio, based upon existing U.S. Army maintenance records and recommendations for future procedures (flushing) to enhance and maintain system performance. Costs are also presented when records are available.

Maintenance activities and costs can be divided into three distinct categories:

- General maintenance on manholes, catchbasins, and open channels;
- General maintenance on storm sewer pipes; and
- Repair due to storm damage.

Existing maintenance records from the Army address the first and last categories. Army budget records break the budget allocation down into maintenance zones somewhat reflecting the configuration of the planning areas delineated in the GMPA. The costs do not correlate to drainage basins developed by Dames & Moore and delineated in this SWMP. Caution should be used when applying this information for budgeting purposes as the Army time estimates do not account for compliance with OSHA confined space access regulations. Furthermore, the condition of the existing system, particularly with regard to sediment buildup in pipes and catchbasins, may indicate that additional resources should be allocated by the NPS for storm sewer system maintenance.

9.1.1 General Structure Maintenance

Table 9.1 presents annual maintenance costs as budgeted by the U.S. Army for fiscal year 1994 to perform the following tasks, which are described in greater detail in Section 12.0. The following tasks should be performed on a biannual basis:

1) Manhole Structure Inspections: It is estimated that this task requires 0.4 hour per manhole.

2) Manhole Pipeline Inspection: It is estimated that this task requires 0.1 hour per manhole.

3) Catchbasin Cleaning: It is estimated that this task requires 0.6 hour per catchbasin.

4) Open Channel Maintenance: It is estimated that this task requires 0.2 hour per 100 lineal feet of drainage ditch.

5) Miscellaneous Repairs: Work hours for specific tasks were not estimated.

Travel time is in addition to the task time estimates presented above and was budgeted by the Army at about 8.1 percent of total labor hours.

Costs

The annual general maintenance costs were budgeted based on the maintenance of 226 manholes, 758 catchbasins, and 13,410 lineal feet of drainage ditches. Labor expenses were estimated based upon an hourly cost of $23.35 for each of the tasks described above. The total budgeted labor hours to perform maintenance tasks on a biannual basis, including travel time, was 1,375 hours. The annual labor cost for general structure maintenance, including inspection and cleaning of existing manholes and catchbasins, was budgeted at $32,100. Equipment costs and miscellaneous materials were budgeted at $2,170 and $500, respectively, for a total annual storm sewer maintenance budget of about $35,000.

It is reasonable to provide an additional annual budget allocation for miscellaneous (minor) repairs of about $10,000, for a total annual budget allocation of about $45,000 (1994 dollars) for general structural maintenance.

In preparing budget estimates for maintenance of the storm sewer system, the NPS should keep in mind the following points and increase labor and equipment budgets accordingly:

- Estimated times for inspection of manholes are not adequate to comply with OSHA confined space access regulation. If entry is required to satisfactorily inspect a manhole, the estimated time should be increased to account for set-up of safety equipment and required crew size. Associated expenses would also include health and safety training for the crew and proper supervision.

- Based upon site reconnaissance, it appears that the existing system has been minimally maintained. Many open channels pipes and catchbasins were observed to be either partially or fully obstructed by debris and sediment. Numerous catch basin structures were also in poor repair with missing or deteriorated grates and cracked or broken walls. Therefore, it is recommended that the NPS increase the annual maintenance and inspection budgets by as much as 100 percent or more.

- The estimated budgets do not account for the cost of miscellaneous repairs. Given the condition of the system, a minimal budget of $20,000 should be allocated for unexpected repairs of broken pipes/sink holes or outfall erosion protection.

9.1.2 General Pipeline Maintenance

The Presidio storm drainage system contains approximately 37,000 lineal feet of conveyance piping in sizes 18″ and larger (Nolte & Associates, 1991). An estimate of the costs associated with this work was made; however, the scope of this work is highly dependent upon the extent of material within the piping system. For small-diameter pipes, say 6 to 12 inches in diameter, the cost for cleaning could be around $1.00 per foot if the pipes are no more than 25 to 30 percent clogged and access is available. However, this cost does not include the cost for storing, analytic testing and disposing of collected material. Disposal costs can escalate rapidly depending upon the results of the testing. The volume of material to be disposed is also a primary factor. General pipeline maintenance would typically include the following tasks:

1) Inspection of pipes for deposition buildup, plugging, cracking, collapse, or other conditions that would hinder the hydraulic capability of the network;

2) Removal and replacement of pipe damaged beyond the scope of miscellaneous repairs described in Section 9.1.1;

3) Flushing of pipelines that have hydraulically constricting depositions and disposing of slurry; and

4) Unplugging of pipelines.

Assuming approximately 20 percent of the piping is within the 6- to 12-inch range and that this piping would require cleaning on an annual basis, it is estimated that an annual budget for cleaning of about $10,000 would be required. Disposal of removed material would be an additional cost, about $5,000, assuming a 30-mile haul and tipping fees of about $60 per ton. These procedures are described in detail in Section 12.3.4.

9.1.3 Storm-Related Maintenance

Storm-related maintenance covers many areas as described below. The costs from Army records are based on three to four major storm events per year, during which heavy precipitation and strong winds may occur, along with fallen power lines and trees. Hours estimated for each task on an annual basis are included after each description.

A) Cleanup and emergency repair of roads and pavement (general). Estimated at 300 hours.

B) Storm damage cleanup of grounds and debris removal. Chain-saw operation for removing damaged trees. Pickup and removal of limbs and other blown debris. Estimated at 400 hours.

C) Repairs to exterior electrical components. Estimated at 200 hours.

D) Repairs to plumbing, water pumping, and roof drain cleaning. Estimated at 50 hours.

E) Carpentry repairs to structures, damaged roofs and broken windows. Estimated at 150 hours.

F) Sheetmetal/welding repairs of flues, gutters, and structures. Estimated at 50 hours.

G) Painting of structures and damaged objects. Estimated at 50 hours.

H) Storm damage operations management team, emergency operations management post used during storm damage conditions. Estimated at 24 hours.

I) Emergency operation management team, chief of O&M, emergency operation management center used to coordinate emergency responses. Estimated at 24 hours.

J) Emergency electrical repair by ground power support crew. Estimated at 100 hours.

K) Repairs of interior electrical systems. Estimated at 50 hours.

Estimated costs associated with performing the above tasks are presented below.

STORM-RELATED MAINTENANCE COSTS						
Task	Labor Hours	Labor Cost ($/hr)	Total Labor Cost ($)	Material Cost ($)	Equipment Cost ($)	Total Cost ($)
A	300	23.35	7,005	0	1,140	8,145
B	400	21.31	8,524	0	1,280	9,804
C	200	25.45	5,090	0	640	5,730
D	50	25.88	1,294	0	160	1,454
E	150	27.00	4,050	0	480	4,530
F	50	27.00	1,350	0	160	1,510
G	50	27.00	1,350	0	160	1,510
H	24	30.42	730	0	0	730
I	24	35.66	856	0	77	933
J	100	25.45	2,545	0	640	3,185
K	50	25.46	1,273	0	120	1,393
TOTAL	**1,398**	—	**$34,067**	**$0**	**$4,857**	**$38,924**

9.2 MAINTENANCE OF ROADS AND OTHER PAVED AREAS

As discussed in previous sections, roads and other paved areas contribute disproportionate pollutant loads, due in part to their low permeability. The primary constituents of concern are oil and grease, particulates, metals, and other sources of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Many of these constituents are typically washed into the storm drain during the first storm of the season and during the first flush of subsequent storms. One relatively inexpensive and effective means of reducing runoff pollutants associated with paved areas is a regular program of street sweeping. In addition to minimizing chemical sources of pollutants, street sweeping removes trash and litter that can clog inlets and pipes.

An effective street cleaning program incorporates several elements, including selecting equipment appropriate for site-specific and local climactic conditions, selecting a baseline cleaning frequency, targeting high traffic areas for more frequent cleaning, targeting the end of

the dry season for more frequent cleaning, and evaluating the effectiveness of the program at intervals to determine whether equipment modifications or more frequent cleaning will improve pollutant load reductions. A more detailed description of street cleaning procedures and prioritization is included in Section 12.0.

Costs

Capital costs for acquisition of suitable street cleaning equipment are expected to be approximately $250,000. It was assumed that two street sweepers would be purchased: one vacuum sweeper and one mechanical broom sweeper. The vacuum sweeper would be used primarily during the dry season, and is capable of picking up fine particulates (where metals tend to be concentrated). A mechanical broom sweeper is more effective for picking up larger debris and cleaning wet streets during the rainy season.

Operation and maintenance costs are primarily dependent on the aggressiveness of the street cleaning program. For the purpose of cost estimating, it was assumed that two full-time maintenance employees would be needed to staff a continuous street cleaning program to clean all streets once per week. Heavy traffic areas would be targeted for more frequent cleaning. Fuel costs were added for 8 hours per day, 5 days per week, 52 weeks per year. Equipment maintenance costs were estimated as approximately 5% of total capital cost per year. The operation and maintenance cost for the street cleaning program is estimated to be about $160,000 per year, excluding waste disposal costs.

9.3 OPERATION AND MAINTENANCE OF ONSITE STORM WATER TREATMENT SYSTEMS

Onsite treatment systems proposed in this SWMP include biofiltration, infiltration trenches, filtration swales, sediment traps, oil/water separators, and constructed wetland (including the treatment detention basin in drainage basin G.4). Each of these requires regular inspection and maintenance. The inspection and maintenance schedule in Section 12.3.6 provides an initial basis for inspection and maintenance frequencies for the proposed onsite treatment systems. These systems are designed with a priority to remove pollutants from storm water before they

enter any storm drainage piping. Pollutants such as oil and grease, suspended solids, and heavy metals will accumulate most heavily and be immobilized by the initial filtration systems such as biofilter inlets, filtration swales, oil/water separators, and sediment traps.

9.4 SPILL PREVENTION AND CONTROL

The NPS is required to adopt a plan that will establish the responsibilities, duties, procedures, policies, and resources to be employed to contain, mitigate, and clean up accidental spills of hazardous and non-hazardous substances at facilities located on the Presidio of San Francisco. This section provides a general overview of the plan. Section 12.0 describes the general guidelines and identifies the essential elements that will comprise the plan. It contains as much specific information as possible at this time, and is presented in the context of stormwater management. The NPS will need to designate appropriate individuals and procedures to complete the plan.

The United States Army adopted an Installation Spill Contingency Plan (ISCP) for their Presidio facilities in November 1993. This plan conforms to Army regulation AR 200-1, Environmental Protection and Enhancement, April 23, 1990. It is required to be reviewed once every three years. The NPS plan should be compatible with the Army ISCP and ensure that responses to spills are, whenever appropriate, coordinated between the two agencies. The NPS plan contained in this document is based on and consistent with the Army ISCP and contains similar language.

The NPS plan will comply with the National Oil and Hazardous Substances Contingency Plan developed in accordance with the provisions of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980 for hazardous substances, and in accordance with Section 311 of the Clean Water Act for oil. The National Plan requires federal agencies to develop a plan to clean up discharges of oil and hazardous substances for which they are responsible.

The NPS will need to develop an overall spill response policy that designates appropriate personnel, a Spill Response Team, and a chain of responsibility or command. The individuals

and team should receive on-going training and specialized skills. The general procedures and responsibilities are discussed further in Section 12.0.

9.5 TURF AND LANDSCAPE CHEMICAL MANAGEMENT

There are several hundred acres of managed landscaping at the Presidio, including the Golf Course and San Francisco National Cemetery. It is likely that a variety of pesticides, herbicides, and chemical fertilizing agents are in use in some of these areas. While some landscape chemicals are taken up by plants or degraded into relatively inert chemicals, others may be present in runoff at concentrations sufficient to ultimately affect the quality of water or sediment near the storm drain outfalls. It is recognized that some chemical use is unavoidable; however, it is recommended that a turf and landscape chemical management program be developed and implemented on a site-wide basis, utilizing the experience of those who have been responsible for landscape management at the Presidio. All use of chemicals at the Presidio are subject to the requirements of NPS Management Policies (Chapter 4) and NPS Natural Resources Management Guidelines (NPS-77), Chapter 2, Integrated Pest Management (pages 218-266).

The purpose of the program would be to identify chemicals to be used for various purposes at the site, develop procedures for handling and use that address the potential for these chemicals to enter the storm drains or surface waters, and develop a schedule for chemical use that considers the timing of the application relative to storm events.

After identifying landscape chemical needs on a site-wide basis, a list of preferred chemicals should be developed. The list should be formulated after consideration of the toxicity of the chemical, potential degradability under normal climactic conditions, degradation products (inert or potentially hazardous), and persistence in the environment.

Wherever practical, operators should avoid chemical application within two weeks or so prior to anticipated rainfall, and chemical use during the rainy season should be minimized. The plan could also set forth specific treatment procedures and dilution rates for each type of application, resulting in a consistently applied, effective, and cost-effective program of landscape management.

9.6 EROSION CONTROL

Erosion forms the major part of the sediment load carried by the storm water which results in not only loss of soil and vegetation but also deposition in the pipes, catchbasins and outfall areas. Erosion is based on many factors of the environment including the rainfall and runoff, soil erodibility, slope length and percent, cover and management, practice. The factors of most interest at the Presidio site are the erodibility, percent slope and cover factors. The erosion loss equation is given as:

$$A = R \times K \times LS \times C \times P$$

where:

A = Computed soil loss per acre per year
R = Rainfall and runoff factor
K = Soil Erodibility factor
LS = Topographic factor derived from the slope gradient and slope length
C = Cover or cropping management factor
P = Erosion Control Practice factor

The rainfall and runoff factor, R, represents the intensity of the mechanism responsible for the detachment of the soil particles by rainfall. For the Presidio, this factor is derived from the equation:

$$R = 16.55\, p^{2.17}$$

where:

p = the 2-year, 6-hour precipitation value (1.4 inches)

The erosion control practice factor, P, is defined as the ratio of soil loss with the supporting practice to the soil loss with up- and down-hill culture. In physical terms, it is a factor describing reduction in runoff intensity caused by the changing geometric characteristics of the site.

The soil erodibility factor, *K*, is a measure of susceptibility of the soil particles to detachment and transport by rainfall and runoff. The values of K have been determined experimentally to range from 0.02 to 0.69 (Soil Conservation Service, 1985). The Sirdrak soils found over much of the site have a K factor of 0.15. The low factor results from the high percentage of sand in the soil.

The slope factor, *LS*, is a composite of the slope and the distance at that particular slope. It is defined as the expected ratio of soil loss per unit width on a field slope to corresponding loss from a field of 9% slope and 72.6 feet in length. This factor has little to do with the dislodging of the soil particles but strongly effects the transport mechanism with runoff providing the energy. The Presidio site has slopes from 0 to >20%. Since this factor is very sensitive with regard to slope, the erosion potential in some of the steeper areas increase rapidly.

The cover factor or cropping-management factor, *C*, is defined as the ratio of soil loss for land cropped under specific conditions to the corresponding loss from tilled, continuous fallow. The *C* factor describes the effect of protection against erosion provided by vegetation. The *C* factor incorporates the effective canopy cover, the vegetation, and the plant residues. This factor is very sensitive to percent ground cover ranging to value in open space from $C = 0.45$ with no ground cover to $C = 0.003$ with good ground cover over 95-100% of the soil. Therefore it is clear that maintaining a ground cover reduces the erodibility significantly. The Presidio site has a wide range of vegetative cover from just trees in the forested areas to open grass lands to sandy barren areas.

A few general guidelines may help to identify some of the areas to watch carefully. Figure 9 shows the slopes of the site broken down to 0-5%, 5-10% and greater than 10%. The area greater than 10% should be watched carefully since this area has the highest potential for erosion. Other areas to watch include trails cut on steep slopes, areas with no ground cover, existing gullies and open channels, and steep cutslopes. Gullying is becoming noticeable in some of the steeper areas with little protection. A management practice of adding water bars on the steep trails would redirect the runoff off the trail and to adjacent vegetated areas. All steep cut slopes should be revegetated. Besides steep slopes, areas with minimal vegetation should be noted and observed frequently. Vegetation should be planted on areas of this type wherever

possible and foot traffic should be discouraged in these areas. Many potential erosion problem areas were noted during the various investigative visits to the Presidio. They have not, however, been quantified. Problem areas will change from year to year depending on the activities in the park. A diligent record of the problem areas, implemented repairs and dates, success of repairs, and physical descriptions and costs of repairs should be kept by the NPS maintenance department. Erosion control policies are discussed in Section 12.3.1.

9.7 STORM WATER QUALITY MONITORING

The stormwater quality monitoring program described in detail in Section 12.0 provides the basis for evaluating the effectiveness of the proposed water quality control measures.

The selection of main monitoring sites presented in this precipitation and flow monitoring program generally conform to the sample sites discussed in Section 6.0. The main monitoring sites correspond to land uses at the Presidio presented in the Proposed Project (Alternative A) as described in the Draft General Management Plan Environmental Impact Statement for the Presidio of San Francisco (DEIR).

Monitoring and sampling sites were selected using the following criteria:

- A single land use occupies a majority of the drainage basin;
- Unique runoff characteristics are present within a specific drainage basin; and
- A larger drainage basin takes precedence over a smaller basin.

The main monitoring site locations are coincident with those shown on Figure 8. Section 12.0 discusses frequency of monitoring and procedures for field observations, data collection, analytical testing, quality assurance and quality control, and data management.

The annual cost of baseline runoff monitoring described in the Storm Water Pollution Prevention Plan is estimated to be $35,000, including labor, analytical testing and data management/ reporting. Consideration should be given to installing automated samplers and flow meters at

all monitoring sites. This can however be cost prohibitive as the cost for one sampler, flow meter, and rain gage can exceed $8,000. The capital costs may be offset by reduced labor costs.

10.0 VALUE ANALYSIS WORKSHOP

Following submittal of the 90% Storm Water Management Plan for the Presidio of San Francisco, the National Park Service held a three day value analysis workshop during which elements of the draft plan were evaluated and issues of concern were identified and discussed. Five NPS staff members and two Dames & Moore engineers participated in the workshop. The purpose of the value analysis workshop was to:

- Discuss the SWMP components and formulate comments to be addressed in the final version;
- Identify and discuss areas of the site which represent the biggest contribution to storm water quality impacts;
- Analyze proposed BMPs and identify additional or preferred storm water BMPs for inclusion in the SWMP;
- Identify solutions with the most attractive life cycle cost;
- Evaluate the plan with regard to NPDES requirements;
- Evaluate the plan with regard to conformance with the GMPA objectives;
- Discuss whether storm drain system improvements should comply with CCSF design standards; and
- Discuss methods to involve tenants in implementation of the SWMP.

During the initial meeting, several agenda items were identified, including:

- Regulatory compliance (lead abatement, permitting issues, coordination with RI/FS efforts, and spill prevention and control);

- Storm drain system-related BMPs, improvements to be implemented in the current fiscal year, identification of all storm water-related problems such as basement flooding, short- and long-term storm drain maintenance issues;

- Coordination with other agencies (Doyle Drive improvements, cooperation with CCSF for operation and maintenance, and experiences of other agencies with similar projects);

- Future Presidio land uses (sustainable development, land use development goals and criteria, coordination of SWMP elements with recreational land use);

- Environmentally sensitive areas (the Golf Course, Lobos Creek, Crissy Field wetlands, and riparian restoration);

- General environmental concerns (contaminated sediments, plant resources, erosion, and trail management); and

- Plan implementation concepts (re-use of runoff, monitoring, inspection, maintenance, tenant requirements, enforcement, and public and staff education).

These agenda items essentially define the functions of the SWMP. Following development of the objectives and general agenda, the value analysis team brainstormed to develop and evaluate alternatives to address storm water system conveyance deficiencies and storm water quality impacts. General concepts identified during this stage fell into three broad categories: storm water transmission and collection, storm water disposal, and water quality improvement concepts, as listed below:

<u>Transmission/Collection</u>

A Collect infiltrate onsite
B Rebuild and discharge through conventional storm drain system
C Do nothing
D Collect into cisterns
E Reduce need for collection (reduce impervious surface area)
F Restore natural drainages
G Build new systems
H Inject runoff into soil
I Collect and send runoff to CCSF combined sewer system
J Collect and store runoff onsite - central site
K Sheet flow where feasible

L Collect runoff in detention ponds
M Abandon unused storm drains in place

Disposal

A Discharge into the bay/ocean
B Store and use as irrigation water
C Infiltrate
D Dispose into Lobos Creek
E Discharge into wetlands
F Evapotranspiration - riparian system
G Sell as reclaimed water
H Discharge to CCSF combined sewer system
I Store and reuse as non-potable water
J Store and reuse for maintenance
K Discharge into Mountain Lake
L Discharge into Palace of Fine Arts lagoon

Storm Water Quality

A Education - high value/priority
B Chemical mgmt. plans - high value/priority
C Tenant Education and enforcement - high value/priority
D Erosion monitoring and control
E Enforcement (future) - medium priority
F Build treatment plant
G Turf management plans (in process) - high value/priority
H Bio-filters
I Street sweeping (ongoing) - high value/priority
J Wetlands/natural treatment
K Storm water quality monitoring (ongoing)- high value/priority
L Containment (in high risk areas) - high value/priority
M Reduce parking areas - medium priority
N Provide sediment traps
O Reduce animal waste - high priority
P Eliminate illicit connections - high value/priority
Q Clean up high hazardous substance release sites (ongoing)
R Routine maintenance (ongoing) - high value/priority
S Treat Doyle Drive/101 as special area
T Expand spill prevention plans - high value/priority
U Develop reaction plans - high value/priority
V Restrict access - high value/priority

W Extend outfalls
X Increase infiltration
Y Lift station back-up/overflow protection
Z Erosion control during construction - high value/priority

An attempt was then made to develop a matrix of applicable concepts for each drainage basin at the Presidio. The matrix is summarized in the following table.

STORM WATER MANAGEMENT CONCEPT MATRIX			
Drainage Basin/ Subbasin	Selected Concepts		
	Transmission/ Collection	Disposal	Storm Water Quality
A	A, C, E, I, K	A, C, E, F, H, M	H, J, N, S, T, W, X
B 1-4	B, C, E, D, L	A, B, C, E, H, M	H, C, G, N, O, X
B 5-10	A, B, E, G, I, L	A, B, C, E, H, I, K, M	B, J, H, M, N, R, S, V, W
C	A, B, E, G, I, L	A, B, C, E, H, I, K, M	B, J, H, M, N, R, S, V, W
D Open	C, B, D, E, F, L	A, B, C, E, F, M	D, H, J, Y, N
D Urban	A, B, E, G, I, J	E, F, G, I, F, K, J	F, H, J, L, N, V
E	A, B, C, E, I, L, M	A, B, C, E, H, I, J, K	F, H, J, N, V
F	A, B, D, E, G, J,	A, B, C, E, H, I, J, K	D, H, L, J, M
G	B, G, J, L	A, B, E, K	D, J, N
H	A, C, I, K	A, C, H	H, L, Y, J
I	B, D, F, L, G	A, C, F, J	D, H, L, N, Y
J	B, D, F, E, L	B, I, J, K, E	D, J, F, N, R, W, Y
K	B, G, K, L	A, B, C, E, I, J, K	D, H, J, R, W
L	A, C, D, J	A, C, B, I, J, K	D, H, L
M	B, A, C, G	A, C, I, K	D, L, P, W

STORM WATER MANAGEMENT CONCEPT MATRIX			
Drainage Basin/ Subbasin	**Selected Concepts**		
	Transmission/ Collection	**Disposal**	**Storm Water Quality**
N	B, G	A, I	F, L
O	B, C, D, F, G, I, K	A, D, F, H, J	D, H, I, J, N, U, W
P	C, D, A	B, C, L	B, G, W, H
Y	C	H	H, L, M

Due to the multiplicity of concepts that were applicable to each drainage basin, the focus of the speculation exercise was shifted to a land use basis. General land use categories and a few special interest areas were selected for discussion and the following storm water management concepts and issues were developed:

<u>Commercial/Office</u> (Transportation/Parking)

- High collection of pollutants
- Separate pollutants before entering system
- Bio-filter/oil separators
- Capture first part of storm event
- Keep pavements clean
- Capture all surface water
- Wetlands/bay disposal
- Active monitoring
- Active education/interpretive programs
- Develop and enforce pet policy

<u>Industrial</u> (i.e., Maintenance facilities, Golden Gate Bridge Maintenance Facility)

- Heavy pollutant potential
- High sediments
- Minimize run-on
- Capture run-off
- Isolate hazardous materials from storm drain system

- Develop education plans
- Develop maintenance and monitoring plans
- Develop best operations and chemical use plans
- Pretreat runoff where feasible
- Low flows with expected poor quality diverted to sanitary sewer
- High flows discharged into bay/ocean

Open Space/Recreational (Excluding Lobos Creek, Crissy Field, and Golf Course)

- Presidio forest
- Provide erosion control and enhance sediment deposition
- Generally very low runoff generated from these areas
- Keep catchbasins and pipes clean
- Discharge storm water to open space where practical
- Maintain sheet flow drainage to minimize erosion
- Capitalize on infiltrative capabilities of open spaces
- Minimize reliance on structural systems to address storm water
- Reuse captured runoff locally
- Monitor erosion
- Develop an erosion control plan

Lobos Creek

- Lincoln Avenue runoff discharges into creek/consider diversion to CCSF combined sewer system
- Drinking water resources need protection
- Upstream coliform counts high
- During storm events coliform counts appear to increase
- Identify and correct illicit connections
- Construct failsafe retrofit for sewage lift station
- Keep runon from impervious areas away from Lobos Creek watershed

Golf Course

- Develop turf management program
- Use drought-tolerant grass species if practical
- Develop spill prevention plan to address landscape chemicals
- Divert wash water to sanitary sewer system
- Evaluate onsite storage and reuse as irrigation water
- Pretreat runoff prior to discharge into Mt. Lake (constructed wetland/pretreatment basin)

Crissy Field

A. Parking for Sail Boarders

- Direct runoff to irrigate landscape
- Use runoff to support bio-filters
- Eliminate "B" outfall.

B. Wetlands

- Fliminate outfalls "A" through "H"
- Consider emergency inflow control into wetland
- Include pretreatment basins
- Control commissary parking lot flooding through diversion of upper runoff to riparian basin)

C. West Crissy - Coast Guard Station/Fort Point

- Outfalls in poor condition
- Address high coliform counts at outfalls
- Reconstruct outfalls/build new outfalls.
- Reduce number of outfalls
- Reroute outfalls to wetlands for possible infiltration

Residential

- Develop turf maintenance policies
- Develop irrigation practices and policies to minimize overwatering
- Develop education program for "home handyman"
- Disconnect all roof leaders from storm drain system
- Address site drainage around buildings
- Develop domestic animal policy
- Address solid waste storage and disposal issues
- Identify and resolve composting/yard waste issues
- Address potential water quality impacts associated with parking areas
- Consider irrigation cisterns for roof runoff, gray-water, and fire protection
- Enhance infiltration

Institutional (i.e., Letterman Hospital and Army Research Institute)

- Address exposed solid waste storage facilities (dumpster)

- Develop plan for hazardous material containment/spill containment (focusing on loading dock area)
- Address pollutant loads from parking areas
- Implement street sweeping program, oil/water separation technologies to reduce pollutant loads
- Use bio-filters to pretreat runoff from paved areas
- Address roof drain water quality concerns (Letterman Army Institute of Research air stacks)
- Collect horse area runoff and divert to sanitary sewer system
- Utilize infiltration technologies to reduce runoff from parking areas
- Consider a water feature for treatment
- Divert runoff from high hazard areas (i.e., loading docks) to sanitary sewer system
- Discharge runoff from other sources to storm drain system
- Eliminate runoff from public Health Service Hospital area into Lobos Creek
- Reroute utilities out of Creek basin

Roads/Special Use

A. Cemetery

- Direct surface collection
- Direct discharge/polishing basin
- Work with Veterans Administration on turf management issues (chemical applications)

B. Roads

- Address runoff from Doyle Drive/Hwy 101
- Address runoff from other Caltrans facilities
- Discuss/negotiate pretreatment and spill prevention plan with Caltrans

If Caltrans takes no action:

- Capture pollutants along road
- Pre-settle flows before reaching wetlands
- Highway 1 North - extend outfall J
- Highway 1 South - consider oil/water separator system before discharge into Mt. Lake/pretreatment basin (coordinate with Caltrans)

Decision criteria were then ranked in accordance with NPS value analysis procedures, as summarized in the following table.

Project: Storm Water Mgmt.
Location: Presidio of S.F.

V.E. Study No.: 103-94
Item: Ranking of Decision Criteria

Criterion	Average Score (Weight)	Rank
A. Reduce Pollutant Loads/Health&Safety	4.5	2
B. Meet permit requirements	3.5	7
C. Life cycle costs	4.0	6
D. Sustainability	4.2	4
E. Resource protection (cultural/natural)	4.2	3
F. Innovation	3.1	9
G. Short-term constructibility	2.7	10
H. Compatibility with GMPA	4.7	1
I. Meets capacity requirements	3.5	8
J. Meets long-term plan	4.1	5

Scoring System:

1 = Low
3 = Medium
5 = High

RAW SCORING OF DECISION CRITERIA

Team Member	Criteria									
	A	B	C	D	E	F	G	H	I	J
1	4	3	4	5	5	4	3	5	4	5
2	5	4	3	4	4	4	3	5	5	4
3	4	3	4	5	4	3	2	5	3	4
4	4	3	5	4	5	3	4	5	5	3
5	5	3	4	4	4	3	2	4	3	4
6	5	5	5	3	3	2	2	5	2	5
7	5	4	3	5	5	3	3	4	3	4
TOTAL SCORE	32	25	28	30	30	22	19	33	25	29

These decision criteria were used to develop an analysis matrix for one of the more significant primary issues facing the value analysis team: whether to improve the existing San Francisco Bay storm drain outfalls to handle anticipated flows or to divert flows through the Crissy Field restored wetlands area. This issue was considered sensitive because of the potential for some storm water contaminants (particularly metals) to accumulate in sediments. Table 10.1 illustrates the analysis matrix. As indicated in Table 10.1, discharge through the Crissy Field wetlands is preferred over outfall retrofitting.

Due to time limitations, it was not possible to complete analysis matrices for other essential components of the SWMP; however, sufficient feedback was generated to allow development of new plan elements and BMPs and to refine others proposed in the draft SWMP. The preferred storm water management concepts listed above are incorporated into this version of the SWMP at appropriate points. The value analysis team identified the following priorities for NPS staff:

- Develop education plans;
- Develop interpretation of SWMP;
- Develop monitoring plans;
- Develop maintenance plans;
- Develop construction/contracts;
- Develop Memorandum of Agreement with Caltrans for Doyle Drive/Highway 101 storm water management;
- Retrofit lift stations;

- Include gate inflow control at storm drain discharge outlet structures at the wetlands restoration to block flows during emergency response to hazardous spills;

- Coordinate with CCSF with regard to operating and maintaining the storm drain system; and

- Identify plant species for biofilters and wetlands restoration.

11.0 PERMIT REQUIREMENTS

Permits required for the improvements described in this SWMP are discussed in various sections. The following table presents a summary of permitting agencies and types of permits likely to be required.

GENERAL PERMITTING REQUIREMENTS		
Agency Name	**Authority/Permit Type**	**Regulated Activities**
Federal Agencies		
U.S. Army Corps of Engineers	Rivers and Harbors Act (33 U.S.C. 403)	Obstruction or alteration of navigable waters
U.S. Army Corps of Engineers	Clean Water Act Section 404 (U.S.C. 1344)	Discharge of dredged or fill material into waters of the U.S.
U.S. Fish and Wildlife Service	Section 10/404 Permits	Discharge of dredged or fill material into waters of the U.S.
National Marine Fisheries	Section 10/404 Permits	Discharge of dredged or fill material into waters of the U.S.
State Agencies		
State Historic Preservation Office	Section 10/404 Permits	Discharge of dredged or fill material into waters of the U.S.
California Department of Fish and Game	Stream Bed Alteration Agreement	Construction activities within lakes, channels, streams, and crossings
California Department of Fish and Game	Standards for Special Suction Dredging Permits	Dredging activities
State Lands Commission	Lake Use Lease	Encroachments, docks, crossing on tide and submerged lands
State Water Resources Control Board; Regional Water Quality Control Board	National Pollutant Discharge Elimination System (NPDES) Permit	Waste Discharge Requirements for discharges to surface waters (includes storm water and waste water)
California Department of Transportation (Caltrans)	Encroachment Permit	Encroachment on or across a state highway (right-of-way)

GENERAL PERMITTING REQUIREMENTS		
Agency Name	**Authority/Permit Type**	**Regulated Activities**
Local Agencies		
San Francisco Bay Conservation and Development Commission	Development Permit	Construction activities in or near San Francisco Bay within the zone extending from high water level to 100 feet inland
California Coastal Commission	Coastal Development Permit	Activities in or near the Pacific Ocean from 3 miles offshore to 1,000 yards inland

Permits for storm water system construction, operation, and maintenance are presented by activity type in Table 11.1.

12.0 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

This Storm Water Pollution Prevention Plan (SWPPP) was developed for the Presidio of San Francisco based on the following elements.

- NPDES municipal storm water discharge permit program guidelines;
- Existing land uses and planned future land uses for the site as described in the GMPA;
- An evaluation of the existing storm water drainage system and current storm water management practices;
- Site-specific hydrologic and hydraulic analyses to assess the ability of the existing system to manage anticipated runoff;
- A preliminary assessment of runoff water quality based on review of previous water quality studies and limited storm water sampling and analysis during the rainy season of 1993-94;
- A plan for capital improvements developed based on planned future land uses and anticipated storm water pollutant loadings; and
- A plan for operational improvements.

The SWPPP sets forth a specific plan for structural and operational improvements, including conceptual design of structural elements and specific operation and maintenance procedures where practical. Several of the recommended management practices require coordination with either Caltrans or the City and County of San Francisco. In addition, the Bay Area Municipalities Storm Water Group could provide useful insight on the effectiveness of various management practices. They can be reached through the San Francisco Water Quality Control Board. The SWPPP is presented in seven subsections, described as follows:

12.1 Storm Water Runoff Quality Goals

12.2 Structural Best Management Practices

12.3 Operational Best Management Practices

12.4 Spill Prevention and Control Plan

12.5 Storm Water Quality Monitoring Plan

12.6 Education and Training Programs

12.7 New Development and Tenant Controls

Section 12.1 presents a discussion of applicable water quality goals established by the Regional Water Quality Control Board based on the beneficial uses of the water bodies that receive runoff from the Presidio site.

Section 12.2 describes the conceptual development and selection of structural BMPs, implementation priorities, BMPs selected for specific facilities, and structural BMP design criteria. The objective of structural BMPs is to reduce pollutant loads in runoff through source control and/or treatment of runoff.

Section 12.3 presents operational BMPs developed and selected to reduce pollutant loads in runoff at the source. The discussion includes temporary erosion control policies for construction activities, a plan to eliminate illicit (non-storm water) discharges to the storm drain system, general structural maintenance guidelines, general pipeline maintenance guidelines, pavement cleaning, storm-related maintenance activities, landscape chemical management, and maintenance of onsite storm water treatment systems.

Section 12.4 is a Spill Prevention and Control Plan focusing on accidental spills of materials that may result in increased pollutant loads in runoff. The plan includes a description of facilities and areas where spills affecting runoff quality are most likely to occur, initial response actions, response policy, spill reporting requirements, and procedures for personnel training. Spill mitigation and cleanup procedures are presented in Appendices D, E, F, and G.

Section 12.5 describes the storm water quality monitoring program developed for the Presidio based on future land uses, results of recent storm water monitoring, and the planned storm water BMPs. The program consists of field observations (visual monitoring of storm water runoff quality), storm water sample collection, analytical laboratory testing, quality assurance and quality control (QA/QC) procedures, and storm water data management. An estimate of pollutant load reductions achieved through implementation of BMPs is included.

Section 12.6 presents general features of education and training programs to be developed and implemented. The program includes public education and participation for visitors and tenants, as well as training specific to three classes of NPS staff: administrators, operations and maintenance staff, and rangers/docents/tour guides.

Section 12.7 discusses general policies developed to shift the economic and administrative burden of storm water pollution reduction to future Presidio tenants, where appropriate. The new tenant and development controls policies include specifying that tenants design, install, and operate BMPs for particular land uses, requirements for storage, handling, and disposal of raw materials and wastes, and control of runon and runoff. Other tenancy requirements include operational policies such as requiring tenants to maintain clean paved areas, development of individual NPDES storm water permits (under the State's General Permit for Industrial Activities) as required, individual tenant storm water monitoring where appropriate, pet policies, and general policies regarding landscape management practices.

12.1 STORM WATER RUNOFF QUALITY GOALS

One of the primary goals of the SWMPPP is to protect water quality. The RWQCB has established a Water Quality Control Plan for the San Francisco Bay Basin Region (Basin Plan).

The Basin Plan identifies beneficial uses of the bay and water quality objectives needed to protect the designated uses. Water contact recreation is identified as a beneficial use in the plan. This use category covers all recreational activities involving actual body contact such as swimming, wading, water-skiing, skindiving, surfing, sport fishing and other uses where

ingestion of water is reasonably possible. The bacterial water quality objectives for recreational water in terms of maximum probable number (MPN) of bacteria detected are as follows:

Fecal Coliform	Log Mean	Less than 200 MPN/100 ml
	90 Percentile	Less than 400 MPN/100 ml
Total Coliform	Median	Less than 240 MPN/100 ml
	No Sample	Greater than 10,000 MPN/100 ml

Other categories of water quality objectives identified by the RWQCB are applicable to discharges to inland surface waters, including the San Francisco Bay, and shall not present a nuisance nor adversely affect beneficial uses. The categories include the following attributes:

- Coloration;
- Tastes and odors;
- Floating material;
- Suspended material;
- Settleable material;
- Oil and grease;
- Biostimulatory substances;
- Sediment;
- Turbidity;
- pH;
- Dissolved oxygen;
- Bacteria;
- Temperature;
- Salinity;
- Toxicity;
- Un-ionized ammonia; and
- Sulfide.

Numerical water quality objectives have also been established for toxic pollutants in surface waters downstream of the Carquinez Strait. These objectives are tabulated on the following page.

WATER QUALITY OBJECTIVES (μg/L)				
Contaminant	4-day Average	1-hour Average	24-hour Average	Instantaneous Maximum
Arsenic	36	69	--	--
Cadmium	9.3	43	--	--
Chromium (VI, or total)	50	1100	--	--
Copper	--	2.9	--	--
Cyanide	--	5.0 (1.0 proposed)	--	--
Lead	5.6	140	--	--
Mercury	0.025	2.1	--	--
Nickel	8.3[1]	75[1]	7.1	140
Selenium	71[1]	300[1]	--	--
Silver	--	--	--	2.3
Tributyl tin	--	--	--	--
Zinc	--	--	58	170
Polycyclic Aromatic Hydrocarbons (PAHs)	--	--	15	--

[1] From *Enclosed Bays and Estuaries Plan*, as compiled in *A Compilation of Water Quality Goals* (Central Valley RWQCB, 1993).

Note: -- None available.

Water quality objectives do not necessarily apply to discharges from the outfalls, but rather to the quality of bay water in the vicinity of the outfalls. Enforcement of the objectives is generally on a case-by-case basis, and the RWQCB is required to consider the potential impact of the discharge on the designated beneficial uses, the existing quality of the receiving waters, and the appropriate water quality objectives. The water quality objectives described above form the basis of evaluating site-specific storm water monitoring data and developing proposed measures (structural and operational) designed to reduce pollutant loading to the bay.

The water quality goal of this SWPPP is to ultimately address these objectives in technically feasible and cost effective ways. The principal methods proposed to meet the water quality objectives are to:

1) eliminate non-storm water discharges from storm drains; and
2) reduce storm water pollution to the maximum extent practicable.

The following sections present the plan for implementing structural and operational BMPs and educational and training programs designed to assist the Presidio in meeting the water quality objectives as discussed above. In the short term, the water quality goals of this SWPPP are non-degradation, meaning that there will be no deterioration in runoff water quality; in the long term the goal of this SWPPP is to improve the water quality of storm water by lowering the pollutant load.

The primary sources of storm water pollution in urban areas include automobiles and associated activities, landscaping practices, industrial activities, construction, non-storm water connections to the drainage system, accidental spills, and illegal dumping. The most effective way to control the discharge of pollution is to implement controls and procedures at the point of source, for example, procedures for handling and storage of chemicals or other substances with the potential to pollute runoff, or implementation of erosion control policies for construction sites or the implementation of an illicit discharge elimination program. These types of controls are known as "operational BMPs" and they deal mostly with policy, management and procedures.

Measures can also be implemented to capture and remove pollutants from storm water runoff. These methods are generally more costly and less effective, but are nonetheless necessary. They typically involve the construction of facilities which are integrated with the overall drainage system. The term "structural BMPs" refers to constructed facilities. The following sections describe the process of selecting structural BMPs and other operational BMPs not included elsewhere in this SWMP.

12.2 STRUCTURAL BEST MANAGEMENT PRACTICES

The majority of pollutants are carried by the "first flush" flow of a storm. Capture of the first flush is critical for an effective pollution control plan. The first flush comes from the amount of flow that is generated by initial rainfall, which is generally considered to be about 0.1 inch of precipitation. The majority of runoff from precipitation of this amount originates from impervious areas such as roof tops and parking areas. Because automobiles are one of the primary sources of storm water runoff pollution, the facilities with the highest priority for implementation of structural BMPs are parking lots and roadways.

In typical development, impervious areas such as roads and parking lots have been designed with drainage systems that are directly connected to the impermeable surface; runoff flowing over the impermeable surface dumps directly into the drainage system. Many of the BMPs discussed in this section interrupt the "direct connection" flow path runoff so that pollutants can be removed prior to entering the drainage system. These interruptions (BMPs) can be readily designed into new facilities but existing facilties will require design changes to force runoff through a BMP prior to entering the drainage system.

The following subsections discuss the range of structural BMPs that were considered for application at the Presidio.

Sediment Traps

A sediment trap is a structure that captures the "first flush" of a storm and removes primarily settleable solids. The effectiveness of a sediment trap is dependent upon the length of time a given volume is held. The shorter the time, the less effective the sediment trap will be. This is because heavy (larger) materials settle faster than lighter (smaller) materials. Sediment traps can operate in a number of ways, including the following:

- Filtering runoff through an existing or designed soil matrix to trap and remove settleable solids and pollutants;

- Diverting runoff through structures and filtration basins designed to temporarily hold the first flush volume prior to discharge to a storm sewer system; and
- Diverting runoff to infiltration basins designed to capture and hold the first flush until it infiltrates into underlying soils.

Oil/Water Separators and Water Quality Inlets

Oil/water separators remove petroleum products and grease and can also remove floatables and settleable solids. When concentrations are low, conventional separators are designed for oil removal only. Maintenance facilities, parking lots, and roads where runoff can be collected are prime candidates for oil separators. Conventional separators are capable of removing oil droplets equal to or greater than 150 microns. Unfortunately, storm water characteristics with respect to oil droplet size have not been thoroughly classified (CDM et al., 1993).

The separator should be designed to treat the first flush and allow excess flows to the bypass the separator. This lowers the cost while still treating the most polluted portion of runoff.

Infiltration Systems

An infiltration system disperses captured runoff into the surrounding and underlying soils. Infiltration can be accomplished by a number of means, among which are the following:

- Infiltration ponds;
- Infiltration beds or trenches; and
- Porous pavements (concrete or asphalt pavements designed to be porous) and precast concrete pavers (modular units containing open areas).

These systems can remove particulates and dissolved pollutants. The degree of treatment depends on the porosity of the soil matrix. Coarse soils allow the water to pass quickly to the groundwater with little removal of the fine particulates and the dissolved constituents. Soils too porous to provide effective pollutant treatment can convey the pollutants to underlying

groundwater. Fine soils, on the other hand, have a tendency to clog rapidly, accumulate heavy metals, and generally lose their capacity to infiltrate water.

Storm Water Detention Basins

Storm water detention basins are usually open earthen channels or grassed impoundment areas or basins designed to control the peak rate discharge for one or more of the peak storm events. The rate of discharge is controlled by the outlet structure. Smaller storm events generally pass through a detention basins with little or no attenuation of the rate of inflow to the basin.

The impact of detention basins on water quality is dependent upon the design of the basin, the type of vegetation and the outlet structure discharge control characteristics. If sized and designed to allow a sufficiently slow rate of discharge through the basin, they can be effective in removing settleable solids. Sediments accumulate in these basins and periodically require excavation and disposal to restore their capacity.

Typically, the first flush enters a detention basin at a relatively slow rate; therefore, to effectively treat the first flush, the outlet structure must be designed to hold the initial runoff for a sufficiently long period of time (about 40 hours) yet still allow higher flows to pass. This can usually be accomplished by using a small diameter orifice. However, small orifices also can be obstructed easily by small debris and can clog and become plugged, therefore requiring regular inspection and maintenance.

Extended Detention Basin

Extended detention basins are similar to infiltration basins except that the discharge of the water is to the downstream pipe network. During dry periods, the basins are dry, and during storms the basins fill. A bottom drain slowly releases the water, allowing sufficient time for the particulates to settle. The slopes of the extended detention basin are vegetated to help in the capture of the sediments and reduce erosion. These basins are most efficient in large watersheds since there is limitation with the size of the outlet orifice. The drawdown time is usually between

24 and 48 hours. The basin should be provided with a trash rack at the outlet. Also an overflow or bypass should be installed to allow large storm events to pass.

Wet Ponds

Wet ponds have permanent water bodies (pools) with rooted vegetation along the perimeter. The pool provides room for sedimentation along with a viable habitat for micro-organisms and plants that consume nutrients and other dissolved contaminants between storm events. The ponds are generally between 3 to 9 feet deep.

Wet ponds are particularly effective in the removal of dissolved nutrients and can be integrated into landscape plans to provide an aesthetically pleasing amenity. They can also provide wetland and wildlife habitat and can provide opportunity for passive recreation. However, they should be designed to discourage pedestrians and small children from getting too close to the water's edge as the pools can pose a safety hazard. This can usually be accomplished by constructing a shallow vegetated bench around the perimeter of the pool.

Wet ponds require annual inspection and removal of debris. Accumulated sediments must be periodically removed. Metals may concentrate in the sediments and testing should be performed on the excavated sediments prior to removal and disposal.

Biofilters

A biofilter consists of a strip of vegetation (usually grass) through which storm water flows prior to discharge into a storm sewer system. The most effective use of a biofilter requires flow to enter as unconcentrated sheet flow. For paved areas, the pavement surface must be capable of achieving sheet flow at the interface with the biofilter. This may not always be practicable and installation of a flow spreading system may be required. Biofilters should be designed for shallow broad flow that must pass through but not overtop the height of the vegetation. They can be placed adjacent to paved areas and can work in combination as a conveyance swale. When used in combination, the swale should be wider than a conventional drainage trench to avoid excess flow velocities and channeling.

Biofilters are suitable for small catchment areas. Biofilters can remove particulate matter although their ability to treat dissolved solids and nutrients is limited by the relatively short contact time. Biofilters can also provide increased infiltration when constructed on porous soils.

The grass species used for biofilters would ideally be one well-adapted to the local climate, require little maintenance, and be relatively drought-tolerant. In general, bentgrass, ryegrass, and bluegrass species are well adapted to the cool coastal climate at the Presidio; however, these grasses have varying irrigation and maintenance requirements. Previous experience of landscape personnel (i.e., golf course greens keeper and cemetery personnel) should provide valuable insight into selection of cost-effective species. Species that become dormant during periods of little water (i.e., summer) may be acceptable if they can be brought out of dormancy prior to the onset of the rainy season.

Constructed Wetlands (Pretreatment Basins)

Constructed wetlands are areas constructed to have a significant percentage of the facility covered by wetland vegetation. They are effective in removing particulates, nutrients, and other dissolved and solid pollutants. They are ideal for treating large drainage basins. Constructed wetlands also have the potential to provide wildlife habitat and passive recreation.

Constructed wetlands require a base flow to maintain their water level. They require a relatively flat area for their construction and cannot be placed on steep slopes. An ideal ratio of surface area to drainage basin area is between one and two percent.

These systems require annual inspection and removal of debris and repair of banks to control erosion. Periodic removal of accumulated sediments is also required. The nutrient removal rate may drop off as the vegetation reaches its maximum density, therefore, harvesting of the vegetation may be required and a program should be implemented to monitor and remove biomass from the system as required. Depending upon the nutrient load entering the wetland, this could be as frequent as once or twice per year. It may also be necessary to remove some species of plants if they are in competition with desirable species intended to remove specific pollutants such as dissolved metals.

The nutrient removal effectiveness of wetlands systems is diminished in areas where the wet season coincides with the low growth period of the year, such as in Northern California. Nutrient uptake is reduced during this time and it is possible that nutrients may be released by the system due to decomposing plant matter.

Dry Wells/Cisterns

Dry wells are underground compartments through which flow is diverted and allowed to infiltrate to the ground. They can be constructed of ungrouted brick or masonry blocks or of precast concrete sections with perforated walls. The dry well is most applicable for treatment of relatively small areas such as rooftops. They should be designed to contain the first flush and allow larger events to pass to the storm sewer. These systems should be inspected and cleaned annually and should not be used where sediment loads or fine solids are anticipated in the runoff. A relatively good inflow runoff water quality (such as from roof tops) will extend the useful life of these structures and minimize the potential for clogging of the soils.

Where desired, underground cisterns based on the same collection principles could be used to collect and store runoff for beneficial re-use such as landscape irrigation. The economics of capturing, storing, and distributing rain water may not favor this approach.

12.2.1 Applicable BMPs

12.2.1.1 Implementation Priorities

Implementation of the BMPs should be initiated during development of preliminary plans for roadway improvements, landscaping and parking facilities throughout the Presidio. The following priorities have been established to help guide the implementation of the BMPs:

1) Major roadways—Highway 1 and Doyle Drive/Highway 101;
2) Proposed parking facilities:
3) Existing parking facilities; and
4) Other structural BMPs.

The first priority should be given to the Doyle Drive/Highway 101 and Highway 1 corridors. It should be recognized that the greatest pollutant load sources are these Caltrans facilities. These facilities will contribute the highest concentrations of oil, grease and heavy metals. Caltrans is in the process of applying for an NPDES permit on a statewide basis. The burden of developing effective BMPs for the Caltrans facilities should be borne by Caltrans. However, unique constraints at the Presidio include a limited right-of way width and substantial grade changes transitioning to the south end of the Golden Gate Bridge and up and through the MacArthur Tunnel.

This SWPPP recommends that Caltrans implement a BMP along Doyle Drive from Highway 101 at Battery Blaney Road west to near the Palace of Fine Arts. This BMP could be implemented either at grade or on an elevated deck roadway. It would allow for the integration of other facilities proposed in the GMPA, and is specifically intended to improve the quality of storm water runoff. Consideration of this BMP should be included in preliminary planning for the improvement of Doyle Drive. Doyle Drive improvements are discussed in more detail in Section 12.2.1.3, below.

The second priority should be given to incorporating BMPs into plans for expanding or constructing new parking facilities. BMPs should be incorporated during the early stages of design development. BMPs for these facilities can for the most part be readily incorporated into the designs and implemented effectively and efficiently.

Third, and less efficient, is the adaption of existing parking facilities to incorporate BMPs. The facilities will likely require modification of existing curbing and pavement. Adaption of existing parking facilities will require more site-specific design measures to effectively integrate with the existing conditions. It may be most effective to combine implementation of the BMPs with another project such as major re-landscaping or during scheduled pavement overlaying operations.

12.2.1.2 Selection Criteria

The criteria used to evaluate and select the specific BMPs proposed for implementation include the following:

- Slope: Certain BMPs cannot be placed on or near slopes as the ponding of the water or velocity of flow may cause instability or excess erosion;
- Required Area: Certain BMPs require an area that limits their applicability to specific locations;
- Soil: Infiltration systems require a well-drained soil; vegetation-dependent BMPs must have soils suitable to sustain the vegetation; wet ponds require a permanent water table or must have impermeable soils along their bottoms to prevent excessive loss of water into the soils;
- Pollution Treatment Capability: Pollutant constituents targeted for removal are a primary consideration in the selection of the BMP or combination of BMPs selected to meet the removal objective; and
- Aesthetics: The selected BMP should be compatible with other planned uses in the area and should not diminish the natural and cultural resources or the aesthetics of the adjacent environment.

12.2.1.3 Selected BMPs

The structural BMPs selected for application at the Presidio are presented below. The time line for implementation of the structural BMPs is dependent upon the schedule for construction of improvements to the Presidio facilities. The structural BMPs and the locations recommended for implementation were developed to integrate with the proposed facilities described in the GMPA. The BMPs should be implemented concurrently with the development of the various facilities as discussed above. The locations of selected BMPs are shown on Figure 10.

Doyle Drive

The management of runoff from Doyle Drive is the responsibility of Caltrans. Doyle Drive was targeted as a "hot spot" in the Presidio because it contains oils and grease, particulates from vehicle wear, heavy metals, and pollutants from accidental spills and leaking recreational vehicle holding tanks. Currently, runoff from Doyle Drive is collected and discharged at grade into conveyance channels and into the storm sewer system which discharges to San Francisco Bay. Biofilters, swales, and infiltration basins were eliminated from consideration for the treatment of runoff from Doyle Drive due to the amount and types of pollutants present.

Two BMPs, implemented in combination, are recommended for Doyle Drive. These include a lined filtration trench designed to filter out particulates, oil and grease, and heavy metals which would adhere to the soils within the filtration channel. Nutrients and other organic pollutants would also biodegrade within the soil matrix of the channel. The channel should be designed with void space sufficient to contain the 2-year rate of runoff. Storm water would filter down through the soil matrix and accumulate in the bottom of the channel. A perforated pipe placed within the channel at a predetermined height would provide positive drainage toward wetland pretreatment basins located either on the east or west side of the Commissary. Connection of the BMP to the wetland restoration area would, however, be contingent upon the ability of Caltrans to reduce pollutant concentrations in Doyle Drive runoff to a level deemed acceptable by the NPS. In the event that this runoff does not meet NPS water quality standards, Caltrans would be directed to convey Doyle Drive runoff to the CCSF combined system. As a note, it is anticipated that the BMP recommended in this plan will effectively reduce pollutant concentrations to a level acceptable to the NPS. Figure 12 shows the recommended lined filtration channel.

The wetland pretreatment basins would be connected to the proposed wetland restoration with two pipes about 30 inches in diameter fitted with a water level control structure that would permit tidal flows to enter the pretreatment basins. An orifice would be used to slowly draw down the water level of the basin. An emergency overflow weir would be designed into the level control structure to allow large storm events to pass to the restored wetlands and on to San

Francisco Bay. These basins would receive runoff from several subbasins (see Figure 10). Figure 13 shows the wetland pretreatment basin water control structure.

Hydrocarbons and heavy metals from Doyle Drive runoff would be captured by the soil matrix within the lined filtration trench; however, it is possible that some compounds could be conveyed to and accumulate within the bottom soils of the wetland pretreatment basin. These contaminants would have to be excavated and properly disposed on a periodic basis, when accumulation of sediments reduces the permanent pool volume by approximately 25 percent.

New Parking

Parking facilities proposed for construction provide the greatest degree of flexibility for integration of BMPs. Three BMPs were selected as most appropriate at new parking facilities. The BMPs should be implemented in combination and include biofiltration followed by oil/water separation and/or infiltration. Two distinct combinations of these systems are proposed.

Figures 14 and 15 show two proposed combinations of a biofilter, infiltration system and oil/water separator (skimmer tee). With the first system, the biofilter would be located within a landscaped median in the parking lot or along the edge of the parking lot. Runoff would flow through the biofilter and into the infiltration trench. The infiltration trench would contain a perforated pipe located at a predetermined height so that positive drainage would be provided when the infiltrative capacity of the trench was exceeded. During high runoff rate events, flows would accumulate on the infiltration trench and overflow into the catchbasin inlet and would then be conveyed to the storm sewer system. The outlet of the drop inlet would be fitted with a simple oil water separator for added protection. Cleanouts would be provided along at the ends of the perforated pipe to provide inspection and cleaning equipment access.

The biofilter would help remove particulates, oils and grease and some heavy metals. The infiltration trench would provide further filtration and some biodegradation of pollutants. The oil/water separator outlet would remove floatables entering the drop inlet.

Existing Parking

Facilities that are not proposed to be replaced or removed can be retrofitted with BMPs designed to capture the runoff for onsite treatment and removal of oils and grease, and particulates. The selected BMPs include one or a combination of the following:

- Redirecting runoff through a biofilter/swale prior to discharge to the storm sewer system;
- Retrofitting catchbasin inlets with biofilters;
- Retrofitting the catchbasins with oil/water separators; and/or,
- Routing the storm sewer system through a sediment trap or infiltration system.

The preferred combination of BMPs is retrofitting existing catchbasin inlets with biofilters, and installing oil/water separators inside catchbasins (if space is available). In some locations the modifications can include construction of an infiltration system, but this is recommended only in combination with biofiltration and oil/water separation. A typical biofilter inlet for use at existing parking facilities is shown on Figure 16.

A review of the existing parking facilities indicated that most can be retrofitted with biofilters, at some locations sufficient room may be available for installation of oil/water separator (an oil skimming device that will also remove other floatables), and at a few locations, installation of an infiltration system would be possible. Other locations proved to have no practicable solution suggesting "no action" as the best recommendation. Proposed treatment facilities at existing parking facilities are shown on Figure 10.

Other Structural BMPs

1) An infiltration basin is proposed to be constructed at the golf course parking lot along Arguello Boulevard. It would be designed to contain the 100-year runoff volume. An emergency overflow would be provided to allow control discharge to Arguello Boulevard should the basin fill past design capacity. The basin would require periodic inspection and removal of sediments which would decrease the infiltrative rate of the basin. Figure 17 shows the proposed infiltration basin at the golf course parking lot.

2) Dry wells can be installed on a case-by-case basis to reduce and treat runoff from rooftops. This type of facility could be installed depending upon the availability of funds. The primary constituents that would be removed are atmospheric deposits, which can include heavy metals. Figure 18 shows a typical dry well; Figure 10 shows the proposed locations.

Specific Design Criteria for BMPs

The following design criteria should be used to design specific BMPs during the preparation of plans and specifications. Some of the facilities are susceptible to plugging from debris and sediments. The designer should be made aware of the importance of providing inlet-filtering of runoff to reduce the potential for clogging infiltration systems. Further, rock-lined trenches and infiltration beds will require the use of geofabric filters to prevent the migration of adjacent soils into the rock media.

Lined Filtration Channel

- Ability to handle 25-year flowrates without overtopping
- Perforated subdrain minimum slope of 0.3% to maintain flow in excess of 3 feet per second.

Wetland Pretreatment Basin

- Area = 1.5 to 2% of drainage area
- Permanent Pool Depths of 2 to 6 feet deep
- Side slopes no greater than 4:1 to a water depth of 2 feet
- Suitable soils for plant growth
- Outflow structure sized to pass 100-year flow.

Biofilter/Infiltration Trench

- Biofilter size (minimum) = 1,000 square feet per acre of pavement drained
- Biofilter slope, 5 percent

- Distance from pavement transition to inlet must be a minimum of 10 feet
- Infiltration trench sized for infiltration rate of 0.6 inch per hour per square foot of trench
- Infiltration trench pore space sufficient to hold average annual storm = 0.2 inch
- Geofabric surrounding trench rock
- Incorporate overflow or bypass for large events
- Access for maintenance vehicles and pipe cleaning equipment.

Biofilter/Swale with Infiltration Bed

- Biofilter size (minimum) = 1,000 square feet per acre of pavement drained
- Biofilter slope must not exceed 5 percent
- Distance from pavement transition to inlet must be a minimum of 10 feet
- Infiltration Trench sized for infiltration rate of 0.6 inch per hour per square foot of trench
- Infiltration Trench Pore space sufficient to hold average annual storm = 0.2 inch
- Geofabric surrounding bed
- Incorporate overflow or bypass for large events
- Access for maintenance vehicles and pipe cleaning equipment.

Biofilter/Swale

- Biofilter size (minimum) = 1,000 square feet per acre of pavement drained
- Biofilter slope must not exceed 5 percent
- Distance from pavement transition to inlet must be a minimum of 10 feet.

Biofilter Inlet

- Biofilter size (minimum) = 1,000 square feet per acre of pavement drained
- Biofilter slope must not exceed 5 percent
- Distance from pavement transition to inlet must be a minimum of 10 feet.

Infiltration Basin

- Infiltration rate of 0.6 inch per hour per square foot
- Detention time no greater than 48 hours
- Volume = runoff volume for the 100-year, 24-hour storm
- Energy dissipator at inlets
- Incorporate bypass or overflow for large events
- Maximum side slope of 3:1.

Dry Well

- Infiltration rate of 0.6 inch per hour per square foot
- Drainage time no greater than 48 hours
- Volume = runoff volume for the 10-year, 24-hour event
- Incorporate bypass or overflow for large events.

12.3 OPERATIONAL BEST MANAGEMENT PRACTICES

Operational BMPs to be implemented as part of this SWPPP include:

- Erosion control;
- Elimination of illicit discharges to storm drains;
- Structure maintenance;
- Pipeline maintenance;
- Storm-related maintenance;
- Operation and maintenance of onsite treatment systems;
- Pavement cleaning;
- Landscape chemical management;
- Spill prevention and control;
- Storm water monitoring;
- Education and training; and
- New development and tenant controls.

These practices are discussed below.

12.3.1 Temporary (Construction) Erosion Control Policies

Policies and procedures for controlling erosion at the Presidio are discussed in this section.

12.3.1.1 Introduction

Erosion control is critical during construction activity on major portions of the Presidio. The area is characterized by sandy soils that support a relatively sensitive and fragile vegetative cover. As a result, these soils become highly erodible when disturbed and this erosion can contribute a high sediment and nutrient load to the storm drainage system.

Effective erosion control during construction is facilitated with a well-developed construction and site usage plan. Also, in order to minimize the financial and environmental impact of erosion control measures, careful consideration must be given to the utilization of temporary measures as the initial development of final measures. Therefore, a well-developed construction plan should result in a final product that contains permanent erosion control facilities. This section identifies and describes the elements of a construction erosion control plan and presents typical measures that can be taken to mitigate erosion impacts. The typical elements of a construction erosion control plan are:

- Site planning considerations;
- Construction schedule
- Vegetative preservation and stabilization;
- Physical stabilization;
- Runoff diversion;
- Velocity reduction; and
- Sediment trapping and filtering.

12.3.1.2 Site Planning Considerations

Proper site planning is the most critical element of any erosion control plan. The use of the site and construction must be planned to minimize disturbance. This is done both by confining the footprint of the construction to the flatter areas, and also by locating the construction so that the effect of temporary as well as permanent access is minimized.

Careful consideration must be given during facility siting to the location of any planned permanent erosion control facilities such as drainage ditches, landscaping, sedimentation basins, infiltration, trenches, etc., to ensure that maximum use may be made of the temporary facilities. The permanent facilities must also be planned to minimize the disturbance to existing vegetation as well to any highly erodible areas, such as the steeper slopes. The characteristics of the site terrain should be used as much as possible to control drainage with the minimum amount of improvement.

12.3.1.3 Construction Scheduling

Construction should be scheduled to reduce the amount of disturbance to the soil at any one time, as well as to reduce the amount of damage that could occur to the soil that is exposed. The first step in the scheduling process is to schedule the work activities to eliminate the possibility of having exposed soil during the rainy period between January and March. In addition, the work must be scheduled to disturb minimal amounts of the site at one time, and to protect any disturbed areas as soon as possible in the construction process.

In order to minimize the impact of erosion during construction, the erosion control facilities discussed throughout this section should be constructed during the initial weeks. These facilities can include protective fencing, cobble-lined drainage channels, sedimentation basins, infiltration trenches, and access-way protection. During construction, the work shall progress in easily managed segments to limit the exposed area. For instance, utility and foundation trenches should be opened to the extent that they can be closed with improvements at the end of the work day. The grading should be scheduled to be completed as soon as possible and revegetation should be a continual activity as work progresses.

12.3.1.4 Vegetative Preservation and Stabilization

The most effective form of vegetative stabilization is the preservation of existing, well-established indigenous vegetation. Planned preservation of existing vegetation shall minimize the need for artificial erosion control structures. This shall be accomplished by clearly marking vegetation which will be saved, defining and protecting vegetation to be saved with berms, fences, etc., and to prohibit construction activities (e.g., traffic routes, spoils piles, etc.) where they could have adverse effects on the existing vegetation.

The vegetative stabilization of a site should include seeding and planting as soon as possible when construction activities allow. This should be done for both short-term erosion control and long-term soil stabilization. Areas to be considered as possible candidates are any graded or cleared areas where construction activities have ceased, cut and fills, steep slopes, spoil piles, swales, landscape corridors, and stream banks. The seeding and planting should be supported by the installation of permanent irrigation facilities as soon as possible so that growth may be established.

A successful seeding and planting program begins with selection of plants that are quickly and easily established and appropriate for the site. The use of a landscape consultant who is familiar with the site conditions is essential. In addition, selected plants should be drought-resistant and should only rely on irrigation during establishment and critical drought periods. The irrigation system should be designed to minimize water dispersion and concentration, and should be easily maintained. The use of drip irrigation and micro-spray head systems with supporting pH/nutrient injection systems for maintenance is recommended.

Mulching is used to temporarily or permanently stabilize cleared or freshly seeded areas. Types of mulches include straw, organic material, wood chips, bark or other wood fibers, decomposed granite or gravel. It must be noted that care should be taken in the selection of the type of mulch, as some lighter mulches require binders or anchors to avoid washing down the slopes. The mulch must be compatible with the revegetation elements, but it is recommended that degradable organic material such as jute be used as much as possible.

12.3.1.5 Physical Stabilization

Physical stabilization can be achieved by geotextiles and mats, dust control through watering or chemical application, and construction of temporary stream crossings and stabilized construction entrance. These options shall be located where necessary to minimize erosion during construction.

Permanent physical stabilization measures such as retaining walls to reduce the presence of steep cut or fill slopes and paving stones that can be used to protect access-ways and support traffic, yet allow infiltration of storm water, should be considered in the design of the improvements. These improvements should be installed as soon as practicable in the construction process.

12.3.1.6 Runoff Diversion

Runoff diversion is an effective erosion control practice that diverts storm water in such a manner as to avoid disturbed areas. Temporary measures such as lined/covered earthen berms, swabs, or dikes may be used for this purpose. Also, with proper planning it may be beneficial to install permanent drainage diversion features that would remain in place after construction.

12.3.1.7 Velocity Reduction

Reducing the velocity of runoff and in water courses is essential in minimizing erosion. This can be done with outlet protectors using energy dissipators, check dams, and slope roughening and terracing. Methods that use native materials, such as cobble-lined or grass-lined swales on slopes, log-supported terracing, etc., should be stressed.

12.3.1.8 Sediment Trapping and Filtering

Sediment, a by-product of erosion, produces downstream impacts. These impacts include clogging of drainage facilities, physical modification of downstream marine habitats and nutrient transportation that can chemically modify downstream aquatic habitats. Due to these secondary impacts, sediment trapping and filtering is one of the most important aspects of storm water

management during construction. With all other precautions installed, it is still difficult to avoid sediment transport in the storm water. Sediment traps and filtering devices should be installed to allow for complete protection of downstream environments. The methods of sediment trapping and filtering to facilitate siltation reduction include silt fences, straw bale barriers, sand bag barriers, brush or rock filters, storm drain inlet protection, sediment traps, and sediment basins. Specific locations of the structures will have to be determined for each construction site.

Some of these facilities, such as sedimentation basins and traps, can be installed as permanent facilities if located and sized properly.

Facilities to be used after construction should be located downstream of areas that may collect contaminants or sediment such as roadways or parking lots. The facilities should be designed to provide effective sedimentation removal during a 2-year/30-minute frequency duration storm and capable of passing a 10-year/one-hour storm.

12.3.2 Illicit Discharge Elimination Plan

12.3.2.1 Introduction

Improper sanitary sewer or other physical connections to the storm drain system can occur in a number of ways and from a number of sources. However, they generally occur in older systems from a prior accepted practice of combined usage that has not been fully corrected, in retrofits to newer systems as a means of convenience, and overflow connections. Typical overflow connections are usually found in applications that are sensitive to clogging (grease traps) or reliance on an outside energy source (sewer lift stations). Convenient connections are typically found in areas where a relatively low flow wastewater source is located close to a storm sewer system, but is somewhat removed from a sanitary sewer system.

Procedures for detection and removal of existing illegal connections tied to storm drain conveyance systems involve a multi-phased effort. Evidence of illegal connections is generally only detectable at storm drain outfall (end-of-pipe) locations. Therefore, the initial phase of source identification is through a field screening program, a sampling program, or a combined

effort of both programs. Secondary or follow-up phases of illegal connection identification require further investigations upgradient of pipelines or drainageways to isolate illegal system connections.

In August 1993, a study of the storm sewer outfall system from the Presidio of San Francisco was prepared by Dames & Moore for the National Park Service. The purpose of the study was to identify possible sources contributing coliform bacteria to the storm sewer system with in the watershed drainage basin tributary to San Francisco Bay. The study included a review of previous reports, analytic testing, repair records, planned improvements to the sanitary and storm systems and known problem areas. Samples of flows within the storm sewer were analyzed and the results were evaluated. A plan for identification of illicit connections was recommended.

The recommendations included inspection and testing of specific pipe segments located within five specific areas of the Presidio. At the time of the study, the U.S. Army was implementing a sanitary sewer slip lining project for most sanitary sewers within the Presidio. In addition, a program was being implemented to reconstruct six sanitary sewer lift stations. Therefore, a further recommendation was to wait until completion of the Army improvements so that an assessment of end-of-pipe conditions could be made to evaluate whether continued investigative actions were warranted. Upon completion and assessment of the effectiveness of the repairs, continued investigation will proceed if warranted.

Within the watershed drainage basin tributary to Lobos Creek, coliform testing by the U.S. Army at the water treatment plant indicates that coliform concentrations have increased since 1991. The National Park Service in conjunction with the City and County of San Francisco is implementing a testing program along Lobos Creek in an attempt to isolate the source of the coliform. Depending upon the results of this investigation, an illicit discharge elimination program may need to be implemented within the Lobos Creek watershed drainage basin. Such a program should consider retrofitting the existing lift station to prevent sewage overflow into the watershed.

The following sections describe the procedures that will be implemented to isolate and identify illicit connections. Some of these steps have already been performed in the San Francisco Bay watershed drainage basin.

12.3.2.2 Field Screening

Prior to any field work, all available as-built information should be reviewed to identify areas of high probability of illicit connections based upon history, use and location as described earlier. In addition, a review of all system maintenance documentation and repair reports can also identify portions of the system subject to inflow from a sanitary sewer system.

The initial detection procedure typically begins with a routine field screening program during dry weather conditions; initial attention is given to high probability collection branches. The presence of dry weather flow or other suspect visual or odorous characteristics that are not typical of normal conditions should be noted in field logbooks for documentation purposes. The field screening process may involve either:

- Notation of visual observations at suspect outfalls;
- Field-testing of dry weather flows with an EPA-approved storm water test kit for copper, chlorine, phenol, detergents/surfactants, coliforms and pH; or
- Sample collection for analytical laboratory testing.

The intent of the routine field screening program is to identify outfalls that have characteristics of illegal connections. Identified suspect outfalls may then be monitored on a more frequent field screening basis or, if evidence is primarily conclusive, a follow-up storm drain system investigation may commence.

12.3.2.3 Follow-Up

Storm drain investigations generally begin at suspect outfalls and work upgradient until either the source is identified or there is no evidence to warrant further investigation. The detection

process may be expedited by field screening every second manhole, open channel outfall, or combination thereof to most quickly isolate the potential source. Bisecting watersheds and working up or downgradient, dependent of observed conditions, can be used effectively to expeditiously isolate the approximate location of an illicit connection. Isolation of an illicit connection within the storm drain piping requires utilization of one or more of the following techniques:

- Fluorometric Dye Testing
- Zinc Chloride Smoke Testing
- Pipeline Television Camera Inspection
- Physical Inspection

Zinc chloride smoke and fluorometric dye testing are the most effective verification technologies. Fluorescent dye testing involves the introduction of a dye such as fluorescein in a discharge point suspected of exhibiting an illicit connection. The dye is flushed down with clear water. Downstream points are observed for the presence of dye. If dye comes through, then an illicit connection has been identified.

Smoke tests may also be used to trace illicit connections; however, it is recommended that dye testing be utilized whenever practicable and applicable. Smoke tests may be conducted at either a discharge point or an outfall and "flushed" through the system with fans. Caution and effective communications are important during smoke testing so the presence of smoke is not perceived as an indication of a fire by those unaware of the test.

In situations where dye or smoke tests fail to identify illicit connections or in order to identify the exact location of a detected illicit connection, an internal visual inspection of the system may be necessary. Manual visual and television camera inspection of storm drain piping can be utilized in the verification process. Television inspection is applicable to all sizes of pipes and also provides information to access the pipe's condition to assist in planning future maintenance operations. Manual visual inspection of larger pipe is a very positive form of identification, but it requires trained personnel certified for confined space entry located both below and above the ground.

12.3.2.4 Removal and Restoration of Service

Once detected and located, the illicit connection must be removed from the storm sewer. This action will also necessitate the repair of the storm sewer as well as providing sanitary service to the source of the previous illicit connection. The repair of the storm sewer is usually performed by excavation and replacement of the pipe section that is affected. However, there are many products that may be used for in situ pipe reconstruction if excavation is not necessary to provide service to the sanitary sewer source (service abandonment). The work necessary to provide service to the sanitary sewer source will be site-specific and may include the installation of pumping facilities if gravity service is not available in a cost-effective location.

12.3.2.5 General

The procedures defined above are primarily directed toward identifying illicit sanitary sewer inflows to the storm sewer system. However, should the need arise, the same procedures can be used to identify illicit storm water inflow into sanitary sewer systems.

12.3.3 General Structure Maintenance

The following tasks should be performed on a biannual basis:

1) **Manhole Structure Inspections:** Checking frames, rings, covers and ladders for rust, poor fit, loose fittings, and physical damage to vaults.

2) **Manhole Pipeline Inspection:** Check manholes for clogging of inlets and outlets, or clogging and concentration of suspended solids; check for presence of hydrocarbons.

3) **Catchbasin Cleaning:** Clean the catchbasin or drop inlet and remove debris. Catchbasins in high pollutant load areas should be cleaned just before the wet season.

4) **Open Channel Maintenance:** Clean and wash open channels and ditches to remove debris; pick up debris and load into truck for proper disposal.

5) **Miscellaneous Repairs:** Immediate repair of deterioration of manholes and catchbasins which threaten structural integrity and repair of pipeline blockages.

12.3.4 General Pipeline Maintenance

The Presidio storm drainage system contains approximately 37,000 lineal feet of conveyance piping in sizes 18″ and larger (Nolte & Associates, 1991). General pipeline maintenance would typically include the following tasks:

1) Inspection of pipes for deposition buildup, plugging, cracking, collapse, or other conditions that would hinder the hydraulic capability of the network. This inspection can be performed usually by "lumping" straight runs of piping where a line-of-sight may be observed and by observing head build-up in catchbasins during a storm event.

2) Remove and replace pipe damaged beyond the scope of miscellaneous repairs.

3) Flush pipelines that have hydraulically constricting depositions; dispose of the slurry in a sanitary sewer or other disposal site when possible. This procedure is further described below.

4) Unplug pipelines using waterjet vacuum devices, or hydraulic cutting devices, capturing and disposing of the material in sanitary sewer or other disposal site when possible (or as required based upon analytic testing). This procedure, combined with flushing, is described below.

The following paragraphs provide general information on processes and procedures that should be performed to implement tasks 1 and 2, described above.

<u>Flushing Procedures</u>

1) **General:** A common maintenance procedure to remove deposited material such as sediment and organic debris from storm drain piping is to flush it with clean water. This action is particularly beneficial for small-diameter storm drainage piping with grades too flat to be self cleansing. Flushing helps to ensure that the storm drainage network conveys the design flows to eliminate flooding and remove pollutants from the system that could create downstream impacts.

2) **Define Area and Schedule:** It is recommended that all storm drainage piping with an inside diameter of 12 inches or less be flushed on an annual basis. However, a more refined scope of work on piping of all diameters can be developed by maintaining and periodically reviewing inspection and maintenance records of the piping and catchbasin

system. This review would identify the location and frequency of problem areas based on the physical ability of the system to carry the required flows. However, it is possible that sediments and/or contaminants may enter the system in such quantity as to create downstream impacts, yet in insufficient quantity to significantly impact its capacity. Therefore, a periodic review of the results of a precipitation and flow monitoring program would also provide information to define the scope and frequency of a flushing program. The identification of the typical chemical constituents of the storm water effluent will also determine the relative necessity of flushwater retentions.

3) **Procedure:** The procedure for flushing will be dictated by the accessibility to the system to flushing and vacuum equipment as well as the availability of flushing water. However, when the pipes are accessible, it is recommended that they be flushed with a hydraulically operated cleaning device and that the flushing water and resulting debris be collected with a vacuum truck and disposed off-site at an approved location. A typical cleaning device previously mentioned is a rotation cleaning nozzle that is propelled through the pipe with high-pressure water. The cleaning nozzle is connected to the pressure tank with a hose and the water is ejected behind the nozzle as it cleans upstream. The water then becomes a flushing fluid and it is collected in a downstream manhole with a vacuum truck. This method minimizes the amount of water necessary for cleaning and collects all discharge to reduce downstream impacts, but it does require access for the cleaning equipment. It also requires that these accessible cleaning points be located with a frequency that supports the equipment's limitations (usually <400 feet on center).

   In areas where equipment access is not easily obtained, it may be possible to flush the lines with high-pressure water in a downstream direction from an accessible point, either from a compressor or fire hydrant system pressure. The flushing effluent can then be collected at another accessible point downstream, should one exist.

12.3.5 Storm-Related Maintenance

Storm-related maintenance covers many areas, as described below.

1) **Roads and Pavement (General):** Storm damage cleanup and emergency repair, debris removal, equipment operation, dump truck operation, and other heavy equipment operation. Work includes debris disposal.

2) **Grounds (General):** Storm damage cleanup and debris removal. Chain-saw operation for removing damaged trees. Pickup and removal of limbs and other blown debris.

3) **Exterior Electrical (Electric, Electronic):** Repairs to exterior electrical components.

4) **Plumbing:** Repairs to plumbing, water pumping, and roof drain cleaning.

5) **Carpentry:** Repairs to structures, damaged roofs and broken windows.

6) **Sheetmetal Mechanic:** Sheetmetal/welding repairs of flues, gutters, and structures.

7) **Paint Shop:** Painting of structures and damaged objects.

8) **Executive Office Support:** Storm damage operations management team, emergency operations management post used during storm damage conditions.

9) **Operations & Maintenance:** Emergency operation management team, chief of O&M, emergency operation management center used to coordinate emergency responses.

10) **Ground Power Support (Electrical):** Emergency repair by ground power support crew.

11) **Electrical Interior (Electrical, Electronic):** Repairs of interior electrical systems.

12.3.6 Maintenance of Onsite Treatment Systems

Onsite treatment systems include biofiltration, infiltration trenches, filtration swales, sediment traps, oil/water separators, and constructed wetlands. Each of these requires regular inspection and maintenance. The following inspection and maintenance schedule provides an initial basis for inspection and maintenance frequencies for the proposed onsite treatment systems.

INSPECTION AND MAINTENANCE SCHEDULE		
Onsite System	**Inspection and Maintenance Activity**	**Frequency**
Biofilter/Biofilter Swale	1. Inspect to verify that the turf is in good condition prior to the start of the rainy season.	Once annually in early to mid September.
	2. Irrigate turf as required to establish healthy stand prior to start of rainy season.	Twice weekly or as required to establish growth.
	3. Mow grass as required to maintain a stand of about 4 inches during the rainy season.	Twice monthly or as required to maintain 4-inch stand.

INSPECTION AND MAINTENANCE SCHEDULE		
Onsite System	**Inspection and Maintenance Activity**	**Frequency**
Dry Well	1. Inspect and clean.	Once annually prior to start of rainy season.
Treatment/Detention Basin	1. Inspect and clean debris from perimeter	Three times annually.
	2. Remove excess vegetation and intrusive plant species.	Once annually. Mid to late May.
	3. Inspect and clean outlet structure.	Once annually.
Infiltration Trench	1. Inspect to verify that trench gravels are not plugged by surficial debris and sediments.	Once annually prior to the start of the rainy season.
	2. Rake and remove accumulated debris along top of trench.	Once prior to the start of the rainy season and once monthly during the season.
Infiltration Swale	1. Inspect to verify that turf is in good condition at the start of the rainy season.	Once annually in early to mid September.
	2. Irrigate turf as required to establish a healthy stand prior to start of rainy season.	Twice weekly or as required to establish growth.
	3. Mow turf to maintain 4-inch stand.	Twice monthly or as required to maintain a 4-inch stand.
	4. Inspect inlet structures for clogging and accumulation of sediment and debris.	Twice annually.
	5. Clean inlet structures.	Once in early September and Once in late April.
Infiltration Basin	1. Inspect to verify that turf is in good condition at the start of the rainy season.	Once annually in early to mid September.
	2. Rake and remove accumulated debris along top of basin.	Once prior to the start of the rainy season and once monthly during the season.
	3. Remove accumulated sediments, scarify surface and revegetate.	Approximately every 3 to 5 years.
Dry Well	1. Inspect and clean.	Once annually prior to start of rainy season.
Treatment/ Detention Basin	1. Inspect and clean debris from perimeter.	Three times annually.
	2. Remove excess vegetation and intrusive plant species.	Once annually, mid to late May.
	3. Inspect and clean outlet structure.	Once annually.

INSPECTION AND MAINTENANCE SCHEDULE		
Onsite System	**Inspection and Maintenance Activity**	**Frequency**
Sediment Trap	1. Inspect and clean.	Once in early September and once in late April.
Oil/Water Separator	1. Inspect and clean.	Once in early September and once in late April.
Lined Filtration Channel	1. Inspect to verify that trench gravels are not plugged by surficial debris and sediments.	Once annually prior to the start of the rainy season.
	2. Rake and remove accumulated debris along top of trench.	Once prior to the start of the rainy season and once monthly during the season.

12.3.7 Street and Pavement Cleaning

Roads and other paved areas contribute disproportionate pollutant loads, due in part to their low permeability. The primary constituents of concern are oil and grease, particulates, metals, and other sources of BOD and COD. Many of these constituents are typically washed into the storm drain during the first storm of the season and during the first flush of subsequent storms. One relatively inexpensive and effective means of reducing runoff pollutants associated with paved areas is a regular program of street sweeping. In addition to minimizing chemical sources of pollutants, street sweeping removes trash and litter that can clog inlets and pipes.

The street and pavement cleaning program outlined below will be implemented and modified as necessary to achieve the runoff pollutant reduction objectives as more information about its effectiveness becomes available.

<u>Equipment</u>

Street cleaning equipment appropriate for both wet and dry season use should be acquired. A vacuum sweeping vehicle can be used during the dry season, and a mechanical broom sweeper can be used during damp or rainy periods.

It is anticipated that the equipment will be in continuous use, being used to clean all paved areas on a rotating basis. A specific program of equipment maintenance should be developed and implemented based on the equipment manufacturer's recommendations.

Frequency

Heavily traveled roads and high-use parking lots should be targeted for frequent cleaning (once every one to two weeks, depending on buildup of oil, grease, particulates, and litter). Lesser roads and parking lots in isolated and residential areas should require less frequent cleaning, once every two to four weeks.

While a regular pavement cleaning program can be highly effective, additional pollutant load reduction can be achieved by stepping up the frequency immediately prior to the onset of the rainy season.

12.3.8 Turf and Landscape Chemical Management

There are several hundred acres of managed landscaping at the Presidio, including the Golf Course and San Francisco National Cemetery. It is likely that a variety of pesticides, herbicides, and chemical fertilizing agents are in use in some of these areas. While some landscape chemicals are taken up by plants or degraded into relatively inert chemicals, others may present in runoff at concentrations sufficient to ultimately affect the quality of water or sediment near the storm drain outfalls. It is recognized that some chemical use is unavoidable; however, it is recommended that a turf and landscape chemical management program be developed and implemented on a site-wide basis, utilizing the experience of those who have been responsible for landscape management at the Presidio.

The purpose of the program is to identify chemicals to be used for various purposes at the site, develop procedures for handling and use that address the potential for these chemicals to enter the storm drains or surface waters, and develop a schedule for chemical use that considers the timing of the application relative to storm events.

After identifying landscape chemical needs on a site-wide basis, a list of preferred chemicals should be developed. The list should be formulated after consideration of the toxicity of the chemical, potential degradability under normal climactic conditions, degradation products (inert or potentially hazardous), and persistence in the environment.

Wherever practical, operators should avoid chemical application within two weeks or so prior to anticipated rainfall, and chemical use during the rainy season should be minimized. The plan could also set forth specific treatment procedures and dilution rates for each type of application, resulting in a consistently applied, effective, and cost-effective program of landscape management.

12.4 SPILL PREVENTION AND CONTROL PLAN

12.4.1 Areas of Potential Spills

The following table indicates some of the areas of potential spills for which the NPS would have responsibility.

AREAS OF POTENTIAL SPILLS			
Facility	Subbasin Area (1)	Runoff Drains To	Comments
Doyle Drive	A, B, C, D, E, F, G, K, M, N	SF Bay	Road facility: spills are likely to occur from vehicle traffic accidents.
Highway 1	J, K, M, N	SF Bay	Road facility: spills are likely to occur from vehicle traffic accidents.
Highway 1	P	Mountain Lake (Lobos Creek)	Road facility: spills are likely to occur from vehicle traffic accidents.
Maintenance Facilities	O	Lobos Creek	Potential spills from chemical storage and transfer.
Golf Course	P	Lobos Creek	Potential spills from chemical storage and transfer.
Water Treatment Plant	O	Lobos Creek	Potential spills from chemical storage and transfer.
Notes:	1 - See Figure 3 for a map of watershed areas. 2 - The Golden Gate Bridge Maintenance District is required to implement its own plan.		

12.4.2 Initial Response Actions

Types of Spills

In general, spill events can be characterized as small, medium, or large, and will vary in significance depending upon the material and quantity involved. Some examples are as follows:

1) Small
   - Little or no danger to human health or the environment.
   - Notify the supervisor of the area where the spill occurred.

- Notify NPS Hazardous Material Coordinator (HMC) after routine cleanup, no need for fire personnel or Spill Response Team (SRT) involvement.
- A few gallons or less of oil, non-toxic or non-flammable materials, etc. (antifreeze, solvent, lube oil, waste motor oil, hydraulic oil).

2) Medium
- Some danger to human health or the environment.
- Report immediately to NPS HMC and fire personnel; no need to notify SRT.
- More than a few gallons of non-toxic, non-flammable materials.
- A few gallons or more of known toxic or flammable materials (such as gasoline, methyl alcohol, JP-4).
- Small quantities of very corrosive material (such as acids, DS-2).
- Small quantities of acutely toxic or poisonous materials (such as PCBs, pesticides).

3) Large
- Great danger to human health or the environment
- Notify NPS HCM and fire personnel immediately; SRT may be necessary.
- Large spills of oils, solvents, fuels, etc.
- Medium to large quantities of any unknown, unidentified material.
- Medium to large quantities of acids, bases, etc.
- Medium to large quantities of toxic, acutely toxic, poisonous materials (such as PCBs, ruptured 1-ton cylinder of chlorine gas, pesticides, etc.).

Initial Actions

First Response. The primary concern in any spill is the protection of all personnel involved. The nature of the spill (material and quantity) has a great impact on how easily this can be accomplished. In most cases, the initial observer would probably know the type of material that has been spilled and should be aware of the safety precautions required. If in doubt, additional help should be obtained before approaching the spill area. In the Presidio, most of the materials that could be spilled are petroleum, oil, and lubricants (POL) products. However, NPS personnel should also be aware of toxic and hazardous materials in use. The normal actions that the initial observer of a spill should take to respond to a spill are as follows:

1) Protect self and others from harm

- Evacuate if necessary.
- Use appropriate protective clothing.
- Eliminate smoking in/or around the spill site.
- Remove all other sources of potential ignition. Note anything which might identify the material.
- Stay upwind and/or uphill or otherwise out of harm's way. Attempt to keep others out of the spill area. Do not leave the scene until appropriate NPS personnel arrive.

2) Stop the flow if possible

- Only if the material is known and it is safe to do so.
- Close the valve.
- Turn a ruptured or punctured drum so that the point of exit is up.
- Temporarily plug the leak.
- Put the leaking container in another container (overpack drum).

3) Contain the spill if possible

- Only if the material is known and it is safe to do so.
- Cover floor or storm drains with a mat.
- Shovel dirt, sawdust, sweeping compound, etc., in the path of the flow.
- Place sweeping compound, sorbent pillows, sheets, and/or mats to contain the spreading spill.

4) Notification

- For small spills as defined above, the initial notification goes to the NPS HMC.
- For medium-to-large spills as defined above, the NPS HMC and fire personnel shall be notified.
- Give complete information regarding the spill, including location and substance spilled, if known.

- The level of urgency may affect who is the next person in line to be notified, i.e., paramedics, environmental personnel, security, etc. This will be done by the designated NPS HMC.
- It is the NPS HMC's responsibility to determine if regulatory agencies will be notified and to coordinate and control cleanup procedures.
- Even leaks of a minor nature that are contained and cleaned up by the spiller or the first person on the scene should be reported to appropriate NPS personnel. In this way, the deficiencies and/or malfunctions which led to the cause of the spill may be corrected.

12.4.3 Response Policy

<u>Process</u>

The NPS will need to develop an overall spill response policy that designates appropriate personnel, a Spill Response Team, and a chain of responsibility or command. The individuals and team should receive on-going training and specialized skills. The general procedures and responsibilities are outlined below:

1) Initial Callout. NPS personnel need to be trained to generally identify when a potentially hazardous spill has occurred and the reporting procedure. Individuals trained in fire and police services (perhaps NPS or military police) and an NPS individual, or HMC, who will organize and manage the overall cleanup and reporting, should be notified of any spill. The HMC will be responsible for coordinating all activities, including containment, control, and cleanup of spills. The HMC will make the determination of whether a spill is reportable under state and federal guidelines, and will provide the appropriate notifications. A chain of responsibility should be established that minimizes response times and makes sure that all obligations are met.

   After NPS personnel have contacted the HMC, that person will determine the scope and nature of the spill. Where necessary, this will be accomplished in cooperation with fire and police staff. Should the HMC determine that the incident is large in scope, the Spill Response Team may need to be mobilized.

2) Central Headquarters. The Police or Fire staff, whoever arrives first, will cordon off the spill zone and establish a Central Headquarters (upwind, uphill, etc.). Police staff will be briefed as to evacuation needs, hazards, "hot zones," decontamination requirements, etc., by the HMC.

3) Identification. The HMC, or person designated by the HMC, will identify the spilled substance by checking placards, labels, manifests, or shipping papers; questioning personnel; or taking samples for analysis when necessary.

4) Restricted Access. During large spills, the spill site will be cordoned into an inner perimeter or "hot zone," and an outer perimeter where management and decontamination activities will occur. When decontamination is necessary, it will be conducted at the point passing from the inner perimeter to the outer perimeter. Members of the media and/or public will not be allowed within the inner or outer perimeters.

5) Containment. Drains will be blocked and runoff will be bermed and contained, initially by fire personnel and if necessary with more extensive work by the SRT. Liquid spills will be absorbed by using sand, imbiber bead pillows (for PCB dielectric fluids), absorbent pillows, natural earth, or sweeping compounds.

6) Unknown Spills. Unknown spills and chlorine gas leaks will be treated as extremely hazardous, requiring Level A Protection (fully encapsulated chemical suit and self-contained breathing apparatus). Level A protection will be used by all personnel entering the inner perimeter, or "hot zone," to perform repairs or rescues. Level B protection (not fully encapsulating) will be used to work around PCB spills which do not involve fire, risk and other spills as directed by the HMC. Contaminated equipment will be kept in the "hot zone" until it can be decontaminated or prepared for disposal by overpacking.

7) Medical Emergencies. Medical emergencies will be handled by fire staff in cooperation with medically trained personnel (paramedics) and possibly the emergency room staff at Letterman Army Medical Clinic. Fire staff will retrieve injured personnel from the "hot zone." Decontamination will be performed to as high a degree as possible near the Central Headquarters. Under no circumstances will paramedic personnel be allowed to drive or walk through the "hot zone." They will wrap patients in disposable blankets after decontamination has been performed. Upon acceptance of a casualty from a hazardous spill accident, the emergency treatment personnel, emergency vehicle(s) and any emergency room used will be considered contaminated and will have to be decontaminated accordingly. If the clinic cannot accommodate the number of casualties, the medical staff will contact alternate medical facilities to treat contaminated patients.

8) Cleanup. The cleanup crew will use the level of personal protective gear directed by the HMC. Disposable protective clothing and respirators which are used in the inner perimeter will be left in a receptacle at the outer perimeter before leaving the site. Workers will not smoke or eat until they have washed their hands and face. Debris from the spill scene will be overpacked and prepared for off-site disposal.

If a spill is too large for in-house forces to properly contain and clean up, every effort to stabilize the scene and safeguard the public will be made and the HMC will contact a state-licensed contractor to complete the cleanup. Decisions to call for Mutual Aid and/or state aid will be made by the HMC.

9) Media Inquiries. Media inquiries will be handled by the HMC or an individual designated by the HMC.

Spill Response Team

The NPS needs to establish a Spill Response Team (SRT) that is able to control the resources and staff necessary to effect timely and efficient response to spills. The HMC should direct and manage the SRT. Included in the SRT are individuals trained in:

- Fire Prevention and Control: Responsible for anticipating, preventing, and controlling fires and potential fire situations resulting from spills of flammable materials, and coordinating life-safety surveys and personnel rescue operations as needed. Fire staff may also assist police personnel in controlling access to the location.

- Safety staff: Responsible for the safe conduct of spill control and cleanup operations. Safety staff will ensure that appropriate personal protective equipment is used and that safe procedures are followed during the entire spill incident.

- Maintenance staff: Responsible for moving soil and sand, digging ditches, opening manholes, and constructing barriers and other appropriate structures necessary for adequate spill control and cleanup procedures. Also responsible for evaluating the effects of the spill on, and performing any actions that must be taken in the area of electrical power, drinking water supply, and wastewater disposal.

- Police Protection: Responsible for providing adequate security throughout the spill incident.

- Medical staff: Responsible for assisting the HMC in evaluating the potential hazards (respiratory and otherwise) associated with hazardous materials and performing proper medical procedures.

12.4.4 Resources

Equipment

Necessary equipment such as shovels, brooms, mops, empty drums, sorbent materials, and miscellaneous construction materials needs to be stored in easily accessible areas, and in sufficient quantities.

Outside Assistance

When appropriate, the HMC will seek the assistance of the U.S. Coast Guard Pacific Strike Team, the U.S. Environmental Protection Agency National Response Team, or contract with a certified spill clean-up and waste disposal contractor.

12.4.5 Reporting Requirements

General Requirements

1) Reportable oil spills under federal law are those which reach "navigable waters," are harmful to the health and welfare of the public, violate applicable water quality standards, or which cause a film, sheen, or discoloration of the water surface. Oil is defined as oil of any type, including but not limited to petroleum distillate, sludge oil refuse, and oil mixed with wastes other than dredged soil. Navigable waters have been defined to encompass nearly all surface water, including natural and man-made stormwater channels back to their sources. The federal requirements in this context do not apply to discharges to air, ground, or groundwater.

2) CERCLA, enacted by Congress, groups together several hazardous material listings from the air, water, and solid and hazardous waste programs and designates them as hazardous substances. The regulatory requirements for discharge of these materials are applicable to discharges to the entire environment: air, water (including groundwater), and land. Reportable quantities are established for over 600 specific substances and 90 waste streams. A spill of any of the identified hazardous substances to the environment in amounts equal to or greater than the reportable quantities in a 24-hour period must be reported to the National Response Center. Appendix D provides additional information regarding substances subject to reporting requirements.

3) California law states that all discharges of hazardous materials which pose a threat to human health or the environment are reportable to the Office of Emergency Services or its designated local representative. Hence, when a medium or large spill of any hazardous material occurs, that spill must be reported to the San Francisco City and County Department of Health.

4) Following verbal/telephone notification, a written report is required by federal regulations for a reportable hazardous substance spill, a single oil spill greater than 1,000 gallons, or two reportable oil spills within a 12-month period. A suggested format for a pollution incident report which will assist in gathering and organizing the necessary information is provided in Appendix E.

Specific Reporting Requirements

1) All spills/leaks of oil or hazardous substances must be reported to the appropriate NPS personnel as soon as possible.

2) The designated NPS personnel will report to the City and County of San Francisco Health Department via telephone any spill of oil or a hazardous substance which poses a threat to human health or the environment. A list of important phone numbers is provided in Appendix F.

12.4.6 Procedures For Spill Mitigation and Cleanup

Specific Substance Spills

Procedures for handling specific spills are provided as appendices to this plan as follows:

- Appendix D: Substances Subject to Reportable Quantity Notification
- Appendix E: Suggested Pollution Incident Report Format
- Appendix F: Outside Assistance
- Appendix G: Response Procedures for Substance-Specific Spills

12.4.7 Training

Appropriate NPS personnel should receive yearly plan training and practice to ensure the capability to effect adequate spill response. Training should be performed by and under the direction of designated environmental and fire NPS personnel.

12.5 STORM WATER QUALITY MONITORING PLAN

The precipitation and flow monitoring program outlined below provides the basis for evaluating the effectiveness of the proposed water quality control measures. The program consists of visual observations, storm water sampling and analytical testing, and data management, as discussed in the following sections. The data collected during the precipitation and flow monitoring program can be compared to the baseline data to evaluate the removal efficiencies of the various treatment system components. A summary of 1994 storm water monitoring data is presented in Table 12.1 for comparison purposes.

The main monitoring sites selected for this precipitation and flow monitoring program are shown on Figure 8.

12.5.1 Field Observations

Field observations should include visual monitoring of storm water discharges prior to storm water sampling. These observations can also be conducted at locations other than the main monitoring sites. The information can be gathered as part of the catchbasin and manhole inspection program although this would require a high degree of coordination with maintenance activities and may prove impractical from an administrative perspective. Observations should be recorded and reported on a standardized form. An example form, Form 1, is included in Appendix H along with other forms and tabular data relevant to implementation of this precipitation and flow monitoring program. Field observations should be conducted concurrent with manual collection of storm water samples. Dry season flow monitoring should be implemented as part of an illicit discharge elimination plan as discussed in Section 12.3.2.

Monitoring Parameters. Observations should be noted for floating and suspended materials, color, turbidity, odor, and presence of oil and grease.

Frequency. Observations should be recorded during preparation for sampling events and during the collection of samples.

Observation Location. Field observations should be made in each monitoring site as shown on Figure 8. Additional sites can be designated as needed to monitor other areas.

12.5.2 Quantitative Data Collection

Quantitative data should be developed through laboratory analysis of grab and composite samples. Water quality constituent concentrations should be determined by a certified laboratory. Testing should be performed in accordance with methodologies outlined in the current edition of "Standard Methods for Examination of Water and Wastewater" and/or with current EPA approved testing methods. This effort will provide detailed data regarding the water quality constituents discussed below.

Constituents to be Monitored. Collected storm water samples will be tested for: Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Kjeldahl Nitrogen (TKN), Total Phosphorus, Cadmium, Copper, Chromium IV, Lead, Nickel, Zinc, Oil and Grease, Coliform, and pH. Specific test methods for major monitoring site are identified in the sampling schedule included in Appendix H.

Frequency of Monitoring. Samples should be collected from three storm events greater than 0.1 inches in precipitation depth. The first two storms are to be sequential events occurring at the start of the rainy season after a relatively long period of no rainfall. The third storm should be later in the season, at least one month after the second storm.

Sample Types. The sampling should include a combination of grab and composite samples. Grab samples should be taken during the first thirty minutes of a storm event. An example

form that could be used for recording specific sample event and site data is included as Form 2 in Appendix H.

Composite flow weighted samples should be developed from 9 grab samples collected at 20 minute intervals during the first 3 hours of the runoff discharge. Composite samples should be developed and recorded using the attached Composite Sample Form, Form 3 in Appendix H. Development of a flow weighted sample requires monitoring of parameters that can be related to the rate of flow such as elevation or depth of flow, cross-sectional area of flow and velocity of flow.

Equipment. Automatic samplers connected and actuated by flow meters may provide the most convenient way of collecting composite flow weighted samples. The equipment can be connected to precipitation monitoring equipment and actuated by precipitation amount. Automated equipment has the advantage of being on call 24 hours a day. This circumvents the need to assign personnel to be on call and available during the late hours of the night and the early hours of the morning to monitor precipitation and implement the collection of samples. Consideration should be given to installing automated samplers and flow meters at all monitoring sites. This can however be capital intensive as the cost for one sampler, flow meter, and rain gage up can exceed $8,000.

12.5.3 Quality Assurance and Quality Control

12.5.3.1 Objectives

The objective of the quality assurance and quality control (QA/QC) procedures is to confirm that storm water monitoring data are of known and acceptable quality for their intended use. To achieve this, specific procedures should be implemented for the collection and evaluation of field and laboratory data.

12.5.3.2 Sampling and Analytical Procedures

Quality control procedures for sampling and chemical analyses should comply with the instructions and documented quality assurance procedures from the certified laboratories used for analytical water quality testing. Monitoring personnel should be familiar with the selected laboratory's protocol prior to beginning field operations. The laboratories should define the required volume of sample to be collected. Field replicates and blank samples should not be required for storm water sampling. Chain of custody forms should be used to track sample handling from the collection point to the laboratory.

Field observations should require collection of a grab sample in a clear container, if water is present, and examining the water clarity and odor. Flow rates should be estimated based on depth, area and velocity of flow or by measured readings if a flow meter is in operation at the observation location.

Composite samples should be developed using automatic samplers. After sampling is complete for a storm event, the flow rates and time of sample collection should be recorded. Form 3 in Appendix H provides an example of a form including the information that will be needed to develop the composite sample. The example form should be completed using the following instructions:

1) Add the flow rates to determine the total flow during the sampling event.

2) Divide the flow rate (corresponding to each sample) by the total flow to determine the proportion of the sample to use in developing the composite sample.

3) Note: the laboratory should develop the actual composite sample from the information provided by Form 3 and by measuring the portion of each individual sample with a graduated cylinder.

Form 3 and the above instructions assume that samples are collected at uniform intervals during the storm event. If samples are collected at irregular intervals, consult EPA published composite sampling instructions for guidance.

12.5.3.3 Data Management

The amount of information collected by a monitoring program will rapidly become difficult to manage, sort, review, and interpret. Field records should be maintained of each sampling or observation event using the forms similar to those included in Appendix G. Analytical data should be summarized in a spreadsheet format as illustrated by Form 4 or as presented in Table 12.1. A data base should be developed for storage, retrieval, and evaluation of storm water data. The data base should be configured to allow convenient expandability to incorporate future monitoring data.

A copy of this monitoring program, completed forms, laboratory data, and the data base should be maintained on file for a minimum of five years.

12.5.4 Annual Pollutant Loads Following Implementation of BMPs

Storm water BMPs designed to target specific land uses and unique runoff pollutants associated with those land uses can be expected to significantly reduce the overall loading, particularly for industrial, commercial, and roads land uses and constituents such as BOD, COD, TSS, oil and grease, and certain metals.

The pollutant-reduction benefits of BMPs depend primarily on structural and operational controls implemented and the degree of maintenance invested. Specific pollutant reductions that will be achieved can therefore be difficult to predict. The following table presents an estimate of pollutant load reduction based on the assumption that structural BMPs will be installed to reduce loads associated with vehicular traffic (roads and parking lots), operational BMPs will be implemented, and maintenance efforts will be consistently strong.

Structural and operational BMPs can be expected to reduce pollutant loads discharged into the bay and ocean; however, it should be noted that some constituents can be expected to accumulate within the structural BMPs. For instance, dissolved metals may flow through the system, but solid particles and metals adsorbed onto sediments will tend to accumulate in the wetlands, polishing basin, filtration trenches (especially along Doyle Drive), biofilters, and dry wells (if used). Periodic maintenance to remove impacted soils or filter materials will be needed. Much

of the BOD and COD discharged into wetlands and polishing basins is expected to naturally biodegrade into harmless substances. Variation in nutrient loading may result in occasional decline of dissolved oxygen in these waters; however, a strong BMP maintenance program should minimize this potential.

BMP POLLUTANT LOAD REDUCTION

Constituent	Estimated Site-Wide Annual Load Without BMPs (pounds per year)	Land Use Specific Load Reduction Expected With BMPs (percent)	Applicable Land Use Categories	Estimated Site-Wide Annual Load With BMPs (pounds per year)	Estimated Site-Wide Load Reduction (percent)
BOD	9,200	30-40	Commercial, Industrial, Institutional, Roads	7,300-7,800	15-20
COD	70,000	30-40	Commercial, Industrial, Institutional, Roads	56,000-60,000	15-20
TSS	85,000	70-90	Commercial, Industrial, Institutional, Roads	52,000-59,000	30-40
Oil & Grease	4,300	60-80	Commercial, Industrial, Institutional, Roads	1900-2,500	40-55
Arsenic	8	50-90	Commercial, Industrial, Institutional, Roads	1-4	50-90
Chromium	30	50-90	Commercial, Industrial, Institutional, Roads	~25	~17
Lead	0	50-90	Commercial, Industrial, Institutional, Roads	~0	–
Copper	10	50-90	Commercial, Industrial, Institutional, Roads	5-7	30-50
Zinc	130	50-90	Commercial, Industrial, Institutional, Roads	30-70	45-75
TKN	1,550	10-20	Commercial, Industrial, Institutional, Roads	1,400-1,500	5-10

12.6 EDUCATION AND TRAINING PROGRAMS

This section discusses the role of the public and park employees in implementing storm water BMPs at the Presidio and outlines a strategy for informing and involving those who will work

at the park and/or use its facilities. Strategies are presented for two groups: the public, and park employees.

12.6.1 Public Education and Participation

People who visit the park for business or recreational purposes should be made aware of the following:

- The potential for contaminated runoff to impact water quality in the bay and ocean and impact the vegetation at the Presidio;
- The existence and goals of this SWMP;
- The nature and location of structural BMPs;
- The importance of their contribution to pollution prevention through good housekeeping practices while visiting the park; and
- Other, more active ways in which the public can participate.

Public education can be incorporated into many elements of typical National Park Services offerings, including guided tours, interpretive signs and plaques, and informational brochures.

Visitor tours focusing on the history or natural resources of the Presidio could include a general discussion of the magnitude of storm water runoff generated onsite, historical storm water management practices, major pollutant sources (roads and parking lots), estimated pollutant loads without BMPs, the goals of the Storm Water Management Program, and the nature and location of structural BMPs. Interpretive graphic signs or plaques can be installed at structural BMP locations, to serve as tour stops or stand-alone public education centers. These signs should also present the reasons for the BMPs, how they work, and how the public can assist the National Park Service in keeping the BMPs functional.

Information on the Storm Water Management Plan and BMPs can also be presented in brochures presented to visitors upon arrival at park facilities. Suggestion boxes can also be placed in strategic locations throughout the site to elicit suggestions from members of the public regarding

other ways the Park Service can reduce storm water pollution. Graphic stencils at catchbasins and drop inlets will also serve to alert the public that storm drains discharge into the bay.

12.6.2 Park Employee Education and Training

All park employees should be aware of the existence and goals of the SWPPP. Three classes of park staff will require a greater level of training due to their daily involvement in implementing the SWPPP: docents/tour guides, maintenance worker/supervisors, and administrative staff.

Docents and tour guides should be trained to understand the background of the NPDES program, historical storm water management at the Presidio, the goals of the SWPPP, how the BMPs work, and where they are located.

Training for those responsible for operating and maintaining the storm drain system and structural BMPs should include a discussion of why these facilities are needed, how they work, operation and maintenance requirements, how to trouble-shoot minor problems, and timely identification of needed repairs.

Park administration staff, particularly those responsible for implementing the SWPPP and preparing budgets for operation, maintenance, and repairs should be aware of the nature and location of the facilities, regular operation and maintenance requirements, and the expected frequency and cost of major repairs and retrofitting.

12.7 NEW DEVELOPMENT AND TENANT CONTROLS

As the Presidio is converted to its new uses, new facilities will be constructed to replace demolished facilities and to accommodate some new land uses. It is recommended that new facilities be designed and constructed to be independent of the storm sewer system to the extent feasible. Policies and guidance for planners and designers of new facilities could specify minimum structural and operational storm water BMPs and suggest optional BMPs for incorporation into new development. The following are suggested minimum BMPs for new

development at the Presidio. These BMP requirements can also be applied to tenants of existing facilities.

Structural BMPs

Structural BMPs can be specified by land use and/or impervious area proportions. The objective of the structural BMPs is to minimize discharge to the storm sewer system and control runoff quality to the maximum extent practical:

- Parking lot BMPs should be required to address all runoff from impervious areas, unless diversion to the sanitary sewer system is more desirable. BMPs for paved areas can be pretreatment BMPs, onsite disposal BMPs, or a combination;

- Wherever practical, roof drains should discharge into cisterns or dry wells for onsite reuse or disposal;

- Material and waste storage or transfer areas should be surrounded by berms and under cover to minimize the potential for runoff to contact spilled materials. The storage area itself should be equipped with floor drains connected to the sanitary sewer; and

- Commercial and industrial facilities can be required to control runon, as well as runoff. Connections for non-runoff discharges to the storm drain should be prohibited, and tenants should be required to pretreat all discharges to the storm sewer system as appropriate based on monitoring.

Operational (Non-Structural) BMPs

Operational BMPs can be developed as conditions of tenancy at Presidio facilities. Typical requirements may include one or more of the following:

- Commercial, industrial, and institutional tenants can be required to perform periodic maintenance of structural BMPs and cleaning of paved surfaces;

- Tenants should be required to develop their own Storm Water Pollution Prevention Plan and/or Spill Prevention and Control Plan in accordance with application federal, state, and local regulations;

- Selected tenants may be required to perform periodic storm water quality monitoring to demonstrate adequate performance of the BMPs;
- A pet policy should be developed and stated as a condition of tenancy for all residential units. The policy would set forth acceptable methods of pet waste disposal; and
- Other policies can be developed to regulate the activities of tenants (including residential units) with regard to irrigation practices, use of landscape chemicals, and disposal of solid waste.

Individual NPDES Storm Water Permits

Many industries are subject to the requirements of individual storm water discharge permits under the State's General Permit for Discharge of Storm Water Associated with Industrial Activities. Industries captured by these requirements can be identified by their Standard Industrial Classification (SIC) code. Appendix A lists major SIC codes and the status of these industries with respect to individual storm water permit requirements.

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TABLE 4.1 PIPES IN POOR CONDITION						
Outfall System	Pipeline No.	From MH No.	Direction[1]	Dia. (inches)	Length (feet)	Problem
B	B.4-102	8-10	NE	15	350	Hole
B	B.6-103	NL	NW	24	50	Missing
B	B.7-101	NL	S	10	100	Broken
D	D.6-205	8-25	SW	8	520	Hole
D	D.10-102	8-3	WNW	21	400	Hole
D	D.16-201	NL	NNE	8	180	Cracked and broken
F	F.5-100	10-52	SW	30	1160	Cracked and/or collapsed
F	F.5-101	10-61	SW	30	300	Flattened
F	F.5-102	10-62	SW	30	800	Flattened
G	G.3-200	10-53	S	8	60	Cracked
I	I.1-200	10-50	SW	12	225	Collapsed
I	I.2-103	10-30	NNE	18	170	Cracked
J	J.4-200	11-30	E	15	150	Cracked
J	J.4-204	11-28	W	12	60	Cracked
J	J.4-205	11-28	SSW	10	520	Cracked
J	J.7-100	11-43	SW	12	150	Collapsed
J	J.7-102	6-4	SW	12	220	Hole
J	J.9-100	11-36	WNW	18	670	Cracked
J	J.10-102	11-34	WSW	24	330	Cracked
J	J.13-200	11-17	S	12	60	Broken
M	M.1-200	NL	NE	18	160	Blocked w/ concrete
M	M.2-200	NL	NE	18	100	Broken

[1] Direction pipeline extends from referenced manhole.

TABLE 4.2
SUMMARY OF MEAN ANNUAL PRECIPITATION DATA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Monthly Average (inches)	4.20	3.12	3.00	1.33	0.40	0.15	0.03	0.07	0.25	1.15	2.67	3.34	19.44
Average No. of Days of Precipitation[1]	10.2	8.5	9.2	5.1	2.7	0.9	0.3	0.7	1.6	3.4	6.9	8.6	58.1

[1] Average number of precipitation events per month.

TABLE 5.1 RELATIONSHIP BETWEEN RATIONAL "c" AND SOIL CONSERVATION SERVICE CN FOR SHORT-DURATION, HIGH INTENSITY STORMS	
Rational "c"	**Corresponding SCS CN[1]**
0.15	89
0.20	90
0.25	91
0.30	92
0.35	93
0.40	94
0.45	95
0.50	96
0.60	97
0.75	98
0.95	99

Note: [1] The relationships are only applicable for short-duration, high-intensity storms.

TABLE 5.2
RAINFALL DISTRIBUTION DATA

Storm Duration (minutes)	Frequency (years)	Time (minutes)												Precipitation Amount (inches)
		0	3	6	9	12	16	18	21	24	27	30	33	
		Distribution in Inches per Hour												
30	2	0	0.40	0.50	0.80	1.10	2.20	1.40	0.90	0.60	0.50	0.40	0	0.44
	10	0	0.50	0.80	1.20	1.40	3.20	2.40	1.40	1.00	0.76	0.50	0	0.67
	25	0	0.70	0.93	1.40	1.80	3.80	2.60	1.60	1.20	0.85	0.50	0	0.77
	100	0	0.90	1.10	1.40	1.94	4.40	2.76	1.70	1.10	0.90	0.60	0	0.84
60		0	6	12	18	24	30	36	42	48	54	60	66	
	2	0	0.17	0.29	0.40									0.55
	10	0	0.32	0.40	0.50	1.10	2.80	1.50	0.78	0.50	0.38	0.20	0	0.85
	25	0	0.26	0.60	0.60	1.30	3.20	1.70	0.90	0.60	0.47	0.18	0	0.98
	100	0	0.30	0.50	0.75	1.25	3.58	1.82	1.00	0.70	0.40	0.30	0	1.06

TABLE 5.3 TYPICAL VALUES OF MANNING'S "n"	
For Pipes Constructed with:	
Corrugated metal	0.024
Concrete culverts (normal)	0.013
Drainage tiles (clay)	0.013
Steel	0.012
Timber	0.012
For Open Channels Constructed with:	
Brickwork	0.015
Rubble masonry	0.025
Concrete	0.013

Source: Vennard & Street, 1975.

TABLE 5.4
EL POLIN SPRING
FLOW RATE AND PRECIPITATION MEASUREMENTS
FOR THE STORM OF FEBRUARY 16 AND 17, 1994

Military Time (hr)	Depth of Flow (ft)	Rate of Flow (gpm)	Base Flow (gpm)	Rate of Runoff (gpm)	Volume of Runoff (gallons)	Precipitation Amount (inches)	Precipitation Volume (gallons)
2100	0.030	0.45	0.45	0			
					3.60	0.01	3584
2200	0.033	0.57	0.45	0.12			
					7.20	0.01	3584
2300	0.033	0.57	0.45	0.12			
					10.20	0.03	10752
0	0.036	0.67	0.45	0.22			
					13.20	0.01	3584
100	0.036	0.67	0.45	0.22			
					13.20	0.01	3584
200	0.036	0.67	0.45	0.22			
					13.20	0.12	43009
300	0.036	0.67	0.45	0.22			
					8.10	0.11	39425
400	0.032	0.50	0.45	0.05			
					1.50	0.01	3584
500	0.030	0.45	0.45	0			
					0.00	0.02	7168
600	0.029	0.43	0.45	0			
CUMMULATIVE VOLUMES					70.2		118276

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 1 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
A.1	100	30	C	N/A	200	outfall -0.4	0.0140	0.013
	101	24	TC	3.1	40	N/A	0.0140	0.013
	102-104	24	TC	4.5	220	3.1	0.0064	0.013
	105	24	TC	4.2	90	4.5	0.0156	0.013
	106	24	TC	5.2	180	4.2	0.0056	0.013
	200	12	TC	7.4	250	7.3	0.0004	0.013
	201	12	TC	5.0	210	5.2	0.0010	0.013
B.1	101	12	C	94.3	160	N/A	0.0637	0.013
	102	12	C	108.6	150	94.3	0.0953	0.013
	103	12	C	110.5	20	108.6	0.0950	0.013
	104	12	C	128.7	200	110.5	0.0910	0.013
	105	12	C	138.4	75	128.7	0.1293	0.013
	106	12	C	146.5	150	138.4	0.0953	0.013
	107	12	C	153.0	110	146.5	0.0591	0.013
B.2	100	12	C	48.7	180	37.9	0.0600	0.013
	101	12	C	49.5	40	48.7	0.0200	0.013
	102	12	C	N/A	300	65.0	0.0637	0.013
B.3	100	15	C	39.2	120	31.8	0.0617	0.013
	101	15	C	49.2	200	39.2	0.0500	0.013
	102	15	C	51.7	110	49.1	0.0236	0.013
	103	8	C	63.7	190	51.7	0.0632	0.013

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 2 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
B.4	100	18	C	33.6	75	31.8	0.0240	0.013
	101	18	C	37.9	400	33.6	0.0108	0.013
	102	15	C	N/A	350	N/A	N/A	0.013
B.5	100	12	C	25.6	310	19.8	0.0187	0.013
	101	12	C	30.4	80	25.6	0.0600	0.013
	102	12	C	35.3	80	30.4	0.0613	0.013
	103	12	C	40.2	80	35.3	0.0613	0.013
	104	12	C	45.1	80	40.2	0.0613	0.013
	105	12	C	49.2	80	45.1	0.0513	0.013
	106	18	C	31.8	260	19.8	0.0462	0.013
B.6	100	15	C	7.1	170	4.7	0.0141	0.013
	101	15	C	7.7	70	7.1	0.0086	0.013
	102	24	C	9.0	150	7.7	0.0087	0.013
	103	24	C	11.1	50	9.0	0.0420	0.013
	104	42	C	5.6	180	4.7	0.0050	0.013
	105	36	C	16.1	170	5.6	0.0618	0.013
	106	38	C	19.8	420	16.1	0.0088	0.013
	200	15	C	11.5	80	11.1	0.0050	0.013
	201	15	C	10.2	100	11.5	0.0183	0.013
	202	15	C	15.9	140	10.2	0.0183	0.013
	203	15	C	17.1	70	15.9	0.0171	0.013
	204	10	C	N/A	70	17.1	N/A	0.013

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 3 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
B.7	100	10	TC	6.2	70	4.7	0.0214	0.013
	101	10	TC	N/A	90	6.2	N/A	0.013
B.8	100	42	C	3.6	240	2.4	0.0050	0.013
	101	42	C	4.3	380	3.6	0.0018	0.013
	102	42	C	4.4	100	4.3	0.0010	0.013
	103	42	C	4.5	175	4.4	0.0006	0.013
	104	42	C	4.7	120	4.5	0.0017	0.013
B.9	100	24	TC	N/A	110	1.5	0.0075	0.013
	101	2-24	TC	4.2	500	3.1	0.0022	0.013
	200	24	TC	3.3	130	N/A	0.0075	0.013
	201	24	TC	N/A	390	3.3	0.0029	0.013
	202	12	TC	5.1	230	N/A	0.0029	0.013
	203	12	TC	6.0	220	5.1	0.0041	0.013
	204	36	TC	4.2	260	4.1	0.0004	0.013
	205	36	TC	6.0	210	4.2	0.0086	0.013
B.10	100	42	C	1.5	200	outfall 0.2	0.0075	0.013
	101	42	C	N/A	400	1.5	0.0006	0.013
	102	42	C	1.9	230	N/A	0.0006	0.013
	103	42	C	1.9	60	1.9	0.0006	0.013
	104	42	C	2.4	180	1.9	0.0028	0.013

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 4 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
C.1	100	6	TC	8.7	330	8.1	0.0018	0.013
	200	10	TC	N/A	360	8.7	0.0091	0.013
	201	10	TC	4.5	100	N/A	N/A	0.013
C.2	100	24	TC	2.9	290	outfall 3.2	0.0059	0.013
	101	18	TC	N/A	200	2.9	0.0059	0.013
	102	18	TC	3.8	150	N/A	0.0059	0.013
	103	18[4]	TC	5.2	200	3.8	0.0070	0.013
	104	18[4]	TC	8.1	350	5.2	0.0083	0.013
	200	10	TC	7.6	40	3.8	0.0950	0.013
	201	12	TC	6.5	50	4.7	0.0360	0.013
	202	12	TC	6.6	80	6.5	0.0013	0.013
	203	14	TC	N/A	150	5.2	N/A	0.013
	204	14	TC	N/A	80	N/A	N/A	0.013
D.1	—	—	—	—	—	—	—	—
D.2	100	12	TC	70.9	330	60.3	0.0321	0.013
	101	12	TC	77.7	140	70.9	0.0793	0.013
D.3	100	12	TC	55.2	210	53.6	0.0076	0.013
	101	12	TC	60.3	380	55.2	0.0134	0.013
D.4	—	—	—	—	—	—	—	—
D.5	—	—	—	—	—	—	—	—

TABLE 5.5
STORM SEWER SYSTEM DATA
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Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
D.6	200	18	TC	47	330	39	0.0242	0.013
	201	Ditch	Channel	62	450	47	0.0333	0.013
	202	12	TC	63.3	100	62	0.0130	0.013
	203	12	TC	86.5	600	63.3	0.0387	0.013
	204	12	AC	63	80	62	0.0125	0.012
	205	8	N/A	161.8	520	136.5	0.0487	0.013
D.7	—	—	—	—	—	—	—	—
D.8	—	—	—	—	—	—	—	—
D.9	100	12	C	55.8	280	22.8	0.1179	0.013
	101	12	C	58.3	230	55.8	0.0109	0.013
	200	10	TC	71.2	450	55.8	0.0342	0.013
	201	10	TC	74.4	150	71.2	0.0213	0.013
	202	10	TC	81.9	180	74.4	0.0417	0.013
D.10	100	60	C	27.6	220	22.8	0.0218	0.013
	101	60	C	43.4	400	27.6	0.0395	0.013
	102	18	TC	48.7	400	27.6	0.0528	0.013
D.11	200	12	TC	43.0	240	38.4	0.0192	0.013
	201	12	TC	45.8	350	43.0	0.0067	0.013
	202	12	TC	43.4	110	45.8	0.0067	0.013
	203	12	TC	47.1	150	43.4	0.0067	0.013
	204	12	TC	54.3	300	47.1	0.0240	0.013

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 6 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
D.12	100	60	C	29.1[3]	250	N/A	N/A	0.013
	101	36	C	22.8	190	29.1[3]	0.033[5]	0.013
D.13	—	—	—	—	—	—	—	—
D.14	—	—	—	—	—	—	—	—
D.15	—	—	—	—	—	—	—	—
D.16	200	12	TC	11.6	300	8.0[3]	0.0120	0.013
	201	8	N/A	24.9	180	14.3	0.059	0.013
D.17	100	72	C	7.6	50	6.0	0.0320	0.013
	101	72	C	N/A	650	7.6	N/A	0.013
D.18	200	24	TC	8.0[3]	300	6	0.0067	0.013
	201	8	S	N/A	150	8.0[3]	N/A	0.012
D.19	—	—	—	—	—	—	—	—
D.20	100	72	C	8.2[3]	480	outlet 0.0	0.0053	0.013
	101	72	C	6.8[3]	150	8.2[3]	0.0053	0.013
	102	72	C	6.0	550	6.8[3]	0.0053	0.013
E.1	100	30	CI	2.9	200	outlet 0.0[3]	0.0145	0.013
	101	30	TC	3.3	510	2.9	0.0008	0.013
	102	30	TC	3.6	70	3.3	0.0043	0.013
	103	30	TC	3.9	120	3.6	0.0025	0.013
	104	36 × 24	CM	4.7	350	3.9	0.0023	0.024
F.1	—	—	—	—	—	—	—	—

TABLE 5.5
STORM SEWER SYSTEM DATA
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Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
F.2	—	—	—	—	—	—	—	—
F.3	100	24	CI	114.2	550	75.4	0.0705	0.013
	200	24	C	N/A	270	114.2	N/A	0.013
	201	18	TC	202.4	320	N/A	N/A	0.013
	202	18	TC	220	90	202.4	0.1955	0.013
F.4	100	10	TC	101.1	150	75.4	0.1713	0.013
F.5	100	30	C	75.4	1550	27.1	0.0312	0.013
	101	30[5]	C	44.5	325	27.1	0.0535	0.013
	102	30[5]	C	85.5	835	44.5	0.0491	0.013
	103	30	C	27.1	20	27.1	0.000	0.013
F.6	102	30	C	5.6	150	5.1	0.0033	0.013
	101	30	C	7.6	210	5.6	0.0095	0.013
	100	30	C	8.8	30	7.6	0.0400	0.013
F.7	100	30	C	27.1	170	8.8	0.1076	0.013
	101	30	C	5.1	270	4.5	0.0022	0.013
	200	12	TC	7.6[3]	100	N/A	N/A	0.013
	201	12	TC	5.0	220	7.6[3]	0.012[3]	0.013
F.8	200	12	TC	6.3	170	5.0	0.0076	0.013
	201	12	TC	7.2	200	6.3	0.0045	0.013
F.9	100	30	CI	4.5	100	N/A	0.0036	0.013

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 8 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
F.10	100	30	CI	N/A	150	3.6	0.0036	0.013
	101	30	CI	3.6	470	outfall -0.2	0.0077	0.013
	200	12	TC	5.5	120	3.6	0.0158	0.013
	201	12	TC	5.4	80	3.6	0.0225	0.013
G.1	100	24	CM	82	200	22	0.3000	0.024
G.2	100	18	AC	67.9	150	12[5]	0.3727	0.024
G.3	200	6	TC	N/A	75	85.6	N/A	0.013
G.4	100	24	TC	4.6	400	outfall 3.8	0.0020	0.013
	101	24	TC	4.7	150	4.6	0.0007	0.013
	102	24	TC	6.4	360	4.7	0.0047	0.013
	103	24	CM	10.5	120	6.4	0.0342	0.024
	200	8	TC	4.2[5]	280	4.9	0.002[5]	0.013
H.1	100	24	CI	4.9	200	outfall 1.9	0.0150	0.013
	101	18	CI	N/A	180	4.9	0.0015	0.013
	102	18	CI	5.6	280	N/A	0.0015	0.013
	103	15	WS	6.1	85	5.6	0.0059	0.012
	200	8	TC	5.9	140	4.9	0.0071	0.013
	201	8	TC	6.5	200	6.1	0.0020	0.013
	202	8	TC	N/A	160	N/A	N/A	0.013
	203	15	WS	7.9	140	6.1	0.0129	0.012

TABLE 5.5
STORM SEWER SYSTEM DATA
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Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
I.1	100	15	TC	34.9	170	20.3	0.0859	0.013
	101	15	TC	46.5	360	20.3	0.0728	0.013
	102	15	TC	70.3	260	46.5	0.0915	0.013
	200	12	TC	108.8	225	70.3	0.1711	0.013
I.2	100	24	TC	4.0	85	Outfall N/A	0.0021[3]	0.013
	101	24	TC	4.8	390	4.0	0.0021	0.013
	102	18	TC	5.0	170	4.8	0.0071	0.013
	103	18	TC	20.3	270	5.0	0.0567	0.013
	200	N/A	TC	N/A	400	N/A	N/A	0.013
	201	6	TC	N/A	90	N/A	N/A	0.013
	202	N/A	TC	N/A	270	N/A	N/A	0.013
J.1	—	—	—	—	—	—	—	—
J.2	—	—	—	—	—	—	—	—
J.3	200	15	TC	202.4	300	173.0	0.0980	0.013
	201	15	TC	N/A	430	202.4	0.0170	0.013
	202	12	TC	211.6	110	N/A	0.0170	0.013
J.4	200	15	TC	196	150	173	0.1533	0.013
	201	15	TC	197	70	196	0.0143	0.013
	202	15	TC	212.8	220	197	0.0718	0.013
	203	15	TC	227.3[3]	140	212.8	0.1036	0.013
	204	10	TC	245	520	227.3	0.0340	0.013
	205	12	TC	227.3	60	205.1	0.3700	0.013

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TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 10 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
J.5	100	15	TC	264.6	680	225	0.0582	0.013
J.6	—	—	—	—	—	—	—	—
J.7	100	12	TC	107.5	150	92.2	0.1637	0.013
	101	15	TC	108.4	160	107.5	0.0056	0.013
	102	15	TC	133.9	220	108.4	0.1159	0.013
	103	15	TC	135.4	80	133.9	0.0188	0.013
	104	15	TC	173.0[3]	410	135.4	0.0917	0.013
J.8	—	—	—	—	—	—	—	—
J.9	100	18	TC	173.0	650	104.5	0.0938	0.013
J.10	100	24	TC	53.9	210	48.4	0.0262	0.013
	101	24	TC	72.8	150	53.9	0.1260	0.013
	102	24	TC	104.5	330	72.8	0.0961	0.013
J.11	100	18	TC	55.5	140	48.4	0.0507	0.013
	101	18	TC	69.5	280	55.5	0.0500	0.013
	102	18	TC	N/A	250	69.6	0.0568	0.013
	103	18	TC	92.2	150	N/A	0.0568	0.013
J.12	100	30	TC	18.9	70	8.0	0.1557	0.013
	101	30	TC	23.2	50	18.9	0.0720	0.013
	102	24	TC	48.4	360	23.2	0.0720	0.013
	200	24	TC	94.0	500	18.9	0.1502	0.013

TABLE 5.5
STORM SEWER SYSTEM DATA
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Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
J.13	100	30	CI	3.3	240	outfall 1.1	0.0138	0.013
	101	30	CI	3.7	130	3.3	0.0031	0.013
	102	30	TC	4.5	230	3.7	0.0035	0.013
	103	30	TC	6.6	290	4.5	0.0072	0.013
	104	30	TC	8.0	140	6.6	0.0100	0.013
	200	12	N/A	23.6	60	17.1	0.1083	0.013
K.1	—	—	—	—	—	—	—	—
K.2	100	24	TC	133	410	89.3	0.1066	0.013
K.3	100	24	TC	5.2	430	4.8	0.0009	0.013
	201	24	TC	6.5	130	5.2	0.0100	0.013
K.4	100	30	TC	4.8	430	outfall 4.1	0.0112	0.013
	101	30	TC	5.3[3]	380	4.8	0.0014	0.013
	102	30	TC	5.6	200	5.3[3]	0.0014	0.013
	103	30	TC	89.3	260	5.6	0.3219	0.013
L.1	100	24	TC	6	440	outfall 2.0	0.0091	0.013
	101	24	TC	7.4	215	6	0.0057	0.013
	102	24	TC	75.5	200	7.4	0.3505	0.013
M.1	200	18	TC	158.4	160	156.2	0.0138	0.013
M.2	100	18	TC	111.3	230	78.9	0.1409	0.013
	101	18	TC	153.3	280	111.3	0.1500	0.013
	200	18	TC	155.0	100	153.3	0.0170	0.013

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 12 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
M.3	100	30	TC	12.0	110	outfall 4.3	0.0700	0.013
	101	2-18	TC	78.9	280	12.0	0.2389	0.013
N.1	100	36	C	14.9	50	outfall 0.0[3]	0.2980	0.013
	101	36	C	131.7	330	14.9	0.3539	0.013
O.1	—	—	—	—	—	—	—	—
O.2	—	—	—	—	—	—	—	—
O.3	—	—	—	—	—	—	—	—
O.4	—	—	—	—	—	—	—	—
O.5	100	60	C	47.7	1250	10.2	0.03	0.013
P.1	—	—	—	—	—	—	—	—
P.2	—	—	—	—	—	—	—	—
P.3	—	—	—	—	—	—	—	—
P.4	—	—	—	—	—	—	—	—
P.5	100	4	C	N/A	1,150	N/A	0.1000	0.013
P.6	—	—	—	—	—	—	—	—
P.7	—	—	—	—	—	—	—	—
P.8	—	—	—	—	—	—	—	—

TABLE 5.5
STORM SEWER SYSTEM DATA
(Page 13 of 13)

Subbasin	Pipe No.	Diameter (inches)	Materials[1]	Upstream Inv. Elev.[2] (feet)	Length (feet)	Downstream Inv. Elev.[2] (feet)	Pipe Slope (ft/ft)	Manning's "n"
P.9	—	—	—	—	—	—	—	—
P.10	—	—	—	—	—	—	—	—

Note:
[1] Materials referenced as follows: TC - terracota; C - concrete; AC - asbestos concrete; S - steel; CM - corrugated metal; CI - cast iron; WS - wood stave
[2] Elevations are referenced to Mean Lower Low Water 0.0 feet.
[3] Estimated value.
[4] Assumed diameter.
[5] Actual pipe is horizontal elliptical; reported diameter is a hydraulic equivalent diameter.
N/A Data not available.
— No piping in this subbasin; or piping present but not specifically modeled.

Piping servicing drainage areas Y and Z drains to CCSF combined sewer system. These areas were therefore not modeled.

TABLE 5.6
SUBBASIN DATA
(PAGE 1 OF 5)

Subbasin	Time of Concentration (minutes)	Pervious Areas		Impervious Areas		Total Area	
		Area (acres)	CN	Area (acres)	CN	Area (acres)	Weighted CN
A.1	10.8	5.08	91	2.62	99	7.70	96
B.1	30.0	6.40	94	2.74	99	9.14	96
B.2	27.6	5.32	93	0.17	99	5.49	93
B.3	21.0	2.90	94	2.91	99	5.81	97
B.4	4.2	3.54	90	0.07	99	3.61	90
B.5	4.8	0.57	92	4.61	99	5.18	98
B.6	3.0	3.23	92	4.85	99	8.08	97
B.7	3.0	1.75	92	1.07	99	2.82	96
B.8	7.2	0.61	90	5.60	99	6.21	98
B.9	13.8	7.27	90	3.42	99	10.69	95
B.10	5.4	2.95	90	2.23	99	5.18	96
C.1	6.0	1.72	90	2.57	99	4.29	97
C.2	6.0	4.12	90	2.87	99	6.99	96
D.1	28.8	29.80	94	2.95	99	32.75	95
D.2	7.8	12.54	94	0.52	99	13.06	94
D.3	6.6	3.04	93	0.00	99	3.04	93
D.4	36.0	56.93	92	7.76	99	64.69	94
D.5	9.6	5.49	93	1.20	99	6.69	95
D.6	30.0	83.96	93	6.32	99	90.28	94
D.7	2.4	2.98	94	0.65	99	3.63	96
D.8	9.0	1.22	94	1.08	99	2.30	97

TABLE 5.6
SUBBASIN DATA
(PAGE 2 OF 5)

Subbasin	Time of Concentration (minutes)	Pervious Areas		Impervious Areas		Total Area	
		Area (acres)	CN	Area (acres)	CN	Area (acres)	Weighted CN
D.9	8.4	6.42	91	6.43	99	12.85	97
D.10	16.2	5.80	92	0.79	99	6.59	94
D.11	11.4	8.53	91	6.98	99	15.51	96
D.12	4.2	0.59	91	1.61	99	2.20	98
D.13	6.6	1.90	91	1.03	99	2.93	96
D.14	3.6	2.57	91	0.57	99	3.14	94
D.15	3.0	2.42	91	0.39	99	2.81	93
D.16	6.0	3.45	91	3.32	99	6.77	97
D.17	18.0	3.60	91	0.27	99	3.87	92
D.18	5.4	1.25	91	1.41	99	2.66	97
D.19	4.8	0.20	91	2.33	99	2.53	98
D.20	9.0	1.21	90	0.81	99	2.02	96
E.1	6.0	6.40	90	1.60	99	8.00	93
F.1	21.6	2.14	93	1.90	99	4.04	97
F.2	19.8	10.30	94	0.90	99	11.20	95
F.3	25.2	17.39	93	5.51	99	22.90	96
F.4	21.0	3.10	93	0.68	99	3.78	95
F.5	13.2	9.18	91	13.78	99	22.96	97
F.6	6.6	1.04	91	3.89	99	4.93	98
F.7	9.0	3.53	91	1.37	99	4.90	95
F.8	9.6	6.33	91	4.98	99	11.31	96

TABLE 5.6
SUBBASIN DATA
(PAGE 3 OF 5)

Subbasin	Time of Concentration (minutes)	Pervious Areas		Impervious Areas		Total Area	
		Area (acres)	CN	Area (acres)	CN	Area (acres)	Weighted CN
F.9	7.8	4.27	91	1.83	99	6.10	95
F.10	13.8	10.82	91	1.20	99	12.02	92
G.1	12.6	17.46	90	3.32	99	20.78	93
G.2	22.8	13.60	91	3.19	99	16.79	94
G.3	12.6	3.15	91	3.03	99	6.18	97
G.4	9.0	11.46	91	2.18	99	13.64	93
H.1	14.4	18.08	91	0.75	99	18.83	91
I.1	10.2	8.56	90	5.03	99	13.59	96
I.2	6.0	10.76	91	2.05	99	12.81	93
J.1	6.0	18.71	90	1.19	99	19.90	91
J.2	18.0	10.33	91	0.90	99	11.23	92
J.3	19.2	10.56	90	2.98	99	13.54	94
J.4	30.0	14.33	91	5.04	99	19.37	94
J.5	6.6	3.13	92	1.16	99	4.29	95
J.6	25.2	9.22	91	1.02	99	10.24	93
J.7	41.4	30.01	90	4.48	99	34.49	92
J.8	24.0	22.01	92	2.45	99	24.46	93
J.9	20.4	30.04	93	5.30	99	35.34	95
J.10	9.0	4.53	93	1.76	99	6.29	96
J.11	7.8	4.77	91	1.35	99	6.12	94
J.12	9.6	6.20	92	1.10	99	7.30	94

TABLE 5.6
SUBBASIN DATA
(PAGE 4 OF 5)

Subbasin	Time of Concentration (minutes)	Pervious Areas		Impervious Areas		Total Area	
		Area (acres)	CN	Area (acres)	CN	Area (acres)	Weighted CN
J.13	2.4	5.22	94	0.78	99	6.00	95
K.1	22.2	13.97	92	2.66	99	16.63	94
K.2	14.4	3.63	93	3.65	99	7.28	97
K.3	6.6	5.67	91	2.21	99	7.88	95
K.4	6.0	2.97	91	0.99	99	3.96	95
L.1	12.0	8.31	92	3.23	99	11.54	96
M.1	18.6	18.76	92	10.10	99	28.86	96
M.2	15.0	6.24	93	0.93	99	7.17	95
M.3	13.2	13.11	94	3.48	99	16.59	96
N.1	26.4	20.00	93	0.56	99	20.56	93
O.1	16.2	16.07	90	4.02	99	20.09	93
O.2	26.4	22.68	89	2.52	99	25.20	91
O.3	17.4	19.12	90	3.64	99	22.76	92
O.4	11.4	6.73	90	0.75	99	7.48	92
O.5	9.0	18.22	90	6.08	99	24.30	94
P.1	7.8	3.75	93	0.56	99	4.31	95
P.2	10.8	27.51	93	2.39	99	29.90	94
P.3	16.2	31.32	93	2.36	99	33.68	94
P.4	17.4	15.94	90	0.49	99	16.43	90
P.5	13.8	10.86	94	1.62	99	12.48	95
P.6	18.0	29.60	93	1.89	99	31.49	93

TABLE 5.6
SUBBASIN DATA
(PAGE 5 OF 5)

Subbasin	Time of Concentration (minutes)	Pervious Areas		Impervious Areas		Total Area	
		Area (acres)	CN	Area (acres)	CN	Area (acres)	Weighted CN
P.7	16.8	15.60	93	0.82	99	16.42	94
P.8	16.2	19.30	90	1.68	99	20.98	91
P.9	10.8	13.33	90	0.70	99	14.03	91
P.10	7.8	8.59	93	4.04	99	12.63	96
Y.1	30.0	5.66	90	2.42	99	8.08	94
Y.2	28.8	9.29	90	4.37	99	13.66	95
Y.3	28.2	17.52	91	1.52	99	19.04	92
Z.1	3.0	0.57	94	0.72	99	1.29	97
Z.2	6.0	1.46	89	1.59	99	3.05	96
Z.3	4.2	14.31	94	5.03	99	19.34	96

TABLE 5.7
MODEL RESULTS
(Page 1 of 5)

Subbasin	30 min-2 yr		30 min-10 yr		30 min-25 yr		30 min-100 yr		1 hr-2 yr		1 hr-10 yr		1 hr-25 yr		1 hr-100 yr	
	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)
A1	0.09	3.7	0.24	10.1	0.29	12.3	0.35	14.9	0.18	5.9	0.35	11.0	0.40	12.8	0.46	14.7
B1	0.08	1.9	0.24	5.8	0.30	7.2	0.36	8.7	0.18	3.7	0.36	7.2	0.43	8.5	0.50	9.7
B2	0.03	0.7	0.11	2.7	0.14	3.5	0.17	4.4	0.08	1.6	0.17	3.5	0.21	4.3	0.24	5.0
B3	0.09	2.6	0.21	6.3	0.25	7.6	0.30	8.9	0.17	4.0	0.30	7.1	0.34	8.1	0.39	9.2
B4	0.01	0.4	0.04	2.4	0.06	3.3	0.08	4.5	0.03	1.1	0.08	2.9	0.10	3.7	0.12	4.5
B5	0.10	5.4	0.22	11.7	0.26	13.8	0.30	16.5	0.18	6.9	0.30	11.4	0.34	12.9	0.38	14.6
B6	0.09	5.3	0.25	14.7	0.31	18.2	0.36	22.6	0.19	7.9	0.36	14.7	0.42	17.1	0.49	19.8
B7	0.02	1.4	0.07	4.4	0.09	5.5	0.11	7.0	0.06	2.3	0.11	4.5	0.13	5.3	0.15	6.2
B8	0.12	5.7	0.26	12.6	0.31	14.9	0.36	17.6	0.21	7.6	0.36	12.6	0.41	14.2	0.46	16.1
B9	0.06	2.1	0.21	8.0	0.27	10.4	0.33	12.9	0.15	4.4	0.33	9.6	0.40	11.6	0.47	13.6
B10	0.04	1.8	0.12	6.3	0.15	7.9	0.18	10.0	0.19	3.3	0.18	6.9	0.22	8.2	0.25	9.6
C1	0.04	1.9	0.11	5.9	0.14	7.3	0.17	9.1	0.09	3.2	0.17	6.3	0.20	7.4	0.23	8.7
C2	0.05	2.4	0.16	8.3	0.20	10.4	0.25	13.1	0.12	4.3	0.25	9.1	0.29	10.8	0.34	12.7
D1	0.22	5.6	0.74	18.3	0.94	23.3	1.15	28.5	0.55	11.2	1.15	23.2	1.37	27.8	1.60	32.3
D2	0.09	4.1	0.29	14.2	0.38	18.0	0.46	22.6	0.22	7.7	0.46	16.0	0.55	19.0	0.64	22.2
D3	0.02	0.8	0.06	3.0	0.08	3.9	0.09	4.9	0.04	1.5	0.09	3.4	0.11	4.1	0.13	4.9
D4	0.33	7.0	1.25	26.0	1.62	33.8	2.01	41.9	0.91	16.2	2.02	35.5	2.43	43.0	2.85	50.2
D5	0.05	2.0	0.15	6.8	0.19	8.6	0.24	10.7	0.11	3.7	0.24	7.8	0.28	9.2	0.33	10.8
D6	0.47	11.4	1.74	42.2	2.26	54.7	2.81	67.5	1.26	25.3	2.81	55.4	3.39	66.9	3.98	78.4
D7	0.03	1.9	0.10	5.8	0.12	7.3	0.14	9.2	0.07	3.0	0.14	6.0	0.17	7.1	0.20	8.3

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TABLE 5.7
MODEL RESULTS
(Page 2 of 5)

Subbasin	30 min-2 yr		30 min-10 yr		30 min-25 yr		30 min-100 yr		1 hr-2 yr		1 hr-10 yr		1 hr-25 yr		1 hr-100 yr	
	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)
D8	0.03	1.2	0.07	3.2	0.09	3.9	0.10	4.8	0.05	1.9	0.10	3.5	0.12	4.0	0.14	4.6
D9	0.11	5.2	0.34	15.0	0.42	19.8	0.51	24.4	0.26	8.9	0.51	17.5	0.60	20.6	0.70	23.8
D10	0.03	1.2	0.13	4.6	0.17	5.9	0.21	7.3	0.09	2.5	0.21	5.5	0.25	6.7	0.29	7.8
D11	0.14	5.6	0.41	17.0	0.51	21.3	0.62	26.0	0.31	9.8	0.62	19.2	0.73	22.6	0.84	26.1
D12	0.03	1.8	0.08	4.4	0.10	5.3	0.11	6.5	0.06	2.5	0.11	4.4	0.13	5.0	0.15	5.8
D13	0.02	1.0	0.07	3.4	0.08	4.3	0.10	5.4	0.05	1.8	0.10	3.8	0.12	4.5	0.14	5.2
D14	0.01	0.7	0.05	3.0	0.17	4.0	0.09	5.2	0.04	1.4	0.09	3.4	0.11	4.2	0.12	5.0
D15	0.01	0.6	0.05	2.8	0.06	3.6	0.08	4.7	0.03	1.3	0.08	3.1	0.09	3.8	0.11	4.5
D16	0.01	3.0	0.18	9.3	0.22	11.6	0.27	14.4	0.14	5.1	0.27	10.0	0.32	11.7	0.37	13.7
D17	0.02	0.5	0.06	2.2	0.08	2.9	0.11	3.6	0.05	1.2	0.11	2.7	0.13	3.3	0.15	3.9
D18	0.02	1.2	0.07	3.7	0.09	4.7	0.11	5.8	0.05	2.0	0.11	4.0	0.12	4.7	0.14	5.4
D19	0.05	2.6	0.11	5.7	0.13	6.8	0.15	8.1	0.09	3.4	0.15	5.6	0.17	6.3	0.19	7.2
D20	0.01	0.6	0.05	2.1	0.06	2.6	0.07	3.3	0.03	1.1	0.07	2.4	0.08	2.8	0.10	3.3
E1	0.03	1.5	0.13	6.9	0.17	9.1	0.22	11.7	0.09	3.4	0.22	8.1	0.27	9.9	0.32	11.8
F1	0.05	1.4	0.12	3.7	0.15	4.6	0.17	5.4	0.10	2.3	0.18	4.3	0.21	5.0	0.24	5.7
F2	0.08	2.4	0.25	8.1	0.32	10.3	0.38	12.5	0.19	4.7	0.39	9.7	0.47	11.6	0.55	13.5
F3	0.15	4.3	0.51	14.1	0.65	18.0	0.74	21.9	0.38	8.4	0.80	17.4	0.96	20.8	1.11	24.2
F4	0.03	0.8	0.09	2.6	0.11	3.4	0.13	4.1	0.06	1.5	0.13	3.2	0.16	3.8	0.18	4.4
F5	0.26	10.0	0.70	27.4	0.87	33.6	1.03	40.5	0.55	16.5	1.03	30.6	1.21	35.6	1.38	40.7
F6	0.07	3.6	0.18	8.9	0.21	10.7	0.25	12.9	0.14	5.2	0.25	9.1	0.29	10.4	0.33	11.9

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TABLE 5.7
MODEL RESULTS
(Page 3 of 5)

Subbasin	30 min-2 yr		30 min-10 yr		30 min-25 yr		30 min-100 yr		1 hr-2 yr		1 hr-10 yr		1 hr-25 yr		1 hr-100 yr	
	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)
F7	0.03	1.1	0.09	4.4	0.12	5.6	0.15	7.1	0.07	2.3	0.15	5.1	0.18	6.2	0.22	7.2
F8	0.10	4.3	0.30	13.3	0.37	16.6	0.45	20.4	0.23	7.5	0.45	14.9	0.53	17.5	0.61	20.3
F9	0.03	1.5	0.12	5.7	0.15	7.3	0.19	9.4	0.09	3.0	0.19	6.6	0.23	7.9	0.27	9.3
F10	0.05	1.8	0.20	7.7	0.26	10.2	0.33	12.8	0.14	4.1	0.33	9.5	0.40	11.6	0.48	13.7
G1	0.06	2.5	0.29	11.9	0.39	16.0	0.50	20.4	0.20	6.0	0.50	14.9	0.62	18.4	0.75	22.0
G2	0.09	2.6	0.32	9.6	0.42	12.4	0.52	15.3	0.24	5.5	0.52	12.0	0.63	14.5	0.74	16.9
G3	0.05	2.1	0.16	6.5	0.20	8.1	0.25	9.9	0.12	3.8	0.25	7.4	0.29	8.7	0.34	10.1
G4	0.05	2.4	0.23	10.4	0.30	13.7	0.38	17.5	0.16	5.3	0.38	12.4	0.46	15.2	0.54	18.1
H1	0.05	2.1	0.27	10.2	0.36	13.7	0.46	17.4	0.18	5.2	0.46	12.8	0.56	15.9	0.68	18.9
I1	0.07	3.0	0.26	11.5	0.34	14.9	0.42	18.8	0.19	6.2	0.42	13.6	0.51	16.3	0.60	19.2
I2	0.05	2.5	0.21	11.1	0.28	14.5	0.35	18.8	0.15	5.5	0.35	12.9	0.43	15.8	0.51	18.8
J1	0.06	2.8	0.28	14.7	0.38	19.6	0.48	25.7	0.19	7.0	0.48	17.4	0.60	21.8	0.71	26.2
J2	0.04	1.5	0.19	6.3	0.25	8.4	0.31	10.4	0.13	3.4	0.31	7.9	0.38	9.7	0.45	11.4
J3	0.05	1.8	0.22	7.4	0.30	9.7	0.37	12.1	0.16	4.0	0.37	9.3	0.45	11.3	0.54	13.4
J4	0.10	2.5	0.38	9.1	0.49	11.9	0.61	14.6	0.27	5.5	0.61	12.0	0.73	14.5	0.86	17.0
J5	0.03	1.4	0.10	4.9	0.12	6.2	0.15	7.9	0.07	2.6	0.15	5.5	0.18	6.5	0.21	7.7
J6	0.04	1.1	0.17	4.7	0.22	6.2	0.28	7.7	0.12	2.6	0.28	6.1	0.34	7.5	0.41	8.8
J7	0.10	1.9	0.48	9.1	0.65	12.2	0.83	15.5	0.34	5.5	0.84	13.6	1.04	16.8	1.24	20.0
J8	0.13	3.7	0.47	13.5	0.61	17.4	0.76	21.5	0.34	7.8	0.76	17.0	0.92	20.5	1.08	24.0
J9	0.24	7.6	0.80	25.1	1.02	31.9	1.25	38.8	0.59	14.6	1.25	30.2	1.48	36.1	1.73	41.9

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TABLE 5.7
MODEL RESULTS
(Page 4 of 5)

Subbasin	30 min-2 yr		30 min-10 yr		30 min-25 yr		30 min-100 yr		1 hr-2 yr		1 hr-10 yr		1 hr-25 yr		1 hr-100 yr	
	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)
J10	0.06	2.5	0.17	7.6	0.21	9.5	0.25	11.6	0.13	4.3	0.25	8.4	0.30	9.9	0.34	11.5
J11	0.03	1.5	0.12	5.7	0.15	7.4	0.19	9.4	0.09	3.0	0.19	6.6	0.23	7.9	0.27	9.4
J12	0.04	1.6	0.14	6.3	0.18	8.2	0.23	10.3	0.10	3.4	0.23	7.4	0.27	9.0	0.32	10.6
J13	0.05	3.1	0.16	9.6	0.20	12.0	0.24	15.2	0.12	5.0	0.24	10.0	0.28	11.8	0.33	13.8
K1	0.09	2.6	0.32	9.6	0.42	12.5	0.52	15.4	0.23	5.5	0.52	12.0	0.62	14.5	0.73	17.0
K2	0.08	3.1	0.22	8.3	0.27	10.2	0.33	12.3	0.17	5.1	0.33	9.4	0.38	10.9	0.44	12.4
K3	0.04	2.0	0.15	7.8	0.20	10.0	0.25	12.7	0.11	4.0	0.25	8.9	0.30	10.7	0.35	12.7
K4	0.02	1.0	0.08	4.0	0.10	5.1	0.12	6.6	0.06	2.0	0.12	4.5	0.15	5.5	0.17	6.5
L1	0.08	3.1	0.26	10.7	0.33	13.6	0.41	16.7	0.19	6.0	0.41	12.4	0.48	14.8	0.56	17.2
M1	0.20	6.5	0.65	21.6	0.83	27.5	1.02	33.5	0.48	12.5	1.02	25.8	1.21	30.8	1.41	35.7
M2	0.05	1.8	0.16	6.0	0.21	7.6	0.25	9.3	0.12	3.4	0.25	7.1	0.30	8.4	0.35	9.8
M3	0.15	5.6	0.44	17.1	0.55	21.3	0.66	25.9	0.33	10.0	0.66	19.5	0.78	22.9	0.90	26.4
N1	0.11	2.9	0.40	10.6	0.52	13.7	0.64	16.9	0.29	6.2	0.64	13.5	0.77	16.3	0.91	19.2
O1	0.08	2.9	0.33	12.0	0.44	15.8	0.55	19.8	0.23	6.4	0.55	14.9	0.67	18.2	0.80	21.5
O2	0.05	1.4	0.30	8.2	0.42	11.2	0.54	14.4	0.20	4.3	0.54	11.4	0.67	14.2	0.81	17.1
O3	0.07	2.4	0.32	11.2	0.43	15.1	0.55	19.1	0.22	5.8	0.55	14.3	0.68	17.7	0.82	21.1
O4	0.02	0.9	0.11	4.5	0.14	6.0	0.18	7.7	0.07	2.3	0.18	5.5	0.22	6.9	0.27	8.2
O5	0.09	4.2	0.40	18.5	0.53	24.3	0.67	31.2	0.28	9.5	0.67	22.1	0.81	27.1	0.97	32.2
P1	0.03	1.4	0.10	4.7	0.12	6.0	0.15	7.5	0.07	2.5	0.15	5.3	0.18	6.3	0.21	7.3
P2	0.15	6.5	0.58	24.8	0.75	32.1	0.93	40.2	0.42	13.4	0.93	29.4	1.12	35.4	1.32	41.5

TABLE 5.7
MODEL RESULTS
(Page 5 of 5)

Subbasin	30 min-2 yr		30 min-10 yr		30 min-25 yr		30 min-100 yr		1 hr-2 yr		1 hr-10 yr		1 hr-25 yr		1 hr-100 yr	
	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)	Vol. (ac-ft)	Peak Flowrate (cfs)
P3	0.17	6.3	0.65	23.4	0.84	30.3	1.05	37.4	0.47	12.9	1.05	28.3	1.26	34.1	1.49	40.0
P4	0.03	1.3	0.20	6.9	0.27	9.5	0.35	12.2	0.13	3.4	0.35	9.1	0.44	11.4	0.53	13.7
P5	0.11	4.2	0.33	12.6	0.41	15.7	0.50	19.1	0.25	7.4	0.50	14.4	0.59	17.0	0.68	19.5
P6	0.16	5.6	0.61	20.7	0.79	26.8	0.98	33.0	0.44	11.5	0.98	25.2	1.18	30.4	1.39	35.6
P7	0.08	3.0	0.32	11.2	0.41	14.5	0.51	17.9	0.23	6.2	0.51	13.6	0.62	16.4	0.72	19.2
P8	0.06	2.3	0.30	10.8	0.40	14.5	0.51	18.3	0.20	5.5	0.51	13.6	0.63	16.9	0.75	20.1
P9	0.03	1.3	0.17	7.3	0.23	10.0	0.30	13.0	0.11	3.5	0.30	9.3	0.37	11.7	0.45	14.1
P10	0.11	5.2	0.33	16.0	0.42	20.0	0.50	24.7	0.25	8.9	0.50	17.5	0.59	20.6	0.68	24.1
Y1	0.04	1.0	0.16	3.8	0.20	4.9	0.25	6.0	0.11	2.3	0.25	5.0	0.30	6.0	0.36	7.0
Y2	0.07	1.8	0.26	6.6	0.34	8.5	0.43	10.5	0.19	3.9	0.43	8.6	0.51	10.4	0.60	12.1
Y3	0.07	1.9	0.31	8.0	0.42	10.6	0.52	13.2	0.22	4.6	0.52	10.7	0.64	13.1	0.76	15.4
Z1	0.02	1.0	0.05	2.4	0.06	2.9	0.07	3.5	0.04	1.4	0.07	2.4	0.08	2.8	0.09	3.2
Z2	0.02	1.0	0.07	3.6	0.09	4.6	0.11	5.7	0.05	1.9	0.11	4.0	0.13	4.7	0.15	5.5
Z3	0.17	9.3	0.51	28.9	0.64	36.0	0.77	45.0	0.39	15.2	0.77	30.4	0.91	35.8	1.05	41.8

TABLE 5.8
COMPARISON OF EXISTING PIPE CAPACITY TO 10-YEAR, 25-YEAR, AND 100-YEAR DESIGN FLOWS
(Page 1 of 3)

Subbasin	Pipe No.	Existing Pipe Diameter (in)	Existing Pipe Length (ft)	Existing Full Pipe Capacity (cfs)	Existing Full Pipe Velocity (ft/s)	10-Year Design Flow (cfs)	10-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)	25-Year Design Flow (cfs)	25-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)	100-Year Design Flow (cfs)	100-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)
A1	100	30	40	48.5	2.04	10.9	30	0	12.7	30	0	14.5	30	0
	101	24	200	26.8	3.18	11.0	24	0	12.7	24	0	14.7	24	0
B2	100	12	180	8.7	11.9	7.2	12	0	8.4	12	0	9.7	15	180
B4	100-101	18	475	11.9	7.64	10.6	18	0	12.6	21	0	14.8	21	475
B5	106	18	260	22.6	13.6	17.3	18	0	20.5	18	0	23.6	21	0
B6	106	36	420	62.6	7.5	19.8	36	0	23.4	36	0	26.9	36	0
	105	36	170	165.8	17.6	29.5	36	0	34.5	36	0	39.8	36	0
	104	42	180	71.1	6.36	29.0	42	0	33.8	42	0	38.9	42	0
B8	100-104	42	1015	48.3	6.26	30.5	42	0	35.8	42	0	41.2	42	0
B10	101-104	42	870	31.8	6.96	39.2	48	870	45.8	54	870	52.5	54	870
	100	42	200	67.5	9.03	53.1	42	0	62.5	42	0	72.1	48	0
C2	104	18	350	9.6	4.41	6.2	18	0	7.3	18	0	8.5	18	0
	103	18	200	8.8	4.36	6.0	18	0	7.1	18	0	8.3	18	0
	101-102	18	350	8.1	10.41	14.7	24	350	17.4	27	350	20.3	27	350
D2	100-101	12	470	6.9	36.42	23.2	21	470	27.7	21	470	32.1	24	470
D3	100-101	12	590	3.8	42.27	29.4	27	590	35.2	30	590	40.9	30	590
D10	100-101	60	620	400.0	2.39	95.4	60	0	113.1	60	0	120.2	60	0
D12	101	60	190	451.0	7.04	96.5	60	0	114.8	60	0	121.5	60	0
	100	60	250	451.0	8.51	99.3	60	0	119.8	60	0	127.6	60	0
D17	100-101	72	700	757.0	5.87	99.1	72	0	119.2	72	0	127.6	72	0
D18	200	12	300	2.9	42.02	19.6	27	300	23.1	27	300	27.4	30	300
D20	100-102	72	1180	308.0	6.95	101.2	72	0	123.3	72	0	136.3	72	0
E1	101	30	510	11.6	1.94	7.1	30	0	8.7	30	0	10.5	30	0
	100	30	200	49.4	1.94	7.1	30	0	8.7	30	0	10.4	30	0
F3	100	24	550	60.1	8.15	17.4	24	0	20.7	24	0	24.1	24	0
F4	100	30	150	169.8	7.11	24.4	30	0	29.0	30	0	33.6	30	0
F5	100,101,102	2-30	1550	144.9	17.64	33.1	2-30	0	39.5	2-30	0	45.8	2-30	0
F6	100,101	30	240	47.3	14.20	53.8	36	240	63.7	36	240	73.5	36	240
F6	102	30	150	20.9	15.03	57.3	48	150	67.8	48	150	78.2	54	150

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TABLE 5.8
COMPARISON OF EXISTING PIPE CAPACITY TO 10-YEAR, 25-YEAR, AND 100-YEAR DESIGN FLOWS
(Page 2 of 3)

Subbasin	Pipe No.	Existing Pipe Diameter (in)	Existing Pipe Length (ft)	Existing Full Pipe Capacity (cfs)	Existing Full Pipe Velocity (ft/s)	10-Year Design Flow (cfs)	10-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)	25-Year Design Flow (cfs)	25-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)	100-Year Design Flow (cfs)	100-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)
F7	100	30	170	134.5	14.22	53.9	30	0	63.8	30	0	73.6	30	0
F7	101	30	270	19.2	19.46	72.1	54	270	85.2	54	270	98.1	60	270
F7	200,201	12	320	3.2	26.36	14.6	24	320	17.2	24	320	20.0	24	320
F9	100	30	100	24.6	20.78	76.6	48	100	90.6	54	100	104.5	54	100
F10	100	30	150	24.6	20.76	76.5	48	150	90.5	54	150	104.3	54	150
F10	101	30	470	36.0	22.82	85.5	42	470	101.5	48	470	117.3	48	470
G4	103	24	120	22.7	16.04	31.1	30	120	37.8	30	120	44.4	36	120
	101,102	24	510	13.4	15.88	30.7	36	510	37.4	36	510	44.0	42	510
	100	24	400	10.1	21.39	39.9	42	400	48.6	48	400	57.3	48	400
H1	100	24	200	27.7	7.96	12.8	24	0	15.8	24	0	18.8	24	0
I2	103	18	270	25.0	11.88	13.5	18	0	16.3	18	0	19.1	18	0
	102	18	170	8.9	11.83	13.4	24	170	16.1	24	170	19.0	24	170
	101	18	390	10.4	22.86	24.4	36	390	29.6	36	390	34.9	42	390
	100	24	220	12.8	12.76	24.2	36	220	29.3	36	220	34.6	36	220
J5	100	15	680	23.2	15.16	17.1	18	0	21.2	18	0	25.4	21	0
J9	100	18	650	32.2	11.83	19.8	18	0	24.0	18	0	28.2	18	0
J10	100,101,102	24	690	64.5	28.52	65.4	27	0	79.0	27	690	92.6	30	690
J12	101,102	24	410	60.7	36.64	102.3	30	410	123.9	36	410	145.6	36	410
	100	30	70	161.8	23.45	102.3	30	0	123.9	30	0	145.6	30	0
J11	100-103	18	820	24.3	23.54	34.6	21	820	42.3	24	820	49.9	24	820
J7	100-103	12	610	9.5	25.85	17.3	18	610	21.4	18	610	25.4	18	610
	104	15	410	19.6	8.07	7.9	15	0	9.6	15	0	11.4	15	0
J13	103,104	30	430	36.9	25.26	106.1	48	430	128.5	48	430	151.1	54	430
	100, 101, 102	30	600	35.5	25.97	108.2	48	600	131.1	54	600	153.9	54	600
K2	100	24	410	73.9	4.77	12.0	24	0	14.5	24	0	17.0	24	0
K4	103	30	260	232.7	4.81	19.4	30	0	23.1	30	0	26.8	30	0
	101, 102	30	580	15.3	5.36	21.2	36	580	25.3	42	580	29.5	42	580
	100	30	430	43.4	6.21	26.6	30	0	31.8	30	0	37.0	30	0
K3	100	24	430	6.8	4.11	8.1	27	430	9.9	30	430	11.7	36	430

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TABLE 5.8
COMPARISON OF EXISTING PIPE CAPACITY TO 10-YEAR, 25-YEAR, AND 100-YEAR DESIGN FLOWS
(Page 3 of 3)

Subbasin	Pipe No.	Existing Pipe Diameter (in)	Existing Pipe Length (ft)	Existing Full Pipe Capacity (cfs)	Existing Full Pipe Velocity (ft/s)	10-Year Design Flow (cfs)	10-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)	25-Year Design Flow (cfs)	25-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)	100-Year Design Flow (cfs)	100-Year Design Pipe Diameter (in)	Replace Pipe Length (ft)
L1	102	24	200	133.9	43.19	12.4	24	0	14.8	24	0	17.2	24	0
	101	24	215	17.1	5.52	12.3	24	0	14.6	24	0	17.0	24	0
	100	24	440	21.6	6.97	12.1	24	0	14.4	24	0	16.7	24	0
M2	101	18	280	40.7	41.31	25.8	18	0	30.7	18	0	35.7	18	0
	100	18	230	39.4	21.89	25.8	18	0	30.7	18	0	35.6	18	0
M3	101	2-18	280	48.8	29.5	32.4	2-18	0	38.6	2-18	0	44.8	2-18	0
	100	30	110	108.5	14.85	50.1	30	0	59.4	30	0	68.8	30	0
N1	100	36	50	364.1	51.28	13.5	36	0	16.3	36	0	19.2	36	0
	101	36	330	396.8	55.89	13.5	36	0	16.3	36	0	19.2	36	0
O5	100	60	1250	451.1	23.02	14.0	60	0	17.4	60	0	20.8	60	0
P5	100	15	1150	20.4	17.00	22.0	18	0*	25.7	18	0*	23.9	18	0*
Total Length of Under-Capacity Pipe.						10 Year = 9,970lf			25 Year = 10,660 lf			100 Year = 11,165 lf		

Note: Pipe recommended for replacement if design flow exceeds estimated existing full pipe capacity by more than 10 percent.

* Pipe P5-100 not scheduled for replacement because it serves only the golf course, a non-critical facility.

TABLE 5.9
INLET CAPACITY EVALUATION
(PAGE 1 OF 5)

Subbasin	Number of Inlets with Slopes that are:			Cumulative Inlet Capacity for Slopes that are:			Total Subbasin Inlet Capacity	10-year Runoff Flow Rate (cfs)	Summary of Inlet Capacity
	Flat	Mild	Steep	Flat 3.0 cfs	Mild 2.0 cfs	Steep 1.0 cfs			
A1	31	0	0	24.80	0.00	0.00	24.80	11.00	O.K.
B1	0	0	9	0.00	0.00	9.00	9.00	7.20	O.K.
B2	2	0	0	6.00	0.00	0.00	6.00	3.50	O.K.
B3	3	3	0	9.00	6.00	0.00	15.00	7.10	O.K.
B4	0	0	0	0.00	0.00	0.00	0.00	2.90	Increase Capacity
B5	4	4	0	12.00	8.00	0.00	20.00	11.70	O.K.
B6	15	0	0	45.00	0.00	0.00	45.00	14.70	O.K.
B7	0	9	0	0.00	18.00	0.00	18.00	4.50	O.K.
B8	13	0	0	39.00	0.00	0.00	39.00	12.60	O.K.
B9	30	0	0	90.00	0.00	0.00	90.00	9.60	O.K.
B10	3	0	0	9.00	0.00	0.00	9.00	6.90	O.K.
Subtotal	70	16	9	210.00	32.00	9.00	251.00	80.70	O.K.
C1	12	0	0	36.00	0.00	0.00	36.00	6.30	O.K.
C2	36	0	0	108.00	0.00	0.00	108.00	9.10	O.K.
Subtotal	48	0	0	144.00	0.00	0.00	144.00	15.40	O.K.

TABLE 5.9
INLET CAPACITY EVALUATION
(PAGE 2 OF 5)

Subbasin	Number of Inlets with Slopes that are:			Cumulative Inlet Capacity for Slopes that are:			Total Subbasin Inlet Capacity	10-year Runoff Flow Rate (cfs)	Summary of Inlet Capacity
	Flat	Mild	Steep	Flat 3.0 cfs	Mild 2.0 cfs	Steep 1.0 cfs			
D1	0	2	0	0.00	4.00	0.00	4.00	23.20	Increase Capacity
D2	0	2	0	0.00	4.00	0.00	4.00	16.00	Increase Capacity
D3	0	3	0	0.00	6.00	0.00	6.00	3.40	O.K.
D4	0	0	5	0.00	0.00	5.00	5.00	35.50	Increase Capacity
D5	2	0	4	6.00	0.00	4.00	10.00	7.80	O.K.
D6	10	10	0	30.00	20.00	0.00	50.00	55.40	Marginal
D7	0	7	0	0.00	14.00	0.00	14.00	6.00	O.K.
D8	4	0	0	12.00	0.00	0.00	12.00	3.50	O.K.
D9	10	0	0	30.00	0.00	0.00	30.00	17.50	O.K.
D10	3	0	0	9.00	0.00	0.00	9.00	5.50	O.K.
D11	0	21	0	0.00	42.00	0.00	42.00	19.20	O.K.
D12	3	0	0	9.00	0.00	0.00	9.00	4.40	O.K.
D13	11	0	0	33.00	0.00	0.00	33.00	3.80	O.K.
D14	13	0	0	39.00	0.00	0.00	39.00	3.40	O.K.
D15	8	0	0	24.00	0.00	0.00	24.00	3.10	O.K.
D16	0	22	0	0.00	44.00	0.00	44.00	10.00	O.K.
D17	0	11	0	0.00	22.00	0.00	22.00	2.70	O.K.
D18	3	0	0	9.00	0.00	0.00	9.00	4.00	O.K.
D19	0	6	0	0.00	12.00	0.00	12.00	5.70	O.K.
D20	5	0	0	15.00	0.00	0.00	15.00	2.40	O.K.
Subtotal	72	84	9	216.00	168.00	9.00	393.00	232.50	O.K.
E1	7	0	0	21.00	0.00	0.00	21.00	8.10	O.K.

TABLE 5.9
INLET CAPACITY EVALUATION
(PAGE 3 OF 5)

Subbasin	Number of Inlets with Slopes that are:			Cumulative Inlet Capacity for Slopes that are:			Total Subbasin Inlet Capacity	10-year Runoff Flow Rate (cfs)	Summary of Inlet Capacity
	Flat	Mild	Steep	Flat 3.0 cfs	Mild 2.0 cfs	Steep 1.0 cfs			
F1	0	1	3	0.00	2.00	3.00	5.00	4.30	O.K.
F2	0	0	0	0.00	0.00	0.00	0.00	9.70	Increase Capacity
F3	24	0	2	72.00	0.00	2.00	74.00	17.40	O.K.
F4	7	0	0	21.00	0.00	0.00	21.00	3.20	O.K.
F5	0	21	0	0.00	42.00	0.00	42.00	30.60	O.K.
F6	8	0	0	24.00	0.00	0.00	24.00	9.10	O.K.
F7	9	0	2	27.00	0.00	2.00	29.00	5.10	O.K.
F8	24	0	0	72.00	0.00	0.00	72.00	14.90	O.K.
F9	12	0	0	36.00	0.00	0.00	36.00	6.60	O.K.
F10	13	0	0	39.00	0.00	0.00	39.00	9.50	O.K.
Subtotal	97	22	7	291.00	44.00	7.00	342.00	110.40	O.K.
G1	2	4	0	6.00	8.00	0.00	14.00	14.90	Marginal
G2	0	12	0	0.00	24.00	0.00	24.00	12.00	O.K.
G3	0	5	0	0.00	10.00	0.00	10.00	7.40	O.K.
G4	13	0	0	39.00	0.00	0.00	39.00	12.40	O.K.
Subtotal	15	21	0	45.00	42.00	0.00	87.00	46.70	O.K.
H1	39	0	0	117.00	0.00	0.00	117.00	12.80	O.K.
I1	0	11	3	0.00	22.00	3.00	25.00	13.60	O.K.
I2	38	0	0	114.00	0.00	0.00	114.00	12.90	O.K.
Subtotal	38	11	3	114.00	22.00	3.00	139.00	26.50	O.K.

TABLE 5.9
INLET CAPACITY EVALUATION
(PAGE 4 OF 5)

Subbasin	Number of Inlets with Slopes that are:			Cumulative Inlet Capacity for Slopes that are:			Total Subbasin Inlet Capacity	10-year Runoff Flow Rate (cfs)	Summary of Inlet Capacity
	Flat	Mild	Steep	Flat 3.0 cfs	Mild 2.0 cfs	Steep 1.0 cfs			
J1	3	0	1	9.00	0.00	1.00	10.00	17.40	Increase Capacity
J2	3	2	0	9.00	4.00	0.00	13.00	7.90	O.K.
J3	0	10	0	0.00	20.00	0.00	20.00	9.30	O.K.
J4	0	12	7	0.00	24.00	7.00	31.00	12.00	O.K.
J5	1	3	0	3.00	6.00	0.00	9.00	5.50	O.K.
J6	1	3	3	3.00	6.00	3.00	12.00	6.10	O.K.
J7	3	1	1	9.00	2.00	1.00	12.00	13.60	Increase Capacity
J8	2	3	0	6.00	6.00	0.00	12.00	17.00	Increase Capacity
J9	7	1	7	21.00	2.00	7.00	30.00	30.20	Marginal
J10	2	0	1	6.00	0.00	1.00	7.00	8.40	Increase Capacity
J11	0	4	0	0.00	8.00	0.00	8.00	6.60	O.K.
J12	4	0	2	12.00	0.00	2.00	14.00	7.40	O.K.
J13	24	0	0	72.00	0.00	0.00	72.00	10.00	O.K.
Subtotal	50	39	22	150.00	78.00	22.00	250.00	151.40	O.K.
K1	0	1	0	0.00	2.00	0.00	2.00	12.00	Open Channel / Culvert
K2	5	0	0	15.00	0.00	0.00	15.00	9.40	O.K.
K3	11	0	0	33.00	0.00	0.00	33.00	8.90	O.K.
K4	12	0	0	36.00	0.00	0.00	36.00	4.50	O.K.
Subtotal	28	1	0	84.00	2.00	0.00	86.00	34.80	O.K.
L1	17	0	0	51.00	0.00	0.00	51.00	12.40	O.K.
M1	0	10	0	0.00	20.00	0.00	20.00	25.80	Increase Capacity
M2	0	0	0	0.00	0.00	0.00	0.00	7.10	Increase Capacity
M3	1	0	3	3.00	0.00	3.00	6.00	19.50	Increase Capacity
Subtotal	1	10	3	3.00	20.00	3.00	26.00	52.40	Increase Capacity
N1	3	0	5	9.00	0.00	5.00	14.00	1.70	O.K.

TABLE 5.9
INLET CAPACITY EVALUATION
(PAGE 5 OF 5)

Subbasin	Number of Inlets with Slopes that are:			Cumulative Inlet Capacity for Slopes that are:			Total Subbasin Inlet Capacity	10-year Runoff Flow Rate (cfs)	Summary of Inlet Capacity
	Flat	Mild	Steep	Flat 3.0 cfs	Mild 2.0 cfs	Steep 1.0 cfs			
Y1	0	4	0	0.00	8.00	0.00	8.00	5.00	O.K.
Y2	21	0	0	63.00	0.00	0.00	63.00	8.60	O.K.
Y3	0	8	0	0.00	16.00	0.00	16.00	10.70	O.K.
Subtotal	21	12	0	63.00	24.00	0.00	87.00	24.30	O.K.
Z1	3	0	0	9.00	0.00	0.00	9.00	2.40	O.K.
Z2	0	6	0	0.00	12.00	0.00	12.00	4.00	O.K.
Z3	6	2	6	18.00	4.00	6.00	28.00	30.40	Marginal
Subtotal	9	8	6	27	16	6	49	36.8	O.K.

Note: 1.) Inlet grate capacities are based upon Neenah grate model R-1979 A2G with 1.2 square feet of open area.
2.) Inlet slope assumptions, 2 percent transverse with flat at less than 1 percent mild at 2-4 percent and steep at 5 percent and up.

TABLE 6.1 SAMPLE SIZE AND OTHER REQUIREMENTS			
Analyte(s)	**Bottle Size (ml)**	**Bottle Type**	**Preservative**
TSS, PO_4	1,000	Plastic	N/A
COD	125	Plastic	H_2SO_4 to pH <2
BOD	500	Plastic	N/A
TKN	1,000	Plastic	H_2SO_4 to pH <2
Metals	500	Plastic	HNO_3 to pH <2
Oil and Grease	1,000	Amber Glass	H_2SO_4 to pH <2
Herbicides	1,000	Amber Glass	N/A
Pesticides	1,000	Amber Glass	N/A
Coliform	100	Plastic (sterile)	N/A

TABLE 6.2
STORM WATER ANALYTICAL DATA
(PAGE 1 OF 6)

Sample I.D. No.	SL-1	SL-2	SL-3		SL-4	SL-5	SL-6
Location	Industrial	Roads	Residential		Commercial	Open Space	Golf Course
Sample Type	Grab	Grab	Grab	Composite	Grab	Grab	Grab
Total Coliform (MPN/100ml)							
Reported Concentration							
23 JAN 1994	50000	>16000	>16000	NA	70000	>16000	9000
6 FEB 1994	>1,600	5000	24000	NA	300000	>1600	130
EPA Median EMC	NA						
Fecal Coliform (MPN/100ml)							
Reported Concentration							
23 JAN 1994	50000	5000	5000	NA	70000	300	14
6 FEB 1994	>1600	700	2400	NA	300000	>1600	50
EPA Median EMC	1,000 cold weather/21,000 warm weather						
E. Coli (MPN/100ml)							
Reported Concentration							
23 JAN 1994	50000	240	3000	NA	70000	130	<2
6 FEB 1994	30	700	2400	NA	300000	170	<2
EPA Median EMC	NA						
pH							
Field Measurement							
23 JAN 1994	7.6	7.6	7.1	NA	8.5	7.9	6.9
6 FEB 1994	7.8	7.7	NA	NA	7.8	8.0	7.0
EPA Median EMC	NA						

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TABLE 6.2
STORM WATER ANALYTICAL DATA
(PAGE 2 OF 6)

Sample I.D. No.	SL-1	SL-2	SL-3		SL-4	SL-5	SL-6
Location	Industrial	Roads	Residential		Commercial	Open Space	Golf Course
Sample Type	Grab	Grab	Grab	Composite	Grab	Grab	Grab
BOD (mg/L)							
Reported Concentration							
23 JAN 1994	30	7	9	<5	<5	12	<5
EPA Median EMC	9.3	9.3	10	10	9.3	--	
COD (mg/L)							
Reported Concentration							
23 JAN 1994	160	54	250	57	95	41	<20
EPA Median EMC	57	57	73	73	57	40	
Total Suspended Solids (mg/L)							
Reported Concentration							
23 JAN 1994	40	6	350	27	NA	6	<4
EPA Median EMC	69	69	101	101	69	70	
Total Oil & Grease (mg/L)							
Reported Concentration							
23 JAN 1994	4.9	6.2	NA	NA	9.6	<5	<5
EPA Median EMC	NA						
Total Kjeldahl Nitrogen (mg/L)							
Reported Concentration							
23 JAN 1994	3.4	2.2	2.6	2.2	3	<0.4	0.9
EPA Median EMC	1.179	1.179	1.9	1.9	1.179	0.965	

b:MT4.tx2

TABLE 6.2
STORM WATER ANALYTICAL DATA
(PAGE 3 OF 6)

Sample I.D. No.	SL-1	SL-2	SL-3		SL-4	SL-5	SL-6
Location	Industrial	Roads	Residential		Commercial	Open Space	Golf Course
Sample Type	Grab	Grab	Grab	Composite	Grab	Grab	Grab
Phosphate (mg/L)							
Reported Concentration							
23 JAN 1994	<0.2	<0.2	<0.2	<0.2	NA	<0.2	<0.2
EPA Median EMC	NA						
Antimony (mg/L)							
Reported Concentration							
23 JAN 1994	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
EPA Detection Range	NA	0.0026 to 0.023					
Beryllium (mg/L)							
Reported Concentration							
23 JAN 1994	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
EPA Detection Range	NA	0.001 to 0.049					
Cadmium (mg/L)							
Reported Concentration							
23 JAN 1994	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
EPA Detection Range	NA	0.001 to 0.014					
Chromium (mg/L)							
Reported Concentration							
23 JAN 1994	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
EPA Detection Range	NA	0.001 to 0.190					

b:MT4.002

TABLE 6.2
STORM WATER ANALYTICAL DATA
(PAGE 4 OF 6)

Sample I.D. No.	SL-1	SL-2	SL-3		SL-4	SL-5	SL-6
Location	Industrial	Roads	Residential		Commercial	Open Space	Golf Course
Sample Type	Grab	Grab	Grab	Composite	Grab	Grab	Grab
Copper (mg/L)							
Reported Concentration							
23 JAN 1994	0.27	<0.05	0.092	<0.05	<0.05	<0.05	<0.05
EPA Median EMC	0.029	0.029	0.033	0.033	0.029	--	
Lead (mg/L)							
Reported Concentration							
23 JAN 1994	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
EPA Median EMC	0.104	0.104	0.144	0.144	0.104	0.03	
Nickel (mg/L)							
Reported Concentration							
23 JAN 1994	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
EPA Detection Range	NA	0.001 to 0.182					
Silver (mg/L)							
Reported Concentration							
23 JAN 1994	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
EPA Detection Range	NA	0.0002 to 0.0008					
Thallium mg/L)							
Reported Concentration							
23 JAN 1994	<1	<1	<1	<1	<1	<1	<1
EPA Detection Range	NA	0.001 to 0.014					

TABLE 6.2
STORM WATER ANALYTICAL DATA
(PAGE 5 OF 6)

Sample I.D. No.	SL-1	SL-2	SL-3		SL-4	SL-5	SL-6
Location	Industrial	Roads	Residential		Commercial	Open Space	Golf Course
Sample Type	Grab	Grab	Grab	Composite	Grab	Grab	Grab
Zinc (mg/L)							
Reported Concentration							
23 JAN 1994	0.19	0.31	0.27	<0.05	0.14	<0.05	<0.05
EPA Median EMC	0.226	0.226	0.135	0.135	0.226	0.195	
Arsenic (mg/L)							
Reported Concentration							
23 JAN 1994	0.16	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
EPA Detection Range	NA	0.001 to 0.505					
Selenium (mg/L)							
Reported Concentration							
23 JAN 1994	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
EPA Detection Range	NA	0.002 to 0.077					
Mercury (mg/L)							
Reported Concentration							
23 JAN 1994	<0.0002	<0.0002	0.00041	<0.0002	<0.0002	<0.0002	<0.0002
EPA Detection Range	NA	0.0006 to 0.0012					
Pesticides & PCBs (mg/L)							
Reported Concentration							
23 JAN 1994	NA	NA	NA	NA	NA	NA	ND*
EPA Detection Range	NA	Pesticides (sum of detections): 0.0002 to 0.02; PCBs generally not detected.					

b:MT4.002

TABLE 6.2 STORM WATER ANALYTICAL DATA (PAGE 6 OF 6)							
Sample I.D. No.	SL-1	SL-2	SL-3		SL-4	SL-5	SL-6
Location	Industrial	Roads	Residential		Commercial	Open Space	Golf Course
Sample Type	Grab	Grab	Grab	Composite	Grab	Grab	Grab
Herbicides (mg/L)							
Reported Concentration							
23 JAN 1994	NA	NA	NA	NA	NA	NA	ND*
EPA Detection Range	NA						

KEY TO SYMBOLS

NA Not analyzed.

ND Not Detected.

* Several individual constituents were included in the analyte list.

< Not detected (detection limit accompanies symbol).

1) Where EPA results are reported as a detection range, sites specifically did not include industrial land uses.

2) In addition to climate effects on fecal coliform counts, the EPA reported a wide range of fecal coliform counts.

3) EPA median EMCs are reported for total and soluble phosphorus as P.

TABLE 6.3
LAND USES BY DRAINAGE BASIN

Drainage Basin	PERCENTAGE OF AREA BY LAND USE CATEGORY						
	Commercial	Industrial	Residentia l	Institutional	Roads	Open Space	Total Area (Acres)
A	0	0	0	20	0	80	7.70
B	0	0	25	30	10	35	62.20
C	0	25	0	25	5	45	11.28
D	4	3	25	10	1	57	280.30
E	5	5	0	0	5	85	8.00
F	15	0	20	20	2	43	104.03
G	8	0	10	10	2	70	57.39
H	0	0	0	40	5	55	18.83
I	15	0	0	25	3	57	26.40
J	3	5	20	20	3	49	198.88
K	0	0	10	30	25	35	35.73
L	0	0	50	30	0	20	11.54
M	0	5	30	30	5	30	52.63
N	0	0	0	0	20	80	20.56
O	0	0	5	15	1	79	99.83
P	0	0	0	5	5	90	192.35
Y	0	0	0	40	0	60	40.78
Z	0	0	40	20	0	40	23.68

TABLE 6.4 ESTIMATE RUNOFF COEFFICIENTS FOR VARIOUS LAND USE CATEGORIES		
Land Use Category	**Percent Impervious**	**Estimated Runoff Coefficient, C**
Commercial	35-55	0.60
Industrial	50-80	0.85
Residential	10-20	0.30
Institutional	40-60	0.65
Roads	100	0.90
Open Space	5-10	0.20

TABLE 6.5
EPA MEDIAN EVENT MEAN POLLUTANT CONCENTRATIONS

Constituent	Concentration (mg/L)				
	U.S. EPA LAND USE CATEGORY	Residential	Mixed	Commercial	Open/ Nonurban
	PRESIDIO LAND USE CATEGORY	Residential	Institutional	Commercial, Industrial, Roads	Open Space
BOD		10.0	7.8	9.3	--
COD		73	65	57	40
TSS		101	67	69	70
Total Lead		0.144	0.114	0.104	0.030
Total Copper		0.033	0.027	0.029	--
Total Zinc		0.135	0.154	0.226	0.195
Total Kjeldahl Nitrogen		1.900	1.288	1.179	0.965
Nitrate/Nitrite		0.736	0.558	0.572	0.543
Total Phosphorus		0.383	0.263	0.201	0.121
Soluble Phosphorus		0.143	0.056	0.080	0.026

-- Data not available. Median EMCs for residential land use assumed applicable to open space areas for pollutant load estimate.

Reference: Results of the Nationwide Urban Runoff Program Final Report, Volume 1 (U.S. EPA, 1983).

TABLE 6.6
ESTIMATE OF ANNUAL STORM WATER POLLUTANT LOADING
(Based on Nationwide Urban Runoff Program Median EMCs)

Drainage Basin	Weighted Mean Runoff Coefficient C	Mean Annual Runoff Volume (Acre Feet)	ESTIMATED ANNUAL POLLUTANT LOADING IN RUNOFF (POUNDS)									
			BOD	COD	TSS	Lead	Copper	Zinc	TKN	Nitrate/ Nitrite	Phos-phorus, Total	Phos-phorus, Soluble
A	0.29	1.99	49	277	372	0.37	0.16	0.96	6.01	2.98	1.00	0.21
B	0.43	23.85	574	3,934	4,789	6.71	1.91	11.18	85.57	38.24	16.07	4.63
C	0.51	5.13	125	789	956	1.31	0.41	2.76	16.41	7.85	2.88	0.88
D	0.31	78.10	2,009	11,960	16,277	18.84	6.59	37.78	275.43	127.00	48.51	14.96
E	0.29	2.05	55	262	388	0.34	0.17	1.16	5.87	3.09	0.86	0.27
F	0.38	35.62	891	5,657	7,125	9.40	2.89	17.48	124.06	56.81	22.52	6.74
G	0.30	15.40	397	2,196	3,025	3.17	1.29	7.83	49.22	23.95	8.18	2.35
H	0.42	6.97	162	1,090	1,289	1.72	0.55	3.27	22.56	10.53	4.14	0.96
I	0.39	9.26	227	1,395	1,725	2.18	0.74	4.72	29.27	14.05	5.12	1.37
J	0.38	66.59	1,649	10,484	13,344	17.12	5.43	32.32	231.10	106.09	41.77	12.25
K	0.52	16.57	400	2,642	3,164	4.51	1.31	8.54	55.54	25.79	10.09	3.04
L	0.39	3.96	96	706	868	1.26	0.32	1.63	16.08	6.74	3.18	0.93
M	0.43	20.30	489	3,399	4,134	5.88	1.63	9.40	74.44	32.89	14.12	4.13
N	0.34	6.23	163	831	1,178	1.17	0.52	3.58	18.28	9.47	2.77	0.93
O	0.28	24.88	623	3,454	4,776	4.59	2.08	12.08	76.78	37.86	12.66	3.01
P	0.26	44.16	1,153	5,540	8,341	6.43	3.79	23.45	125.30	66.06	18.37	4.71
Y	0.38	13.82	319	2,146	2,553	3.29	1.09	6.27	44.57	20.79	8.20	1.75
Z	0.33	6.97	173	1,172	1,518	1.98	0.58	2.98	27.14	11.73	5.16	1.52
TOTAL ALL DRAINAGE AREAS		382	9,600	58,000	76,000	90	31	190	1,300	600	230	65

b:MT4.002

TABLE 6-7
ESTIMATED MEAN RUNOFF CONCENTRATIONS

CONSTITUENT	CONCENTRATION (mg/L)						COMMENTS (Source)
	Commercial	Industrial	Residential	Institutional*	Roads	Open Space	
BOD	7.2	20.2	8	7.2	10.7	9	Mean of grab sample data, except open space and industrial (composite).
COD	58	100	71.5	58	24.5	56	Mean of mean detection and EPA median EMC.
TSS	65	98	87.5	65	63.5	82.5	Mean of mean detection and EPA median EMC.
Total Oil and Grease	5.05	5.3	2.53	5.05	7.88	2.53	Mean detection; residential assumed to be same as open space.
Total Kjeldahl Nitrogen	1.34	2.325	1.825	1.34	1.69	1.235	Mean of mean detection and EPA median EMC.
Phosphate	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Antimony	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Beryllium	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Cadmium	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Chromium	0	0.048	0	0	0	0.068	Zero where consistently not detected; otherwise, mean of detections.
Copper	0	0.029	0.033	0	0.029	0	Zero where consistently not detected; otherwise, mean of detections.
Lead	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Nickel	0	0	0	0	0	0.14	Zero where consistently not detected; otherwise, mean of detections.
Silver	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Thallium	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Zinc	0.1705	0.2465	0.2025	0.1705	0.2895	0	Zero where consistently not detected; otherwise, mean of detections.
Arsenic	0	0.1642	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Selenium	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Mercury	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Pesticides and PCBs	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.
Herbicides	0	0	0	0	0	0	Zero where consistently not detected; otherwise, mean of detections.

TABLE 6.8
ESTIMATE OF ANNUAL STORM WATER POLLUTANT LOADING
(Based on Site-Specific Storm Water Monitoring Data)

Drainage Basin	Weighted Mean Runoff Coefficient C	Mean Annual Runoff Volume (Acre Feet)	Estimated Annual Pollutant Loading in Runoff (pounds)									
			BOD	COD	TSS	Lead	Copper	Zinc	TKN	Oil & Grease	Arsenic	Chromium
A	0.29	1.99	44	308	404	0.0	0.00	0.4	6.9	20	0.0	0.20
B	0.43	23.85	543	3,439	4,635	0.0	0.77	11.2	96.0	311	0.0	0.72
C	0.51	5.13	185	1,007	1,140	0.0	0.20	2.5	24.6	69	1.0	0.45
D	0.31	78.10	1,956	13,376	16,873	0.0	2.36	26.7	320.4	771	2.8	6.10
E	0.29	2.05	60	322	446	0.0	0.05	0.6	8.2	23	0.1	0.26
F	0.38	35.62	765	5,627	7,010	0.0	0.63	13.8	136.5	409	0.0	1.48
G	0.30	15.40	349	2,363	3,154	0.0	0.21	4.2	57.0	159	0.0	1.32
H	0.42	6.97	153	1,020	1,317	0.0	0.06	2.6	25.6	89	0.0	0.34
I	0.39	9.26	201	1,389	1,763	0.0	0.05	3.3	33.6	114	0.0	0.50
J	0.38	66.59	1,724	11,224	13,906	0.0	1.93	26.8	276.5	764	3.4	4.20
K	0.52	16.57	406	1,983	3,064	0.0	0.65	0.0	67.8	261	0.0	0.41
L	0.39	3.96	83	679	814	0.0	0.14	1.8	16.4	41	0.0	0.08
M	0.43	20.30	511	3,377	4,151	0.0	0.70	9.6	86.1	248	0.9	0.78
N	0.34	6.23	168	667	1,228	0.0	0.26	2.6	25.0	91	0.0	0.54
O	0.28	24.88	567	3,824	5,146	0.0	0.18	5.4	89.2	242	0.0	2.60
P	0.26	44.16	1,089	6,095	9,245	0.0	0.61	8.7	159.5	454	0.0	5.71
Y	0.38	13.82	292	2,156	2,650	0.0	0.00	4.4	49.1	160	0.0	0.81
Z	0.33	6.97	150	1,183	1,467	0.0	0.23	2.7	28.2	67	0.0	0.31
TOTAL ALL DRAINAGE AREAS		382	9,200	60,000	78,000	0.0	10	140	1,500	4,300	10	30

bcMT4.011

TABLE 8.1
COMPARISON OF STORM DRAIN MATERIAL COST

Material	Unit Price ($ per linear foot)[1,2]										
	Pipe Diameter (inches)										
	10	12	15	18	24	30	36	42	48	54	60
Reinforced Concrete, Class 3 (with gaskets)	—	13.90	16.70	20.30	30.20	55.50	74.40	—	108.00	—	160.00
Corrugated Metal Pipe (with bituminous coating and paved invert)	11.20	13.70	17.50	19.90	29.10	36.10	51.70	—	78.20	—	113.00
Polyvinyl Chloride	8.35	10.30	16.40	—	—	—	—	—	—	—	—
Vitrified Clay (extra strength with compression joints)	12.30	15.80	26.40	36.10	70.10	91.60	141.00	—	—	—	—

[1] Unit price includes material, labor, and equipment costs for placing pipe and fittings. Costs for trench excavation, bedding, and backfill should be similar for all materials, and are therefore not included.

[2] Unit prices include San Francisco City Cost Index of 7.8%.

— Cost data or material not available.

Reference: Means 1994 Building Construction Cost Data (R.S. Means, Co., Inc., 1994).

TABLE 9.1 ANNUAL COSTS FOR GENERAL MAINTENANCE				
Zone	**Hours**	**Labor Cost ($)**	**Equipment Cost ($)**	**Total Cost ($)**
A	312	7,285	494	7,779
B	177	4,133	290	4,423
C	122	2,849	202	3,051
D	106	2,475	173	2,648
E	151	3,535	245	3,780
F	39	911	64	975
G	47	1,097	80	1,177
H	80	1,868	67	1,935
J	53	1,238	86	1,324
K	145	3,386	238	3,624
L	29	677	48	725
M	114	2,662	186	2,848
Miscellaneous Material Cost				500
Totals	1,375	32,116	2,170	34,786

Source: U.S. Army FY 1994 Budget Allocation for General Maintenance of Storm Sewer.

Note: Zone numbering has no relation to watershed basin designation.
Zones are based on the maintenance areas designated on the *Presidio of San Francisco, Integrated Facilities System Real Estate Area Map* (Master Planning Branch, 1985).

Project: Storm Water Mgmt.
Location: Presidio of S.F.

V.E. Study No.: 103-94
Item: Comparison

TABLE 10.1
EVALUATION OF STORM WATER ROUTING ALTERNATIVES AT THE CRISSY FIELD WETLAND RESTORATION AREA
(AVERAGE AND WEIGHTED SCORES)

	Evaluation Criteria																					
	A Health		B Permits		C L.C.C.		D Sustainability		E Resource Protection		F Innovation		G Short-Term Construction		H Compatibility w/GMPA		I Capacity		J Long-Term		Cumulative Weighted Score	Rank
Criteria Weight	4.5		3.5		4.0		4.2		4.2		3.1		2.7		4.7		3.5		4.1			
Alternative	average	weighted	average	weighted	average	weighted	average	weighted	average	weighted	average	weighted	average	weighted	average	weighted	average	weighted	average	weighted		
1. Improve Outfalls	7	31.5	4.1	14.3	2.6	10.4	5	21	6.72	28.1	2.7	8.3	3.4	9.1	3.7	17.3	4.7	16.4	3.7	15.1	155.5	2
2. Discharge Through Wetlands	5.2	36.4	5.1	17.8	7.5	30	6	25.2	5	21	6.0	18.6	3.1	8.3	7.1	33.3	4.7	16.4	6.2	25.4	232.4	1

Scoring System:

1 = Low
5 = Medium
10 = High

A) Protection of health and safety of park visitors and personnel
B) Compliance with permits and applicable regulations
C) Life cycle costs
D) Conformance with sustainable design objectives of the NPS
E) Protection of Natural and Cultural Resources
F) Innovation in design concept
G) Ability to implement or construct in next fiscal year
H) Conformance with the objectives of the General Management Plan Amendment
I) Capable of meeting design flow capacity objectives
J) Ability to meet long term objectives of the SWMP

b:MT5.006

TABLE 11.1
REQUIRED AGENCY PERMITS FOR STORM DRAIN SYSTEM RELATED ACTIVITIES
(Page 1 of 2)

Activity	Permitting Agency											
	USACE	USFWS	NMF	SHPO	CDFG	SLC	SWRCB	RWQCB	CALTRANS	SFBCDC	CCC	CCSF
Storm Drain and Outfall Construction												
Repair/construction of SF Bay outfalls	✓	✓	✓	✓	✓	✓	✓	✓		✓		
Repair/construction of Pacific Ocean outfalls	✓	✓	✓	✓	✓	✓	✓	✓			✓	
Repair/construction of storm drains on Presidio site within 100 feet of SF Bay						✓					✓	
Repair/construction of storm drains on Presidio site (other)												
Repair/construction of storm drains/sewers discharging to CCSF combined sewer system												✓
Wetlands/Riparian Areas Construction												
Wetlands within 100 feet of SF Bay					✓	✓				✓		
Other Wetlands/Polishing Basins					✓							
Riparian Restoration					✓							
Structural Best Management Practices Construction												
Parking lots and Presidio streets												

b:MT4.002

TABLE 11.1
REQUIRED AGENCY PERMITS FOR STORM DRAIN SYSTEM RELATED ACTIVITIES
(Page 2 of 2)

Activity	Permitting Agency											
	USACE	USFWS	NMF	SHPO	CDFG	SLC	SWRCB	RWQCB	CALTRANS	SFBCDC	CCC	CCSF
Doyle Drive/Highway 101									✓			✓
Highway 1									✓			✓
BMPs within 100 feet of SF Bay										✓		
Operation and Maintenance												
Operational BMPs -- street sweeping									✓*			✓*
Storm Drain Maintenance									✓*			✓*
Structural BMP Maintenance												

Key:
USACE = U.S. Army Corps of Engineers
NMF = National Marine Fisheries
CDFG = California Department of Fish and Game
SWRCB = State Water Resources Control Board
CALTRANS = California Department of Transportation
CCC = California Coastal Commission
USFWS = U.S. Fish and Wildlife Service
SHPO = State Historic Preservation Office
SLC = State Lands Commission
RWQCB = Regional Water Quality Control Board
SFBCDC = San Francisco Bay Conservation and Development Commission
CCSF = City and County of San Francisco

* Permitting requirements vary with jurisdiction.

TABLE 12.1
1994 STORM WATER ANALYTICAL DATA

Constituent	Sample I.D. No. Location	SL-1 Industrial	SL-2 Roads		SL-3 Residential		SL-4 Commercial		SL-5 Open Space		SL-6 Golf Course
	Sample Type	Grab	Grab	Composite	Grab	Composite	Grab	Composite	Grab	Composite	Grab
Total Coliform (MPN/100mL)	23 JAN 1994	50,000	>16000		>16000		70,000		>16000		9,000
	6 FEB 1994	>1,600	5,000		24,000		300,000		>1600		130
	17 FEB 1994	170,000	500,000		>160000		24,000		30,000		240
	Mean Detection	73,867	173,667		66,667		131,333		15,867		3,123
	EPA Median EMC	NA									
Fecal Coliform (MPN/100mL)	23 JAN 1994	50,000	5,000		5,000		70,000		300		14
	6 FEB 1994	>1600	700		2,400		300,000		>1600		50
	17 FEB 1994	800	14,000		5,000		5,000		140		130
	Mean Detection	17,467	6,567		4,133		125,000		680		65
	EPA Median EMC	1,000 cold weather/21,000 warm weather									
E. Coli (MPN/100mL)	23 JAN 1994	50,000	240		3,000		70,000		130		<2
	6 FEB 1994	30	700		2,400		300,000		170		<2
	17 FEB 1994	800	200		2,200		5,000		30		4
	Mean Detection	16,943	380		2,533		125,000		110		2
	EPA Median EMC	NA									
pH	23 JAN 1994	7.6	7.6		7.1		8.5		7.9		6.9
	6 FEB 1994	7.8	7.7				7.8		8.0		7.0
	Mean Detection	7.7	7.65		7.1		8.15		7.95		6.95
	EPA Median EMC	NA									
BOD (mg/L)	23 JAN 1994	30	7		9	<5	12		<5		<5
	6 FEB 1994	<5	17		8		7	12	5		<5
	17 FEB 1994	28	8	17	7		<5		<5	9	<5
	Mean Detection	20.2	10.7	17.0	8.0	2.5	7.2	12.0	3.3	9.0	2.5
	EPA Median EMC	9.3	9.3		10	10	9.3		--		
COD (mg/L)	23 JAN 1994	160	54		250	57	95		41		<20
	6 FEB 1994	110	190		82		54	<20	79		<20
	17 FEB 1994	160	82	79	60		27		95	54	24
	Mean Detection	143	109	79	131	57	59	10	72	54	15
	EPA Median EMC	57	57		73	73	57		40		
Total Suspended Solids (mg/L)	23 JAN 1994	40	6		350	27			6		<4
	6 FEB 1994	160	120		120		110	13	160		7
	17 FEB 1994	180	47	12	19		11		120	42	25
	Mean Detection	127	58	12	163	27	61	13	95	42	11
	EPA Median EMC	69	69		101	101	69		70		
Total Oil & Grease (mg/L)	23 JAN 1994	4.90	6.20				9.60		<5		<5
	6 FEB 1994	5.80	15.00				<6.1		<5		<5
	17 FEB 1994	5.20	<4.9		<4.9		<5.0		<5.2		<5
	Mean Detection	5.30	7.88		2.45		5.05		2.53		2.50
	EPA Median EMC	NA									

TABLE 12.1
1994 STORM WATER ANALYTICAL DATA

Constituent	Sample I.D. No. Location	SL-1 Industrial	SL-2 Roads		SL-3 Residential		SL-4 Commercial		SL-5 Open Space		SL-6 Golf Course
	Sample Type	Grab	Grab	Composite	Grab	Composite	Grab	Composite	Grab	Composite	Grab
Total Kjeldahl Nitrogen (mg/L)	23 JAN 1994	3.40	2.20		2.60	2.20	3.00		<0.4		0.90
	6 FEB 1994	1.90	5.20		1.30		0.75	1.50	1.90		0.75
	17 FEB 1994	5.10	2.20	2.20	3.00		0.75		2.20	1.50	4.10
	Mean Detection	3.47	3.20	2.20	2.30	2.20	1.50	1.50	1.43	1.50	1.92
	EPA Median EMC	1.18	1.18		1.90	1.90	1.18		0.97		
Phosphate (mg/L)	23 JAN 1994	<0.2	<0.2		<0.2	<0.2			<0.2		<0.2
	6 FEB 1994	<0.2	<0.2		<0.2		<0.2	<0.2	<0.2		<0.2
	17 FEB 1994	<0.2	<0.2	<0.2	<0.2		<0.2		<0.2	<0.2	<0.2
	Mean Detection	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	EPA Median EMC	NA									
Antimony (mg/L)	23 JAN 1994	<0.2	<0.2		<0.2	<0.2	<0.2		<0.2		<0.2
	6 FEB 1994	<0.2	<0.2		<0.2		<0.2	<0.2	<0.2		<0.2
	17 FEB 1994	<0.2	<0.2	<0.2	<0.2		<0.2		<0.2	<0.2	<0.2
	Mean Detection	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	EPA Detection Range	NA	0.0026 to 0.023								
Beryllium (mg/L)	23 JAN 1994	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005		<0.005
	6 FEB 1994	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005		<0.005
	17 FEB 1994	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005
	Mean Detection	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
	EPA Detection Range	NA	0.001 to 0.049								
Cadmium (mg/L)	23 JAN 1994	<0.05	<0.05		<0.05	<0.05	<0.05		<0.05		<0.05
	6 FEB 1994	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05		<0.05
	17 FEB 1994	<0.05	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05
	Mean Detection	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
	EPA Detection Range	NA	0.001 to 0.014								
Chromium (mg/L)	23 JAN 1994	<0.05	<0.05		<0.05	<0.05	<0.05		<0.05		<0.05
	6 FEB 1994	<0.05	<0.05		<0.05		<0.05	<0.05	0.17		<0.05
	17 FEB 1994	0.094	<0.05	<0.05	<0.05		<0.05		0.15	0.068	<0.05
	Mean Detection	0.048	0.025	0.025	0.025	0.025	0.025	0.025	0.115	0.068	0.025
	EPA Detection Range	NA	0.001 to 0.190								
Copper (mg/L)	23 JAN 1994	0.27	<0.05		0.092	<0.05	<0.05		<0.05		<0.05
	6 FEB 1994	<0.05	0.12		<0.05		<0.05	<0.05	<0.05		<0.05
	17 FEB 1994	0.33	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05
	Mean Detection	0.208	0.057	0.025	0.047	0.025	0.025	0.025	0.025	0.025	0.025
	EPA Median EMC	0.029	0.029		0.033	0.033	0.029		--		
Lead (mg/L)	23 JAN 1994	<0.15	<0.15		<0.15	<0.15	<0.15		<0.15		<0.15
	6 FEB 1994	<0.15	<0.15		<0.15		<0.15	<0.15	<0.15		<0.15
	17 FEB 1994	<0.15	<0.15	<0.15	<0.15		<0.15		<0.15	<0.15	<0.15
	Mean Detection	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
	EPA Median EMC	0.104	0.104		0.144	0.144	0.104		0.03		

TABLE 12.1
1994 STORM WATER ANALYTICAL DATA

Constituent	Sample I.D. No. Location	SL-1 Industrial	SL-2 Roads		SL-3 Residential		SL-4 Commercial		SL-5 Open Space		SL-6 Golf Course
	Sample Type	Grab	Grab	Composite	Grab	Composite	Grab	Composite	Grab	Composite	Grab
Nickel (mg/L)	23 JAN 1994	<0.1	<0.1		<0.1	<0.1	<0.1		<0.1		<0.1
	6 FEB 1994	<0.1	<0.1		<0.1		<0.1	<0.1	0.16		<0.1
	17 FEB 1994	<0.1	<0.1	<0.1	<0.1		<0.1		0.21	<0.1	<0.1
	Mean Detection	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.14	0.05	0.05
	EPA Detection Range	NA	0.001 to 0.182								
Silver (mg/L)	23 JAN 1994	<0.05	<0.05		<0.05	<0.05	<0.05		<0.05		<0.05
	6 FEB 1994	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05		<0.05
	17 FEB 1994	<0.05	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05
	Mean Detection	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
	EPA Detection Range	NA	0.0002 to 0.0008								
Thallium (mg/L)	23 JAN 1994	<1	<1		<1	<1	<1		<1		<1
	6 FEB 1994	<1	<1		<1		<1	<1	<1		<1
	17 FEB 1994	<1	<1	<1	<1		<1		<1	<1	<1
	Mean Detection	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	EPA Detection Range	NA	0.001 to 0.014								
Zinc (mg/L)	23 JAN 1994	0.19	0.31		0.27	<0.05	0.14		<0.05		<0.05
	6 FEB 1994	0.28	0.51		0.094		0.18	<0.05	<0.05		<0.05
	17 FEB 1994	0.33	0.24	0.69	<0.05		<0.05		<0.05	<0.05	0.051
	Mean Detection	0.267	0.353	0.690	0.130	0.025	0.115	0.025	0.025	0.025	0.034
	EPA Median EMC	0.226	0.226		0.135	0.135	0.226		0.195		
Arsenic (mg/L)	23 JAN 1994	0.16	<0.005		<0.005	<0.005	<0.005		<0.005		<0.005
	6 FEB 1994	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005		<0.005
	17 FEB 1994	0.33	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005
	Mean Detection	0.1642	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
	EPA Detection Range	NA	0.001 to 0.505								
Selenium (mg/L)	23 JAN 1994	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005		<0.005
	6 FEB 1994	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005		<0.005
	17 FEB 1994	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005
	Mean Detection	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	EPA Detection Range	NA	0.002 to 0.077								
Mercury (mg/L)	23 JAN 1994	<0.0002	<0.0002		0.00041	<0.0002	<0.0002		<0.0002		<0.0002
	6 FEB 1994	<0.0002	<0.0002		<0.0002		<0.0002	<0.0002	<0.0002		<0.0002
	17 FEB 1994	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002		<0.0002	<0.0002	
	Mean Detection	<0.0002	<0.0002	<0.0002	0.0002033	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
	EPA Detection Range	NA	0.0006 to 0.0012								
Pesticides & PCBs (mg/L)	23 JAN 1994										ND*
	6 FEB 1994										ND*
	Mean Detection										0*
	EPA Detection Range	NA	Pesticides (sum of detections): 0.0002 to 0.02; PCBs generally not detected.								

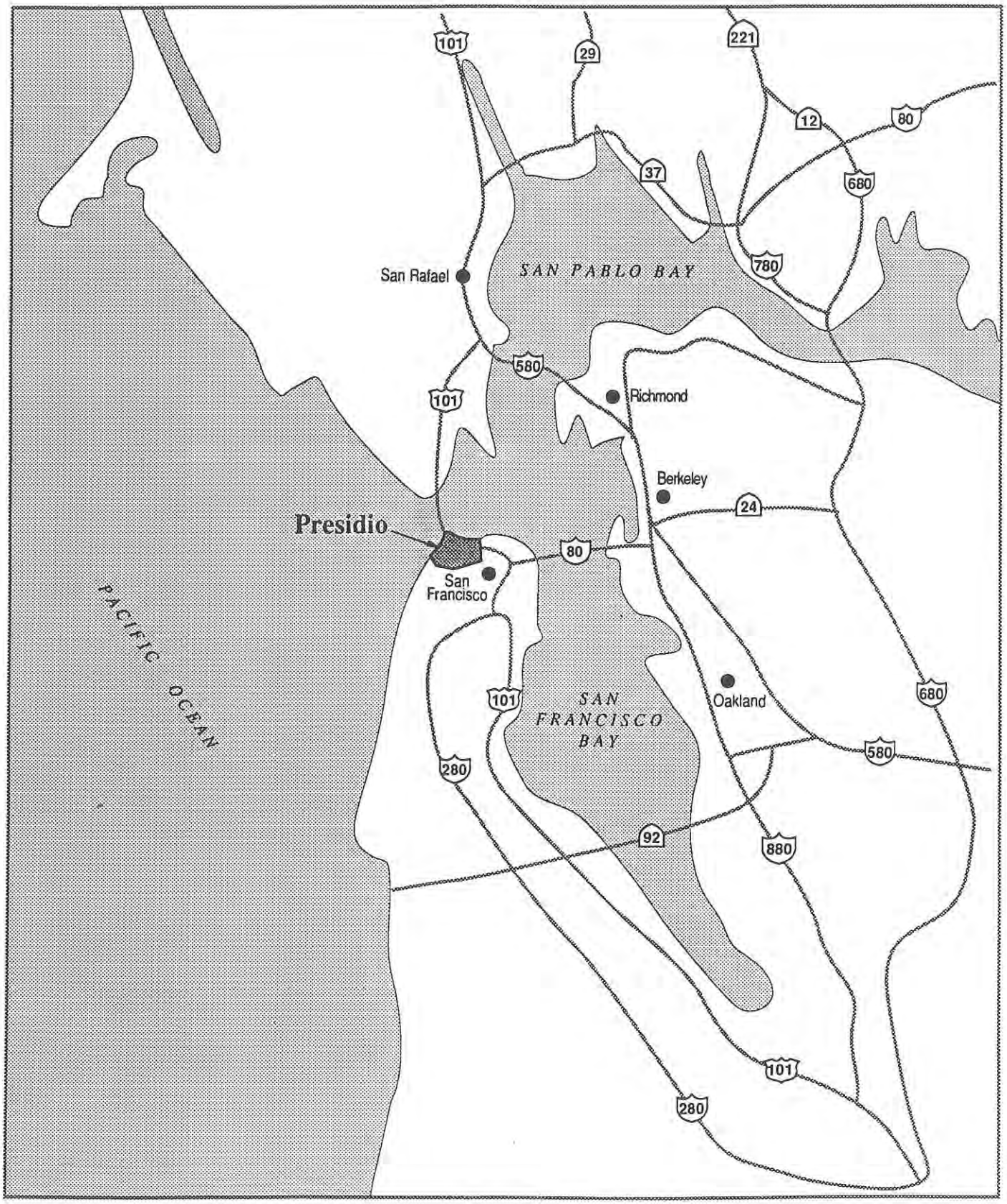
94SWDATA.WK1

TABLE 12.1
1994 STORM WATER ANALYTICAL DATA

Constituent	Sample I.D. No. Location	SL-1 Industrial	SL-2 Roads		SL-3 Residential		SL-4 Commercial		SL-5 Open Space		SL-6 Golf Cours
	Sample Type	Grab	Grab	Composite	Grab	Composite	Grab	Composite	Grab	Composite	Grab
Herbicides (mg/L)	23 JAN 1994										ND*
	6 FEB 1994										ND*
	Mean Detection										0*
	EPA Detection Range	NA									

Notes:

NA Not analyzed.
*ND Several individual constituents were included in the analyte list; however, none were detected.
< Not detected (detection limit accompanies symbol).
1) Where EPA results are reported as a detection range, sites specifically did not include industrial land uses.
2) In addition to climate effects on fecal coliform counts, the EPA reported a wide range of fecal coliform counts.
3) EPA median EMCs are reported for total and soluble phosphorus as P.
4) Where constituents were occasionally not detected, the mean was calculated using 1/2 the detection limit.



0 10
Miles

N

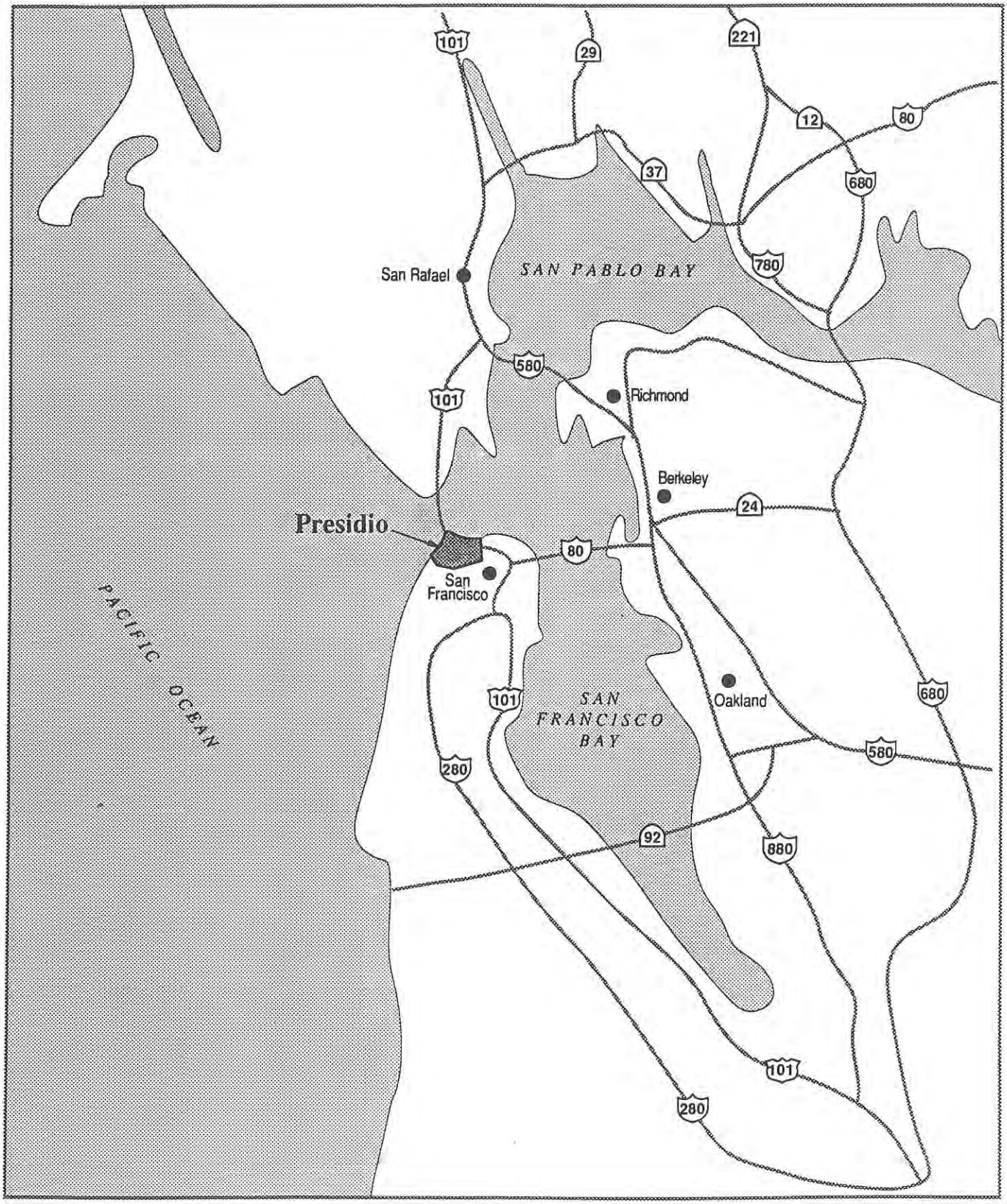
REGIONAL LOCATION MAP

National Park Service
641 | 20377 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of San Francisco
STORM WATER MANAGEMENT PLAN

DAMES & MOORE

FIGURE 1



0 10
Miles

N

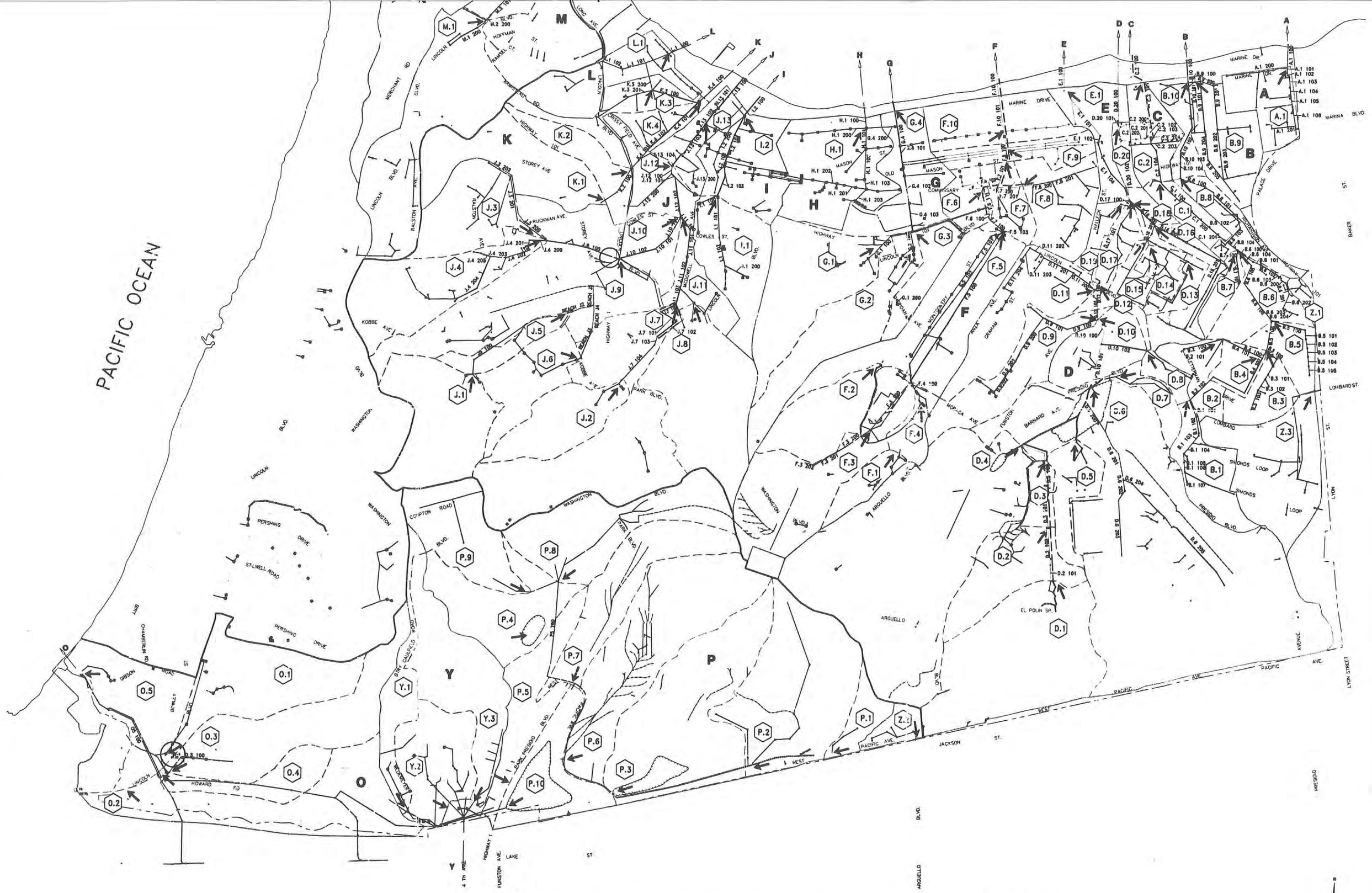
REGIONAL LOCATION MAP

National Park Service
641 | 20377 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of San Francisco
STORM WATER MANAGEMENT PLAN

DAMES & MOORE

FIGURE 1



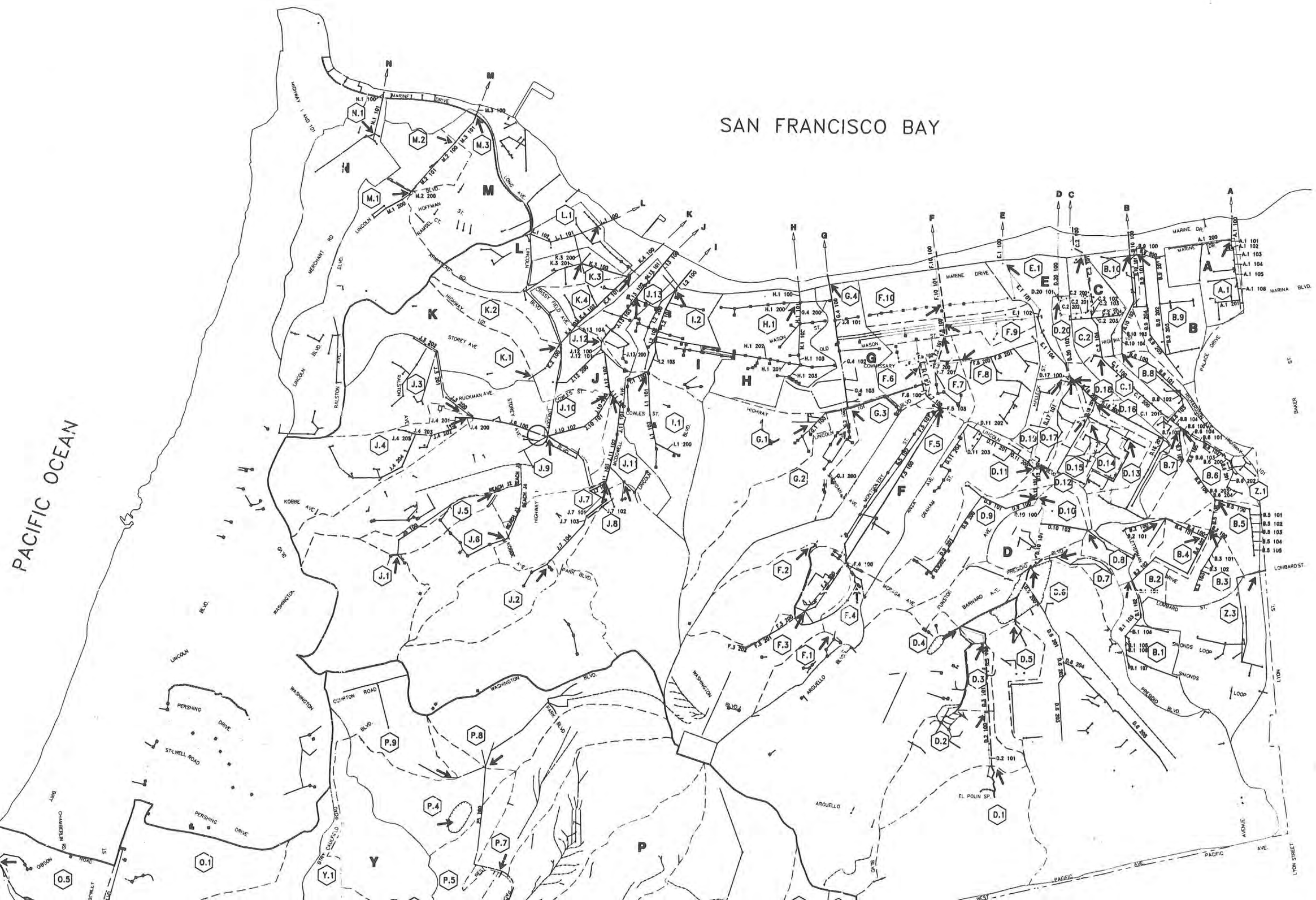
KEY:

STORM SEWER PIPE

TOPOGRAPHIC DEPRESSION

MAJOR WATERSHED DIVIDE

FREQUENT FLOODING HAS BEEN REPORTED AT THE FOLLOWING LOCATIONS:


SAN FRANCISCO BAY
PACIFIC OCEAN
MARINE DRIVE
MARINA BLVD.
PALACE DRIVE
BAKER ST.
LYON ST.
LOMBARD ST.
PRESIDIO BLVD.
PACIFIC AVE.
LYON STREET
WASHINGTON BLVD.
PARK BLVD.
LINCOLN BLVD.
GEARY BLVD.
HIGHWAY 1 AND 101
MERCHANT RD
STOREY AVE
KOBBE AVE.
PERSHING DRIVE
STILWELL ROAD
CHAMBERLIN RD
COMPTON ROAD
ARGUELLO BLVD.
EL POLIN SP.
SIMONDS LOOP
MASON ST.
COWLES ST.
RUCKMAN AVE.
HOFFMAN BLVD.
LONG AVE.
MOSCA AVE.
BARNARD AVE.
GRAHAM AVE.
MONTGOMERY AVE.
MOULTRIE ST.
HALLECK ST.
RICHARDSON AVE.
LINCOLN BLVD.
N
M
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P
O

SOIL TYPES

National Park Service
641 | 20362 | DSC | OCTOBER 1994
D&M 02350-155-038

Golden Gate National Recreation Area
Presidio of San Francisco
STORM WATER MANAGEMENT PLAN

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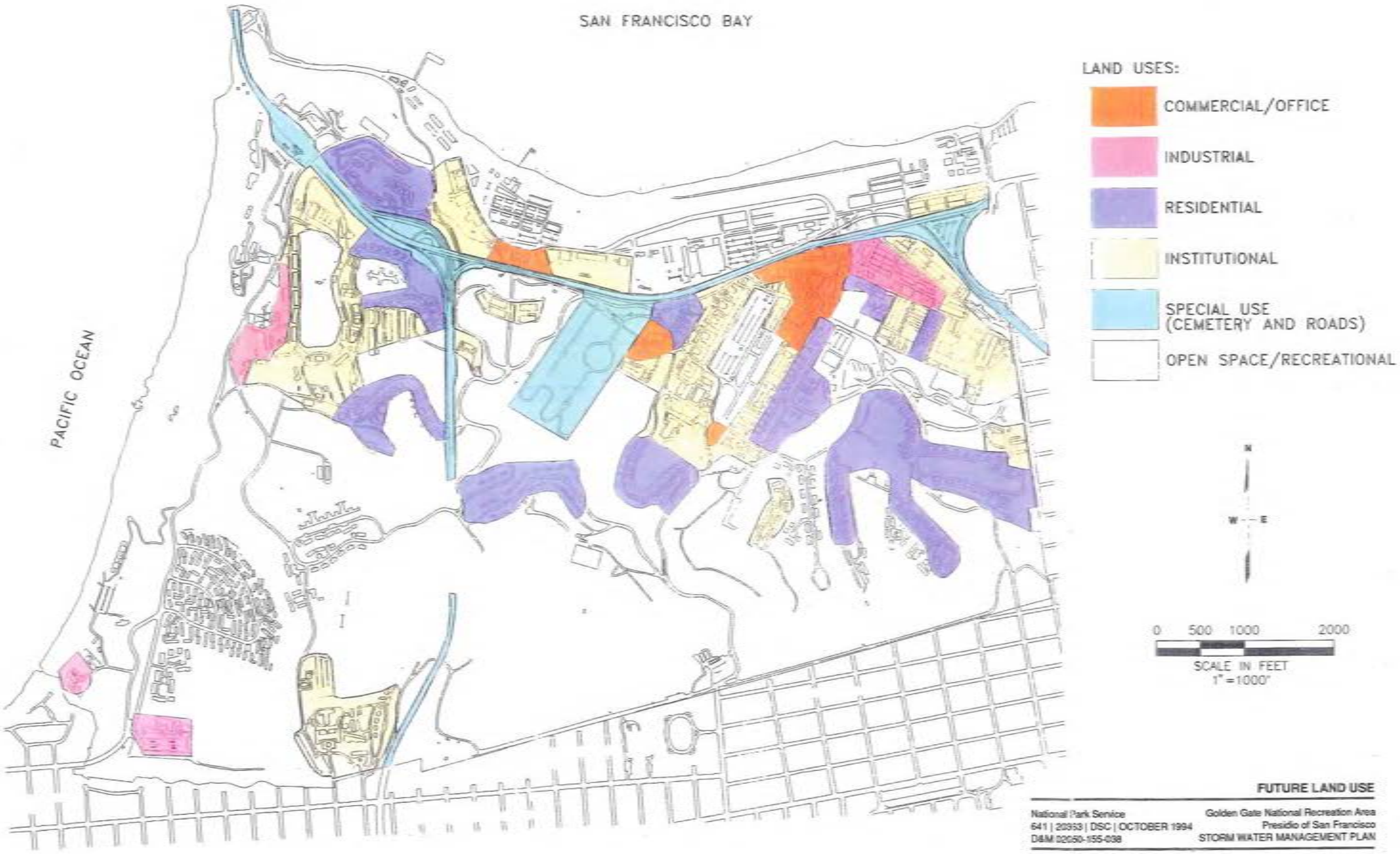
FIGURE 4

ON MICROFILM



FUTURE LAND USE

National Park Service
641 | 20353 | DSC | OCTOBER 1994
D&M 02050-155-038

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Presidio of San Francisco
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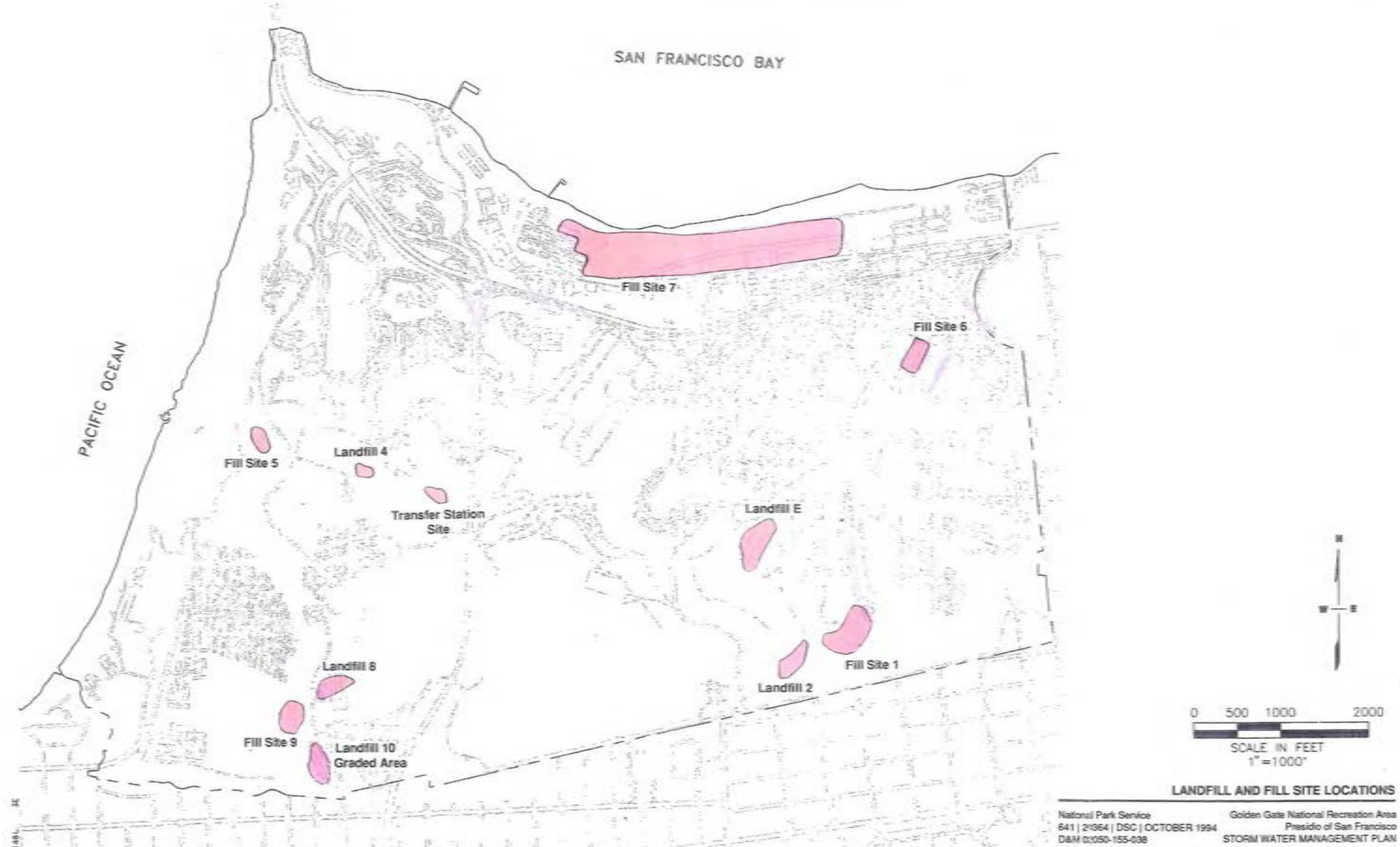
FIGURE 5

ON MICROFILM



LANDFILL AND FILL SITE LOCATIONS

National Park Service
641 | 21964 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of San Francisco
STORM WATER MANAGEMENT PLAN

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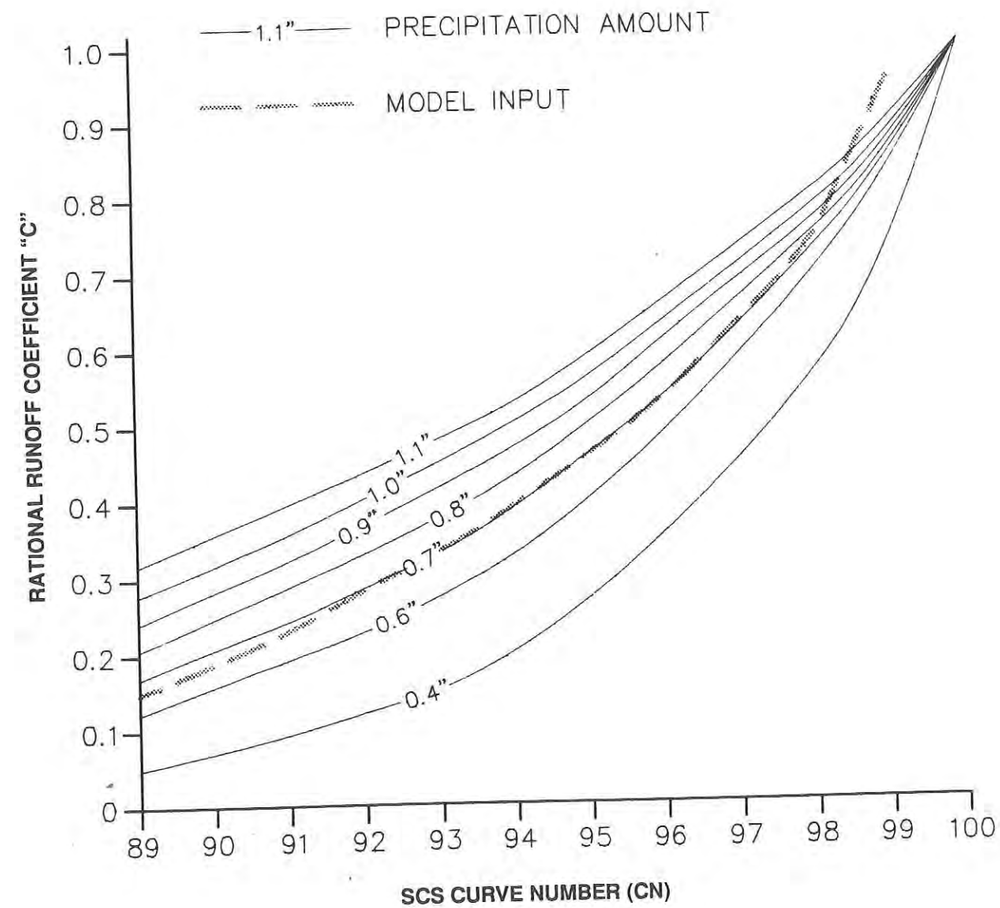
FIGURE 6

ON MICROFILM



STORM FREQUENCY AND DURATION	PRECIPITATION (IN INCHES)
2 YEAR–30 MINUTE	0.4"
2 YEAR–1 HOUR	0.6"
10 YEAR–30 MINUTE	0.7"
25 YEAR–30 MINUTE	0.8"
10 YEAR–1 HOUR	0.9"
100 YEAR–30 MINUTE	0.9"
25 YEAR–1 HOUR	1.0"
100 YEAR–1 HOUR	1.1"

RATIONAL RUNOFF COEFFICIENT "C" vs. SCS CN FOR VARIOUS PRECIPITATION AMOUNTS

National Park Service
641 | 20365 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of San Francisco
STORM WATER MANAGEMENT PLAN

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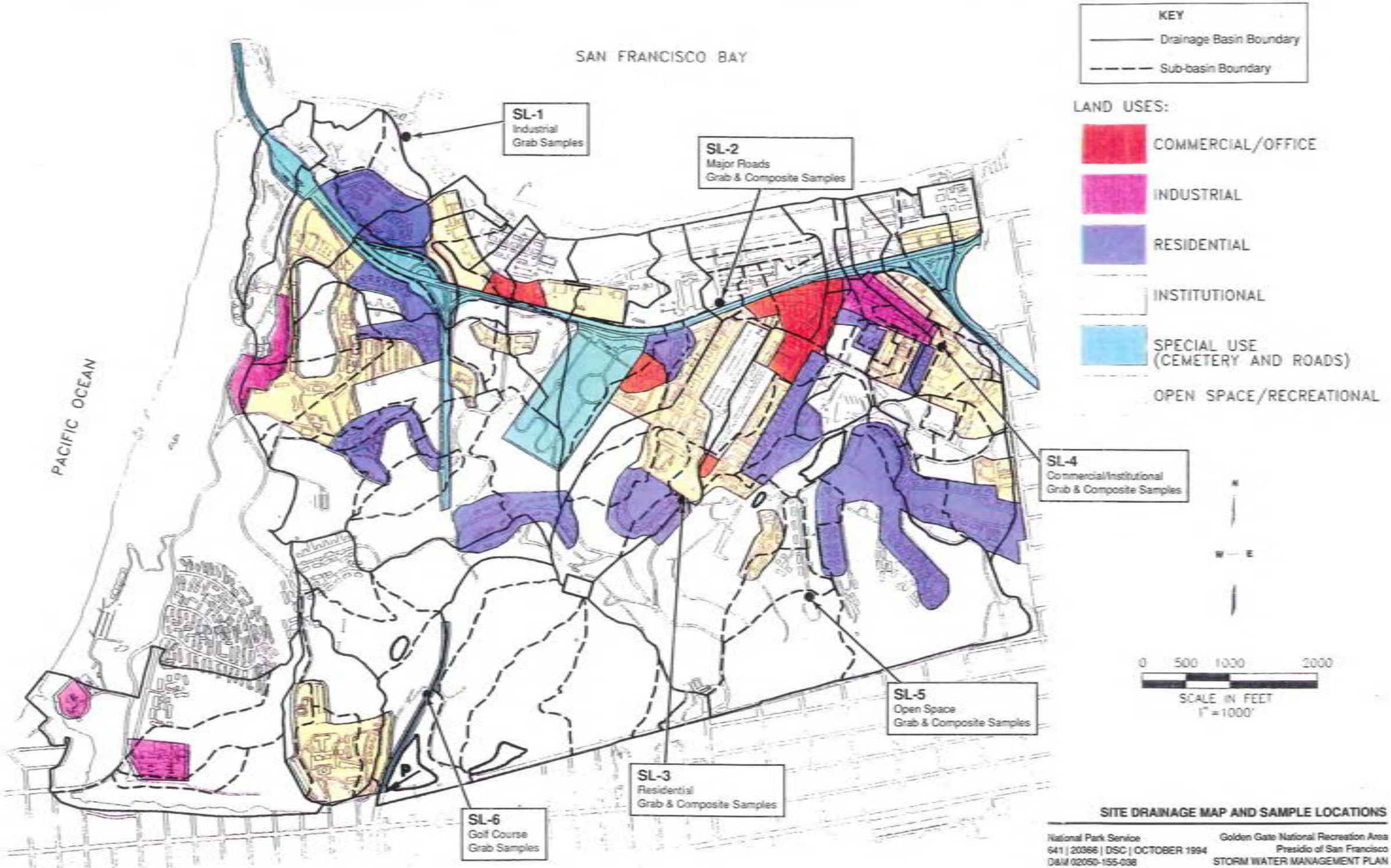
FIGURE 7



SITE DRAINAGE MAP AND SAMPLE LOCATIONS

National Park Service
641 | 20366 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of San Francisco
STORM WATER MANAGEMENT PLAN

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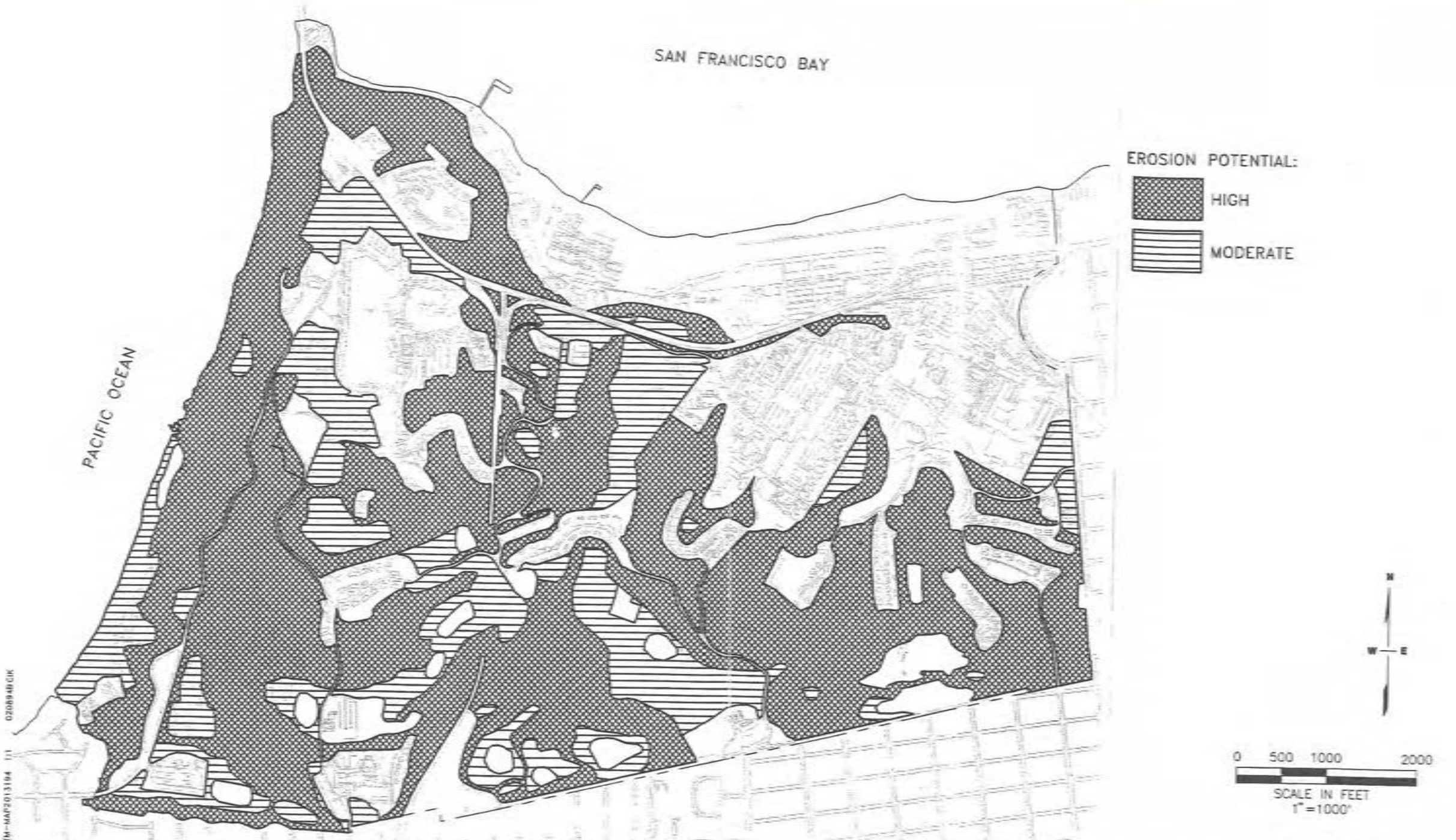
FIGURE 8

ON MICROFILM



SOIL EROSION POTENTIAL

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641 | 20367 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of California
STORM WATER MANAGEMENT PLAN

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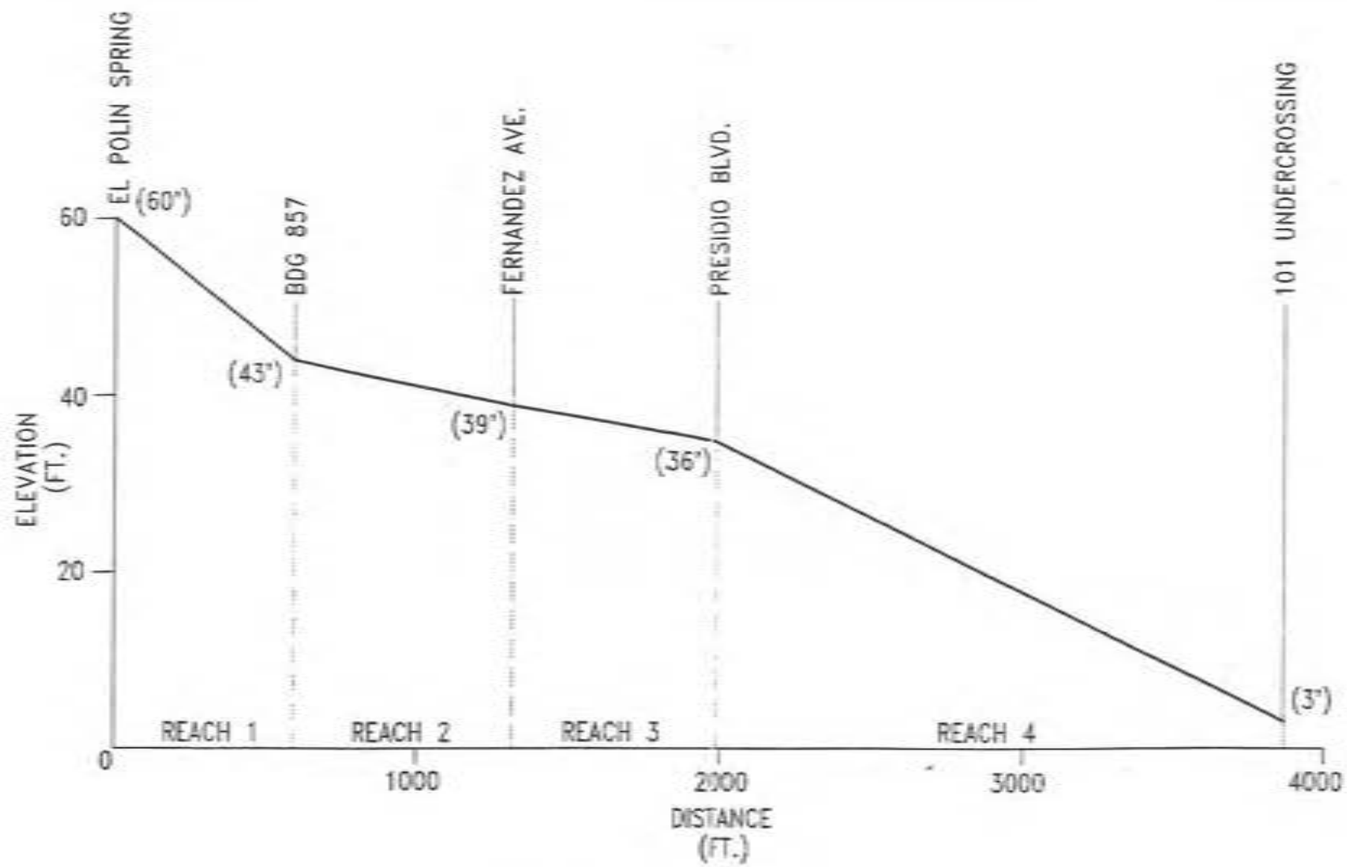
FIGURE 9

CA MICROFILM



TENNESSEE HOLLOW RIPARIAN RESTORATION CHANNEL PROFILE

NOTE:
ELEVATIONS REFERENCE MEAN LOWER LOW WATER (MLLW)

TENNESSEE HOLLOW RIPARIAN RESTORATION CHANNEL PROFILE

National Park Service
641 | 20369 | DSC | OCTOBER 1994
D&M 12050-155-038

Golden Gate National Recreation Area
Presidio of San Francisco
STORM WATER MANAGEMENT PLAN

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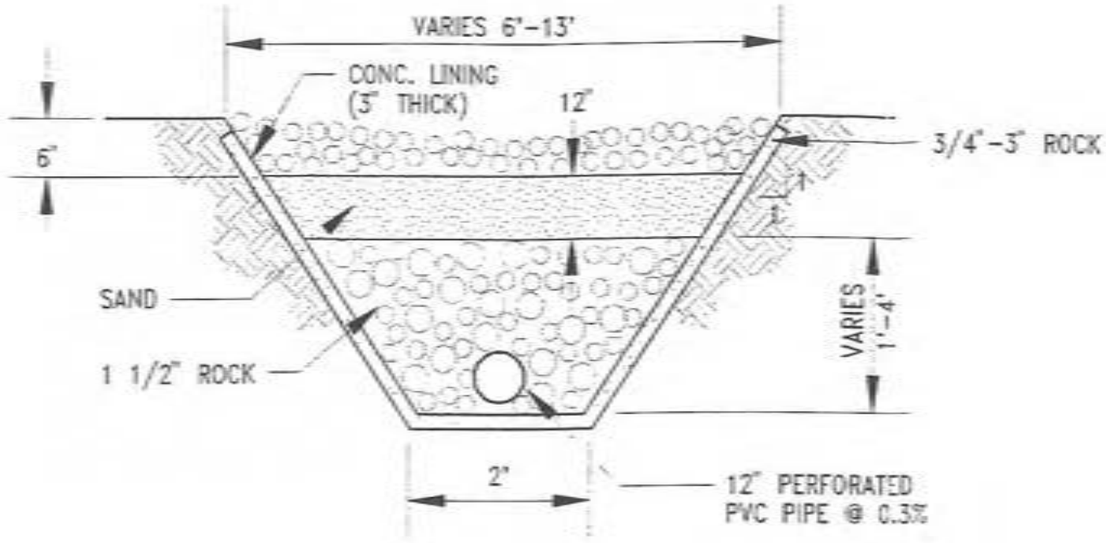
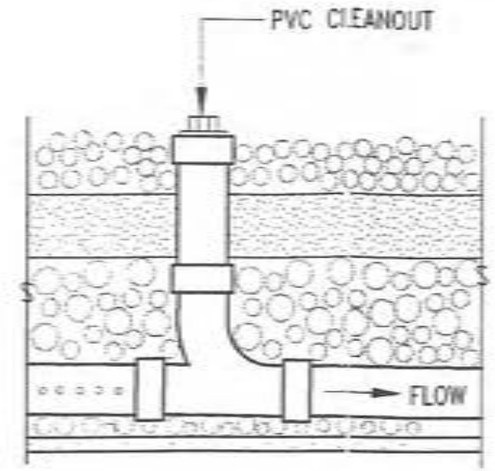
FIGURE 11





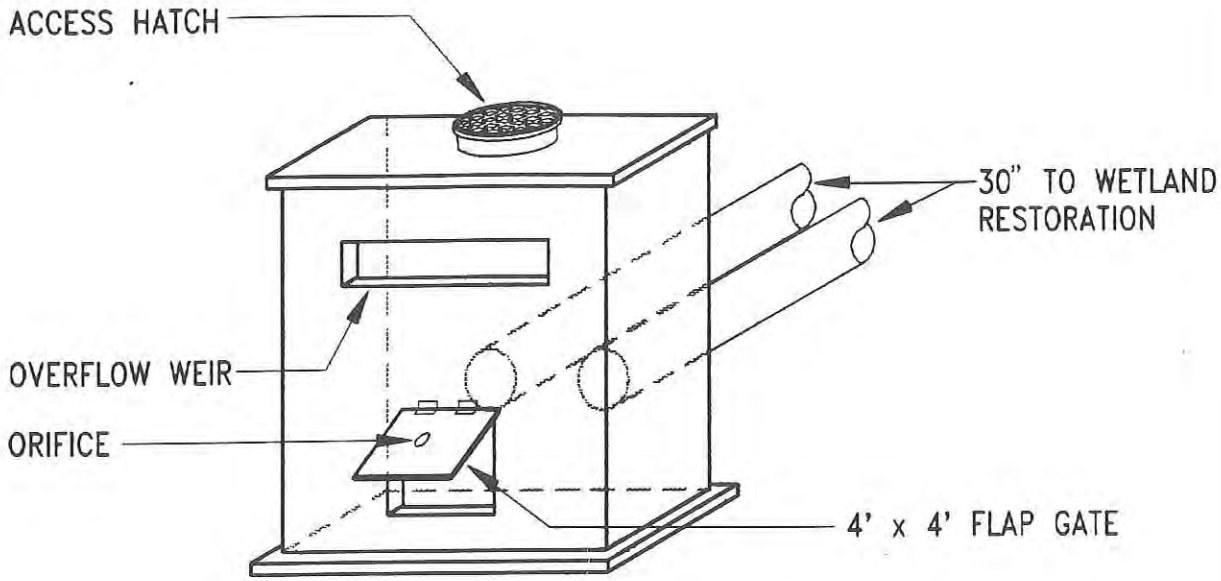
NOTE:
PROVIDE CLEANOUT ON PERFORATED
PVC PIPE EVERY 100 FOOT

LINED FILTRATION CHANNEL

LINED FILTRATION CHANNEL

National Park Service — Golden Gate National Recreation Area
641 | 20370 | DSC | OCTOBER 1994 — Presidio of California
D&M 62050-155-038 — STORM WATER MANAGEMENT PLAN

DAMES & MOORE — FIGURE 12



WATER LEVEL CONTROL STRUCTURE

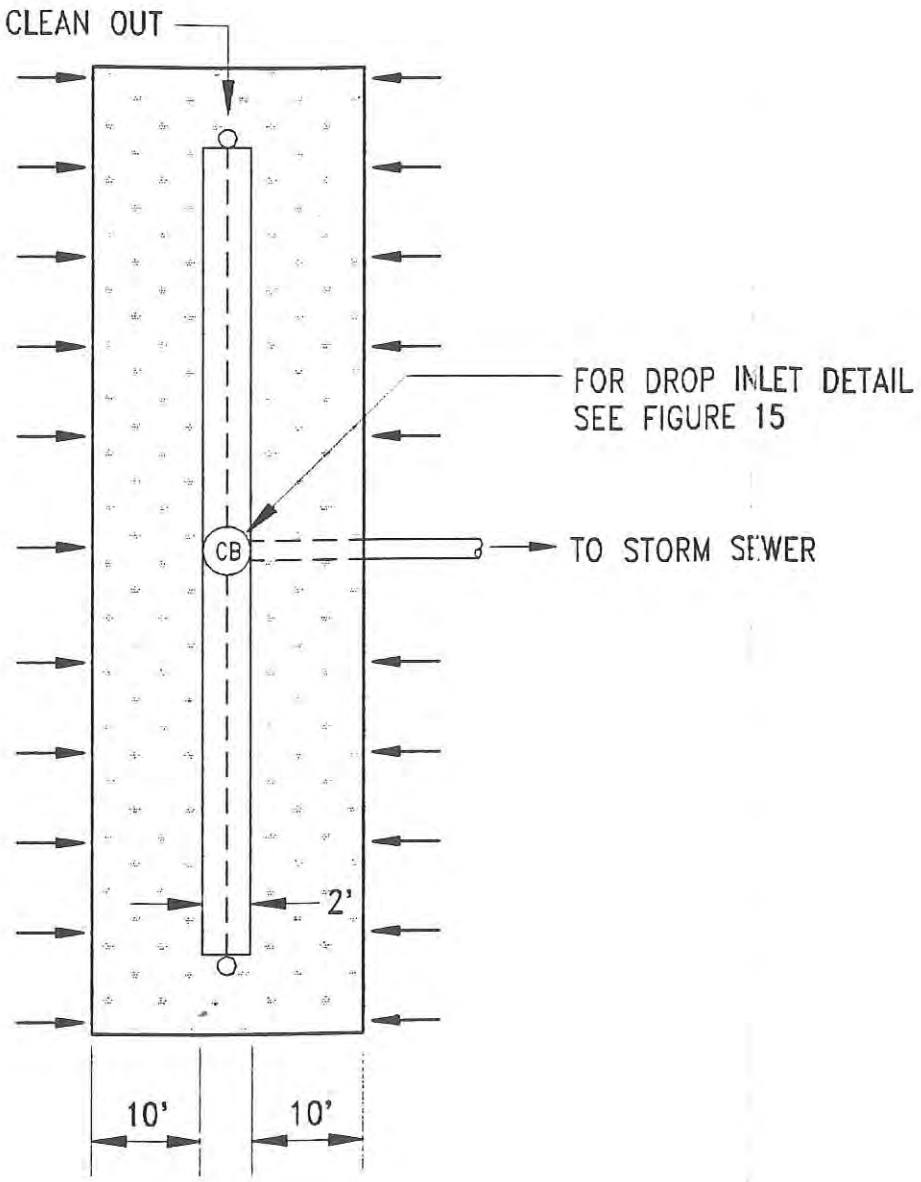
PRETREATMENT BASIN
WATER LEVEL CONTROL STRUCTURE

National Park Service
641 | 20371 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of California
STORM WATER MANAGEMENT PLAN

DAMES & MOORE

FIGURE 13



ICH DETAIL

BIOFILTER/INFILTRATION TRENCH

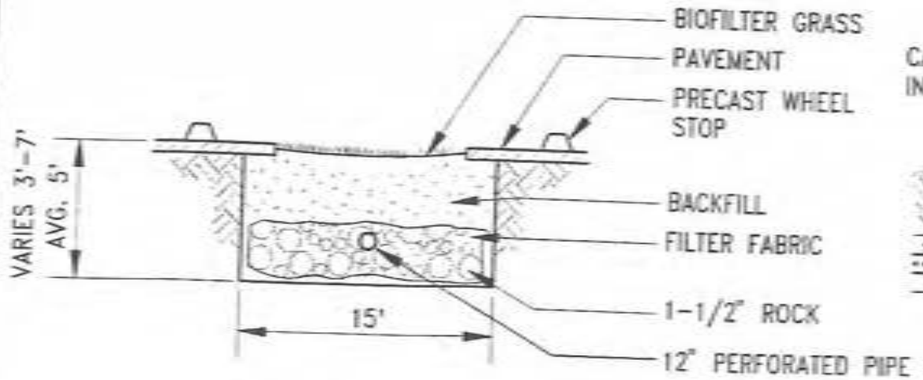
National Park Service
641 | 20372 | DSC | OCTOBER 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio of California
STORM WATER MANAGEMENT PLAN

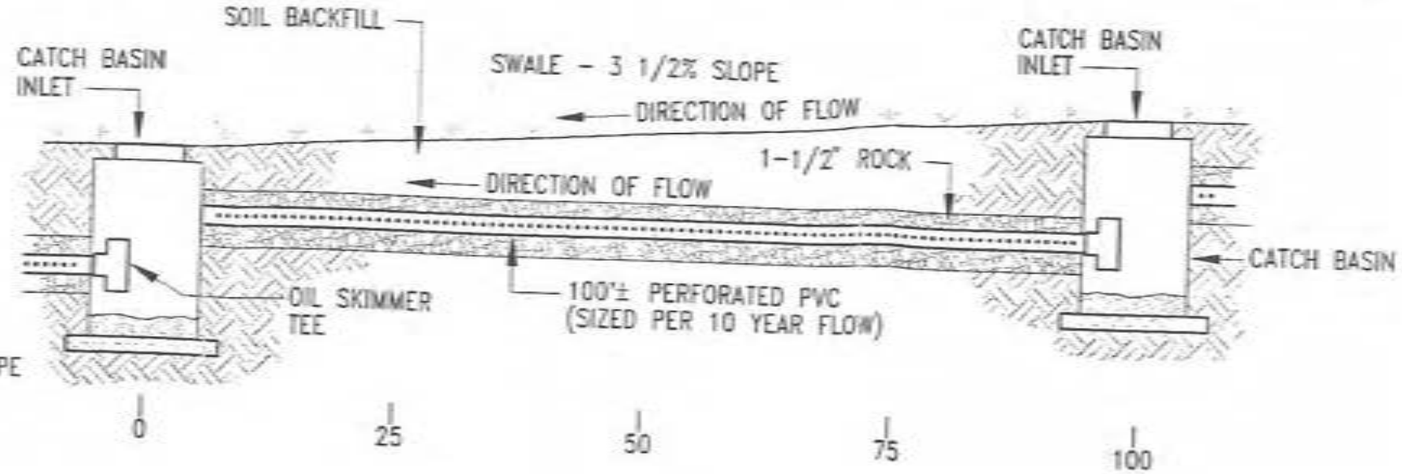
DAMES & MOORE

FIGURE 14

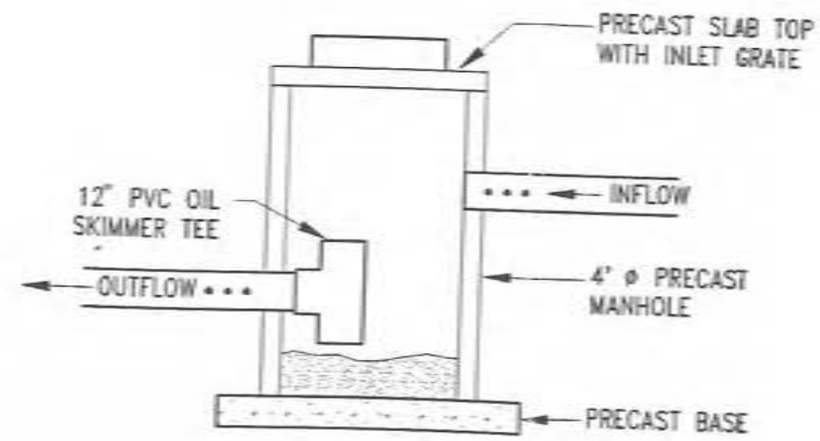
CM MICROFILM



TYPICAL INFILTRATION BED CROSS SECTION



PROFILE



TYPICAL DROP INLET OIL/WATER SEPARATOR

PARADE GROUNDS PARKING
BIOFILTER/SWALE WITH INFILTRATION BED

National Park Service
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DAM 02050-155-038

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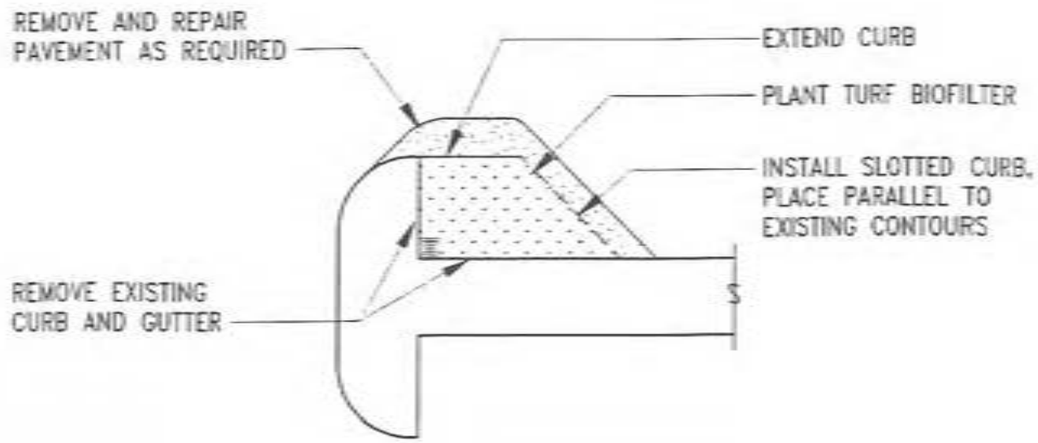
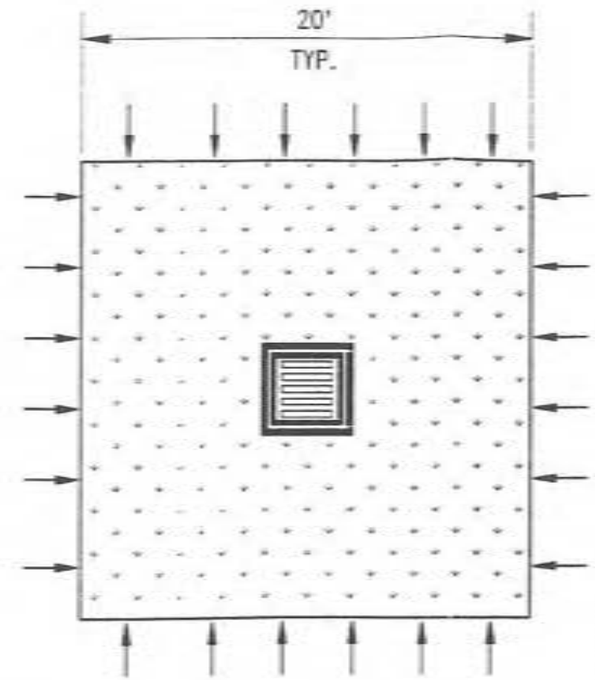
Presidio of California
STORM WATER MANAGEMENT PLAN

DAMES & MOORE

FIGURE 15



BIOFILTER INLETS
LETTERMAN COMPLEX



NOTE:
PROVIDE MINIMUM FLOW PATH
OF 10 FEET TO INLET

TYPICAL BIOFILTER INLET

BIOFILTER INLET

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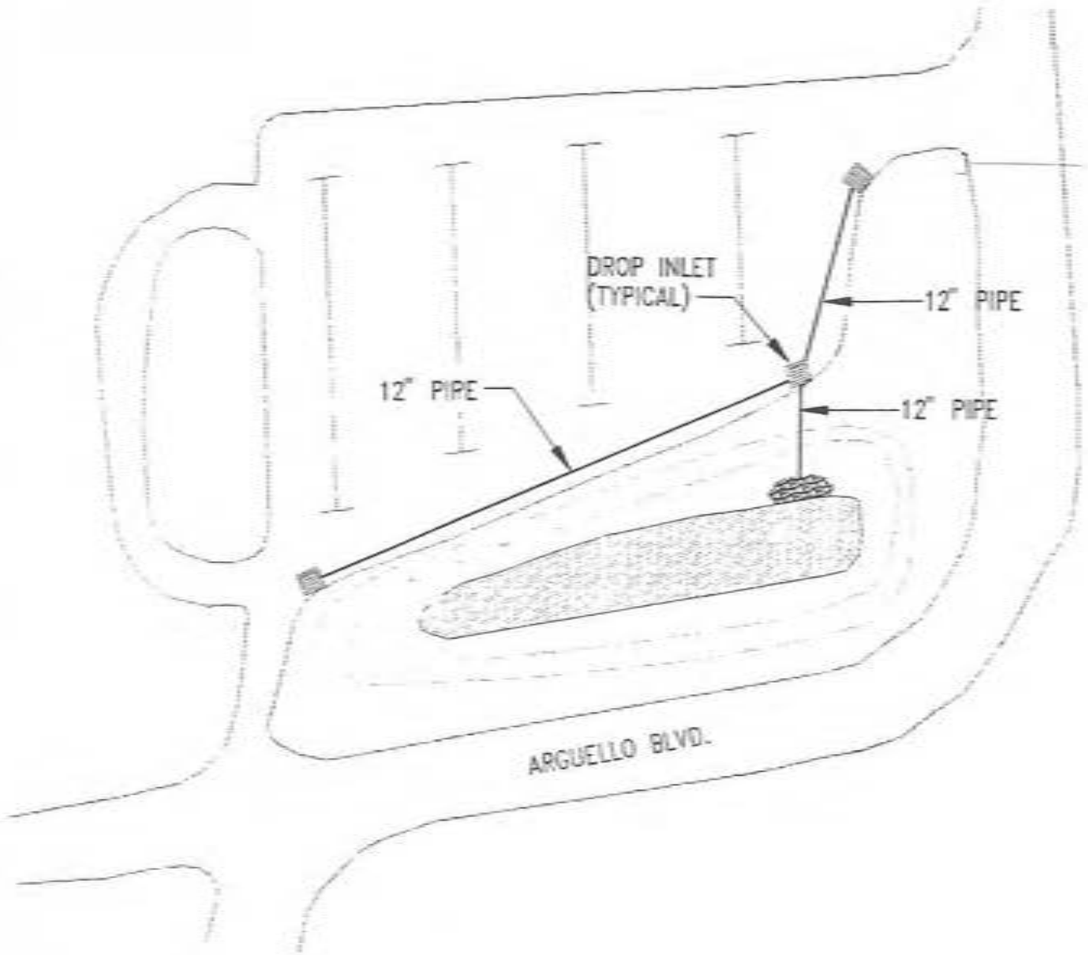
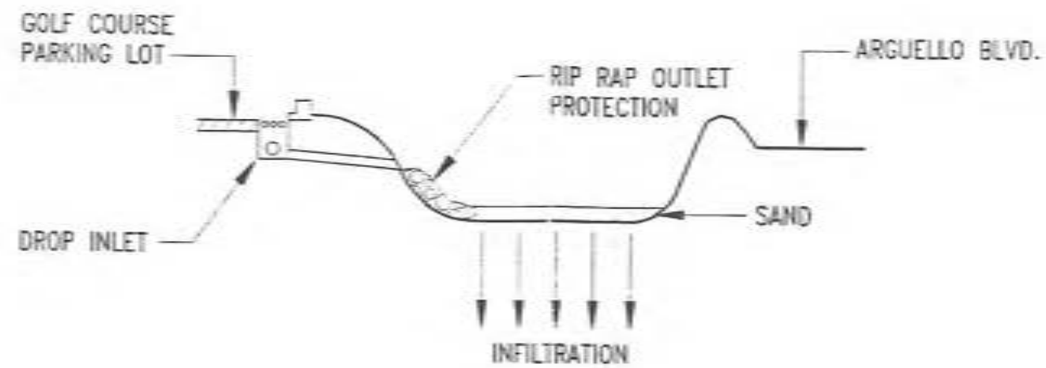
641 | 20374 | DSC | OCTOBER 1994 — Presidio of California
D&M 02050-155-038 — STORM WATER MANAGEMENT PLAN

DAMES & MOORE — FIGURE 16

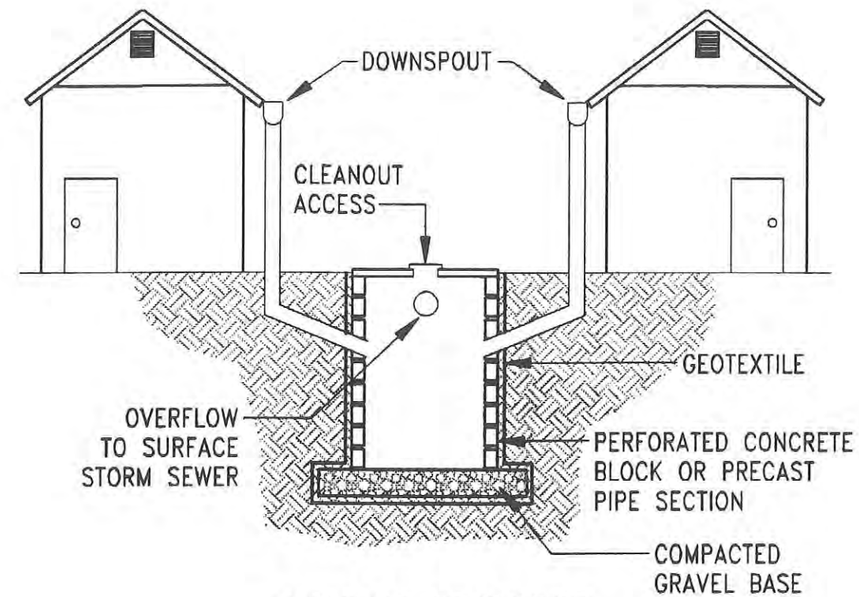




GOLF COURSE PARKING LOT INFILTRATION BASIN

National Park Service — Golden Gate National Recreation Area
6-1 | 20375 | DSC | OCTOBER 1994 — Presidio of California
D&M 02050-155-038 — STORM WATER MANAGEMENT PLAN

DAMES & MOORE — FIGURE 17



TYPICAL DRY WELL

NOTE: TO CONVERT TO STORAGE CISTERN, SUBSTITUTE IMPERMEABLE BASE AND WALLS.

02050145.CIK STM-DET 042094 1:1 042094A.CIK

TYPICAL DRY WELL

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Golden Gate National Recreation Area
Presidio of California
STORM WATER MANAGEMENT PLAN

DAMES & MOORE

FIGURE 18

APPENDIX A

STANDARD INDUSTRIAL CLASSIFICATION CODES

STANDARD INDUSTRIAL CLASSIFICATION CODES

SIC Code	Industry

1) **40 CFR 122.26 (b)(14)(ii)** (These classifications are required to get storm water discharge permits)

24 Lumber and Wood Products

2411 Logging camps and logging contractors
2421 Sawmills and planing mills, general
2426 Hardwood dimension and flooring
2429 Special product sawmills, nec
2431 Millwork
2435 Hardwood veneer and plywood
2436 Softwood veneer and plywood
2439 Structural veneer and plywood
2441 Nailed wood boxes and shook
2448 Wood pallets and skids
2449 Wood containers, nec
2451 Mobile homes
2491 Wood preserving
2492 Particleboard
2499 Wood products, nec

26 Paper Products

2611 Pulp mills
2621 Paper mills, except building paper
2631 Paperboard mills
2641 Paper coating and glazing
2642 Envelopes
2643 Bags, except textile bags
2645 Die-cut paper and board
2646 Pressed and molded pulp goods
2647 Sanitary paper products
2648 Stationary products
2649 Converted paper products, nec
2661 Building paper and board mills

Note: nec = not elsewhere classified

SIC Code	Industry	
28	**Chemical Products**	
	2800	General chemical manufacturing
	2812	Alkalies and chlorine
	2813	Industrial gases
	2816	Inorganic pigments
	2818	Organic pesticide products
	2819	Industrial inorganic chemicals, nec
	2821	Plastic materials and resins
	2822	Synthetic rubber
	2823	Cellulosic man-made fibers
	2824	Organic fibers, noncellulosic
	2841	Soap and other detergents
	2842	Polishes and sanitation goods
	2843	Surface active agents
	2844	Toilet preparations
	2851	Paints and allied products
	2861	Gum and wood chemicals
	2865	Cyclic crudes and intermediates
	2869	Industrial organic chemicals, nec
	2873	Nitrogenous fertilizers
	2874	Phosphatic fertilizers
	2875	Fertilizers, mixing only
	2879	Agricultural chemicals, nec
	2891	Adhesives and sealants
	2892	Explosives
	2893	Printing ink
	2895	Carbon black
	2899	Chemical preparations, nec
29	**Petroleum and Coal Products**	
	2911	Petroleum refining
	2951	Paving mixtures and blocks
	2952	Asphalt felts and coatings
	2992	Lubricating oils and greases
	2999	Petroleum and coal products, nec

Note: nec = not elsewhere classified

SIC Code	Industry
31	**Leather Products**
	3111 Leather tanning and finishing
32	**Stone, Clay, and Glass Products**
	3211 Flat glass
	3221 Glass containers
	3229 Pressed and blown glass, nec
	3241 Cement, hydraulic
	3251 Brick and structural clay tile
	3253 Ceramic wall and floor tile
	3255 Clay refractories
	3259 Structural clay products, nec
	3261 Vitreous plumbing fixtures
	3262 Vitreous china food utensils
	3263 Fine earthenware food utensils
	3264 Porcelain electrical supplies
	3269 Pottery products, nec
	3271 Concrete block and brick
	3272 Concrete products, nec
	3273 Ready-mixed concrete
	3274 Lime
	3275 Gypsum products
	3281 Cut stone and stone products
	3291 Abrasive products
	3292 Asbestos products
	3293 Gaskets, packing and sealing devices
	3295 Mineral, ground or treated
	3296 Mineral wood
	3297 Nonclay refractories
	3299 Nonmetallic mineral products, nec

Note: nec = not elsewhere classified

SIC Code	Industry
33	**Primary Metal Industries**
	3312 Blast furnaces and steel mills
	3313 Electrometallurgical products
	3315 Steel wire and related products
	3316 Cold finishing of steel shapes
	3317 Steel pipe and tubes
	3321 Gray iron foundries
	3324 Steel investment foundries
	3325 Steel foundries, nec
	3331 Primary copper
	3332 Primary lead
	3333 Primary zinc
	3334 Primary aluminum
	3339 Primary nonferrous metals, nec
	3341 Secondary nonferrous metals
	3351 Copper rolling and drawing
	3353 Aluminum sheet, plate, and foil
	3354 Aluminum extruded products
	3355 Aluminum rolling and drawing, nec
	3356 Nonferrous rolling and drawing, nec
	3357 Nonferrous wire drawing and insulating
	3361 Aluminum foundries
	3362 Brass, bronze, and copper foundries
	3369 Nonferrous foundries, nec
	3398 Metal heat treating
	3399 Primary metal products, nec
34	**Metal Fabrications**
	3441 Fabricated structural metal
37	**Transportation Equipment**
	3731 Ship building and repairing
	3732 Boat building and repairing

Note: nec = not elsewhere classified

SIC
Code **Industry**

2) **40 CFR 122.26 (b)(14)(iii)** (These classifications are required to get storm water discharge permits)

10-14 **Mining**

1011 Iron ores
1021 Copper ores
1031 Lead and zinc ores
1041 Gold ores
1044 Silver ores
1051 Bauxite and other aluminum ores
1061 Ferroalloy ores, except vanadium
1081 Metal mining services
1092 Mercury ores
1094 Uranium, radium, vanadium ores
1099 Metal ores, nec

1111 Anthracite
1112 Anthracite mining services

1211 Bituminous coal and lignite
1213 Bituminous and lignite services

1311 Crude petroleum and natural gas
1321 Natural gas liquids
1381 Drilling oil and gas wells
1382 Oil and gas exploration services
1389 Oil and gas field services, nec

1411 Dimension stone
1422 Crushed and broken limestone
1423 Crushed and broken granite
1429 Crushed and broken stone, nec
1442 Construction sand and gravel
1446 Industrial sand
1452 Bentonite
1453 Fire clay
1454 Fuller's earth

Note: nec = not elsewhere classified

SIC Code	Industry
	Mining (continued)
1455	Kaolin and ball clay
1459	Clay and related minerals, nec
1472	Barite
1473	Fluorspar
1474	Potash, soda and borate minerals
1475	Phosphate rock
1476	Rock salt
1477	Sulfur
1479	Chemical and fertilizer mining, nec
1481	Nonmetallic minerals services
1492	Gypsum
1496	Talc, soapstone, and pyrophyllite
1499	Nonmetallic minerals, nec

3) **40 CFR 122.26 (b)(14)(viii)** (These classifications are required to get storm water discharge permits)

40	**Railroad Transportation**
4011	Railroads, line-haul operating
4013	Switching and terminal devices
4041	Railway express service
41	**Local Passenger Transportation**
4111	Local and suburban transit
4119	Local passenger transportation, nec
4121	Taxicabs
4131	Intercity highway transportation
4141	Local passenger charter service
4142	Charter service, except local
4151	School buses
4171	Bus terminal facilities
4172	Bus service facilities

Note: nec = not elsewhere classified

SIC Code	Industry
42-43	**Trucking**
	4212 Local trucking, without storage
	4213 Trucking, except local
	4214 Local trucking and storage
	4226 Special warehousing and storage, nec
	4231 Trucking terminal facilities
	4311 U.S. Postal Service
44	**Water Transportation**
	4411 Deep sea foreign transportation
	4421 Noncontiguous area transportation
	4422 Coastwise transportation
	4423 Intercoastal transportation
	4431 Great Lakes transportation
	4441 Transportation on rivers and canals
	4452 Ferries
	4453 Lighterage
	4454 Towing and tugboat service
	4459 Local water transportation, nec
	4463 Marine cargo handling
	4464 Canal operation
	4469 Water transportation services, nec
45	**Air Transportation**
	4511 Certified air transportation
	4521 Noncertified air transportation
	4582 Airports and flying fields
	4583 Air terminal services
50	**Wholesale Trade - Durable Goods**
	5015 Motor vehicle parts, used
	5093 Scrap and waste materials

Note: nec = not elsewhere classified

SIC Code	Industry
51	**Wholesale Trade - Nondurable Products**
	5171 Petroleum bulk stations and terminals

4) **40 CFR 122.26 (b)(14)(xi)** (These classifications are required to get storm water discharge permits if materials are exposed to storm water)

20	**Food Products**
	2011 Meat packaging plants
	2013 Sausages and other prepared meats
	2016 Poultry dressing plants
	2017 Poultry and egg processing
	2021 Creamery butter
	2022 Cheese, natural and processed
	2023 Condensed and evaporated milk
	2024 Ice cream and frozen desserts
	2026 Fluid milk
	2032 Canned specialties
	2033 Canned fruits and vegetables
	2034 Dehydrated fruits, vegetables, soups
	2035 Pickles, sauces, and salad dressings
	2037 Frozen fruits and vegetables
	2038 Frozen specialties
	2041 Flour and other grain mill products
	2043 Cereal breakfast foods
	2044 Rice milling
	2045 Blended and prepared flour
	2046 Wet corn milling
	2047 Dog, cat and other pet food
	2048 Prepared feeds, nec
	2051 Bread, cake, and related products
	2052 Cookies and crackers
	2061 Raw cane sugar
	2062 Cane sugar refining
	2063 Beet sugar
	2065 Confectionery products
	2066 Chocolate and cocoa products

Note: nec = not elsewhere classified

SIC Code	Industry
2067	Chewing gum
2074	Cottonseed oil mills
2075	Soybean soil mills
2076	Vegetable oil mills, nec

Note: nec = not elsewhere classified

SIC Code	Industry
	Food Products (continued)
	2077 Animal and marine fats and oils
	2078 Shortening and cooking oils
	2082 Malt beverages
	2083 Malt
	2084 Wines, brandy, brandy and brandy spirits
	2085 Distilled liquor, except brandy
	2086 Bottled and canned soft drinks
	2087 Flavoring extracts and syrups, nec
	2091 Canned and cured seafoods
	2092 Fresh or frozen packaged fish
	2095 Roasted coffee
	2097 Manufactured ice
	2098 Macaroni and spaghetti
	2099 Food preparations, nec
21	**Tobacco**
	2111 Cigarettes
	2121 Cigars
	2131 Chewing and smoking tobacco
	2141 Tobacco stemming and redrying
22	**Textile Mill Products**
	2211 Weaving mills, cotton
	2221 Weaving mills, synthetics
	2231 Weaving and finishing mills, wool
	2241 Narrow fabric mills
	2251 Women's hosiery, except socks
	2252 Hosiery, nec
	2253 Knit outwear mills
	2254 Knit underwear mills
	2256 Circular knit fabric mills
	2257 Warp knit fabric mills
	2259 Knitting mills, nec
	2261 Finishing plants, cotton

Note: nec = not elsewhere classified

SIC Code	Industry
	Textile Mill Products (continued)
	2262 Finishing plants, synthetics
	2269 Finishing plants, nec
	2271 Woven carpets and rugs
	2272 Tufted carpets and rugs
	2279 Carpets and rugs, nec
	2281 Yarn mills, except wool
	2282 Throwing and winding mills
	2283 Wool yarn mills
	2284 Thread mills
	2291 Felt goods, except woven felts and hats
	2292 Lace goods
	2293 Paddings and upholstery filling
	2294 Processed textile waste
	2295 Coated fabrics, not rubberized
	2296 Tire cord and fabric
	2297 Nonwoven fabrics
	2298 Cordage and twine
	2299 Textile goods, nec
23	**Apparel and Related Textiles**
	2311 Men's and boys' suits and coats
	2321 Men's and boys' shirts and nightwear
	2322 Men's and boys' underwear
	2323 Men's and boys' neckwear
	2327 Men's and boys' separate trousers
	2328 Men's and boys' work clothing
	2329 Men's and boys' clothing, nec
	2331 Women's and misses' blouses and waists
	2335 Women's and misses' dresses
	2337 Women's and misses' suits and coats
	2339 Women's and misses' outerwear, nec
	2341 Women's and children's underwear
	2342 Brassieres and allied garments
	2351 Millinery
	2352 Hats and caps, except millinery

Note: nec = not elsewhere classified

SIC Code	Industry
	Apparel and Related Textiles (continued)
	2361 Children's dresses and blouses
	2363 Children's coats and suits
	2369 Children's outerwear, nec
	2371 Fur goods
	2381 Fabric dress and work gloves
	2384 Robes and dressing gowns
	2385 Waterproof outergarments
	2386 Leather and sheet lined clothing
	2387 Apparel belts
	2389 Apparel and accessories, nec
	2391 Curtains and draperies
	2392 House furnishings, nec
	2393 Textile bags
	2394 Canvas and related products
	2395 Pleating and stitching
	2396 Automotive and apparel trimmings
	2397 Schiffli machine embroideries
	2399 Fabricated textile products, nec
24	**Lumber and Wood Products**
	2434 Wood kitchen cabinets
25	**Furniture and Fixtures**
	2511 Wood household furniture
	2512 Upholstered household furniture
	2514 Metal household furniture
	2515 Mattresses and bedsprings
	2517 Wood TV and radio cabinets
	2519 Household furniture, nec
	2521 Wood office furniture
	2522 Metal office furniture
	2531 Public building and related furniture
	2541 Wood partitions and fixtures
	2542 Metal partitions and fixtures

Note: nec = not elsewhere classified

SIC Code	Industry
	Furniture and Fixtures (continued)
	2591 Drapery hardware and blinds and shades
	2599 Furniture and fixtures, nec
26	**Paper Products**
	2651 Folding paperboard boxes
	2652 Set-up paperboard boxes
	2654 Corrugated and solid fiber boxes
	2654 Sanitary food containers
	2655 Fiber cans, drums, and similar products
	267 Converted paper and paperboard products
27	**Printing and Publishing Industries**
	2711 Newspapers
	2721 Periodicals
	2731 Book publishing
	2732 Book printing
	2741 Miscellaneous publishing
	2751 Commercial printing, letterpress
	2752 Commercial printing, lithographic
	2753 Engraving and plate printing
	2754 Commercial printing, gravure
	2761 Manifold business forms
	2771 Greeting card publishing
	2782 Blankbooks and looseleaf binders
	Printing and Publishing Industries (continued)
	2789 Bookbinding and related work
	2791 Typesetting
	2793 Photoengraving
	2794 Electrotyping and stereotyping
	2795 Lithographic platemaking services

Note: nec = not elsewhere classified

SIC Code	Industry
28	**Chemical Products**
	2831 Biological products
	2833 Medicinals and botanicals
	2834 Pharmaceutical preparations
	2851 Paints and allied products
30	**Rubber and Plastic Products**
	3011 Tires and inner tubes
	3021 Rubber and plastics footwear
	3031 Reclaimed rubber
	3041 Rubber and plastics hose and belting
	3069 Fabricated rubber products, nec
	3079 Miscellaneous plastics products
31	**Leather Products**
	3131 Boot and shoe cut stock and findings
	3142 House slippers
	3143 Men's footwear, except athletic
	3144 Women's footwear, except athletic
	3149 Footwear, except rubber, nec
	3151 Leather gloves and mittens
	3161 Luggage
	3671 Women's handbags and purses
	3172 Personal leather goods, nec
	3199 Leather goods, nec
32	**Stone, Clay, and Glass Products**
	3231 Products of purchased glass

Note: nec = not elsewhere classified

SIC Code	Industry
34	**Metal Fabrications**
3411	Metal cans
3412	Metal barrels, drums, and pails
3421	Cutlery
3423	Hand and edge tools, nec
3425	Hand saws and saw blades
3429	Hardware, nec
3431	Metal sanitary ware
3432	Plumbing fittings and brass goods
3433	Heating equipment, except electric
3452	Bolts, nuts, rivets, and washers
3462	Iron and steel forgings
3463	Nonferrous forgings
3465	Automotive stampings
3466	Crowns and closures
3469	Metal stampings, nec
3471	Plating and polishing
3479	Metal coating and allied services
3482	Small arms ammunition
3483	Ammunition, except for small arms, nec
3484	Small arms
3489	Ordnance and accessories, nec
3493	Steel springs, except wire
3494	Valves and pipe fittings
3495	Wire springs
3496	Miscellaneous fabricated wire products
3497	Metal foil and leaf
3498	Fabricated pipe and fittings
3499	Fabricated metal products, nec

Note: nec = not elsewhere classified

SIC Code	Industry
35	**Nonelectrical Machinery**
3511	Turbines and turbine generator sets
3519	Internal combustion engines, nec
3523	Farm machinery and equipment
3524	Lawn and garden equipment
3531	Construction machinery
3532	Mining machinery
3533	Oil field machinery
3534	Elevators and moving stairways
3535	Conveyors and conveying machinery
3536	Hoist, cranes, and monorails
3537	Industrial trucks and tractors
3541	Machine tools, metal cutting types
3542	Machine tools, metal forming types
3544	Special dies, tools, jigs and fixtures
3545	Machine tool accessories
3546	Power driven hand tools
3547	Rolling mill machinery
3549	Metalworking machinery, nec
3551	Food products machinery
3552	Textile machinery
3553	Woodworking machinery
3554	Paper industries machinery
3555	Printing trades machinery
3559	Special industry machinery, nec
3561	Pumps and pumping equipment
3562	Ball and roller bearings
3563	Air and gas compressors
3564	Blowers and fans
3565	Industrial patterns
3566	Speed changers, drives, and gears
3567	Industrial furnaces and ovens
3568	Power transmission equipment, nec
3569	General industrial machinery, nec
3572	Typewriters
3573	Electronic computing equipment
3574	Calculating and accounting machines

Note: nec = not elsewhere classified

SIC Code	Industry
	Nonelectrical Machinery (continued)
3576	Scales and balances, except laboratory
3579	Office machines, nec
3581	Automatic merchandising machines
3582	Commercial laundry equipment
3585	Refrigerator and heating equipment
3586	Measuring and dispensing pumps
3589	Service industry machinery, nec
3592	Carburetors, pistons, rings, valves
3599	Machinery, except electrical, nec
36	**Electrical and Electronic Machinery, Equipment, and Supplies**
3612	Transformers
3613	Switchgear and switchboard apparatus
3621	Motors and generators
3622	Industrial controls
3623	Welding apparatus, electrical
3624	Carbon and graphite products
3629	Electrical industrial apparatus, nec
3631	Household cooking equipment
3632	Household refrigerators and freezers
3633	Household laundry equipment
3634	Electric housewares and fans
3635	Household vacuum cleaners
3636	Sewing machines
3639	Household appliances, nec
3641	Electric lamps
3643	Current-carrying wiring devices
3644	Noncurrent-carrying wiring devices
3645	Residential lighting fixtures
3646	Commercial lighting fixtures
3647	Vehicular lighting equipment
3648	Lighting equipment, nec
3651	Radio and TV receiving sets
3652	Phonograph records
3661	Telephone and telegraph apparatus

Note: nec = not elsewhere classified

SIC Code	Industry
	Electrical and Electronic Machinery, Equipment, and Supplies (continued)
3662	Radio and TV communication equipment
3671	Electron tubes, receiving type
3672	Cathode ray television picture tubes
3673	Electron tubes, transmitting
3674	Semiconductors and related devices
3675	Electronic capacitors
3676	Electronic resistors
3677	Electronic coils and transformers
3678	Electronic connectors
3679	Electronic components, nec
3691	Storage batteries
3692	Primary batteries, dry and wet
3693	X-ray apparatus and tubes
3694	Engine electrical equipment
3699	Electric equipment and supplies, nec
37	**Transportation Equipment**
3711	Motor vehicles and car bodies
3713	Truck and bus bodies
3714	Motor vehicle parts and accessories
3715	Truck trailers
3716	Motor homes on purchased chassis
3721	Aircraft
3724	Aircraft engines and engine parts
3725	Aircraft equipment, nec
3743	Railroad equipment
3751	Motorcycles, bicycles, and parts
3761	Guided missiles and space vehicles
3764	Space propulsion units and parts
3769	Space vehicle equipment, nec
3792	Travel trailers and campers
3795	Tanks and tank components
3799	Transportation equipment, nec

Note: nec = not elsewhere classified

SIC Code	Industry
38	**Instruments**
3811	Engineering and scientific instruments
3822	Environmental controls
3823	Process control instruments
3824	Fluid meters and counting devices
3825	Instruments to measure electricity
3829	Measuring and controlling devices, nec
3832	Optical instruments and lenses
3841	Surgical and medical instruments
3842	Surgical appliances and supplies
3843	Dental equipment and supplies
3851	Ophthalmic goods
3861	Photographic equipment and supplies
3873	Watches, clocks, and watchcases
39	**Miscellaneous Manufacturing**
3911	Jewelry, precious metal
3914	Silverware and plated ware
3915	Jewelers' materials and lapidary work
3931	Musical instruments
3942	Dolls
3944	Games, toys, and children's vehicles
3949	Sporting and athletic goods, nec
3951	Pens and mechanical pencils
3952	Lead pencils and art work
3953	Marking devices
3955	Carbon paper and inked ribbons
3961	Costume jewelry
3962	Artificial flowers
3963	Buttons
3964	Needles, pins, and fasteners
3991	Brooms and brushes
3993	Signs and advertising displays
3995	Burial caskets
3996	Hard surface floor coverings
3999	Manufacturing industries, nec

Note: nec = not elsewhere classified

SIC Code	Industry
42	**Trucking**
4221	Farm product warehousing and storage
4222	Refrigerated warehousing
4224	Household goods warehousing
4225	General warehousing and storage

Note: nec = not elsewhere classified

APPENDIX B

DESCRIPTION OF SOIL UNITS

B.1 DESCRIPTION OF SOIL UNITS

121-Orthents, cut and fill, 0 to 15 percent slopes

These very shallow to very deep, well drained soils are on alluvial fans, coastal terraces, and hills. The soils formed in alluvium and residuum derived dominantly from hard or soft sandstone. This units consists of soils that have been cut and filled for recreational development, such as the construction of golf courses and ballfields, or cemeteries. In summer, irrigation is needed for lawns and most ornamental plantings. The properties and characteristics of the soils in this unit are highly variable because of the differences in kind and amount of fill material used. Runoff is medium and the hazard of water erosion is moderate.

124-Orthents, cut and fill-Urban land complex, 5 to 75 percent slopes

This map unit is on uplands and consists of a combination of Orthents soils, which have been cut and filled, and urban land. Most areas of this unit are used for homesite development. Excavation for roads and buildings increases the risk of erosion. Structures to divert runoff are needed if buildings and roads are constructed. In summer, irrigation is needed for lawns and most ornamental plantings. The properties and characteristics of the Orthents are highly variable because of the differences in the kind and amount of fill material used. Runoff is medium to very rapid, and the hazard of water erosion is moderate to very high.

127-Rock outcrop-Orthents complex, 30 to 75 percent slopes

This map unit consists mainly of long and narrow, generally rocky areas that rise abruptly along the coastline of the Pacific Ocean. It is made up of cliff faces and associated narrow areas on the top of bluffs that separate the coastal terraces and mountainous uplands from the beaches and ocean. Generally this unit is comprised of equal amounts of rock outcrop (including exposures of sandstone, shale, and basic igneous rock), and Orthents (consisting of alluvium loamy soils and pockets of windblown sand). Occasionally parts of the cliff faces slough away, causing damage to adjacent urban developments.

129-Sirdrak sand, 5 to 50 percent slopes

This very deep, somewhat excessively drained soil is located on coastal dunes. This unit is commonly used as recreation areas or wildlife habitat. Permeability is rapid in this type of soil, and the available water capacity is low. Runoff is very slow, and the hazard of water erosion is moderate or high. The hazard of soil blowing is high. When used for recreational development, it is limited mainly by the slope and hazard of soil blowing. Erosion can be a

problem in recreational areas (specifically foot paths and bridle trails) if runoff if is not diverted. The use of plant cover can be utilized to help control erosion and sedimentation. Properties of this soil unit are summarized on Table B.1.

130-Typic Argiustolls, loamy-Urban land association, 5 to 15 percent slopes

This map unit is located on coastal terraces, and consists of deep, well drained alluvium derived soils. Primary land uses associated with this unit include recreation, urban development and wildlife habitat, with some areas being used for row crops. There are risks associated with urban development on this unit, as it has a moderate to high shrink-swell potential. Proper engineering and design can help mitigate associated hazards. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Permeability is moderately slow or slow and available water capacity is high.

131-Urban land

This map unit consists of areas where more than 85 percent of the surface is covered by asphalt, concrete, buildings, and other structures. Included in this unit are small areas of Orthents, cut and fill, and Orthents, reclaimed. These soils make up approximately 15 percent of the total acreage. The unit is used primarily for homesite, urban, and recreational development.

134-Urban land-Orthents, reclaimed complex, 0 to 2 percent slopes

This map unit is located in areas that were once part of San Francisco Bay, and in adjacent tidal flats. Only a small portion of the Presidio (in Crissy Field near the eastern periphery) contains this soil unit. Urban land accounts for the majority of the unit. Major limitations are associated with susceptibility of the soils to subsidence and highly variable soil properties (texture, permeability, and available water capacity). In summer, irrigation is need for lawns and most ornamental plantings. The properties and characteristics of these soils are highly variable because of the differences in the kind and amount of fill material used. Some have a permanent high water table (at a depth of 30 to 60 inches) because of the fluctuating tides. Runoff is slow, and the hazard of erosion is low.

136-Urban land-Sirdrak complex, 2 to 50 percent slopes

This map unit is located on stabilized dunes, and is covered by a combination of urban land and soils that are similar to the Sirdrak soil. The main limitations are the slope, the low available water capacity and hazard of soil blowing. Erosion is a hazard in steeper areas. Only a portion of a construction site should be disturbed and excavation activities should be followed promptly by revegetation. In summer, irrigation is needed for lawn grasses and most ornamental plants and trees. The underlying Sirdrak soil is very deep and somewhat excessively drained. It was formed in eolian material derived dominantly from beach sand, and permeability is rapid. The

TABLE B.1
SOIL UNITS FOUND WITHIN THE PRESIDIO
HYDROLOGIC GROUPS, AND PHYSICAL AND CHEMICAL PROPERTIES

Soil Name, Map Symbol	Depth (in)	Clay (pct)	Permeability (in/hr)	Available Water Capacity (in/in)	Soil Reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion		Organic Matter (pct)	Hydrologic Group
								K[1]	T[2]		
Orthents, cut and fill (0 to 15 percent slopes), 21*											
Orthents, cut and fill-Urban land complex (5 to 75 percent slopes), 124*											
Rock outcrop-Orthents complex (30 to 75 percent slopes), 127*											
Sirdrak sand (5 to 15 percent slopes), 129	0-17 17-60	0-5 0-5	6.0-20 6.0-20	0.05-0.07 0.05-0.07	5.1-6.5 5.1-6.5	<2 <2	Low Low	0.15 0.15	5	1-5	A
Typic Argiustolls, loamy Urban land association (5 to 15 percent slopes), 130*											
Urban land, 131*											
Urban land-Orthents, reclaimed complex (0 to 2 percent slopes), 134*											
Urban land-Sirdrak complex (2 to 50 percent slopes), 136	0-17 17-60	0-5 0-5	6.0-20 6.0-20	0.05-0.07 0.05-0.07	5.1-6.5 5.1-6.5	<2 <2	Low Low	0.15 0.15	5	1-5	A

1 Erosion factor "K" indicates the susceptibility of a soil to sheet and rill erosion. Values of "K" range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

2 Erosion factor "T" is an estimate of the average rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

* see description in text.

Source: USDA Soil Conservation Service, 1991.

available water capacity is low and hazard of soil blowing is high. Runoff is very slow, and the hazard of water erosion is moderate or high.

B.2 DEFINITION OF TERMS

Available water capacity (available moisture capacity): The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 2.5
Low	2.5 to 5.0
Moderate	5.0 to 7.5
High	7.5 to 10.0
Very high	more than 10.0

Clay: As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Erosion: The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion Factor K: Indicates the susceptibility of a soil to sheet and rill erosion. Factor K is one of six factors used in the Universal Soil Loss Equation (SLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

Erosion Factor T: An estimate of the maximum average rate of soil erosion by wind or water than can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Hydrologic Soil Groups: Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having

a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Organic Matter: Plant and animal residue in the soil in various stages of decomposition.

Permeability: The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Shrink-swell: The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Soil Reaction: A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Wilting Point: The moisture content of soil on an overdry basis at which a plant (specifically, a sunflower) wilts so much that it does not recover when placed in a humid dark chamber.

APPENDIX C

COST ESTIMATES FOR CAPITAL IMPROVEMENTS

TABLE OF CONTENTS

COST ESTIMATES FOR CAPITAL IMPROVEMENTS

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C.3 SITEWIDE STORM DRAIN CAPACITY IMPROVEMENTS

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C.1 CONSTRUCTION COST ESTIMATE

REPLACEMENT OF PIPES IN POOR CONDITION (NO CAPACITY UPGRADE)

NPSPOORA.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (NO CAPACITY UPGRADE)

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 05/02/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN B				
1	Pavement Cutting & Removal	193	SY	$10.00	$1,934
2	Manhole/Catchbasin Removal				
		2	EA	$279.00	$558
		2	EA	$419.00	$838
		2	EA	$558.00	$1,116
3	Excavation & Pipe Removal				
	10–inch diameter	100	LF	$12.50	$1,250
	15–inch diameter	350	LF	$12.50	$4,375
	24–inch diameter	50	LF	$20.80	$1,040
4	Debris Disposal	65	CY	$88.00	$5,736
5	Pipe Replacement & Backfill				
	10–inch diameter	100	LF	$14.60	$1,460
	15–inch diameter	350	LF	$22.20	$7,770
	24–inch diameter	50	LF	$38.70	$1,935
6	Manhole/Catchbasin Replacement				
		2	EA	$1,650.00	$3,300
		2	EA	$1,880.00	$3,760
		2	EA	$2,510.00	$5,020
7	Pavement Replacement	193	SY	$10.00	$1,934
			SUBTOTAL		**$42,027**
			15% Contingency		**$6,304**
			TOTAL		**$48,331**
	DRAINAGE BASIN D				
1	Pavement Cutting & Removal	372	SY	$10.00	$3,725
2	Manhole/Catchbasin Removal				
		6	EA	$279.00	$1,674
		2	EA	$419.00	$838
3	Excavation & Pipe Removal				
	8–inch diameter	520	LF	$12.50	$6,500
	12–inch diameter	180	LF	$12.50	$2,250
	18–inch diameter	400	LF	$12.50	$5,000
4	Debris Disposal	136	CY	$88.00	$12,012
5	Pipe Replacement & Backfill				
	8–inch diameter	520	LF	$13.20	$6,864
	12–inch diameter	180	LF	$16.90	$3,042
	18–inch diameter	400	LF	$25.80	$10,320
6	Manhole/Catchbasin Replacement				
		6	EA	$1,650.00	$9,900
		2	EA	$1,880.00	$3,760
7	Pavement Replacement	372	SY	$10.00	$3,725
			SUBTOTAL		**$69,609**
			15% Contingency		**$10,441**
			TOTAL		**$80,051**

NPSPOORA.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (NO CAPACITY UPGRADE)

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 05/02/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN F				
1	Pavement Cutting & Removal	618	SY	$8.70	$5,377
2	Manhole/Catchbasin Removal	7	EA	$558.00	$3,906
3	Excavation & Pipe Removal	1160	LF	$20.80	$24,128
4	Debris Disposal	312	CY	$88.00	$27,422
5	Pipe Replacement & Backfill				
	30–inch diameter	1160	LF	$70.50	$81,780
6	Manhole/Catchbasin Replacement	7	EA	$2,510.00	$17,570
7	Pavement Replacement	618	SY	$10.00	$6,180
			SUBTOTAL		**$166,363**
			15% Contingency		**$24,954**
			TOTAL		**$191,318**
	DRAINAGE BASIN G				
1	Pavement Cutting & Removal	10	SY	$10.00	$104
2	Manhole/Catchbasin Removal	2	EA	$279.00	$558
3	Excavation & Pipe Removal	40	LF	$12.50	$500
4	Debris Disposal	5	CY	$88.00	$464
5	Pipe Replacement & Backfill				
	8–inch diameter	40	LF	$13.20	$528
6	Manhole/Catchbasin Replacement	2	EA	$1,650.00	$3,300
7	Pavement Replacement	10	SY	$10.00	$104
			SUBTOTAL		**$5,558**
			15% Contingency		**$834**
			TOTAL		**$6,392**
	DRAINAGE BASIN I				
1	Pavement Cutting & Removal	150	SY	$10.00	$1,504
2	Manhole/Catchbasin Removal				
		2	EA	$279.00	$558
		3	EA	$419.00	$1,257
3	Excavation & Pipe Removal				
	12–inch diameter	225	LF	$12.50	$2,813
	18–inch diameter	170	LF	$12.50	$2,125
4	Debris Disposal	57	CY	$88.00	$5,010
5	Pipe Replacement & Backfill				
	12–inch diameter	225	LF	$16.90	$3,803
	18–inch diameter	170	LF	$25.80	$4,386
6	Manhole/Catchbasin Replacement				
		2	EA	$1,650.00	$3,300
		3	EA	$1,880.00	$5,640
7	Pavement Replacement	150	SY	$10.00	$1,504
			SUBTOTAL		**$31,899**
			15% Contingency		**$4,785**
			TOTAL		**$36,684**

NPSPOORA.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (NO CAPACITY UPGRADE)

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 05/02/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN J				
1	Pavement Cutting & Removal	860	SY	$10.00	$8,598
2	Manhole/Catchbasin Removal				
		10	EA	$279.00	$2,790
		5	EA	$419.00	$2,095
		2	EA	$558.00	$1,116
3	Excavation & Pipe Removal				
	10–inch diameter	520	LF	$12.50	$6,500
	12–inch diameter	500	LF	$12.50	$6,250
	15–inch diameter	150	LF	$12.50	$1,875
	18–inch diameter	670	LF	$12.50	$8,375
	24–inch diameter	330	LF	$20.80	$6,864
4	Debris Disposal	289	CY	$88.00	$25,394
5	Pipe Replacement & Backfill				
	10–inch diameter	520	LF	$14.60	$7,592
	12–inch diameter	500	LF	$16.90	$8,450
	15–inch diameter	150	LF	$22.20	$3,330
	18–inch diameter	670	LF	$25.80	$17,286
	24–inch diameter	330	LF	$38.70	$12,771
6	Manhole/Catchbasin Replacement				
		10	EA	$1,650.00	$16,500
		5	EA	$1,880.00	$9,400
		2	EA	$2,510.00	$5,020
7	Pavement Replacement	860	SY	$10.00	$8,598
			SUBTOTAL		**$158,805**
			15% Contingency		**$23,821**
			TOTAL		**$182,626**
	DRAINAGE BASIN M				
1	Pavement Cutting & Removal	115	SY	$10.00	$1,154
2	Manhole/Catchbasin Removal	5	EA	$419.00	$2,095
3	Pipe Removal	260	LF	$12.50	$3,250
4	Debris Disposal	51	CY	$88.00	$4,522
5	Trenching & Pipe Replacement				
	18–inch diameter	260	LF	$25.80	$6,708
6	Manhole/Catchbasin Replacement	5	EA	$1,650.00	$8,250
7	Pavement Replacement	115	SY	$10.00	$1,154
			SUBTOTAL		**$27,134**
			15% Contingency		**$4,070**
			TOTAL		**$31,204**
		TOTAL ALL WATERSHED AREAS			**$576,604**

C.2 CONSTRUCTION COST ESTIMATE

REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE)

NPSPOOR2.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE)
PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:
ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)
DATE: 05/02/94
REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN B				
1	Pavement Cutting & Removal	193	SY	$10.00	$1,934
2	Manhole/Catchbasin Removal				
		2	EA	$279.00	$558
		2	EA	$419.00	$838
		2	EA	$558.00	$1,116
3	Excavation & Pipe Removal				
	10–inch diameter	100	LF	$12.50	$1,250
	15–inch diameter	350	LF	$12.50	$4,375
	24–inch diameter	50	LF	$20.80	$1,040
4	Debris Disposal	65	CY	$88.00	$5,736
5	Pipe Replacement & Backfill				
	10–inch diameter	100	LF	$14.60	$1,460
	15–inch diameter	350	LF	$22.20	$7,770
	24–inch diameter	50	LF	$38.70	$1,935
6	Manhole/Catchbasin Replacement				
		2	EA	$1,650.00	$3,300
		2	EA	$1,880.00	$3,760
		2	EA	$2,510.00	$5,020
7	Pavement Replacement	193	SY	$10.00	$1,934
			SUBTOTAL		**$42,027**
			15% Contingency		**$6,304**
			TOTAL		**$48,331**
	DRAINAGE BASIN D				
1	Pavement Cutting & Removal	372	SY	$10.00	$3,725
2	Manhole/Catchbasin Removal				
		6	EA	$279.00	$1,674
		2	EA	$419.00	$838
3	Excavation & Pipe Removal				
	8–inch diameter	520	LF	$12.50	$6,500
	12–inch diameter	180	LF	$12.50	$2,250
	18–inch diameter	400	LF	$12.50	$5,000
4	Debris Disposal	136	CY	$88.00	$12,012
5	Pipe Replacement & Backfill				
	8–inch diameter	520	LF	$13.20	$6,864
	12–inch diameter	180	LF	$16.90	$3,042
	18–inch diameter	400	LF	$25.80	$10,320
6	Manhole/Catchbasin Replacement				
		6	EA	$1,650.00	$9,900
		2	EA	$1,880.00	$3,760
7	Pavement Replacement	372	SY	$10.00	$3,725
			SUBTOTAL		**$69,609**
			15% Contingency		**$10,441**
			TOTAL		**$80,051**

NPSPOOR2.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE)

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 05/02/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN F				
1	Pavement Cutting & Removal	618	SY	$8.70	$5,377
2	Manhole/Catchbasin Removal	7	EA	$558.00	$3,906
3	Excavation & Pipe Removal	1160	LF	$20.80	$24,128
4	Debris Disposal	312	CY	$88.00	$27,422
5	Pipe Replacement & Backfill				
	30–inch diameter	1160	LF	$70.50	$81,780
6	Manhole/Catchbasin Replacement	7	EA	$2,510.00	$17,570
7	Pavement Replacement	618	SY	$10.00	$6,180
			SUBTOTAL		**$166,363**
			15% Contingency		**$24,954**
			TOTAL		**$191,318**
	DRAINAGE BASIN G				
1	Pavement Cutting & Removal	10	SY	$10.00	$104
2	Manhole/Catchbasin Removal	2	EA	$279.00	$558
3	Excavation & Pipe Removal	40	LF	$12.50	$500
4	Debris Disposal	5	CY	$88.00	$464
5	Pipe Replacement & Backfill				
	8–inch diameter	40	LF	$13.20	$528
6	Manhole/Catchbasin Replacement	2	EA	$1,650.00	$3,300
7	Pavement Replacement	10	SY	$10.00	$104
			SUBTOTAL		**$5,558**
			15% Contingency		**$834**
			TOTAL		**$6,392**
	DRAINAGE BASIN I				
1	Pavement Cutting & Removal	150	SY	$10.00	$1,504
2	Manhole/Catchbasin Removal				
		2	EA	$279.00	$558
		3	EA	$419.00	$1,257
3	Excavation & Pipe Removal				
	12–inch diameter	225	LF	$12.50	$2,813
	18–inch diameter	170	LF	$12.50	$2,125
4	Debris Disposal	57	CY	$88.00	$5,010
5	Pipe Replacement & Backfill				
	12–inch diameter	225	LF	$16.90	$3,803
	18–inch diameter	170	LF	$25.80	$4,386
6	Manhole/Catchbasin Replacement				
		2	EA	$1,650.00	$3,300
		3	EA	$1,880.00	$5,640
7	Pavement Replacement	150	SY	$10.00	$1,504
			SUBTOTAL		**$31,899**
			15% Contingency		**$4,785**
			TOTAL		**$36,684**

NPSPOOR2.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE)

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 05/02/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN J				
1	Pavement Cutting & Removal	919	SY	$10.00	$9,192
2	Manhole/Catchbasin Removal				
		10	EA	$279.00	$2,790
		5	EA	$419.00	$2,095
		2	EA	$558.00	$1,116
3	Excavation & Pipe Removal				
	10–inch diameter	520	LF	$12.50	$6,500
	12–inch diameter	500	LF	$12.50	$6,250
	15–inch diameter	150	LF	$12.50	$1,875
	18–inch diameter	670	LF	$12.50	$8,375
	24–inch diameter	330	LF	$20.80	$6,864
4	Debris Disposal	362	CY	$88.00	$31,860
5	Pipe Replacement & Backfill				
	10–inch diameter	520	LF	$14.60	$7,592
	12–inch diameter	130	LF	$16.90	$2,197
	15–inch diameter	150	LF	$22.20	$3,330
	18–inch diameter	1040	LF	$25.80	$26,832
	27–inch diameter	330	LF	$55.00	$18,150
6	Manhole/Catchbasin Replacement				
		10	EA	$1,650.00	$16,500
		5	EA	$1,880.00	$9,400
		2	EA	$2,510.00	$5,020
7	Pavement Replacement	919	SY	$10.00	$9,192
			SUBTOTAL		**$175,131**
			15% Contingency		**$26,270**
			TOTAL		**$201,400**
	DRAINAGE BASIN M				
1	Pavement Cutting & Removal	115	SY	$10.00	$1,154
2	Manhole/Catchbasin Removal	5	EA	$419.00	$2,095
3	Excavation & Pipe Removal	260	LF	$12.50	$3,250
4	Debris Disposal	51	CY	$88.00	$4,522
5	Pipe Replacement & Backfill				
	18–inch diameter	260	LF	$25.80	$6,708
6	Manhole/Catchbasin Replacement	5	EA	$1,880.00	$9,400
7	Pavement Replacement	115	SY	$10.00	$1,154
			SUBTOTAL		**$28,284**
			15% Contingency		**$4,243**
			TOTAL		**$32,527**
		TOTAL ALL WATERSHED AREAS			**$596,701**

C.3 CONSTRUCTION COST ESTIMATE

SITEWIDE STORM DRAIN CAPACITY IMPROVEMENTS

NPCAPUPA.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
SITEWIDE STORM DRAIN CAPACITY IMPROVEMENTS
PARK: PRESIDIO OF SAN FRANCISCO
IFB NUMBER:
ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)
DATE: 02/25/94
REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN B				
1	Pavement Cutting & Removal	696	SY	$8.10	$5,640
2	Manhole/Catchbasin Removal	4	EA	$837.00	$3,348
3	Excavation & Pipe Removal	870	LF	$34.10	$29,667
4	Debris Disposal	282	CY	$88.00	$24,796
5	Pipe Replacement & Backfill				
	48–inch diameter	870	LF	$135.00	$117,450
6	Manhole/Catchbasin Replacement	4	EA	$3,440.00	$13,760
7	Pavement Replacement	696	SY	$10.00	$6,963
			SUBTOTAL		**$201,625**
			15% Contingency		**$30,244**
			TOTAL		**$231,868**
	DRAINAGE BASIN C				
1	Pavement Cutting & Removal	194	SY	$8.70	$1,690
2	Manhole/Catchbasin Removal	5	EA	$558.00	$2,790
3	Excavation & Pipe Removal	350	LF	$20.80	$7,280
4	Debris Disposal	77	CY	$88.00	$6,763
5	Pipe Replacement & Backfill				
	24–inch diameter	350	LF	$38.70	$13,545
6	Manhole/Catchbasin Replacement	5	EA	$2,510.00	$12,550
7	Pavement Replacement	194	SY	$10.00	$1,943
			SUBTOTAL		**$46,560**
			15% Contingency		**$6,984**
			TOTAL		**$53,544**
	DRAINAGE BASIN D				
1	Pavement Cutting & Removal	778	SY	$8.70	$6,770
2	Manhole/Catchbasin Removal				
		3	EA	$419.00	$1,257
		3	EA	$558.00	$1,674
3	Excavation & Pipe Removal	1360	LF	$20.80	$28,288
4	Debris Disposal	207	CY	$88.00	$18,209
5	Pipe Replacement & Backfill				
	21–inch diameter	470	LF	$30.30	$14,241
	27–inch diameter	890	LF	$55.00	$48,950
6	Manhole/Catchbasin Replacement				
		3	EA	$1,880.00	$5,640
		3	EA	$2,510.00	$7,530
7	Pavement Replacement	778	SY	$10.00	$7,781
			SUBTOTAL		**$140,340**
			15% Contingency		**$21,051**
			TOTAL		**$161,391**

NPCAPUPA.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
SITEWIDE STORM DRAIN CAPACITY IMPROVEMENTS

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 02/25/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN F				
1	Pavement Cutting & Removal	1186	SY	$8.50	$10,083
2	Manhole/Catchbasin Removal				
		7	EA	$558.00	$3,906
		7	EA	$837.00	$5,859
3	Excavation & Pipe Removal				
	12–inch diameter	320	LF	$20.80	$6,656
	30–inch diameter	1380	LF	$34.10	$47,058
4	Debris Disposal	489	CY	$88.00	$43,019
5	Pipe Replacement & Backfill				
	24–inch diameter	320	LF	$38.70	$12,384
	36–inch diameter	240	LF	$89.00	$21,360
	42–inch diameter	470	LF	$104.00	$48,880
	48–inch diameter	400	LF	$135.00	$54,000
	54–inch diameter	270	LF	$164.00	$44,280
6	Manhole/Catchbasin Replacement				
		7	EA	$2,510.00	$17,570
		7	EA	$3,440.00	$24,080
7	Pavement Replacement	1186	SY	$10.00	$11,862
			SUBTOTAL		**$350,997**
			15% Contingency		**$52,650**
			TOTAL		**$403,647**
	DRAINAGE BASIN G				
1	Pavement Cutting & Removal	666	SY	$8.50	$5,663
2	Manhole/Catchbasin Removal				
		6	EA	$558.00	$3,348
		2	EA	$837.00	$1,674
3	Excavation & Pipe Removal	1030	LF	$34.10	$35,123
4	Debris Disposal	234	CY	$88.00	$20,560
5	Pipe Replacement & Backfill				
	30–inch diameter	120	LF	$70.50	$8,460
	36–inch diameter	510	LF	$89.00	$45,390
	42–inch diameter	400	LF	$104.00	$41,600
6	Manhole/Catchbasin Replacement				
		6	EA	$2,510.00	$15,060
		2	EA	$3,440.00	$6,880
7	Pavement Replacement	666	SY	$10.00	$6,662
			SUBTOTAL		**$190,420**
			15% Contingency		**$28,563**
			TOTAL		**$218,983**

NPCAPUPA.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
SITEWIDE STORM DRAIN CAPACITY IMPROVEMENTS

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 02/25/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN I				
1	Pavement Cutting & Removal	569	SY	$8.70	$4,952
2	Manhole/Catchbasin Removal	5	EA	$558.00	$2,790
3	Excavation & Pipe Removal	780	LF	$20.80	$16,224
4	Debris Disposal	186	CY	$88.00	$16,390
5	Pipe Replacement & Backfill				
	24–inch diameter	170	LF	$38.70	$6,579
	36–inch diameter	610	LF	$89.00	$54,290
6	Manhole/Catchbasin Replacement	5	EA	$2,510.00	$12,550
7	Pavement Replacement	569	SY	$10.00	$5,692
			SUBTOTAL		**$119,467**
			15% Contingency		**$17,920**
			TOTAL		**$137,388**
	DRAINAGE BASIN J				
1	Pavement Cutting & Removal	1786	SY	$8.70	$15,535
2	Manhole/Catchbasin Removal				
		9	EA	$279.00	$2,511
		3	EA	$419.00	$1,257
		12	EA	$558.00	$6,696
3	Excavation & Pipe Removal				
	12–inch diameter	520	LF	$12.50	$6,500
	18–inch diameter	500	LF	$12.50	$6,250
	24–inch diameter	150	LF	$20.80	$3,120
	30–inch diameter	670	LF	$20.80	$13,936
4	Debris Disposal	563	CY	$88.00	$49,519
5	Pipe Replacement & Backfill				
	18–inch diameter	610	LF	$25.80	$15,738
	21–inch diameter	820	LF	$30.30	$24,846
	30–inch diameter	410	LF	$70.50	$28,905
	48–inch diameter	1030	LF	$135.00	$139,050
6	Manhole/Catchbasin Replacement				
		9	EA	$1,880.00	$16,920
		3	EA	$2,510.00	$7,530
		12	EA	$3,440.00	$41,280
7	Pavement Replacement	1786	SY	$10.00	$17,856
			SUBTOTAL		**$397,449**
			15% Contingency		**$59,617**
			TOTAL		**$457,067**

NPCAPUPA.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
SITEWIDE STORM DRAIN CAPACITY IMPROVEMENTS

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 02/25/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN K				
1	Pavement Cutting & Removal	643	SY	$8.70	$5,591
2	Manhole/Catchbasin Removal	6	EA	$279.00	$1,674
3	Excavation & Pipe Removal				
	24–inch diameter	430	LF	$20.80	$8,944
	30–inch diameter	580	LF	$34.10	$19,778
4	Debris Disposal	286	CY	$88.00	$25,170
5	Pipe Replacement & Backfill				
	27–inch diameter	430	LF	$55.00	$23,650
	36–inch diameter	580	LF	$89.00	$51,620
6	Manhole/Catchbasin Replacement	6	EA	$2,510.00	$15,060
7	Pavement Replacement	643	SY	$10.00	$6,426
				SUBTOTAL	**$157,914**
				15% Contingency	**$23,687**
				TOTAL	**$181,601**
				TOTAL ALL WATERSHED AREAS	**$1,791,944**

C.4 CONSTRUCTION COST ESTIMATE

STRUCTURAL BEST MANAGEMENT PRACTICES — SITEWIDE

BMPSPEC.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STRUCTURAL BMPs – SITEWIDE

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 11/11/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	PRETREATMENT BASIN NEAR COMMISSARY NORTH OF DOYLE DRIVE				
1	Excavation	33880	CY	$4.00	$135,499
2	Lined Filtration Channel	1700	LF	$168.00	$285,600
3	12–inch CMP Pipe (incl. exc. & backfill)	450	LF	$21.00	$9,450
4	30–inch CMP Pipe (incl. exc. & backfill)	300	LF	$59.00	$17,700
5	Riprap Inlet Protection	4	SY	$64.68	$259
6	Outlet Structures				
	Excavation	150	CY	$10.83	$1,625
	8" CIP RC footing	2	CY	$172.48	$362
	6'x8' Precast Box Culvert	18	LF	$295.37	$5,317
	Flap Gate	2	EA	$1,000.00	$2,000
	Outlet Weir	2	EA	$1,000.00	$2,000
	Slab Top w/ MH Opening	2	EA	$241.47	$483
	Frame & Cover	2	EA	$592.90	$1,186
	Backfill & Compact	85	CY	$23.06	$1,960
7	Wetland Vegetation	1	LS	$70,000.00	$70,000
		SUBTOTAL			$533,440
		15% Design Contingency			$80,016
		TOTAL			$613,456
	COMMISSARY PARKING BIOFILTER/INFILTRATION TRENCH				
1	Pavement Removal & Disposal	600	SY	$29.87	$17,923
2	Infiltration Trench	540	LF	$18.00	$9,720
3	Catchbasin with Grate	2	EA	$1,636.00	$3,272
4	PVC Cleanout	4	EA	$75.00	$300
5	Biofilter	600	SY	$8.00	$4,800
		SUBTOTAL			$36,015
		15% Design Contingency			$5,402
		TOTAL			$41,417
	NEW PARKING (BASIN I) BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	270	LF	$18.00	$4,860
2	Catchbasin with Grate	1	EA	$1,636.00	$1,636
3	PVC Cleanout	2	EA	$75.00	$150
4	Biofilter	300	SY	$8.00	$2,400
		SUBTOTAL			$9,046
		15% Design Contingency			$1,357
		TOTAL			$10,403

BMPSPEC.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STRUCTURAL BMPs – SITEWIDE

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 11/11/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	LETTERMAN HOSPITAL PARKING BIOFILTER INLETS				
1	Pavement Removal & Disposal	480	SY	$29.87	$14,338
2	Pavement Repair	200	SY	$2.74	$548
3	Biofilter	480	SY	$8.00	$3,840
		SUBTOTAL			**$18,726**
		15% Design Contingency			**$2,809**
		TOTAL			**$21,535**
	EXISTING STERNBERG RD. PARKING LOT BIOFILTER INLETS				
1	Pavement Removal & Disposal	100	SY	$29.87	$2,987
2	Catchbasin	2	EA	$1,636.00	$3,272
2	Biofilter	100	SY	$8.00	$800
		SUBTOTAL			**$7,059**
		15% Design Contingency			**$1,059**
		TOTAL			**$8,118**
	NEW STERNBERG RD. PARKING LOT BIOFILTER SWALE TO INLET				
1	Biofilter	450	SY	$8.00	$3,600
		SUBTOTAL			**$3,600**
		15% Design Contingency			**$540**
		TOTAL			**$4,140**
	NEW PARKING (GORGAS AT HWY. 101) BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	220	LF	$18.00	$3,960
2	Catchbasin with Grate	2	EA	$1,636.00	$3,272
3	PVC Cleanout	2	EA	$75.00	$150
4	12–inch CMP Pipe (incl. exc. & backfill)	100	LF	$21.00	$2,100
5	Biofilter	1250	SY	$8.00	$10,000
		SUBTOTAL			**$19,482**
		15% Design Contingency			**$2,922**
		TOTAL			**$22,404**
	WINDSURFER STAGING AREA BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	1900	LF	$18.00	$34,200
2	Catchbasin with Grate	9	EA	$1,636.00	$14,724
3	Manhole	1	EA	$1,636.00	$1,636
4	PVC Cleanout	18	EA	$75.00	$1,350
5	12–inch CMP Pipe (incl. exc. & backfill)	570	LF	$21.00	$11,970
6	Biofilter	3500	SY	$8.00	$28,000
		SUBTOTAL			**$91,880**
		15% Design Contingency			**$13,782**
		TOTAL			**$105,662**

BMPSPEC.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STRUCTURAL BMPs – SITEWIDE

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 11/11/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	OLD MASON STREET PARKING BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	110	LF	$18.00	$1,980
2	Catchbasin with Grate	1	EA	$1,636.00	$1,636
3	PVC Cleanout	1	EA	$75.00	$75
4	Biofilter	150	SY	$8.00	$1,200
		SUBTOTAL			**$4,891**
		15% Design Contingency			**$734**
		TOTAL			**$5,625**
	LINCOLN at GARARD PARKING LOT BIOFILTER INLETS				
1	Pavement Removal & Disposal	240	SY	$29.87	$7,169
2	Remove & Dispose Inlet	1	EA	$300.76	$301
3	Biofilter	240	SY	$8.00	$1,920
		SUBTOTAL			**$9,390**
		15% Design Contingency			**$1,408**
		TOTAL			**$10,798**
	FRENCH COURT PARKING LOT BIOFILTER SWALE TO INLET				
1	Pavement Removal & Disposal	170	SY	$29.87	$5,078
2	Biofilter	170	SY	$8.00	$1,360
		SUBTOTAL			**$6,438**
		15% Design Contingency			**$966**
		TOTAL			**$7,404**
	LINCOLN AT HALLECK PARKING LOT BIOFILTER INLETS				
1	Pavement Removal & Disposal	50	SY	$29.87	$1,494
3	Biofilter	50	SY	$8.00	$400
		SUBTOTAL			**$1,894**
		15% Design Contingency			**$284**
		TOTAL			**$2,178**
	PARADE GROUNDS SOUTH PARKING LOT BIOFILTER SWALE W/ INFILTRATION BED				
1	Pavement Removal & Disposal	3250	SY	$29.87	$97,082
3	Biofilter	1250	SY	$8.00	$10,000
4	Infiltration Bed	1200	LF	$92.00	$110,400
5	Catchbasin	14	EA	$1,855.00	$25,970
		SUBTOTAL			**$243,452**
		15% Design Contingency			**$36,518**
		TOTAL			**$279,970**

BMPSPEC.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STRUCTURAL BMPs – SITEWIDE

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 11/11/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	NORTH END BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	310	LF	$18.00	$5,580
2	Catchbasin with Grate	1	EA	$1,636.00	$1,636
3	PVC Cleanout	2	EA	$75.00	$150
4	Biofilter	370	SY	$8.00	$2,960
		SUBTOTAL			**$10,326**
		15% Design Contingency			**$1,549**
		TOTAL			**$11,875**
	PENA STREET PARKING BIOFILTER/INFILTRATION TRENCH				
1	Pavement Removal & Disposal	160	SY	$29.87	$4,779
2	Infiltration Trench	120	LF	$18.00	$2,160
3	Catchbasin with Grate	1	EA	$1,636.00	$1,636
4	PVC Cleanout	2	EA	$75.00	$150
5	Biofilter	160	SY	$8.00	$1,280
		SUBTOTAL			**$10,005**
		15% Design Contingency			**$1,501**
		TOTAL			**$11,506**
	SAL STREET PARKING LOT BIOFILTER SWALE TO INLET				
1	Biofilter	670	SY	$8.00	$5,360
2	Catchbasin with Grate	1	EA	$1,636.00	$1,636
3	12–inch CMP Pipe (incl. exc. & backfill)	400	LF	$21.00	$8,400
		SUBTOTAL			**$15,396**
		15% Design Contingency			**$2,309**
		TOTAL			**$17,705**
	MONTGOMERY STREET VISITOR PARKING LOT BIOFILTER INLETS				
1	Pavement Removal & Disposal	100	SY	$29.87	$2,987
3	Biofilter	100	SY	$8.00	$800
		SUBTOTAL			**$3,787**
		15% Design Contingency			**$568**
		TOTAL			**$4,355**

BMPSPEC.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STRUCTURAL BMPs – SITEWIDE

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 11/11/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	GOLF COURSE PARKING LOT INFILTRATION BASIN				
1	Excavation	810	CY	$4.00	$3,239
2	Fine Grading	810	SY	$1.54	$1,249
3	Catchbasin	3	EA	$1,636.00	$4,908
4	12–inch CMP Pipe (incl. exc. & backfill)	330	LF	$21.00	$6,930
5	Riprap Outlet Protection	2	SY	$64.68	$129
		SUBTOTAL			$16,456
		15% Design Contingency			$2,468
		TOTAL			$18,924
	PUBLIC HEALTH SERVICE HOSPITAL SMALL PARKING LOT BIOFILTER INLETS				
1	Pavement Removal & Disposal	110	SY	$29.87	$3,286
2	Biofilter	110	SY	$8.00	$880
		SUBTOTAL			$4,166
		15% Design Contingency			$625
		TOTAL			$4,791
	PUBLIC HEALTH SERVICE HOSPITAL LARGE PARKING LOT BIOFILTER INLETS				
1	Pavement Removal & Disposal	270	SY	$29.87	$8,065
2	Biofilter	270	SY	$8.00	$2,160
		SUBTOTAL			$10,225
		15% Design Contingency			$1,534
		TOTAL			$11,759
	PUBLIC HEALTH SERVICE HOSPITAL TENNIS COURTS RUNOFF DIVERSION				
1	6" Asphalt Curb	180	LF	$1.95	$351
2	Precast Curb Bumpers	33	EA	$60.00	$2,000
		SUBTOTAL			$2,351
		15% Design Contingency			$353
		TOTAL			$2,704
	PARK MAINTENANCE FACILITY BIOFILTER INLETS				
1	Pavement Removal & Disposal	270	SY	$29.87	$8,065
2	Biofilter	270	SY	$8.00	$2,160
3	Catchbasin	3	EA	$1,636.00	$4,908
4	Manhole	1	EA	$1,636.00	$1,636
5	12–inch CMP Pipe (incl. exc. & backfill)	380	LF	$21.00	$7,980
		SUBTOTAL			$24,749
		15% Design Contingency			$3,712
		TOTAL			$28,462

BMPSPEC.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STRUCTURAL BMPs – SITEWIDE

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 11/11/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	BRIDGE MAINTENANCE FACILITY BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	300	LF	$18.00	$5,400
2	Biofilter	350	SY	$8.00	$2,800
3	PVC Cleanout	1	EA	$75.00	$75
4	Catchbasin/Manhole	5	EA	$1,636.00	$8,180
5	12–inch CMP Pipe (incl. exc. & backfill)	350	LF	$21.00	$7,350
6	Remove Old Pipe	350	SY	$16.17	$5,660
7	Riprap Outlet Protection	3	SY	$64.68	$194
		SUBTOTAL			**$29,659**
		15% Design Contingency			**$4,449**
		TOTAL			**$34,107**
	FORT SCOTT (LINCOLN BLVD.) PARKING BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	260	LF	$18.00	$4,680
2	Catchbasin	3	EA	$1,636.00	$4,908
3	PVC Cleanout	6	EA	$75.00	$450
4	Biofilter	360	SY	$8.00	$2,880
5	12–inch CMP Pipe (incl. exc. & backfill)	260	LF	$21.00	$5,460
		SUBTOTAL			**$18,378**
		15% Design Contingency			**$2,757**
		TOTAL			**$21,135**
	FORT SCOTT (STOREY AVE.) PARKING BIOFILTER SWALE TO INLET				
1	Biofilter	780	SY	$8.00	$6,240
2	Riprap Outfall Protection	4	SY	$64.68	$259
		SUBTOTAL			**$6,499**
		15% Design Contingency			**$975**
		TOTAL			**$7,474**
	FORT SCOTT (RALSTON AVE.) PARKING BIOFILTER/INFILTRATION TRENCH				
1	Infiltration Trench	260	LF	$18.00	$4,680
2	Manhole	1	EA	$1,636.00	$1,636
3	PVC Cleanout	2	EA	$75.00	$150
4	Biofilter	310	SY	$8.00	$2,480
		SUBTOTAL			**$8,946**
		15% Design Contingency			**$1,342**
		TOTAL			**$10,288**

BMPSPEC.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STRUCTURAL BMPs – SITEWIDE

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 11/11/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	TOLL PLAZA VISITOR PARKING (EAST) BIOFILTER INLET				
1	Pavement Removal & Disposal	70	SY	$29.87	$2,091
2	Biofilter	70	SY	$8.00	$560
		SUBTOTAL			**$2,651**
		15% Design Contingency			**$398**
		TOTAL			**$3,049**
	EAST BATTERY PARKING BIOFILTER INLET				
1	Biofilter	70	SY	$8.00	$560
2	Catchbasin	1	EA	$1,636.00	$1,636
		SUBTOTAL			**$2,196**
		15% Design Contingency			**$329**
		TOTAL			**$2,525**
	GOLF COURSE/MOUNTAIN LAKE CONSTRUCTED WETLANDS				
1	Clear & Grub	0.243	AC	$4,338.95	$1,056
2	Excavation, Load, & Haul	7050	CY	$10.15	$71,558
3	Fine Grading	10600	SY	$1.54	$16,340
4	Overflow Weir	400	LF	$14.19	$5,676
5	30–inch CMP Pipe (incl. exc. & backfill)	40	LF	$59.00	$2,360
6	Inlet Structure	2	EA	$2,000.00	$4,000
7	Wetland Vegetation	1	LS	$30,000.00	$30,000
		SUBTOTAL			**$130,990**
		15% Design Contingency			**$19,648**
		TOTAL			**$150,638**
TOTAL SITEWIDE BMP IMPROVEMENTS					**$1,474,406**

C.5 CONSTRUCTION COST ESTIMATE

STORM DRAIN CONVEYANCE IMPROVEMENTS (NEW PIPE)

NPCONVIM.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STORM DRAIN CONVEYANCE IMPROVEMENTS (NEW PIPE)
PARK: PRESIDIO OF SAN FRANCISCO
IFB NUMBER:
ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)
DATE: 05/12/94
REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	COAST GUARD/AIR FIELD				
1	Pavement Cutting & Removal	2785	SY	$8.50	$23,672
2	Debris Disposal	569	CY	$88.00	$50,070
3	Excavation & Pipe Installation				
	15–inch diameter	300	LF	$29.30	$8,790
	18–inch diameter	250	LF	$32.90	$8,225
	24–inch diameter	550	LF	$46.90	$25,795
	30–inch diameter	920	LF	$82.50	$75,900
	36–inch diameter	120	LF	$107.00	$12,840
	48–inch diameter	200	LF	$158.00	$31,600
	54–inch diameter	800	LF	$183.00	$146,400
4	Manhole/Catchbasin Installation				
		4	EA	$1,880.00	$7,520
		8	EA	$2,510.00	$20,080
		3	EA	$3,440.00	$10,320
5	Pavement Replacement	2785	SY	$10.00	$27,849
				SUBTOTAL	**$449,061**
				15% Contingency	**$67,359**
				TOTAL	**$516,420**
	MONTGOMERY STREET/PARADE GROUNDS				
1	Pavement Cutting & Removal	1010	SY	$8.50	$8,582
2	Debris Disposal	210	CY	$88.00	$18,473
3	Excavation & Pipe Installation				
	15–inch diameter	200	LF	$29.30	$5,860
	18–inch diameter	400	LF	$32.90	$13,160
	24–inch diameter	350	LF	$46.90	$16,415
	36–inch diameter	380	LF	$107.00	$40,660
4	Manhole/Catchbasin Installation				
		4	EA	$1,880.00	$7,520
		4	EA	$2,510.00	$10,040
5	Pavement Replacement	1010	SY	$10.00	$10,096
				SUBTOTAL	$130,806
				15% Contingency	$19,621
				TOTAL	$150,426

NPCONVIM.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
STORM DRAIN CONVEYANCE IMPROVEMENTS (NEW PIPE)
PARK: PRESIDIO OF SAN FRANCISCO
IFB NUMBER:
ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)
DATE: 05/12/94
REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	GORGAS AT HIGHWAY 101				
1	Pavement Cutting & Removal	564	SY	$8.50	$4,790
2	Debris Disposal	116	CY	$88.00	$10,182
3	Excavation & Pipe Installation				
	48–inch diameter	500	LF	$158.00	$79,000
4	Manhole/Catchbasin Installation				
		3	EA	$3,440.00	$10,320
5	Pavement Replacement	564	SY	$10.00	$5,636
			SUBTOTAL		**$109,928**
			15% Contingency		**$16,489**
			TOTAL		**$126,417**
	MISCELLANEOUS				
1	Pavement Cutting & Removal	320	SY	$8.50	$2,723
2	Debris Disposal	70	CY	$88.00	$6,166
3	Excavation & Pipe Installation				
	12–inch diameter	150	LF	$20.90	$3,135
	15–inch diameter	250	LF	$29.30	$7,325
	18–inch diameter	150	LF	$32.90	$4,935
4	Manhole/Catchbasin Installation				
		2	EA	$1,650.00	$3,300
		4	EA	$1,880.00	$7,520
5	Pavement Replacement	320	SY	$10.00	$3,203
			SUBTOTAL		**$38,307**
			15% Contingency		**$5,746**
			TOTAL		**$44,053**
			SITEWIDE TOTAL		**$837,316**

C.6 CONSTRUCTION COST ESTIMATE

REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE) IN CONJUNCTION WITH PROPOSED BMPs AND CONVEYANCE IMPROVEMENTS

NPSPOORB.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE)
IN CONJUNCTION WITH PROPOSED BMPs AND CONVEYANCE IMPROVEMENTS

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 02/25/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN B				
1	Pavement Cutting & Removal	193	SY	$10.00	$1,934
2	Manhole/Catchbasin Removal				
		2	EA	$279.00	$558
		2	EA	$419.00	$838
		2	EA	$558.00	$1,116
3	Excavation & Pipe Removal				
	10–inch diameter	100	LF	$12.50	$1,250
	15–inch diameter	350	LF	$12.50	$4,375
	24–inch diameter	50	LF	$20.80	$1,040
4	Debris Disposal	65	CY	$88.00	$5,736
5	Pipe Replacement & Backfill				
	10–inch diameter	100	LF	$14.60	$1,460
	15–inch diameter	350	LF	$22.20	$7,770
	24–inch diameter	50	LF	$38.70	$1,935
6	Manhole/Catchbasin Replacement				
		2	EA	$1,650.00	$3,300
		2	EA	$1,880.00	$3,760
		2	EA	$2,510.00	$5,020
7	Pavement Replacement	193	SY	$10.00	$1,934
			SUBTOTAL		**$42,027**
			15% Contingency		**$6,304**
			TOTAL		**$48,331**
	DRAINAGE BASIN D				
1	Pavement Cutting & Removal	372	SY	$10.00	$3,725
2	Manhole/Catchbasin Removal				
		6	EA	$279.00	$1,674
		2	EA	$419.00	$838
3	Excavation & Pipe Removal				
	8–inch diameter	520	LF	$12.50	$6,500
	12–inch diameter	180	LF	$12.50	$2,250
	18–inch diameter	400	LF	$12.50	$5,000
4	Debris Disposal	136	CY	$88.00	$12,012
5	Pipe Replacement & Backfill				
	8–inch diameter	520	LF	$13.20	$6,864
	12–inch diameter	180	LF	$16.90	$3,042
	18–inch diameter	400	LF	$25.80	$10,320
6	Manhole/Catchbasin Replacement				
		6	EA	$1,650.00	$9,900
		2	EA	$1,880.00	$3,760
7	Pavement Replacement	372	SY	$10.00	$3,725
			SUBTOTAL		**$69,609**
			15% Contingency		**$10,441**
			TOTAL		**$80,051**

NPSPOORB.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE)
IN CONJUNCTION WITH PROPOSED BMPs AND CONVEYANCE IMPROVEMENTS

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 02/25/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN G				
1	Pavement Cutting & Removal	10	SY	$10.00	$104
2	Manhole/Catchbasin Removal	2	EA	$279.00	$558
3	Excavation & Pipe Removal	40	LF	$12.50	$500
4	Debris Disposal	5	CY	$88.00	$464
5	Pipe Replacement & Backfill 8–inch diameter	40	LF	$13.20	$528
6	Manhole/Catchbasin Replacement	2	EA	$1,650.00	$3,300
7	Pavement Replacement	10	SY	$10.00	$104
			SUBTOTAL		**$5,558**
			15% Contingency		**$834**
			TOTAL		**$6,392**
	DRAINAGE BASIN I				
1	Pavement Cutting & Removal	75	SY	$10.00	$749
2	Manhole/Catchbasin Removal	2	EA	$279.00	$558
3	Excavation & Pipe Removal 12–inch diameter	225	LF	$12.50	$2,813
4	Debris Disposal	24	CY	$88.00	$2,089
5	Pipe Replacement & Backfill 12–inch diameter	225	LF	$16.90	$3,802
6	Manhole/Catchbasin Replacement	2	EA	$1,650.00	$3,300
7	Pavement Replacement	75	SY	$10.00	$749
			SUBTOTAL		**$14,060**
			15% Contingency		**$2,109**
			TOTAL		**$16,169**

NPSPOORB.WK1

CONSTRUCTION COST ESTIMATE

DESCRIPTION OF PROJECT: STORM WATER MANAGEMENT PLAN:
REPLACEMENT OF PIPES IN POOR CONDITION (WITH CAPACITY UPGRADE)
IN CONJUNCTION WITH PROPOSED BMPs AND CONVEYANCE IMPROVEMENTS

PARK: PRESIDIO OF SAN FRANCISCO

IFB NUMBER:

ESTIMATE: CLASS – C

PREPARED BY: DAMES & MOORE (A. Olson)

DATE: 02/25/94

REVIEWED BY:

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Amount
	DRAINAGE BASIN J				
1	Pavement Cutting & Removal	919	SY	$10.00	$9,192
2	Manhole/Catchbasin Removal				
		10	EA	$279.00	$2,790
		5	EA	$419.00	$2,095
		2	EA	$558.00	$1,116
3	Excavation & Pipe Removal				
	10–inch diameter	520	LF	$12.50	$6,500
	12–inch diameter	500	LF	$12.50	$6,250
	15–inch diameter	150	LF	$12.50	$1,875
	18–inch diameter	670	LF	$12.50	$8,375
	24–inch diameter	330	LF	$20.80	$6,864
4	Debris Disposal	362	CY	$88.00	$31,860
5	Pipe Replacement & Backfill				
	10–inch diameter	520	LF	$14.60	$7,592
	12–inch diameter	130	LF	$16.90	$2,197
	15–inch diameter	150	LF	$22.20	$3,330
	18–inch diameter	1040	LF	$25.80	$26,832
	27–inch diameter	330	LF	$55.00	$18,150
6	Manhole/Catchbasin Replacement				
		10	EA	$1,650.00	$16,500
		5	EA	$1,880.00	$9,400
		2	EA	$2,510.00	$5,020
7	Pavement Replacement	919	SY	$10.00	$9,192
			SUBTOTAL		**$175,131**
			15% Contingency		**$26,270**
			TOTAL		**$201,400**
	DRAINAGE BASIN M				
1	Pavement Cutting & Removal	115	SY	$10.00	$1,154
2	Manhole/Catchbasin Removal	5	EA	$419.00	$2,095
3	Excavation & Pipe Removal	260	LF	$12.50	$3,250
4	Debris Disposal	51	CY	$88.00	$4,522
5	Pipe Replacement & Backfill				
	18–inch diameter	260	LF	$25.80	$6,708
6	Manhole/Catchbasin Replacement	5	EA	$1,880.00	$9,400
7	Pavement Replacement	115	SY	$10.00	$1,154
			SUBTOTAL		**$28,284**
			15% Contingency		**$4,243**
			TOTAL		**$32,527**
			TOTAL ALL WATERSHED AREAS		**$384,869**

APPENDIX D

SUBSTANCES SUBJECT TO REPORTABLE QUANTITY NOTIFICATION

SUBSTANCES SUBJECT TO REPORTABLE QUANTITY NOTIFICATION

Federal facilities are exempt from SARA Title III requirements due to the omission of the federal government from the definition of "person" in the Title III statute. However, in the interest of maintaining a healthy relationship between NPS facilities and adjoining communities, the NPS should comply with SARA Title III where practicable. Specifically, you should appoint a representative to your community's Local Emergency Planning Committee (LEPC) and participate in LEPC's activities. You should also cooperate with the LEPC if requests are made for information, as long as that information is available under the Freedom of Information Act. Of course, in the event of a chemical release, you must notify the appropriate authorities as required.

Chemicals are listed according to their reportable quantities (RQ) and threshold planning quantities (TPQ) dictated by federal law. If a chemical is present in quantities equal to or greater than its TPQ, it should be reported to the LEPC. If a chemical is spilled in quantities equal to or greater than its RQ, the spill must be reported to the proper authorities. These quantities are subject to change, thus the Federal Register must be consulted periodically to determine any changes in RQs or TPQs. Individual state agencies may also have RQ and TPQ requirements, and must also be consulted to assure that compliance with all state regulations has been attained.

APPENDIX E

SUGGESTED POLLUTION INCIDENT REPORT FORMAT

SUGGESTED POLLUTION INCIDENT REPORT FORMAT

1. Name and location of installation.
2. Name and telephone number of installation on-scene coordinator.
3. Date and time of incident or time of discovery.
4. Severity of incident.
5. Location and specific areas affected by spill.
   a. Building number or area.
   b. Terrain.
      (1) Type.
      (2) Slope.
   c. Drainage.
      (1) Runoff.
      (2) Subsurface.
   d. Relationship to nearby bodies of water.
6. Cause and source of incident.
   a. Human error.
   b. Physical damage.
   c. Corrosion.
7. Type and estimated amount.
   a. Oil.
      (1) Type.
      (2) Amount.
      (3) Area of slick.
   b. Hazardous material.
      (1) Type of chemical.
      (2) Chemical name and reportable quantity (RQ).
      (3) Manufacturer, trade name, catalog number.
      (4) Amount.
8. Samples taken.
      a. Number of samples.
      b. Disposition of samples.
9. Damage impact on surroundings.
      a. Fish and wildlife.
      b. Groundwater or surface water.

10. Potential dangers.
    a. Fire.
    b. Explosion.
    c. Toxic fumes or fluids.
11. Corrective actions taken, and recommended to eliminate pollution sources or preclude recurrence.
12. Corrective actions taken to remove pollutant.
13. Additional assistance required.
14. Estimated completion date of remedial action.
15. Anticipated or actual reaction by news media and public to the incident.
16. Notification summary: agency, individual, date and time, and summary of information given.
17. General discussion of incident.

APPENDIX F

OUTSIDE ASSISTANCE

APPENDIX F

OUTSIDE ASSISTANCE

Chemical Transportation Emergency Center (CHEMTREC)	(800) 424-9300
National Response Center	(800) 424-8802
Pesticides Hotline	(800) 531-7790
Resources Conservation and Recovery Act (RCRA) Hotline	(800) 424-9346
Toxic Substance Control Act (TSCA) Hotline	(202) 554-1404
USAEHA Oil and Hazardous Substance Spill Response Team	(301) 671-3816 AUTOVON 584-3816
U.S. Environmental Protection Agency Region IX	(415) 974-8131
Coast Guard	(415) 437-3073
City and County of San Francisco Health Department Hazardous Materials Section	(415) 558-2783
California Office of Emergency Services Hazardous Materials Section	(916) 427-4287
California Department of Health Services Emergency Response Coordinator	(916) 324-2445

APPENDIX G

RESPONSE PROCEDURES FOR SUBSTANCE-SPECIFIC SPILLS

APPENDIX G

RESPONSE PROCEDURES FOR SUBSTANCE-SPECIFIC SPILLS

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RESPONSE PROCEDURES FOR SUBSTANCE-SPECIFIC SPILLS

G.1 OIL SPILLS

1. ABOVE GROUND PETROLEUM PRODUCT SPILL

   a. Precautions. No smoking or flames.

   b. Protective Equipment. Protective gloves and goggles or face shield.

   c. Spill Control Actions.

      (1) Close off the entrance to any nearby surface-water drainage ditches/channels, or inlets to storm drains and other subsurface utilities.

      (2) Using sorbent material soil, or sand, control the spreading of the spill and seal off any pooled product.

      (3) Collect any pooled product in 55-gallon drums, if possible. It may be possible to clean up a major spill by using a vacuum truck supplied by an outside contractor.

   d. Disposal. Off-site of the appropriate hazardous waste disposal facility transported by licensed hazardous waste hauler documented with proper hazardous waste manifest.

2. UNDERGROUND LEAKS

   a. Spill Control Actions.

      (1) If there is a question as to whether an underground tank is leaking, the tank should be hydrostatically pressure tested. The test method(s) must be currently approved by the EPA.

      (2) When a leak is identified, the fluid remaining in the tank must be removed immediately and pumped into appropriate containers.

      (3) Based on the circumstances, a consultant may be required to determine the extent and location of the leaked material by using monitoring wells. The appropriate NPS personnel will arrange for any consulting service needed.

(4) If a significant amount of material is located, a recovery operation should be initiated to collect the product. Plans for recovery operations will be coordinated with the California Regional Water Quality Control Board (RWQCB) and U.S. EPA Region IX.

b. Disposal.

(1) Recovered product may be salvaged and reused, if not contaminated.

(2) When the leaking tank is repaired or replaced, any heavily contaminated soil and waste product will be removed and disposed in accordance with the requirements of the California RWQCB. Contaminated soil and product will be disposed off-site at an approved hazardous waste disposal facility with proper manifest by a licensed hazardous waste hauler.

G.2 ACID SPILLS

COLOR CODE - WHITE LETTERS ON BLACK BACKGROUND

1. SPILL CONTAINMENT. Enclose spilled acid with a dike of clay absorbent.

2. NEUTRALIZATION. Add sodium bicarbonate slowly and carefully to the liquid acid spill until it is completely covered. All neutralizing agents should be added with great care as reactions may be violent and result in splattering of chemicals. This is true for both acid and base neutralization. If the spilled acid is a solid pellet, flake, or powder, clean it up by placing as much of the material as possible into containers; then add sodium bicarbonate to the remaining material until it is completely covered. The solution should be tested with pH paper to ensure it is in the 6 to 8 pH range after neutralization.

   Recommended Treatment — with Sodium Bicarbonate:

Acetic acid	Hydrogen fluoride
Acrylic acid	Nitric acid
Formic acid	Oxalic acid
Hydrochloric acid	Phosphoric acid
Hydrofluoric acid	Propionic acid
Hydrogen chloride	Sulfuric acid

   Compounds that React in Water to Give Acids (Recommended Treatment — Sodium Bicarbonate):

Acetic anhydride	Oleum
Aluminum chloride	Phosphorus oxychloride
Benzoyl chloride	Phosphorus pentasulfide
Bromine	Phosphorus trichloride
Chlorosulfonic acid	Polyphosphoric acid
Maleic anhydride	Sulfur monochloride
Nitrogen tetroxide	Sulfuryl chloride
Nitrosyl chloride	Titanium tetrachloride

3. CLEANUP. Add sawdust or clay until the acid and sodium bicarbonate are completely covered. Scoop up spent solid absorbent with a long-handled nonsparking shovel. Place spent waste in a proper container. The waste container should be properly color coded and labeled "ACID WASTE."

4. PERSONAL PROTECTIVE EQUIPMENT. Employees involved in cleaning up an acid spill must use the following protective clothing and procedures or their equivalent:

a. Rubber or neoprene 18-inch gauntlet gloves.

b. Rubber or neoprene apron.

c. Rubber hightop boots or overshoes.

d. Wash all clothing after use, and have it cleaned before reuse.

e. Long-sleeved shirt.

f. Full facepiece respirator with organic vapor/acid gas cartridges, the complete assembly approved by NIOSH (TC-146-XXX).

g. A full face shield is to be used when not wearing the respirator and still handling a spill.

6. FIRE EXTINGUISHERS. Use water, dry chemical, or carbon dioxide extinguishers.

7. EMERGENCY.

a. If an employee ingests an acid or breathes acid fumes, transport him/her to the local medical facility immediately.

b. If an employee has acid spilled on him/her, provide immediate treatment by using an eye wash or shower, as appropriate. and then transport the employee to the local medical facility. Take off any clothing that acids have contaminated.

c. Be prepared to tell the doctor what chemicals are involved.

G.3 CAUSTIC SPILLS

1. SPILL CONTAINMENT. Enclose spilled caustic with a dike of solid sorbent (sawdust, vermiculite, or clay).

2. NEUTRALIZATION. Add sodium dihydrogen phosphate to the spilled liquid caustic. If the spilled caustic is a solid powder, pellet, or flake, clean up by placing as much of the material as possible in containers, then add water to the remaining material. Next, add sodium dihydrogen phosphate to the material for neutralization. The solution should be tested with pH paper to ensure it is in the 6 to 8 pH range after neutralization.

   Recommended Treatment — Sodium Dihydrogen Phosphate:

Aminoethylethanolamine	Hydrazine
Ammonium hydroxide	Monethanolamine
Caustic potash solution	Monoisopropanolamine
Caustic soda solution	Morpholine
Cyclohexylamine	Potassium hydroxide
Diethanolamine	Triethanolamine
Diethylenetriamine	Triethylamine
1,1-Dimethylhydrazine	Trimethylamine
Ethylenediamine	Hexamethylenediamine

   Compounds that React in Water to Give Bases (Recommended Treatment — Sodium Dihydrogen Phosphate):

Anhydrous ammonia	Sodium
Ethyleneamine	Sodium amide
Lithium aluminum hydride	Sodium hydride

3. CLEANUP. Add more absorbent, if necessary. Scoop up spent solid absorbent material with a nonsparking shovel or long-handled scoop. Place in the proper spent waste container. The waste container should be properly color coded and labeled "CAUSTIC WASTES."

4. CONTAINER. Rubber or plastic.

5. PERSONAL PROTECTIVE EQUIPMENT. Spilled caustics are very slippery, and care must be taken to avoid falls. Employees involved in cleaning up spills must wear the following protective clothing and equipment, or their equivalent:

   a. Rubber or neoprene 18-inch gauntlet gloves.

b. Long-sleeved shirt.

c. Rubber suit.

d. Rubber hightop boots or overshoes.

e. Brimmed felt hat or treated fiber hat.

f. Disposable coveralls.

g. Respirator approved for mists and fumes, NIOSH approval TC-1. Use this face mask to leave the area after a spill. To clean up spills, use a supplied air respirator, if at all possible.

h. A full face shield should be worn when a respirator is not worn while working with open chemicals.

i. Air respirator.

6. FIRE EXTINGUISHERS. Use water spray, dry chemical, or carbon dioxide extinguishers.

7. EMERGENCY.

a. Remove contaminated clothing. Wash skin for 15 minutes under an emergency shower. Transport the employee to a local medical treatment facility.

b. If a chemical gets into an employee's eyes, use an eye lavage to flush the eyes for 15 minutes. Transport the employee to a medical facility.

c. Be prepared to tell the doctor what chemicals are involved.

G.4 FLAMMABLE AND COMBUSTIBLE ORGANIC LIQUID SPILLS

1. SPILL CONTAINMENT. Enclose spilled organic liquid with a dike of sawdust or sweeping compound (solid absorbent).

2. CLEANUP. Use enough absorbent to soak up all the spilled liquid. Since most organic liquids are very flammable, avoid all sources of ignition or SPARKING. Scoop up spent solid absorbent with a nonsparking shovel or long-handled scoop. Place absorbent in a proper waste container. The waste container should be color-coded and labeled "WASTE FLAMMABLE OR COMBUSTIBLE MATERIAL."

3. CONTAINER. Metal can lined with plastic.

4. PERSONAL PROTECTIVE EQUIPMENT. Vapors heavier than air tend to accumulate in low places; avoid having flammable vapors come in contact with ignition sources to prevent flashback. Employees involved in cleaning up a spill must wear the following protective clothing and equipment or their equivalent:

   a. Rubber or neoprene 18-inch gauntlet gloves.

   b. Rubber or neoprene apron.

   c. Rubber hightop-boots or overshoes.

   d. Disposable coveralls.

   e. A respirator should be used when working with organic chemical vapors.

5. FIRE EXTINGUISHERS. Use carbon dioxide or dry chemical type. In case of fire, call the fire department. Cool nearby drums with a stream of water to prevent ignition and the possibility of pressure increase in the containers.

6. EMERGENCY.

   a. Skin contact. All clothing contaminated with chemicals must be removed at once, including rubber foot wear, and should be thoroughly washed with plenty of water for at least 15 minutes. The skin should be washed with soap and water, and the employee transported to the local medical treatment facility.

   b. Inhalation or taken internally: Transport the employee to the local medical facility immediately.

c. If any substances get into an employee's eyes, irrigate the eyes for 15 minutes and transport the employee to the local medical facility.

d. Be prepared to tell the doctor what chemicals are involved.

G.5 PESTICIDE SPILLS

1. SPILL CONTAINMENT. Enclose liquid spills with a dike of solid absorbent (e.g., sawdust, clay, or vermiculite).

2. NEUTRALIZATION. Add sodium hypochlorite (bleach) and cover with lime.

3. CLEANUP. Add more absorbent if necessary. Scoop up spent solid absorbent and place in proper waste container.

4. CONTAINERS. Metal can lined with plastic liner.

5. PERSONAL PROTECTIVE EQUIPMENT. The following protective clothing and equipment must be worn:

   a. Apron: impermeable cotton duck, both sides chloroprene rubber coated, tie tape fasteners at back, without sleeves or pockets.

   b. Boots: knee, noninsulated, black rubber water proof upper, knurled rubber sole, non-slip heel, 15 inches high.

   c. Cap: cotton.

   d. Gloves: rubber, natural or synthetic rubber, organic solvent resistant, rolled edge-cuff, 14 inches long, black.

   e. Goggles: chemical splash, without vent, rubber neoprene material, AO model 40989 or equivalent. Used when respirator is not worn.

   f. For ULV pesticides, use gas masks, MSA Part No. 4648983 with canister part number 448972, NIOSH approval number TG-14G-86, or equivalent.

   g. For other than ULV pesticides use respirator, chemical cartridge, MSA Part No. 448972, NIOSH approval number TG-14G-86, or equivalent.

   h. Full faceshield for use when a respirator is not worn while working with open chemicals.

   j. Pest control personnel require additional items which are prescribed in USAEHA Guide to Protective Equipment for Pest Control Personnel, dated June 1977.

6. FIRE EXTINGUISHERS. None. Evacuate and call Fire Department.

7. EMERGENCY.

   a. Remove contaminated clothing. Wash skin for 15 minutes and report to the local medical facility.

   b. If pesticides are spilled in the eyes, wash in an eye lavage for 15 minutes and report to the local medical facility.

   c. If there are any signs of dizziness, upset stomach, etc., report to the medical facility.

   d. When going to the medical facility, take with you the names of the pesticides you have been cleaning up.

G.6 CHLORINE GAS LEAKS AND SPILLS

1. SPILL CONTAINMENT. Stop the leak with a chlorine cylinder patch kit if it can be done without personal risk. Chlorine cylinder patch kits are available for 1-ton and 150-pound chlorine cylinders.

2. HEALTH HAZARDS. Chlorine gas is a poison hazard indoors, outdoors, and in sewers; it may be fatal if inhaled. Contact with chlorine gas may cause burns to the skin and eyes.

3. PERSONAL PROTECTIVE EQUIPMENT. Employees involved in containing a chlorine gas spill must wear the following protective clothing and equipment:

   a. Self-contained breathing apparatus.

   b. Rubber gloves.

   c. Rubber hightop boots or overshoes.

   d. Coveralls.

4. FIRE EXTINGUISHERS. Released chlorine gas vapors and chlorine gas cylinders can explode. In case of a fire, call the fire department. For small fires, use dry chemical or carbon dioxide-type fire extinguishers. For large fires, use water spray, fog, or foam.

5. EMERGENCY.

   a. Evacuation and isolation: Keep unnecessary people away; evacuate the area endangered by gas; isolate the hazard area and deny entry. Specific evacuation and isolation distances are as follows:

      (1) Small spill or leak from a drum, container, or tank: Isolate the area 140 feet in all directions.

      (2) Large spill or leak from a drum, container, or tank: initially isolate the area 290 feet in all directions. Then evacuate the area in a downwind direction 1.0 mile long by 0.7 mile wide.

   b. Inhalation: Move the victim to fresh air and call for emergency medical care. If the victim is not breathing, give artificial respiration.

c. Skin and eye contact: Immediately flush skin or eyes with running water for at least 15 minutes. Remove and isolate contaminated clothing and shoes at the site.

G.7 PCB SPILLS AND TRANSFORMER LEAKAGE

1. DEFINITION. PCBs are chemical substances limited to the biphenyl molecule that have been chlorinated to varying degrees. PCBs are California-listed wastes. They are found in hydraulic fluids or heat transfer fluids, but are most commonly found in electrical equipment.

2. SPILL CONTAINMENT.

   a. Immediately cordon off area.

   b. Eliminate foot and vehicular traffic.

   c. Use barricades, fencing and or tape to provide a buffer zone of at least five feet from any area that appears to have received PCB fluid spill.

3. NEUTRALIZATION.

   Use vermiculite to adsorb spilled PCB fluids.

4. CLEAN UP.

   a. Pour vermiculite onto spill area until all fluid is adsorbed.

   b. Sweep adsorbent into piles using street brooms. Sweep in such a manner to minimize dust circulation.

   c. Shovel sand into PCB approved containers and seal. Label drums accordingly.

   d. If soil is contaminated, excavate to a depth of at least 6 inches. Concrete/Asphalt substances may be removed at the discretion of the HMC.

   e. Decontaminate any contaminated material with an approved PCB solvent.

   f. Transfer all contaminated equipment and adsorbent product to building 680 storage area.

5. CONTAINER - USE ONLY APPROVED PCB CONTAINERS TO INCLUDE:

   55 - Gallon Drums: Removable lid.

55 - Gallon Drums: PLASTIC DRUMS OR DRUMS WITH BUNG HOLES. HAZARDOUS WASTE CONTAINER.

PCB "Half-box" 2 feet × 4 feet × 4 feet plywood.

LABELS: Adhesive and magnetic backing "Caution PCB".

6. PERSONAL PROTECTIVE EQUIPMENT - Required for first response/clean up team (only trained/qualified personnel).

   - Tyvek coveralls with hood/cap.
   - Rubber boots.
   - Rubber gloves with inserts.
   - Respirator device (not hospital dust filter, nose/mouth cover).

7. FIRE EXTINGUISHER - Is necessary to contain fires/explosions from potential electrical hazards. PCBs do not pose an ignitable/reactivity threat.

8. EMERGENCY PROCEDURES.

   a. Conduct test using field sampling kits to determine the concentration of the PCB spill. The concentration level affects the reporting requirements.

   b. Report the spill to outside agencies (if required).

   c. Follow standard operating procedures or emergency response and reporting.

G.8 RAW SEWAGE SPILLS

1. RAW SEWAGE ONTO GROUND.

   a. Using absorbent socks, sand bags, dirt or other suitable material, confine material to smallest possible area.

   b. Limit access to contaminated area by means of stakes and tapes.

   c. Douse area with 10% concentration of chlorine solution.

   d. Allow area to dry out and then excavate a proper amount of soil and dispose of as hazardous waste (via guidance from appropriate NPS personnel).

2. RAW SEWAGE INTO STORM DRAIN.

   a. Immediately block "lower" manhole to restrict/limit sewage to the minimal length of storm drain pipe.

   b. Using Presidio's own sewer pump (or Contracted Services, if necessary), transport sewage from blocked section of line to a lower or an alternative sewer system.

   c. Correct source of blockage.

   d. If directed by appropriate NPS personnel, decontaminate storm drainage lines by "triple flushing" first with clear water, second with 10% chlorine solution (minimum of 500 gallons for 6-inch main) and third with repeat of clear water (from nearby fire hydrant or other convenient source).

   e. Prepare report and submit to HMC.

APPENDIX H

FIELD SAMPLING FORMS

FORM 1

Field Observations

Presidio Storm Water Sampling and Analysis Program

Sampling Location: _____ Date & Time: _____

Weather Conditions: _____

Depth of Flow (in): _____

Clarity, Color, and/or Turbidity: _____

Odor: _____

_____

Foreign Material: _____

_____

Other Observations: _____

_____

_____

SIGNATURE

_____

QA/QC INITIALS

FORM 2

Grab Sample Data Collection

Presidio Storm Water Sampling and Analysis Program

Sampling Location: _____ **Date & Time:** _____

Weather Conditions: _____

Time Precipitation Started: _____

Depth of Flow (in): _____

Flow Rate (use table): _____

Sample is to be labeled, placed in a cool ice chest, and delivered to laboratory for testing

Chain of Custody Form Complete: _____

Time Sample Shipped: _____

Carrier: _____ **Initials:** _____

_____

SIGNATURE

_____

QA/QC INITIALS

FORM 3

Composite Sample Data Collection

Presidio Storm Water Sampling and Analysis Program

Sampling Location: _____ **Date & Time:** _____

Weather Conditions: _____

Time Precipitation Started: _____

Time Sample Shipped: _____

Carrier: _____ **Initials:** _____

Laboratory Arrival Time: _____

(Samples must be collected at uniform intervals.)

#	Time	Depth (in)	Flow (gpm) @ Catchbasin CB-1	Contribution * (ml)
1				
2				
3				
4				
5				
6				
7				
8				
9				
		Total Flow (gpm)		

* Volume required for composite sample equals *Flow @ #/Total Flow × 1L.* Stir sample vigorously prior to adding composite

_____

SIGNATURE

_____

QA/QC INITIALS

FORM 4

DATA COLLECTION SUMMARY

CHAIN OF CUSTODY SAMPLE NAME	COMPOSITE OR GRAB	DATE AND TIME SAMPLED		DATE ANALYZED	PARAMETER	VALUE	UNITS	METHOD	COMMENTS

FIGURE 2

SAMPLING SCHEDULE

Analyte	EPA Method	SL-1 Toll Plaza	SL-2 Industrial	SL-3 Major Roads	SL-4 Residential	SL-5 Commercial/ Industrial	SL-6 Open Space	SL-7 Golf Course
BOD	405.1	G	G	G	C/G	C/G	G	G
COD	410.4	G	G	G	C/G	C/G	G	G
TSS	160.2	G	G	G	C/G	C/G	G	G
TKN	351.3	G	G	G	C/G	C/G	G	G
Ortho-P	365.3	G	G	G	C/G	C/G	G	G
Metals								
Cadmium	200.7	G	G	G	C/G	C/G	G	G
Chromium	200.7	G	G	G	C/G	C/G	G	G
Copper	200.7	G	G	G	C/G	C/G	G	G
Lead	239.2	G	G	G	C/G	C/G	G	G
Nickel	200.7	G	G	G	C/G	C/G	G	G
Zinc	6010	G	G	G	C/G	C/G	G	G
Oil and Grease	413.2	G	G	G	C/G	C/G	G	G
Coliforms	9221B	G	G	G	C/G	C/G	G	G
pH	Field	G	G	G	C/G	C/G	G	G
Automatic Sampler					X	X		

G = Grab sample obtained during first flush of storm event.

C = Flow weighted sample from individual samples taken at 20-minute intervals during the first 3 hours of storm event.

APPENDIX I

MODEL DISKETTES

Directory of Diskettes

Diskettes contain model input and output files for the Hydrologic Model, HydroCAD™. The files are arranged in subdirectories on each disk organized as one disk for each storm event modeled. The following example explains the data arrangement on the disks. The input data for the 2-year, 30-minute event can be found in the subdirectory

DRIVE:\2-YEAR\30MIN\INPUT.

These data are in binary form and can only be accessed by the HydroCAD™ program. The output files for the 2-year, 30-minute storm can be found in the subdirectory

DRIVE:\2-YEAR\30MIN\OUTPUT.

These files can be accessed with a file editor, or can be printed directly. In order to download the information on these discs to a hard drive, use the following DOS commands:

```
xcopy a:(or b:) c:\hydrocad /s
```

Each disk represents a storm event modeled. The storms modeled and stored are as follows:

- 2-year, 30-minute;
- 2-year, 1-hour;
- 10-year, 30-minute;
- 10-year, 1-hour;
- 25-year, 30-minute;
- 25-year, 1-hour;
- 100-year, 30-minute; and
- 100-year, 1-hour.

An additional disk contains the output files for the pipe sizing runs used to determine the required pipe size for a specific storm event. The data are organized in the following subdirectories:

DRIVE:\10-YEAR\30MIN\RESIZE\OUTPUT
DRIVE:\25-YEAR\30MIN\RESIZE\OUTPUT
DRIVE:\100-YEAR\30MIN\RESIZE\OUTPUT
DRIVE:\10-YEAR\1HR\RESIZE\OUTPUT
DRIVE:\25-YEAR\1HR\RESIZE\OUTPUT
DRIVE:\100-YEAR\1HR\RESIZE\OUTPUT

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\2-year\30 min\input(545 KB)
Drive:\2-year\30 min\output(450 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\2-year\1 HR\input(545 KB)
Drive:\2-year\1 HR\output(453 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\10-year\30 min\input(545 KB)
Drive:\10-year\30 min\output(482 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\10-year\1 HR\input(545 KB)
Drive:\10-year\1 HR\output(480 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\25-year\1 HR\input(545 KB)
Drive:\25-year\1 HR\output(456 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

B

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\25-year\30 min\input(545 KB)
Drive:\25-year\30 min\output(455 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

HD

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\100-year\30 min\input(545 KB)
Drive:\100-year\30 min\output(452 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

B

HD

Presidio of San Francisco
Storm Water Management Plan
I.Q.C. 1443CX200092035
Task Order No. 13
Hydrologic Model Diskette
Containing Files:
Drive:\100-year\1 HR\input(545 KB)
Drive:\100-year\1 HR\output(456 KB)
Date: January, 1994
Diskette: 3.5", 2HD, 1.44MB type

B

HD
Presidio of San Francisco
Storm Water Management Plan
Hydrologic Model Diskette Containing Files:
Drive:\10-year\30min\resize\output
Drive:\25-year\30min\resize\output
Drive:\100-year\30min\resize\output
Drive:\10-year\1hr\resize\output
Drive:\25-year\1hr\resize\output
Drive:\100-year\1hr\resize\output
Diskette: 3.5", 2HD, 1.44MB type

APPENDIX J

HydroCAD™ COMPUTER PROGRAM DISKETTE AND MANUAL

APPENDIX K

1994 STORM WATER MONITORING ANALYTICAL LABORATORY REPORTS

ENVIRONMENTAL AND INDUSTRIAL HYGIENE SERVICES

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX (707) 763-4065

Jeff Bensch
Dames & Moore-San Francisco
221 Main Street
Suite 600
San Francisco, CA 94105

February 10, 1994

Customer Project: 02050-155-SWMP National Park Service
Laboratory Job: L9401183

On **January 24, 1994** we received 7 sample(s) for analysis. Samples were analyzed by the following method(s):

Oil & Grease (EPA 413.1)

PCB's and Pesticides (EPA 8080)

Chlorinated Herbicides (EPA 8150)

BOD (EPA 405.1)

COD (EPA 410.4 / SM 5220)

Phosphate, Ortho (EPA 300.0)

Priority Pollutant Metals (13)

Nitrogen, Total Kjeldahl (EPA 351.3)

Total Suspended Solids (EPA 160.2)

Robin Cochrane
Project Manager

Robert Peak
Laboratory Director
Robert Peak

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-1
Lab Id: L9401183-1

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	4.9	4.9	mg/L	02-FEB-94	03-FEB-94
Comments:					
ANIONS-W					
Phosphate	ND <	0.20	mg/L		24-JAN-94
COD					
Chemical Oxygen Demand	160	20.	mg/L	04-FEB-94	04-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Copper-6010	0.27	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	0.19	0.050	mg/L	02-FEB-94	02-FEB-94
Comments:					
TSS					
Total Suspended Solids	40.	4.0	mg/L		28-JAN-93
TTLC-GFW					
Arsenic- EPA 7060	0.16	0.025	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-2
Lab Id: L9401183-2

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	6.2	5.1	mg/L	02-FEB-94	03-FEB-94
Comments:					
ANIONS-W					
Phosphate	ND <	0.20	mg/L		24-JAN-94
COD					
Chemical Oxygen Demand	54.	20.	mg/L	04-FEB-94	04-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Copper-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	0.31	0.050	mg/L	02-FEB-94	02-FEB-94
Comments:					
TSS					
Total Suspended Solids	6.0	4.0	mg/L		28-JAN-93
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-3
Lab Id: L9401183-3

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		24-JAN-94
COD					
Chemical Oxygen Demand	250	20.	mg/L	04-FEB-94	04-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Copper-6010	0.092	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	0.27	0.050	mg/L	02-FEB-94	02-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	350	7.0	mg/L		28-JAN-93
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	0.00041	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-4
Lab Id: L9401183-4

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	9.6	5.6	mg/L	02-FEB-94	03-FEB-94
Comments:					
COD					
Chemical Oxygen Demand	95.	20.	mg/L	04-FEB-94	04-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Copper-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	0.14	0.050	mg/L	02-FEB-94	02-FEB-94
Comments:					
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-5
Lab Id: L9401183-5

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	02-FEB-94	03-FEB-94
Comments:					
ANIONS-W					
Phosphate	ND <	0.20	mg/L		24-JAN-94
COD					
Chemical Oxygen Demand	41.	20.	mg/L	04-FEB-94	04-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Copper-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Comments:					
TSS					
Total Suspended Solids	6.0	4.0	mg/L		28-JAN-93
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-6
Lab Id: L9401183-6

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		24-JAN-94
COD					
Chemical Oxygen Demand	ND <	20.	mg/L	04-FEB-94	04-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Copper-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Comments:					
TSS					
Total Suspended Solids	ND <	4.0	mg/L		28-JAN-93
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-6
Lab Id: L9401183-6

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	02-FEB-94	03-FEB-94
Comments:					
8080W					
Aldrin	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
ARO1016	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1221	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1232	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1242	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1248	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1254	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1260	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
BHC-Alpha	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
BHC-Beta	ND <	0.040	ug/L	28-JAN-94	31-JAN-94
BHC-Delta	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
BHC-Gamma	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Chlordane	ND <	1.0	ug/L	28-JAN-94	31-JAN-94
DDD	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
DDE	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
DDT	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Dieldrin	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Endosulfan	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Endosulfan Sulfate	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Endosulfan2	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Endrin	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Endrin Aldehyde	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Heptachlor	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Heptachlor Epoxide	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Toxaphene	ND <	5.0	ug/L	28-JAN-94	31-JAN-94
Methoxychlor	ND <	0.060	ug/L	28-JAN-94	31-JAN-94
Surrogate:					
Tetrachloro-meta-xylene	122.	-	%	28-JAN-94	31-JAN-94
Decachlorobiphenyl	151.	-	%	28-JAN-94	31-JAN-94
Comments:	None				
8150-W					
Dalapon	ND	3.0	ug/L	28-JAN-94	03-FEB-94
Dicamba	ND	0.30	ug/L	28-JAN-94	03-FEB-94
Dinoseb	ND	0.40	ug/L	28-JAN-94	03-FEB-94
MCPP	ND	150	ug/L	28-JAN-94	03-FEB-94
MCPA	ND	150	ug/L	28-JAN-94	03-FEB-94
2,4-D	ND	1.2	ug/L	28-JAN-94	03-FEB-94
2,4-DB	ND	0.90	ug/L	28-JAN-94	03-FEB-94
2,4,5-T	ND	0.10	ug/L	28-JAN-94	03-FEB-94
Silvex	ND	0.10	ug/L	28-JAN-94	03-FEB-94
Dichloroprop	ND	0.65	ug/L	28-JAN-94	03-FEB-94
Surrogate:					
2,4-Dichlorophenyl acetic acid	99.0	-	%	28-JAN-94	03-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: COMP SL-3
Lab Id: L9401183-7

Collected: 23-JAN-94
Received: 24-JAN-94
Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		24-JAN-94
COD					
Chemical Oxygen Demand	57.	20.	mg/L	04-FEB-94	04-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Copper-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Comments:					
TSS					
Total Suspended Solids	27.	4.0	mg/L		28-JAN-93
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3860-1

Reported: 03-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TSS					
Total Suspended Solids	ND <	4.0	mg/L		28-JAN-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3860-2

Reported: 03-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TSS					
Total Suspended Solids	ND <	4.0	mg/L		28-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Duplicate
Lab Id: WG3860-3

Reported: 16-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TSS						
Total Suspended Solids	ND <	mg/L		0.0		28-JAN-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3896-1

Reported: 08-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
COD					
Chemical Oxygen Demand	ND <	20.	mg/L	04-FEB-94	04-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3896-2

Reported: 08-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
COD							
Chemical Oxygen Demand	190.	mg/L	200	mg/L	95 %	04-FEB-94	04-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3738-3

Reported: 08-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
COD					
Chemical Oxygen Demand	276.	20.	mg/L	13-JAN-94	13-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3738-4

Reported: 08-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
COD							
Chemical Oxygen Demand	463.	mg/L	200	mg/L	94 %	13-JAN-94	13-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3738-5

Reported: 08-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
COD						
Chemical Oxygen Demand	466.	mg/L	95 %	0.65	13-JAN-94	13-JAN-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3863-4

Reported: 03-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3863-5

Reported: 03-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TTLC-GFW							
Arsenic- EPA 7060	0.0243	mg/L	.025	mg/L	97	31-JAN-94	01-FEB-94
Selenium - EPA 7740	0.0253	mg/L	.025	mg/L	101	31-JAN-94	01-FEB-94
Mercury - EPA 7470	0.00208	mg/L	.002	mg/L	104	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3863-1

Reported: 03-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.00500	mg/L	31-JAN-94	01-FEB-94
Selenium - EPA 7740	ND <	0.00500	mg/L	31-JAN-94	01-FEB-94
Mercury - EPA 7470	ND <	0.000200	mg/L	31-JAN-94	01-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3863-3

Reported: 22-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TTLC-GFW						
Arsenic- EPA 7060	0.0228	mg/L	91	1.7	31-JAN-94	01-FEB-94
Selenium - EPA 7740	0.0205	mg/L	82	2.9	31-JAN-94	01-FEB-94
Mercury - EPA 7470	0.00222	mg/L	111	0.90	31-JAN-94	01-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3863-2

Reported: 03-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TTLC-GFW							
Arsenic- EPA 7060	0.0232	mg/L	.025	mg/L	93	31-JAN-94	01-FEB-94
Selenium - EPA 7740	0.0211	mg/L	.025	mg/L	84	31-JAN-94	01-FEB-94
Mercury - EPA 7470	0.00220	mg/L	.002	mg/L	110	31-JAN-94	01-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3858-4

Reported: 03-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Barium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Cobalt-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Copper-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.15	mg/L	02-FEB-94	02-FEB-94
Molybdenum-6010	ND <	0.20	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.10	mg/L	02-FEB-94	02-FEB-94
Phosphorus-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.0	mg/L	02-FEB-94	02-FEB-94
Vanadium-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	ND <	0.050	mg/L	02-FEB-94	02-FEB-94

Comments:

D&H Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3858-5

Reported: 03-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TALMET-ICPW							
Antimony-6010	1.99	mg/L	2	mg/L	99	02-FEB-94	02-FEB-94
Barium-6010	2.05	mg/L	2	mg/L	103	02-FEB-94	02-FEB-94
Beryllium-6010	0.978	mg/L	1	mg/L	98	02-FEB-94	02-FEB-94
Cadmium-6010	2.09	mg/L	2	mg/L	104	02-FEB-94	02-FEB-94
Chromium-6010	2.05	mg/L	2	mg/L	102	02-FEB-94	02-FEB-94
Cobalt-6010	2.11	mg/L	2	mg/L	106	02-FEB-94	02-FEB-94
Copper-6010	2.03	mg/L	2	mg/L	101	02-FEB-94	02-FEB-94
Lead-6010	1.97	mg/L	2	mg/L	98	02-FEB-94	02-FEB-94
Molybdenum-6010	2.07	mg/L	2	mg/L	103	02-FEB-94	02-FEB-94
Nickel-6010	2.04	mg/L	2	mg/L	102	02-FEB-94	02-FEB-94
Phosphorus-6010	10.7	mg/L	10	mg/L	107	02-FEB-94	02-FEB-94
Silver-6010	2.14	mg/L	2	mg/L	107	02-FEB-94	02-FEB-94
Thallium-6010	10.1	mg/L	10	mg/L	101	02-FEB-94	02-FEB-94
Vanadium-6010	2.07	mg/L	2	mg/L	103	02-FEB-94	02-FEB-94
Zinc-6010	1.98	mg/L	2	mg/L	99	02-FEB-94	02-FEB-94

Comments:

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG385B-1

Reported: 03-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TALMET-ICPW					
Antimony-6010	ND <	0.200	mg/L	02-FEB-94	02-FEB-94
Barium-6010	ND <	0.0500	mg/L	02-FEB-94	02-FEB-94
Beryllium-6010	ND <	0.00500	mg/L	02-FEB-94	02-FEB-94
Cadmium-6010	ND <	0.0500	mg/L	02-FEB-94	02-FEB-94
Chromium-6010	ND <	0.0500	mg/L	02-FEB-94	02-FEB-94
Cobalt-6010	ND <	0.100	mg/L	02-FEB-94	02-FEB-94
Copper-6010	ND <	0.0500	mg/L	02-FEB-94	02-FEB-94
Lead-6010	ND <	0.150	mg/L	02-FEB-94	02-FEB-94
Molybdenum-6010	ND <	0.200	mg/L	02-FEB-94	02-FEB-94
Nickel-6010	ND <	0.100	mg/L	02-FEB-94	02-FEB-94
Phosphorus-6010	1.11	1.00	mg/L	02-FEB-94	02-FEB-94
Silver-6010	ND <	0.0500	mg/L	02-FEB-94	02-FEB-94
Thallium-6010	ND <	1.00	mg/L	02-FEB-94	02-FEB-94
Vanadium-6010	ND <	0.0500	mg/L	02-FEB-94	02-FEB-94
Zinc-6010	0.167	0.0500	mg/L	02-FEB-94	02-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3858-2

Reported: 03-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TALMET-ICPW							
Antimony-6010	1.98	mg/L	2	mg/L	99	02-FEB-94	02-FEB-94
Barium-6010	2.04	mg/L	2	mg/L	102	02-FEB-94	02-FEB-94
Beryllium-6010	0.953	mg/L	1	mg/L	95	02-FEB-94	02-FEB-94
Cadmium-6010	1.98	mg/L	2	mg/L	99	02-FEB-94	02-FEB-94
Chromium-6010	1.93	mg/L	2	mg/L	97	02-FEB-94	02-FEB-94
Cobalt-6010	2.14	mg/L	2	mg/L	107	02-FEB-94	02-FEB-94
Copper-6010	2.14	mg/L	2	mg/L	107	02-FEB-94	02-FEB-94
Lead-6010	1.91	mg/L	2	mg/L	96	02-FEB-94	02-FEB-94
Molybdenum-6010	1.96	mg/L	2	mg/L	98	02-FEB-94	02-FEB-94
Nickel-6010	1.93	mg/L	2	mg/L	97	02-FEB-94	02-FEB-94
Phosphorus-6010	11.7	mg/L	10	mg/L	106	02-FEB-94	02-FEB-94
Silver-6010	1.85	mg/L	2	mg/L	93	02-FEB-94	02-FEB-94
Thallium-6010	9.24	mg/L	10	mg/L	92	02-FEB-94	02-FEB-94
Vanadium-6010	2.05	mg/L	2	mg/L	103	02-FEB-94	02-FEB-94
Zinc-6010	2.15	mg/L	2	mg/L	99	02-FEB-94	02-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3858-3

Reported: 03-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TALMET-ICPW						
Antimony-6010	2.03	mg/L	102	2.5	02-FEB-94	02-FEB-94
Barium-6010	2.03	mg/L	101	0.49	02-FEB-94	02-FEB-94
Beryllium-6010	0.973	mg/L	97	2.1	02-FEB-94	02-FEB-94
Cadmium-6010	1.98	mg/L	99	0.0	02-FEB-94	02-FEB-94
Chromium-6010	1.95	mg/L	98	1.0	02-FEB-94	02-FEB-94
Cobalt-6010	2.16	mg/L	108	0.93	02-FEB-94	02-FEB-94
Copper-6010	2.07	mg/L	103	3.3	02-FEB-94	02-FEB-94
Lead-6010	1.90	mg/L	95	0.52	02-FEB-94	02-FEB-94
Molybdenum-6010	1.95	mg/L	98	0.51	02-FEB-94	02-FEB-94
Nickel-6010	1.97	mg/L	98	2.0	02-FEB-94	02-FEB-94
Phosphorus-6010	12.1	mg/L	110	3.4	02-FEB-94	02-FEB-94
Silver-6010	1.79	mg/L	90	3.3	02-FEB-94	02-FEB-94
Thallium-6010	10.0	mg/L	100	7.9	02-FEB-94	02-FEB-94
Vanadium-6010	2.10	mg/L	105	2.4	02-FEB-94	02-FEB-94
Zinc-6010	2.10	mg/L	97	2.4	02-FEB-94	02-FEB-94

Comments:

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3853-1

Reported: 08-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Fluoride	ND <	1.0	mg/L		24-JAN-94
Chloride	ND <	0.20	mg/L		24-JAN-94
Nitrite	ND <	0.30	mg/L		24-JAN-94
Bromide	ND <	0.10	mg/L		24-JAN-94
Nitrate	ND <	0.10	mg/L		24-JAN-94
Phosphate	ND <	0.20	mg/L		24-JAN-94
Sulfate	ND <	0.50	mg/L		24-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3853-2

Reported: 08-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
ANIONS-W							
Chloride	1.02	mg/L	1	mg/L	102 %		24-JAN-94
Nitrate	2.82	mg/L	3	mg/L	94 %		24-JAN-94
Sulfate	3.94	mg/L	4	mg/L	98 %		24-JAN-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3821-3

Reported: 08-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Chloride	1.05	0.20	mg/L		21-JAN-94
Nitrate	1.02	0.10	mg/L		21-JAN-94
Sulfate	1.07	0.50	mg/L		21-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3821-4

Reported: 08-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
ANIONS-W							
Chloride	2.04	mg/L	1	mg/L	99 %		21-JAN-94
Nitrate	3.85	mg/L	3	mg/L	94 %		21-JAN-94
Sulfate	5.10	mg/L	4	mg/L	101 %		21-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3821-5

Reported: 08-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
ANIONS-W						
Chloride	2.00	mg/L	95 %	2.0		21-JAN-94
Nitrate	3.87	mg/L	95 %	0.52		21-JAN-94
Sulfate	5.07	mg/L	100 %	0.59		21-JAN-94

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3881-1

Reported: 07-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	02-FEB-94	03-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3881-2

Reported: 07-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
413.1W							
Oil & Grease-Grav.(413.1W)	56.5	mg/L	60	mg/L	94.2	02-FEB-94	03-FEB-94
-	-						
Comments:	-						

D&H Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike D
Lab Id: WG3881-3

Reported: 07-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
413.1W						
Oil & Grease-Grav.(413.1W)	51.9	mg/L	86.5	8.5	02-FEB-94	03-FEB-94

Comments:

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3839-1

Reported: 08-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
8150-W					
Dalapon	ND	3.0	ug/L	28-JAN-94	03-FEB-94
Dicamba	ND	0.30	ug/L	28-JAN-94	03-FEB-94
Dinoseb	ND	0.40	ug/L	28-JAN-94	03-FEB-94
MCPP	ND	150	ug/L	28-JAN-94	03-FEB-94
MCPA	ND	150	ug/L	28-JAN-94	03-FEB-94
2,4-D	ND	1.2	ug/L	28-JAN-94	03-FEB-94
2,4-DB	ND	0.90	ug/L	28-JAN-94	03-FEB-94
2,4,5-T	ND	0.10	ug/L	28-JAN-94	03-FEB-94
Silvex	ND	0.10	ug/L	28-JAN-94	03-FEB-94
Dichloroprop	ND	0.65	ug/L	28-JAN-94	03-FEB-94
-	-				
-	-				
Surrogate:	-				
2,4-Dichlorophenyl acetic acid	74.0	-	%	28-JAN-94	03-FEB-94
-	-				
-	-				
Comments:	MB=MX				

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike
Lab Id: WG3839-2

Reported: 08-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
8150-W							
Dalapon	ND	ug/L				28-JAN-94	03-FEB-94
Dicamba	ND	ug/L				28-JAN-94	03-FEB-94
Dinoseb	ND	ug/L				28-JAN-94	03-FEB-94
MCPP	ND	ug/L				28-JAN-94	03-FEB-94
MCPA	ND	ug/L				28-JAN-94	03-FEB-94
2,4-D	4.12	ug/L	5	ug/L	82 %	28-JAN-94	03-FEB-94
2,4-DB	ND	ug/L				28-JAN-94	03-FEB-94
2,4,5-T	ND	ug/L				28-JAN-94	03-FEB-94
Silvex	1.28	ug/L	2	ug/L	64 %	28-JAN-94	03-FEB-94
Dichloroprop	ND	ug/L				28-JAN-94	03-FEB-94
Surrogate:							
2,4-Dichlorophenyl acetic acid	76.0	%				28-JAN-94	03-FEB-94

Comments: None

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike Duplicat
Lab Id: WG3839-3

Reported: 08-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
8150-W						
Dalapon	ND	ug/L			28-JAN-94	03-FEB-94
Dicamba	ND	ug/L			28-JAN-94	03-FEB-94
Dinoseb	ND	ug/L			28-JAN-94	03-FEB-94
MCPP	ND	ug/L			28-JAN-94	03-FEB-94
MCPA	ND	ug/L			28-JAN-94	03-FEB-94
2,4-D	4.55	ug/L	91 %	9.9	28-JAN-94	03-FEB-94
2,4-DB	ND	ug/L			28-JAN-94	03-FEB-94
2,4,5-T	ND	ug/L			28-JAN-94	03-FEB-94
Silvex	1.42	ug/L	71 %	10.	28-JAN-94	03-FEB-94
Dichloroprop	ND	ug/L			28-JAN-94	03-FEB-94
-	-					
-	-					
Surrogate:	-					
2,4-Dichlorophenyl acetic acid	81.0	%			28-JAN-94	03-FEB-94
-	-					
-	-					
Comments:	None					

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3786-4

Reported: 01-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
8080W					
Aldrin	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
ARO1016	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1221	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1232	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1242	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1248	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1254	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
ARO1260	ND <	0.50	ug/L	28-JAN-94	31-JAN-94
BHC-Alpha	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
BHC-Beta	ND <	0.040	ug/L	28-JAN-94	31-JAN-94
BHC-Delta	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
BHC-Gamma	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Chlordane	ND <	1.0	ug/L	28-JAN-94	31-JAN-94
DDD	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
DDE	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
DDT	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Dieldrin	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Endosulfan	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Endosulfan Sulfate	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Endosulfan2	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Endrin	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Endrin Aldehyde	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Heptachlor	ND <	0.030	ug/L	28-JAN-94	31-JAN-94
Heptachlor Epoxide	ND <	0.020	ug/L	28-JAN-94	31-JAN-94
Toxaphene	ND <	5.0	ug/L	28-JAN-94	31-JAN-94
Methoxychlor	ND <	0.060	ug/L	28-JAN-94	31-JAN-94
-	-				
Surrogate:	-				
Tetrachloro-meta-xylene	121.	-	%	28-JAN-94	31-JAN-94
Decachlorobiphenyl	29.0	-	%	28-JAN-94	31-JAN-94
-	-				
Comments:	None				

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3786-5

Reported: 01-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
8080QCW							
DDT	2.46	ug/L	2	ug/L	123 %	28-JAN-94	31-JAN-94
Heptachlor	0.779	ug/L	.5	ug/L	156 %	28-JAN-94	31-JAN-94
-	-						
Surrogate:	-						
Tetrachlorometaxylene	117.	%				28-JAN-94	31-JAN-94
Decachlorobiphenyl	73.0	%				28-JAN-94	31-JAN-94
-	-						
Comments:	None						

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike
Lab Id: WG3786-2

Reported: 01-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
8080QCW							
DDT	2.26	ug/L	2	ug/L	113 %	24-JAN-94	25-JAN-94
Heptachlor	0.736	ug/L	.5	ug/L	147 %	24-JAN-94	25-JAN-94
-	-						
Surrogate:	-						
Tetrachlorometaxylene	123.	%				24-JAN-94	25-JAN-94
Decachlorobiphenyl	128.	%				24-JAN-94	25-JAN-94
-	-						
Comments:	None						

D&H Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike Duplicat
Lab Id: WG3786-3

Reported: 01-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
8080QCW						
DDT	2.18	ug/L	109 %	3.6	24-JAN-94	25-JAN-94
Heptachlor	0.715	ug/L	143 %	2.8	24-JAN-94	25-JAN-94
-	-					
Surrogate:	-					
Tetrachlorometaxylene	115.	%			24-JAN-94	25-JAN-94
Decachlorobiphenyl	127.	%			24-JAN-94	25-JAN-94
-	-					
Comments:	None					

QUALITY CONTROL REPORT

In order to provide you with the means of assessing the quality of the data in our report, **D&M Laboratories** reports the results of Quality Control samples analyzed with your samples.

The Quality Control samples provide the following QC information:

The Method Blank (**MB**) monitors the level of contamination introduced by reagents or glassware. A minimum of one MB is run per batch of 20 samples or less.

The Method Blank Spike (**MBS**) measures the accuracy of analytical techniques and is not subject to matrix effects. A minimum of one MBS is run per batch of 20 samples or less.

The Matrix Spike (**MS**) measures the accuracy of the method for a matrix type. Due to the high variability within matrix types and the necessity of batching samples from varied sources, matrix spike information from one sample is not necessarily relevant to other samples on the batch. A minimum of two matrix spikes, MS and MSD, are run per batch of 20 samples or less. The sample selected for the matrix spike is designated **MX**, and may or may not have been submitted by the recipient of this report.

The Matrix Spike Duplicate (**MSD**), along with the MS, is used to monitor the precision (**RPD**) of the method and to indicate possible non homogeneity of the sample matrix.

Equations used for determining percent recovery and relative percent difference (RPD) are as follows:

MBS % Recovery = (MBS result / MBS spike level) x 100
MS % Recovery = [(MS result - MX result) / MS spike level] x 100
RPD ={ | MS result - MSD result | / [(MS result + MSD result) / 2]} x 100

We continue to strive to improve the quality of service to our clients. We welcome any questions or comments you may have about this information, or about **D&M Laboratories** in general. Please contact a Project Manager for further information.

BRELJE AND RACE

LABORATORIES, INC. 425 SOUTH E STREET SANTA ROSA, CALIFORNIA 95404 (707) 544-8807

February 8, 1994
Sample Collected: 1-23-94
Sample Received : 1-24-94
Collected By : Client

D&M Laboratories
3700 Lakeville Hwy.
Petaluma CA 94954

Attention: Sample Control

LOG NUMBER	SAMPLE DESCRIPTION	BOD_5 @ 20°C mg/L
	Reagent Blank mg/L	<5.
	Detection Limit mg/L	5.
	Reference Sample True Value mg/L	198.
	Acceptance Limits mg/L	±30.5
	Reference Sample Result mg/L	204.
	Method Number	Std. Mthds. 18th ed. 5210
	Date Started	1/24/94
	Date Completed	1/29/94
194-1304	SL-1	30.
194-1306	SL-2	7.
194-1308	SL-3	9.
194-1310	SL-3 Composite	<5.
194-1312	SL-4	12.
194-1314	SL-5	<5.
194-1316	SL-6	<5.

VERY TRULY YOURS,

BRELJE AND RACE LABORATORIES, INC.

LABORATORY SUPERVISOR
CG/RC:tag

BRELJE AND RACE

LABORATORIES, INC. 425 SOUTH E STREET SANTA ROSA, CALIFORNIA 95404 (707) 544-8807

February 8, 1994
Sample Collected: 1-23-94
Sample Received : 1-24-94
Collected By : Client

D&M Laboratories
3700 Lakeville Hwy.
Petaluma CA 94954

Attention: Sandy

LOG NUMBER	SAMPLE DESCRIPTION	TOTAL KJELDAHL N mg/L
	Reagent Blank mg/L	<0.4
	Detection Limit mg/L	0.4
	Reference Sample True Value mg/L	19.0
	Acceptance Limits mg/L	(13.9-23.1)
	Reference Sample Result mg/L	17.7
	Reference Sample Result Dup. mg/L	18.7
	%RSD	3.89
	EPA Method Number	351.3
194-1305	SL-1	3.4
194-1307	SL-2	2.2
194-1309	SL-3	2.6
194-1311	SL-3 Composite	2.2
194-1313	SL-4	3.0
194-1315	SL-5	<0.4
194-1317	SL-6	0.9

VERY TRULY YOURS,

BRELJE AND RACE LABORATORIES, INC.

LABORATORY SUPERVISOR
CG/RC:tag

L9401183

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA. 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name National Park Service (D.I.R. - SFC) Phone 213-[illegible]
Address
City, State, Zip
Client's or Representative's Signature J. Brown
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 02-0-50-153 PROJECT NAME Swmf
SAMPLERS (Signature) Michael Thomas

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	BOD	TPD	TKN	Metals	TSS	Fecal Coliform	REMARKS	LAB USE ONLY LAB NO
SW-1	1/23			X	Industrial	(8)	✓	✓	✓	✓	✓	✓		

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Michael Thomas	1/24	11:45	Sam Nelson
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Sam Nelson	1/24	By NM	Kevin Carbidum
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

General Remarks

CLIENT COPY

L9401183

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA. 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name (D.M - SFO) Phone 213 - 7845
Address
City, State, Zip

Client's or Representative's Signature
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 0.2050 155 PROJECT NAME Swimf
SAMPLERS (Signature) Nicolas Thomas

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS	LAB USE ONLY LAB NO
	1/23			X		1 ea	X	X	X	X	X	X		
						7								

Relinquished by (Signature)	DATE	TIME	Received by (Signature)	General Remarks
Nicolas Thomas	1/23	10:45	Dan Klein	
Relinquished by (Signature)	DATE	TIME	Received by (Signature)	
Dan Klein	1/24/99	[illegible]	Kristy Perkins	
Relinquished by (Signature)	DATE	TIME	Received by (Signature)	

CLIENT COPY

L9401183

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA. 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4085

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name National Park Service (Dr. M.-SFC) Phone 707-39-45
Address
City, State, Zip
Client's or Representative's Signature Michael Thomas
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 0-05-155 PROJECT NAME SLIMF
SAMPLERS (Signature) Michael Thomas

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	PCB	O&G	TKN	TSS	PO4	Nitrate Nitrite	REMARKS	LAB USE ONLY LAB NO.
SL-3	1/23	4:30		X	SL-3 Regulator	1/2A	X	X	X	X	X			
SL-3	1/23	4:30	1		SL-3 Regulator	9	X	X	X	X	X	X		
						6								

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Michael Thomas	1/24	10:45	Dan Nelson
Dan Nelson	1/24	NOON	Kristy Corrington
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

General Remarks:

CLIENT COPY

L9401183

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA. 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4068

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name [illegible] Phone

Address

City, State, Zip

Client's or Representative's Signature [illegible]

(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 02050-155 PROJECT NAME Swimf

SAMPLERS (Signature) [illegible]

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS	LAB USE ONLY LAB NO.
[illegible]	1/23			X	[illegible]	1-L 6	X	X	X	X		X		

COOLER CUSTODY SEALS INTACT ☐ NOT INTACT ☐ N/A

COOLER TEMPERATURE 16 °C

COOLER CUSTODY SEALS INTACT ☐ NOT INTACT ☐ N/A

COOLER TEMPERATURE 16 °C

43 Waters - HD

SAMPLES RECEIVED IN GOOD CONDITION
NO BROKEN OR LEAKING CONTAINERS

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	General Remarks
[illegible]	1/23	15:15	[illegible]	
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	
[illegible]	1/24/94	[illegible]	[illegible]	
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	

CLIENT COPY

L9401183

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA, 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name (Dam SFC) Phone 201-3-3915
Address
City, State, Zip
Client's or Representative's Signature
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 0.012-155 PROJECT NAME SW 17 P
SAMPLERS (Signature)

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS	LAB USE ONLY LAB NO.
				x		7		x	x	x	x	x		

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
	1/24	11:45	
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
	1/24/94	1200	
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

General Remarks:

CLIENT COPY

L9401183

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA. 94975-8024
Telephone: (707)763-8248 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name [illegible] (DPM - SFO) Phone 213 - 3845
Address
City, State, Zip
Client's or Representative's Signature Michael Thomas
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 02030.155 PROJECT NAME SWMF
SAMPLERS (Signature) Michael Thomas

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS	LAB USE ONLY LAB NO.
	1/23	3:35		X		1 liter	X	X	X	X	X	X		
						9								

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Michael Thomas	1/24/16	10:45	[illegible]
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
[illegible]	1/24	Noon	[illegible]
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

General Remarks:

CLIENT COPY

ANRESCO
INCORPORATED
ANALYSIS RESEARCH

1370 Van Dyke Ave., S.F., CA 94124
Tel: (415) 822-1100 Fax: (415) 822-6615
790 Basin Street, #2, San Pedro, CA 90731
Tel: (310) 833-4598 Fax: (310) 833-1585
Toll Free - 800-359-0920

January 28, 1994

Danmes & Moore Consulting
221 Main Street Suite 600
San Francisco, CA 94105

File No. 194390

Attn: Mr. Jeff Bensch

RE: Storm Water Analyses
Client: National Park Service
Project: SWMP
Project No: 02050-155

Collected By: Michael Thomas
Date Collected: 1/23/94
Date Received: 1/23/94

ANALYSES

			----------MPN/100ml----------		
Sample	**Location**	**Time**	**Presumptive Coliform**	**Confirmed Coliform**	**E. coli.**
SL-1	Industrial	6:00am	50,000	50,000	50,000
SL-2	Roads	6:08am	>16,000	5,000	240
SL-3	Residential	4:30am	>16,000	5,000	3,000
SL-4	Commercial	3:32am	70,000	70,000	70,000
SL-5	Open Space	6:24am	>16,000	300	130
SL-6	Golf Course	6:56am	9,000	14	<2

Method: Standard Methods for the Examination of Water and Wastewater 17th Edition. Reference 9221 "Multiple Tube Fermentation Technique for the Members of the Coliform Group."

Reported By:
ANRESCO, INC.

Laila Lam
Microbial Analyst

LL:Micro-194390

ENVIRONMENTAL AND INDUSTRIAL HYGIENE SERVICES

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX (707) 763-4065

February 24, 1994

Jeff Bensch
Dames & Moore-San Francisco
221 Main Street
Suite 600
San Francisco, CA 94105

Customer Project: 02050-155-SWMP National Park Service
Laboratory Job: L9402055

On February 7, 1994 we received 7 sample(s) for analysis. Samples were analyzed by the following method(s):

Oil & Grease (EPA 413.1)

PCB's and Pesticides (EPA 8080)

Chlorinated Herbicides (EPA 8150)

BOD (EPA 405.1)

COD (EPA 410.4 / SM 5220)

Phosphate, Ortho (EPA 300.0)

Priority Pollutant Metals (13)

Nitrogen, Total Kjeldahl (EPA 351.3)

Total Suspended Solids (EPA 160.2)

Robin Cockerham
Project Manager

Robert Peak
Laboratory Director
Robert Peak

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-1
Lab Id: L9402055-1

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	5.8	5.0	mg/L	14-FEB-94	16-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		07-FEB-94
COD					
Chemical Oxygen Demand	110	20.	mg/L	11-FEB-94	11-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	0.28	0.050	mg/L	10-FEB-94	10-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	160	4.0	mg/L		10-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-2
Lab Id: L9402055-2

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	15.	5.0	mg/L	14-FEB-94	16-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		07-FEB-94
COD					
Chemical Oxygen Demand	190	20.	mg/L	11-FEB-94	11-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Copper-6010	0.12	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	0.51	0.050	mg/L	10-FEB-94	10-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	120	4.0	mg/L		10-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: COMP SL-3
Lab Id: L9402055-3

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		07-FEB-94
COD					
Chemical Oxygen Demand	82.	20.	mg/L	11-FEB-94	11-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	0.094	0.050	mg/L	10-FEB-94	10-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	120	4.0	mg/L		10-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

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ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: COMP SL-4
Lab Id: L9402055-4

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		07-FEB-94
COD					
Chemical Oxygen Demand	ND <	20.	mg/L	11-FEB-94	11-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Comments:					
TSS					
Total Suspended Solids	13.	4.0	mg/L		10-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-5
Lab Id: L9402055-5

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	14-FEB-94	16-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		07-FEB-94
COD					
Chemical Oxygen Demand	79.	20.	mg/L	11-FEB-94	11-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	0.17	0.050	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	0.16	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	160	4.0	mg/L		10-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-6
Lab Id: L9402055-6

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	14-FEB-94	16-FEB-94
8080W					
Aldrin	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
ARO1016	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
ARO1221	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
ARO1232	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
ARO1242	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
ARO1248	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
ARO1254	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
ARO1260	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
BHC-Alpha	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
BHC-Beta	ND <	0.040	ug/L	09-FEB-94	12-FEB-94
BHC-Delta	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
BHC-Gamma	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Chlordane	ND <	1.0	ug/L	09-FEB-94	12-FEB-94
DDD	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
DDE	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
DDT	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Dieldrin	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Endosulfan	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Endosulfan Sulfate	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Endosulfan2	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Endrin	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Endrin Aldehyde	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Heptachlor	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Heptachlor Epoxide	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Toxaphene	ND <	5.0	ug/L	09-FEB-94	12-FEB-94
Methoxychlor	ND <	0.060	ug/L	09-FEB-94	12-FEB-94
-	-				
Surrogate:	-				
Tetrachloro-meta-xylene	82.0	-	%	09-FEB-94	12-FEB-94
Decachlorobiphenyl	102.	-	%	09-FEB-94	12-FEB-94
-	-				
Comments:	None				
8150-W					
Dalapon	ND	3.0	ug/L	11-FEB-94	14-FEB-94
Dicamba	ND	0.30	ug/L	11-FEB-94	14-FEB-94
Dinoseb	ND	0.40	ug/L	11-FEB-94	14-FEB-94
MCPP	ND	150	ug/L	11-FEB-94	14-FEB-94
MCPA	ND	150	ug/L	11-FEB-94	14-FEB-94
2,4-D	ND	1.2	ug/L	11-FEB-94	14-FEB-94
2,4-DB	ND	0.90	ug/L	11-FEB-94	14-FEB-94
2,4,5-T	ND	0.10	ug/L	11-FEB-94	14-FEB-94
Silvex	ND	0.10	ug/L	11-FEB-94	14-FEB-94
Dichloroprop	ND	0.65	ug/L	11-FEB-94	14-FEB-94
-	-				
-	-				
Surrogate:	-				
2,4-Dichlorophenyl acetic acid	86.0	-	%	11-FEB-94	14-FEB-94
-	-				
-	-				

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-6
Lab Id: L9402055-6

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		07-FEB-94
COD					
Chemical Oxygen Demand	ND <	20.	mg/L	11-FEB-94	11-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	7.0	4.0	mg/L		10-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155-SWMP National Park Service
Sample Id: SL-4
Lab Id: L9402055-7

Collected: 06-FEB-94
Received: 07-FEB-94
Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	6.1	mg/L	14-FEB-94	16-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		07-FEB-94
COD					
Chemical Oxygen Demand	54.	20.	mg/L	11-FEB-94	11-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	0.18	0.050	mg/L	10-FEB-94	10-FEB-94
Comments:					
TSS					
Total Suspended Solids	110	4.0	mg/L		10-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3987-1

Reported: 16-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	14-FEB-94	16-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3987-2

Reported: 17-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
413.1W							
Oil & Grease-Grav.(413.1W)	58.2	mg/L	60	mg/L	97 %	14-FEB-94	16-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike
Lab Id: WG3987-3

Reported: 17-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
413.1W							
Oil & Grease-Grav.(413.1W)	56.5	mg/L	60	mg/L	94 %	02-FEB-94	03-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike Duplicat
Lab Id: WG3987-4

Reported: 17-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
413.1W						
Oil & Grease-Grav.(413.1W)	51.9	mg/L	86 %	8.5	02-FEB-94	03-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3970-3

Reported: 14-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Fluoride	ND <	1.0	mg/L		07-FEB-94
Chloride	ND <	0.20	mg/L		07-FEB-94
Nitrite	ND <	0.30	mg/L		07-FEB-94
Bromide	ND <	0.10	mg/L		07-FEB-94
Nitrate	ND <	0.10	mg/L		07-FEB-94
Phosphate	ND <	0.20	mg/L		07-FEB-94
Sulfate	ND <	0.50	mg/L		07-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3970-4

Reported: 14-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
ANIONS-W							
Chloride	1.00	mg/L	1	mg/L	100 %		07-FEB-94
Nitrate	2.78	mg/L	3	mg/L	93 %		07-FEB-94
Sulfate	4.02	mg/L	4	mg/L	100 %		07-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3822-3

Reported: 14-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Chloride	1.66	0.20	mg/L		22-JAN-94
Nitrate	0.965	0.10	mg/L		22-JAN-94
Sulfate	14.4	0.50	mg/L		22-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3822-4

Reported: 14-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
ANIONS-W							
Chloride	2.49	mg/L	1	mg/L	83 %		22-JAN-94
Nitrate	3.65	mg/L	3	mg/L	90 %		22-JAN-94
Sulfate	18.6	mg/L	4	mg/L	105 %		22-JAN-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3822-5

Reported: 14-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
ANIONS-W						
Chloride	2.54	mg/L	88 %	2.0		22-JAN-94
Nitrate	3.68	mg/L	90 %	0.82		22-JAN-94
Sulfate	18.7	mg/L	108 %	0.54		22-JAN-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3961-1

Reported: 14-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
COD					
Chemical Oxygen Demand	ND <	20.	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3961-3

Reported: 14-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
COD					
Chemical Oxygen Demand	161.	20.	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3961-2

Reported: 14-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
COD							
Chemical Oxygen Demand	193.	mg/L	200	mg/L	96 %	11-FEB-94	11-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3961-4

Reported: 14-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
COD							
Chemical Oxygen Demand	338.	mg/L	200	mg/L	88 %	11-FEB-94	11-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3961-5

Reported: 17-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
COD						
Chemical Oxygen Demand	348.	mg/L	94 %	2.9	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3934-4

Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Barium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Cobalt-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.15	mg/L	10-FEB-94	10-FEB-94
Molybdenum-6010	ND <	0.20	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.10	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.0	mg/L	10-FEB-94	10-FEB-94
Vanadium-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	ND <	0.050	mg/L	10-FEB-94	10-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3934-5

Reported: 10-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TALMET-ICPW							
Antimony-6010	1.90	mg/L	2	mg/L	95	10-FEB-94	10-FEB-94
Barium-6010	2.07	mg/L	2	mg/L	103	10-FEB-94	10-FEB-94
Beryllium-6010	0.998	mg/L	1	mg/L	100	10-FEB-94	10-FEB-94
Cadmium-6010	2.07	mg/L	2	mg/L	104	10-FEB-94	10-FEB-94
Chromium-6010	2.06	mg/L	2	mg/L	103	10-FEB-94	10-FEB-94
Cobalt-6010	2.20	mg/L	2	mg/L	110	10-FEB-94	10-FEB-94
Copper-6010	2.14	mg/L	2	mg/L	107	10-FEB-94	10-FEB-94
Lead-6010	2.02	mg/L	2	mg/L	101	10-FEB-94	10-FEB-94
Molybdenum-6010	1.98	mg/L	2	mg/L	99	10-FEB-94	10-FEB-94
Nickel-6010	2.05	mg/L	2	mg/L	103	10-FEB-94	10-FEB-94
Silver-6010	2.16	mg/L	2	mg/L	108	10-FEB-94	10-FEB-94
Thallium-6010	10.7	mg/L	10	mg/L	107	10-FEB-94	10-FEB-94
Vanadium-6010	2.15	mg/L	2	mg/L	108	10-FEB-94	10-FEB-94
Zinc-6010	2.04	mg/L	2	mg/L	102	10-FEB-94	10-FEB-94

Comments:

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3934-1

Reported: 10-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TALMET-ICPW					
Antimony-6010	ND <	0.200	mg/L	10-FEB-94	10-FEB-94
Barium-6010	ND <	0.0500	mg/L	10-FEB-94	10-FEB-94
Beryllium-6010	ND <	0.00500	mg/L	10-FEB-94	10-FEB-94
Cadmium-6010	ND <	0.0500	mg/L	10-FEB-94	10-FEB-94
Chromium-6010	ND <	0.0500	mg/L	10-FEB-94	10-FEB-94
Cobalt-6010	ND <	0.100	mg/L	10-FEB-94	10-FEB-94
Copper-6010	ND <	0.0500	mg/L	10-FEB-94	10-FEB-94
Lead-6010	ND <	0.150	mg/L	10-FEB-94	10-FEB-94
Molybdenum-6010	ND <	0.200	mg/L	10-FEB-94	10-FEB-94
Nickel-6010	ND <	0.100	mg/L	10-FEB-94	10-FEB-94
Silver-6010	ND <	0.0500	mg/L	10-FEB-94	10-FEB-94
Thallium-6010	ND <	1.00	mg/L	10-FEB-94	10-FEB-94
Vanadium-6010	ND <	0.0500	mg/L	10-FEB-94	10-FEB-94
Zinc-6010	ND <	0.0500	mg/L	10-FEB-94	10-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3934-2

Reported: 10-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TALMET-ICPW							
Antimony-6010	1.98	mg/L	2	mg/L	99	10-FEB-94	10-FEB-94
Barium-6010	2.07	mg/L	2	mg/L	104	10-FEB-94	10-FEB-94
Beryllium-6010	0.987	mg/L	1	mg/L	99	10-FEB-94	10-FEB-94
Cadmium-6010	2.02	mg/L	2	mg/L	101	10-FEB-94	10-FEB-94
Chromium-6010	2.05	mg/L	2	mg/L	103	10-FEB-94	10-FEB-94
Cobalt-6010	2.17	mg/L	2	mg/L	109	10-FEB-94	10-FEB-94
Copper-6010	2.07	mg/L	2	mg/L	103	10-FEB-94	10-FEB-94
Lead-6010	1.98	mg/L	2	mg/L	99	10-FEB-94	10-FEB-94
Molybdenum-6010	2.07	mg/L	2	mg/L	103	10-FEB-94	10-FEB-94
Nickel-6010	2.03	mg/L	2	mg/L	101	10-FEB-94	10-FEB-94
Silver-6010	1.87	mg/L	2	mg/L	93	10-FEB-94	10-FEB-94
Thallium-6010	9.95	mg/L	10	mg/L	100	10-FEB-94	10-FEB-94
Vanadium-6010	2.12	mg/L	2	mg/L	106	10-FEB-94	10-FEB-94
Zinc-6010	2.01	mg/L	2	mg/L	100	10-FEB-94	10-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3934-3

Reported: 10-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TALMET-ICPW						
Antimony-6010	2.04	mg/L	102	3.0	10-FEB-94	10-FEB-94
Barium-6010	2.08	mg/L	104	0.48	10-FEB-94	10-FEB-94
Beryllium-6010	0.979	mg/L	98	0.81	10-FEB-94	10-FEB-94
Cadmium-6010	2.04	mg/L	102	0.98	10-FEB-94	10-FEB-94
Chromium-6010	2.03	mg/L	102	0.98	10-FEB-94	10-FEB-94
Cobalt-6010	2.17	mg/L	108	0.0	10-FEB-94	10-FEB-94
Copper-6010	2.06	mg/L	103	0.0	10-FEB-94	10-FEB-94
Lead-6010	1.99	mg/L	99	0.50	10-FEB-94	10-FEB-94
Molybdenum-6010	1.99	mg/L	100	3.5	10-FEB-94	10-FEB-94
Nickel-6010	2.02	mg/L	101	0.0	10-FEB-94	10-FEB-94
Silver-6010	1.75	mg/L	88	6.6	10-FEB-94	10-FEB-94
Thallium-6010	10.2	mg/L	102	2.5	10-FEB-94	10-FEB-94
Vanadium-6010	2.17	mg/L	108	2.3	10-FEB-94	10-FEB-94
Zinc-6010	2.02	mg/L	101	0.50	10-FEB-94	10-FEB-94

Comments:

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3945-1

Reported: 11-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TSS					
Total Suspended Solids	ND <	4.0	mg/L		10-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3883-2

Reported: 11-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TSS					
Total Suspended Solids	255.	4.0	mg/L		03-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Duplicate
Lab Id: WG3883-3

Reported: 11-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TSS						
Total Suspended Solids	258.	mg/L		1.2		03-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3964-4

Reported: 14-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3964-5

Reported: 14-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TTLC-GFW							
Arsenic- EPA 7060	0.0307	mg/L	.025	mg/L	123	11-FEB-94	11-FEB-94
Selenium - EPA 7740	0.0265	mg/L	.025	mg/L	106	11-FEB-94	11-FEB-94
Mercury - EPA 7470	0.00170	mg/L	.002	mg/L	85	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG3964-1

Reported: 14-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.00500	mg/L	11-FEB-94	11-FEB-94
Selenium - EPA 7740	ND <	0.00500	mg/L	11-FEB-94	11-FEB-94
Mercury - EPA 7470	ND <	0.000200	mg/L	11-FEB-94	11-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG3964-2

Reported: 14-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TTLC-GFW							
Arsenic- EPA 7060	0.0216	mg/L	.025	mg/L	86	11-FEB-94	11-FEB-94
Selenium - EPA 7740	0.0244	mg/L	.025	mg/L	98	11-FEB-94	11-FEB-94
Mercury - EPA 7470	0.00198	mg/L	.002	mg/L	99	11-FEB-94	11-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG3964-3

Reported: 14-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TTLC-GFW						
Arsenic- EPA 7060	0.0240	mg/L	96	11.	11-FEB-94	11-FEB-94
Selenium - EPA 7740	0.0260	mg/L	104	6.0	11-FEB-94	11-FEB-94
Mercury - EPA 7470	0.00200	mg/L	100	1.0	11-FEB-94	11-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3786-14

Reported: 17-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
8080W					
Aldrin	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
AR01016	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
AR01221	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
AR01232	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
AR01242	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
AR01248	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
AR01254	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
AR01260	ND <	0.50	ug/L	09-FEB-94	12-FEB-94
BHC-Alpha	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
BHC-Beta	ND <	0.040	ug/L	09-FEB-94	12-FEB-94
BHC-Delta	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
BHC-Gamma	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Chlordane	ND <	1.0	ug/L	09-FEB-94	12-FEB-94
DDD	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
DDE	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
DDT	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Dieldrin	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Endosulfan	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Endosulfan Sulfate	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Endosulfan2	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Endrin	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Endrin Aldehyde	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Heptachlor	ND <	0.030	ug/L	09-FEB-94	12-FEB-94
Heptachlor Epoxide	ND <	0.020	ug/L	09-FEB-94	12-FEB-94
Toxaphene	ND <	5.0	ug/L	09-FEB-94	12-FEB-94
Methoxychlor	ND <	0.060	ug/L	09-FEB-94	12-FEB-94
-	-				
Surrogate:	-				
Tetrachloro-meta-xylene	79.0	-	%	09-FEB-94	12-FEB-94
Decachlorobiphenyl	41.0	-	%	09-FEB-94	12-FEB-94
-	-				
Comments:	None				

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG3786-15

Reported: 17-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
8080QCW							
DDT	2.15	ug/L	2	ug/L	107 %	09-FEB-94	12-FEB-94
Heptachlor	0.685	ug/L	.5	ug/L	137 %	09-FEB-94	12-FEB-94
-	-						
Surrogate:	-						
Tetrachlorometaxylene	97.0	%				09-FEB-94	12-FEB-94
Decachlorobiphenyl	65.0	%				09-FEB-94	12-FEB-94
-	-						
Comments:	None						

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike
Lab Id: WG3786-2

Reported: 17-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
8080QCW							
DDT	2.26	ug/L	2	ug/L	113 %	24-JAN-94	25-JAN-94
Heptachlor	0.736	ug/L	.5	ug/L	147 %	24-JAN-94	25-JAN-94
-	-						
Surrogate:	-						
Tetrachlorometaxylene	123.	%				24-JAN-94	25-JAN-94
Decachlorobiphenyl	128.	%				24-JAN-94	25-JAN-94
-	-						
Comments:	None						

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike Duplicat
Lab Id: WG3786-3

Reported: 17-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
8080QCW						
DDT	2.18	ug/L	109 %	3.6	24-JAN-94	25-JAN-94
Heptachlor	0.715	ug/L	143 %	2.8	24-JAN-94	25-JAN-94
-	-					
Surrogate:	-					
Tetrachlorometaxylene	115.	%			24-JAN-94	25-JAN-94
Decachlorobiphenyl	127.	%			24-JAN-94	25-JAN-94
-	-					
Comments:	None					

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG3839-4

Reported: 15-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
8150-W					
Dalapon	ND	3.0	ug/L	11-FEB-94	14-FEB-94
Dicamba	ND	0.30	ug/L	11-FEB-94	14-FEB-94
Dinoseb	ND	0.40	ug/L	11-FEB-94	14-FEB-94
MCPP	ND	150	ug/L	11-FEB-94	14-FEB-94
MCPA	ND	150	ug/L	11-FEB-94	14-FEB-94
2,4-D	ND	1.2	ug/L	11-FEB-94	14-FEB-94
2,4-DB	ND	0.90	ug/L	11-FEB-94	14-FEB-94
2,4,5-T	ND	0.10	ug/L	11-FEB-94	14-FEB-94
Silvex	ND	0.10	ug/L	11-FEB-94	14-FEB-94
Dichloroprop	ND	0.65	ug/L	11-FEB-94	14-FEB-94
-	-				
-	-				
Surrogate:	-				
2,4-Dichlorophenyl acetic acid	90.0	-	%	11-FEB-94	14-FEB-94
-	-				
-	-				
Comments:	None				

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank SPIKE
Lab Id: WG3839-5

Reported: 15-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
8150-W							
Dalapon	ND	ug/L				11-FEB-94	14-FEB-94
Dicamba	ND	ug/L				11-FEB-94	14-FEB-94
Dinoseb	ND	ug/L				11-FEB-94	14-FEB-94
MCPP	ND	ug/L				11-FEB-94	14-FEB-94
MCPA	ND	ug/L				11-FEB-94	14-FEB-94
2,4-D	5.85	ug/L	5	ug/L	117 %	11-FEB-94	14-FEB-94
2,4-DB	ND	ug/L				11-FEB-94	14-FEB-94
2,4,5-T	ND	ug/L				11-FEB-94	14-FEB-94
Silvex	1.62	ug/L	2	ug/L	81 %	11-FEB-94	14-FEB-94
Dichloroprop	ND	ug/L				11-FEB-94	14-FEB-94
-	-						
-	-						
Surrogate:	-						
2,4-Dichlorophenyl acetic acid	87.0	%				11-FEB-94	14-FEB-94
-	-						
-	-						
Comments:	None						

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March 1, 1994

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File No. 294302

Attn: Mr. Jeff Bensch

RE: Storm Water Analyses
Client: National Park Service
Project: SWMP
Project No: 02050-155

Collected By: Jeff Bensch/BC
Date Collected: 2-17-94
Date Received: 2-17-94

ANALYSES

			----------MPN/100ml----------		
Sample	**Location**	**Time**	**Presumptive Coliform**	**Confirmed Coliform**	**E. coli.**
SL-1	Industrial	3:27am	170,000	800	800
SL-2	Roads	3:00am	500,000	14,000	200
SL-3	Residential	3:40am	>160,000	5,000	2,200
SL-4	Commercial	3:10am	24,000	5,000	5,000
SL-5	Open Space	2:50am	30,000	140	30
SL-6	Golf Course	3:50am	240	130	4

Method: Standard Methods for the Examination of Water and Wastewater 17th Edition. Reference 9221 "Multiple Tube Fermentation Technique for the Members of the Coliform Group."

Reported By:
ANRESCO, INC.

Laila Lam
Microbial Analyst

LL:Micro-294302

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike
Lab Id: WG3839-2

Reported: 15-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
8150-W							
Dalapon	ND	ug/L				28-JAN-94	03-FEB-94
Dicamba	ND	ug/L				28-JAN-94	03-FEB-94
Dinoseb	ND	ug/L				28-JAN-94	03-FEB-94
MCPP	ND	ug/L				28-JAN-94	03-FEB-94
MCPA	ND	ug/L				28-JAN-94	03-FEB-94
2,4-D	4.12	ug/L	5	ug/L	82 %	28-JAN-94	03-FEB-94
2,4-DB	ND	ug/L				28-JAN-94	03-FEB-94
2,4,5-T	ND	ug/L				28-JAN-94	03-FEB-94
Silvex	1.28	ug/L	2	ug/L	64 %	28-JAN-94	03-FEB-94
Dichloroprop	ND	ug/L				28-JAN-94	03-FEB-94
-	-						
-	-						
Surrogate:	-						
2,4-Dichlorophenyl acetic acid	76.0	%				28-JAN-94	03-FEB-94
-	-						
-	-						

Comments: None

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Water Spike Duplicat
Lab Id: WG3839-3

Reported: 15-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
8150-W						
Dalapon	ND	ug/L			28-JAN-94	03-FEB-94
Dicamba	ND	ug/L			28-JAN-94	03-FEB-94
Dinoseb	ND	ug/L			28-JAN-94	03-FEB-94
MCPP	ND	ug/L			28-JAN-94	03-FEB-94
MCPA	ND	ug/L			28-JAN-94	03-FEB-94
2,4-D	4.55	ug/L	91 %	9.9	28-JAN-94	03-FEB-94
2,4-DB	ND	ug/L			28-JAN-94	03-FEB-94
2,4,5-T	ND	ug/L			28-JAN-94	03-FEB-94
Silvex	1.42	ug/L	71 %	10.	28-JAN-94	03-FEB-94
Dichloroprop	ND	ug/L			28-JAN-94	03-FEB-94
-	-					
-	-					
Surrogate:	-					
2,4-Dichlorophenyl acetic acid	81.0	%			28-JAN-94	03-FEB-94
-	-					
-	-					
Comments:	None					

QUALITY CONTROL REPORT

In order to provide you with the means of assessing the quality of the data in our report, **D&M Laboratories** reports the results of Quality Control samples analyzed with your samples.

The Quality Control samples provide the following QC information:

The Method Blank (**MB**) monitors the level of contamination introduced by reagents or glassware. A minimum of one MB is run per batch of 20 samples or less.

The Method Blank Spike (**MBS**) measures the accuracy of analytical techniques and is not subject to matrix effects. A minimum of one MBS is run per batch of 20 samples or less.

The Matrix Spike (**MS**) measures the accuracy of the method for a matrix type. Due to the high variability within matrix types and the necessity of batching samples from varied sources, matrix spike information from one sample is not necessarily relevant to other samples on the batch. A minimum of two matrix spikes, MS and MSD, are run per batch of 20 samples or less. The sample selected for the matrix spike is designated **MX**, and may or may not have been submitted by the recipient of this report.

The Matrix Spike Duplicate (**MSD**), along with the MS, is used to monitor the precision (**RPD**) of the method and to indicate possible non homogeneity of the sample matrix.

Equations used for determining percent recovery and relative percent difference (RPD) are as follows:

MBS % Recovery = (MBS result / MBS spike level) x 100
MS % Recovery = [(MS result - MX result) / MS spike level] x 100
RPD ={ | MS result - MSD result | / [(MS result + MSD result) / 2]} x 100

We continue to strive to improve the quality of service to our clients. We welcome any questions or comments you may have about this information, or about **D&M Laboratories** in general. Please contact a Project Manager for further information.

BRELJE AND RACE

LABORATORIES, INC. 425 SOUTH E STREET SANTA ROSA, CALIFORNIA 95404 (707) 544-8807

February 18, 1994
Sample Collected: 2-6-94
Sample Received : 2-7-94
Collected By : Client

D&M Laboratories
3700 Lakeville Hwy.
Petaluma CA 94954

Attention: Sample Control

LOG NUMBER:	**294-2357-8**	**294-2359-60**	**294-2361&5**	**294-2366-7**
Sample Description:	SL-1	SL-2	Comp SL-3	SL-4
ANALYSIS				
BOD @ 20° C mg/L (Std. Mthds. 18th ed. 5210)	<5.	17.	8.	7.
Total Kjeldahl N mg/L (EPA Method # 351.3)	1.9	5.2	1.3	0.75

BOD Start Date: 2-9-94
BOD Complete Date: 2-14-94

VERY TRULY YOURS,

BRELJE AND RACE LABORATORIES, INC.

LABORATORY SUPERVISOR
CG/RC:tag

LABORATORIES, INC. 425 SOUTH E STREET SANTA ROSA, CALIFORNIA 95404 (707) 544-8807

February 18, 1994
Sample Collected: 2-6-94
Sample Received : 2-7-94
Collected By : Client

D&M Laboratories
3700 Lakeville Hwy.
Petaluma CA 94954

Attention: Sample Control

LOG NUMBER:	294-2368-9	294-2370-1	294-2372-3
Sample Description:	Comp SL4	SL-5	SL-6
ANALYSIS			
BOD @ 20° C mg/L (Std. Mthds. 18th ed. 5210)	12.	5.	<5.
Total Kjeldahl N mg/L (EPA Method # 351.3)	1.5	1.9	0.75

BOD Start Date: 2-9-94
BOD Complete Date: 2-14-94

VERY TRULY YOURS,

BRELJE AND RACE LABORATORIES, INC.

LABORATORY SUPERVISOR
CG/RC:tag

L9402055

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA, 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name NATIONAL PARK SERVICE Phone 243-3845
Address
City, State, Zip
Client's or Representative's Signature Michael Thomas
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 0200-155 PROJECT NAME SWMP
SAMPLERS (Signature)

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	~~COLIFORM~~	BOD	COD	TKN	TSS	PO4	OIL & GREASE	METALS	REMARKS	LAB USE ONLY LAB NO.
SL-1				X	INDUSTRIAL	1 ea	X	X	X	X	X	X				
~~[illegible]~~				~~X~~	~~[illegible]~~											
~~[illegible]~~				~~X~~												
~~[illegible]~~				~~X~~												
~~[illegible]~~				~~X~~	~~OPENS PARK~~											
~~[illegible]~~				~~X~~	~~GOLF COURSE~~											

o WATERS - HP

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
			Christy Cockerham
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

General Remarks:
SAMPLES RECEIVED IN GOOD CONDITION
NO BROKEN OR LEAKING CONTAINERS
COOLER CUSTODY SEALS INTACT ☐ NOT INTACT ☐ N/A
COOLER TEMPERATURE COLD °C

CLIENT COPY

L9402055

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA. 94975-8024
Telephone: (707)763-6245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name NPS (D&M SFO) Phone 243-3845
Address 221 MAIN ST.
City, State, Zip SAN FRANCISCO, CA

Client's or Representative's Signature
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 02050-155 PROJECT NAME SWMP
SAMPLERS (Signature)

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	BOD	COD	TKN	TSS	PO4	OIL & GREASE	METALS	REMARKS	LAB USE ONLY LAB NO.
~~[illegible]~~					~~[illegible]~~										
SL-2				X	ROADS	1 ea	X	X	X	X	X	X			
~~[illegible]~~															
~~[illegible]~~															
~~[illegible]~~					~~OPEN SPACE~~										
~~[illegible]~~					~~GOLF COURSE~~										

@ WATERS - HD

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	General Remarks:
			Christy Cockerham	COOLER CUSTODY SEALS INTACT ☐ NOT INTACT ☐ N/A
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	COOLER TEMPERATURE COLD °C
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	SAMPLES RECEIVED IN GOOD CONDITION NO BROKEN OR LEAKING CONTAINERS

L9402055

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA, 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name NPS (D&M SPO) Phone 243-3845
Address
City, State, Zip

Client's or Representative's Signature
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 92050-155 PROJECT NAME SWMP
SAMPLERS (Signature)

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	BOD	COD	TKN	TSS, pH	OIL & GREASE	METALS	REMARKS	LAB USE ONLY LAB NO.
52-3				X		1 ea	X	X	X	X	X	X	COMP only no 4/13/1	

Co WATERS-HD

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	General
			Christy Cockerham	COOLER CUSTODY SEALS INTACT ☐ NOT INTACT ☐ N/A
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	COOLER TEMPERATURE COLD °C
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	SAMPLES RECEIVED IN GOOD CONDITION NO BROKEN OR LEAKING CONTAINERS

L9402055

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA, 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name NPS (D&M SFO) Phone 243-3845
Address
City, State, Zip

Client's or Representative's Signature
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 02050-195 PROJECT NAME SWMP
SAMPLERS (Signature)

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	BOD	COD	TKN	TSS	PO4	OIL & GREASE	METALS	REMARKS	LAB USE ONLY LAB NO.
SL-4				X		1 ea	X	X	X	X	X	X			
COMP SL-4							X	X	X	X		X			

L. WATERS-HD

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
			Christy Cockerham
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

General Remarks:
COOLER CUSTODY SEALS INTACT ☐ NOT INTACT ☐ N/A
COOLER TEMPERATURE COLD °C

SAMPLES RECEIVED IN GOOD CONDITION
UNBROKEN OR LEAKING CONTAINERS

L9402055

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA. 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name NPS (D&M SFO) Phone 243-3845
Address
City, State, Zip

Client's or Representative's Signature
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 02-50-155 PROJECT NAME SWMP

SAMPLERS (Signature)

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	BOD	COD	TKN	TSS	POA	OIL & GREASE	METALS	REMARKS	LAB USE ONLY LAB NO.
SL-5				X		1 ea	X	X	X	X	X	X			
4 WATER-HD															

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
			Christy Lockerham
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

General Remarks:
COOLER CUSTODY SEALS INTACT ☐ NOT INTACT ☐ N.
COOLER TEMPERATURE COOL °C
SAMPLES RECEIVED IN GOOD CO
NO BROKEN OR LEAKING

L9402053

3700 Lakeville Highway, Petaluma, CA 94952
P.O. Box 808024, Petaluma, CA, 94975-8024
Telephone: (707)763-8245 FAX: (707)763-4065

SAMPLE CHAIN OF CUSTODY / WORK ORDER

Client's Name NPS (R&M SPO) Phone 243-3845
Address
City, State, Zip

Client's or Representative's Signature
(signature authorizes the work and terms listed below)

All samples remain the property of the client who is responsible for disposal. A disposal fee may be imposed if client fails to pick up samples.

PROJ. NO. 02050-155 PROJECT NAME SWMP
SAMPLERS (Signature)

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	BOD	COD	TKN	TSS, POA	OIL & GREASE	METALS	REMARKS	LAB USE ONLY LAB NO.
SL-6				X		1 ea								
							HERBICIDES	PESTICIDES						
						1 ea	+	X						

ANRESCO
INCORPORATED
ANALYSIS RESEARCH

1370 Van Dyke Ave., S.F., CA 94124
Tel: (415) 822-1100 Fax: (415) 822-6615
790 Basin Street, #2, San Pedro, CA 90731
Tel: (310) 833-4598 Fax: (310) 833-1585
Toll Free - 800-359-0920

February 14, 1994

Danmes & Moore Consulting
221 Main Street Suite 600
San Francisco, CA 94105

File No. 294129

Attn: Mr. Jeff Bensch

RE: Storm Water Analyses
Client: National Park Service
Project: SWMP
Project No: 02050-155

Collected By: Michael Thomas
Date Collected: 2/6/94
Date Received: 2/6/94

ANALYSES

Sample	Location	Time	MPN/100ml Presumptive Coliform	MPN/100ml Confirmed Coliform	MPN/100ml E. coli.
SL-1	Industrial	2:58am	>1,600	>1,600	30
SL-2	Roads	2:40am	5,000	700	700
SL-3	Residential	-	24,000	2,400	2,400
SL-4	Commercial	3:30am	300,000	300,000	300,000
SL-5	Open Space	3:06am	>1,600	>1,600	170
SL-6	Golf Course	3:20am	130	50	<2

Method: Standard Methods for the Examination of Water and Wastewater 17th Edition. Reference 9221 "Multiple Tube Fermentation Technique for the Members of the Coliform Group."

Reported By:
ANRESCO, INC.

Laila Lam
Microbial Analyst

LL:Micro-294129

ENVIRONMENTAL AND INDUSTRIAL HYGIENE SERVICES

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX (707) 763-4065

Jeff Bensch
Dames & Moore-San Francisco
221 Main Street
Suite 600
San Francisco, CA 94105

March 3, 1994

Customer Project: 02050-155 NPS Presidio Stormwater
Laboratory Job: L9402125

On February 17, 1994 we received 8 sample(s) for analysis. Samples were analyzed by the following method(s):

Oil & Grease (EPA 413.1)

BOD (EPA 405.1)

COD (EPA 410.4 / SM 5220)

Phosphate, Ortho (EPA 300.0)

Priority Pollutant Metals (13) ()

Nitrogen, Total Kjeldahl (EPA 351.3)

Total Suspended Solids (EPA 160.2)

Mary Tanner
Project Manager
for Robin Cockerham

Robert Peak
Laboratory Director
Robert Peak

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: SL-1
Lab Id: L9402125-1

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	5.2	5.0	mg/L	21-FEB-94	22-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		17-FEB-94
COD					
Chemical Oxygen Demand	160	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	0.094	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	0.33	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	0.33	0.050	mg/L	23-FEB-94	23-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	180	4.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	0.33	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: SL-2
Lab Id: L9402125-2

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	4.9	mg/L	21-FEB-94	22-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		17-FEB-94
COD					
Chemical Oxygen Demand	82.	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	0.24	0.050	mg/L	23-FEB-94	23-FEB-94
-					
Comments:					
TSS					
Total Suspended Solids	47.	4.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: SL-3
Lab Id: L9402125-3

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	4.9	mg/L	21-FEB-94	22-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		17-FEB-94
COD					
Chemical Oxygen Demand	60.	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	19.	4.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: SL-4
Lab Id: L9402125-4

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	21-FEB-94	22-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		17-FEB-94
COD					
Chemical Oxygen Demand	27.	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Comments:					
TSS					
Total Suspended Solids	11.	4.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: SL-5
Lab Id: L9402125-5

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.2	mg/L	21-FEB-94	22-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		17-FEB-94
COD					
Chemical Oxygen Demand	95.	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	0.15	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	0.21	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	120	8.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: SL-6
Lab Id: L9402125-6

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	21-FEB-94	22-FEB-94
ANIONS-W					
Phosphate	ND <	0.20	mg/L		17-FEB-94
COD					
Chemical Oxygen Demand	24.	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	0.051	0.050	mg/L	23-FEB-94	23-FEB-94
Comments:					
TSS					
Total Suspended Solids	25.	4.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: COMP SL-2
Lab Id: L9402125-7

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		18-FEB-94
COD					
Chemical Oxygen Demand	79.	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	0.69	0.050	mg/L	23-FEB-94	23-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	12.	4.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for: Dames & Moore-San Francisco
Project Id: 02050-155 NPS Presidio Stormwater
Sample Id: COMP SL-5
Lab Id: L9402125-8

Collected: 17-FEB-94
Received: 17-FEB-94
Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Phosphate	ND <	0.20	mg/L		18-FEB-94
COD					
Chemical Oxygen Demand	54.	20.	mg/L	23-FEB-94	23-FEB-94
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	0.068	0.050	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
-	-				
Comments:	-				
TSS					
Total Suspended Solids	42.	4.0	mg/L		21-FEB-94
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG4028-1

Reported: 23-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
413.1W					
Oil & Grease-Grav.(413.1W)	ND	5.0	mg/L	21-FEB-94	22-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG4028-2

Reported: 23-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
413.1W							
Oil & Grease-Grav.(413.1W)	56.3	mg/L	60	mg/L	94	21-FEB-94	22-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike D
Lab Id: WG4028-3

Reported: 23-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
413.1W						
Oil & Grease-Grav.(413.1W)	51.5	mg/L	86	8.9	21-FEB-94	22-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG4017-1

Reported: 21-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Fluoride	ND <	1.0	mg/L		17-FEB-94
Chloride	ND <	0.20	mg/L		17-FEB-94
Nitrite	ND <	0.30	mg/L		17-FEB-94
Bromide	ND <	0.10	mg/L		17-FEB-94
Nitrate	ND <	0.10	mg/L		17-FEB-94
Phosphate	ND <	0.20	mg/L		17-FEB-94
Sulfate	ND <	0.50	mg/L		17-FEB-94

D&H Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG4017-2

Reported: 21-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
ANIONS-W							
Chloride	1.05	mg/L	1	mg/L	105 %		17-FEB-94
Nitrate	2.80	mg/L	3	mg/L	93 %		17-FEB-94
Sulfate	4.05	mg/L	4	mg/L	101 %		17-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG4017-6

Reported: 21-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Fluoride	ND <	1.0	mg/L		18-FEB-94
Chloride	ND <	0.20	mg/L		18-FEB-94
Nitrite	ND <	0.30	mg/L		18-FEB-94
Bromide	ND <	0.10	mg/L		18-FEB-94
Nitrate	ND <	0.10	mg/L		18-FEB-94
Phosphate	ND <	0.20	mg/L		18-FEB-94
Sulfate	ND <	0.50	mg/L		18-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG4017-7

Reported: 21-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
ANIONS-W							
Chloride	1.09	mg/L	1	mg/L	109 %		18-FEB-94
Nitrate	2.80	mg/L	3	mg/L	93 %		18-FEB-94
Sulfate	4.06	mg/L	4	mg/L	102 %		18-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG4017-3

Reported: 21-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
ANIONS-W					
Chloride	2.82	0.20	mg/L		17-FEB-94
Nitrate	0.466	0.10	mg/L		17-FEB-94
Sulfate	5.02	0.50	mg/L		17-FEB-94

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG4042-1

Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
COD					
Chemical Oxygen Demand	ND <	20.	mg/L	23-FEB-94	23-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG4042-2

Reported: 24-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
COD							
Chemical Oxygen Demand	201.	mg/L	200	mg/L	100 %	23-FEB-94	23-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG4042-3

Reported: 24-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
COD					
Chemical Oxygen Demand	81.7	20.	mg/L	23-FEB-94	23-FEB-94

D&H Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG4042-4

Reported: 24-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
COD							
Chemical Oxygen Demand	250.	mg/L	200	mg/L	84 %	23-FEB-94	23-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG4042-5

Reported: 24-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
COD						
Chemical Oxygen Demand	253.	mg/L	86 %	1.2	23-FEB-94	23-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG4023-4

Reported: 23-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TALMET-ICPW					
Antimony-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Barium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.0050	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Cobalt-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.15	mg/L	23-FEB-94	23-FEB-94
Molybdenum-6010	ND <	0.20	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.10	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.0	mg/L	23-FEB-94	23-FEB-94
Vanadium-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	ND <	0.050	mg/L	23-FEB-94	23-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG4023-5

Reported: 23-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TALMET-ICPW							
Antimony-6010	1.91	mg/L	2	mg/L	96	23-FEB-94	23-FEB-94
Barium-6010	2.08	mg/L	2	mg/L	104	23-FEB-94	23-FEB-94
Beryllium-6010	0.990	mg/L	1	mg/L	99	23-FEB-94	23-FEB-94
Cadmium-6010	1.95	mg/L	2	mg/L	97	23-FEB-94	23-FEB-94
Chromium-6010	2.07	mg/L	2	mg/L	103	23-FEB-94	23-FEB-94
Cobalt-6010	2.08	mg/L	2	mg/L	104	23-FEB-94	23-FEB-94
Copper-6010	2.10	mg/L	2	mg/L	105	23-FEB-94	23-FEB-94
Lead-6010	1.97	mg/L	2	mg/L	99	23-FEB-94	23-FEB-94
Molybdenum-6010	1.99	mg/L	2	mg/L	100	23-FEB-94	23-FEB-94
Nickel-6010	2.01	mg/L	2	mg/L	101	23-FEB-94	23-FEB-94
Silver-6010	2.17	mg/L	2	mg/L	109	23-FEB-94	23-FEB-94
Thallium-6010	10.1	mg/L	10	mg/L	101	23-FEB-94	23-FEB-94
Vanadium-6010	2.08	mg/L	2	mg/L	104	23-FEB-94	23-FEB-94
Zinc-6010	2.00	mg/L	2	mg/L	100	23-FEB-94	23-FEB-94

Comments:

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG4023-1

Reported: 23-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TALMET-ICPW					
Antimony-6010	ND <	0.200	mg/L	23-FEB-94	23-FEB-94
Barium-6010	0.0682	0.0500	mg/L	23-FEB-94	23-FEB-94
Beryllium-6010	ND <	0.00500	mg/L	23-FEB-94	23-FEB-94
Cadmium-6010	ND <	0.0500	mg/L	23-FEB-94	23-FEB-94
Chromium-6010	ND <	0.0500	mg/L	23-FEB-94	23-FEB-94
Cobalt-6010	ND <	0.100	mg/L	23-FEB-94	23-FEB-94
Copper-6010	ND <	0.0500	mg/L	23-FEB-94	23-FEB-94
Lead-6010	ND <	0.150	mg/L	23-FEB-94	23-FEB-94
Molybdenum-6010	ND <	0.200	mg/L	23-FEB-94	23-FEB-94
Nickel-6010	ND <	0.100	mg/L	23-FEB-94	23-FEB-94
Silver-6010	ND <	0.0500	mg/L	23-FEB-94	23-FEB-94
Thallium-6010	ND <	1.00	mg/L	23-FEB-94	23-FEB-94
Vanadium-6010	ND <	0.0500	mg/L	23-FEB-94	23-FEB-94
Zinc-6010	ND <	0.0500	mg/L	23-FEB-94	23-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG4023-2

Reported: 23-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TALMET-ICPW							
Antimony-6010	1.92	mg/L	2	mg/L	96	23-FEB-94	23-FEB-94
Barium-6010	2.02	mg/L	2	mg/L	98	23-FEB-94	23-FEB-94
Beryllium-6010	0.906	mg/L	1	mg/L	91	23-FEB-94	23-FEB-94
Cadmium-6010	1.76	mg/L	2	mg/L	88	23-FEB-94	23-FEB-94
Chromium-6010	1.91	mg/L	2	mg/L	96	23-FEB-94	23-FEB-94
Cobalt-6010	1.93	mg/L	2	mg/L	96	23-FEB-94	23-FEB-94
Copper-6010	1.94	mg/L	2	mg/L	97	23-FEB-94	23-FEB-94
Lead-6010	1.82	mg/L	2	mg/L	91	23-FEB-94	23-FEB-94
Molybdenum-6010	1.86	mg/L	2	mg/L	93	23-FEB-94	23-FEB-94
Nickel-6010	1.87	mg/L	2	mg/L	93	23-FEB-94	23-FEB-94
Silver-6010	1.82	mg/L	2	mg/L	91	23-FEB-94	23-FEB-94
Thallium-6010	8.85	mg/L	10	mg/L	88	23-FEB-94	23-FEB-94
Vanadium-6010	1.97	mg/L	2	mg/L	99	23-FEB-94	23-FEB-94
Zinc-6010	1.94	mg/L	2	mg/L	97	23-FEB-94	23-FEB-94

Comments:

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG4023-3

Reported: 23-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TALMET-ICPW						
Antimony-6010	1.84	mg/L	92	4.3	23-FEB-94	23-FEB-94
Barium-6010	2.01	mg/L	97	1.0	23-FEB-94	23-FEB-94
Beryllium-6010	0.905	mg/L	91	0.11	23-FEB-94	23-FEB-94
Cadmium-6010	1.78	mg/L	89	1.1	23-FEB-94	23-FEB-94
Chromium-6010	1.89	mg/L	95	1.0	23-FEB-94	23-FEB-94
Cobalt-6010	1.86	mg/L	93	3.2	23-FEB-94	23-FEB-94
Copper-6010	2.01	mg/L	100	3.5	23-FEB-94	23-FEB-94
Lead-6010	1.86	mg/L	93	2.2	23-FEB-94	23-FEB-94
Molybdenum-6010	1.88	mg/L	94	1.1	23-FEB-94	23-FEB-94
Nickel-6010	1.88	mg/L	94	1.1	23-FEB-94	23-FEB-94
Silver-6010	1.90	mg/L	95	4.3	23-FEB-94	23-FEB-94
Thallium-6010	9.05	mg/L	90	2.1	23-FEB-94	23-FEB-94
Vanadium-6010	2.02	mg/L	101	2.5	23-FEB-94	23-FEB-94
Zinc-6010	1.88	mg/L	94	3.1	23-FEB-94	23-FEB-94

Comments:

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG4020-1

Reported: 22-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TSS					
Total Suspended Solids	ND <	4.0	mg/L		21-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG4020-2

Reported: 22-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TSS					
Total Suspended Solids	120.	8.0	mg/L		21-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Duplicate
Lab Id: WG4020-3

Reported: 22-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TSS						
Total Suspended Solids	118.	mg/L		1.7		21-FEB-94

D&M Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: Method Blank
Lab Id: WG4044-4

Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.0050	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.00020	mg/L	22-FEB-94	23-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Method Blank Spike
Lab Id: WG4044-5

Reported: 25-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TTLC-GFW							
Arsenic- EPA 7060	0.0240	mg/L	.025	mg/L	96	22-FEB-94	23-FEB-94
Selenium - EPA 7740	0.0250	mg/L	.025	mg/L	100	22-FEB-94	23-FEB-94
Mercury - EPA 7470	0.00190	mg/L	.002	mg/L	95	22-FEB-94	23-FEB-94

D&H Laboratories

ANALYTICAL DATA REPORT

Prepared for:
Project Id:
Sample Id: MX
Lab Id: WG4044-1

Reported: 25-FEB-94

Parameter	Value	Limit	Units	Extracted	Analyzed
TTLC-GFW					
Arsenic- EPA 7060	ND <	0.00500	mg/L	22-FEB-94	23-FEB-94
Selenium - EPA 7740	ND <	0.00500	mg/L	22-FEB-94	23-FEB-94
Mercury - EPA 7470	ND <	0.000200	mg/L	22-FEB-94	23-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike
Lab Id: WG4044-2

Reported: 25-FEB-94

Parameter	Value	Units	Spike	Units	% Rec	Extracted	Analyzed
TTLC-GFW							
Arsenic- EPA 7060	0.0250	mg/L	.025	mg/L	100	22-FEB-94	23-FEB-94
Selenium - EPA 7740	0.0230	mg/L	.025	mg/L	92	22-FEB-94	23-FEB-94
Mercury - EPA 7470	0.00190	mg/L	.002	mg/L	95	22-FEB-94	23-FEB-94

D&M Laboratories

QUALITY CONTROL REPORT

Prepared for:
Project Id:
Sample Id: Matrix Spike Dup
Lab Id: WG4044-3

Reported: 25-FEB-94

Parameter	Value	Units	% Rec	RPD	Extracted	Analyzed
TTLC-GFW						
Arsenic- EPA 7060	0.0240	mg/L	96	4.1	22-FEB-94	23-FEB-94
Selenium - EPA 7740	0.0230	mg/L	92	0.0	22-FEB-94	23-FEB-94
Mercury - EPA 7470	0.00190	mg/L	95	0.0	22-FEB-94	23-FEB-94

BRELJE AND RACE

LABORATORIES, INC. 425 SOUTH E STREET SANTA ROSA, CALIFORNIA 95404 (707) 544-8807

March 1, 1994
Sample Collected: 2-17-94
Sample Received : 2-18-94
Collected By : Client

D&M Laboratories
3700 Lakeville Hwy.
Petaluma CA 94954

Attention: Sample Control

LOG NUMBER	SAMPLE DESCRIPTION	BOD_5 @ 20°C mg/L
	Reagent Blank mg/L	<5.
	Detection Limit mg/L	5.
	Reference Sample True Value mg/L	198.
	Acceptance Limits mg/L	±30.5
	Reference Sample Result mg/L	220.
	Method Number	Std. Mthds. 18th ed. 5210
	Date Started	2/18/94
	Date Completed	2/23/94
294-3182	SL-1	28.
294-3183	SL-2	8.
294-3184	Comp SL-2	17.
294-3185	SL-3	7.
294-3186	SL-4	<5.
294-3187	SL-5	<5.
294-3188	Comp SL-5	9.
294-3189	SL-6	<5.

VERY TRULY YOURS,

BRELJE AND RACE LABORATORIES, INC.

Carlito Gray

LABORATORY SUPERVISOR
CG/RC:tag

BRELJE AND RACE

LABORATORIES, INC. 425 SOUTH E STREET SANTA ROSA, CALIFORNIA 95404 (707) 544-8807

March 1, 1994
Sample Collected: 2-18-94
Sample Received : 2-18-94
Collected By : Client

D&M Laboratories
3700 Lakeville Hwy.
Petaluma CA 94954

Attention: Sample Control

LOG NUMBER	SAMPLE DESCRIPTION	TOTAL KJELDAHL N mg/L
294-3191	SL-1	5.1
294-3192	SL-2	2.2
294-3193	Comp SL-2	2.2
294-3194	SL-3	3.
294-3195	SL-5	2.2
294-3196	Comp SL-5	1.5
294-3197	SL-6	4.1
294-3198	SL-4	0.75
	Reagent Blank mg/L	0.2
	Log Number of Spiked Sample	294-3197
	Sample Result mg/L	4.1
	Spike Added mg/L	27.4
	Spiked Sample Result mg/L	28.
	Spiked Sample Result %R	87%
	Spiked Sample Duplicate Result mg/L	27.
	Spiked Sample Duplicate Result %R	84%
	%RSD	2.57

VERY TRULY YOURS,

BRELJE AND RACE LABORATORIES, INC.

Cristo Gray

LABORATORY SUPERVISOR
CG/RC:tag

QUALITY CONTROL REPORT

In order to provide you with the means of assessing the quality of the data in our report, **D&M Laboratories** reports the results of Quality Control samples analyzed with your samples.

The Quality Control samples provide the following QC information:

The Method Blank (**MB**) monitors the level of contamination introduced by reagents or glassware. A minimum of one MB is run per batch of 20 samples or less.

The Method Blank Spike (**MBS**) measures the accuracy of analytical techniques and is not subject to matrix effects. A minimum of one MBS is run per batch of 20 samples or less.

The Matrix Spike (**MS**) measures the accuracy of the method for a matrix type. Due to the high variability within matrix types and the necessity of batching samples from varied sources, matrix spike information from one sample is not necessarily relevant to other samples on the batch. A minimum of two matrix spikes, MS and MSD, are run per batch of 20 samples or less. The sample selected for the matrix spike is designated **MX**, and may or may not have been submitted by the recipient of this report.

The Matrix Spike Duplicate (**MSD**), along with the MS, is used to monitor the precision (**RPD**) of the method and to indicate possible non homogeneity of the sample matrix.

Equations used for determining percent recovery and relative percent difference (RPD) are as follows:

MBS % Recovery = (MBS result / MBS spike level) x 100
MS % Recovery = [(MS result - MX result) / MS spike level] x 100
RPD ={ | MS result - MSD result | / [(MS result + MSD result) / 2]} x 100

We continue to strive to improve the quality of service to our clients. We welcome any questions or comments you may have about this information, or about **D&M Laboratories** in general. Please contact a Project Manager for further information.

L4402125

CHAIN-OF-CUSTODY RECORD

WHITE COPY - Original (Accompanies Samples) YELLOW COPY - Collector PINK COPY - Project Manager

Sample Number	Depth	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	PEST/PCB 8080	PNA 610/8310	DIESEL 8015M	TPH/HID 8015M	CHLORIDE 413.1	TKN	COD	TPH 418.1	pH	METALS	PP METALS (13)	TTLC METALS (17)	Asbestos	TSS	BOD	FIELD NOTES	Total Number Of Containers	Laboratory Note Number
SL-1		3:27a	Stormwater										X	X	X		X				X	X	X			

RECEIVED FEB 17 '94 12:35

COOLER CUSTODY SEALS INTACT ☑ NOT INTACT ☐

COOLER TEMPERATURE 13 °C

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY: (Signature) L. Farrell

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY: (Signature)

LABORATORY NOTES: 6 waters – H.D.

Clients Name: NPS Stormwater Presidio
Address:
City, State, Zip: San Francisco, CA
Phone: 415-896-5858 Fax: 415-882-9261
Laboratory Contact: Robin Cockerham

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX: (707) 763-4065

JOB NO.: 02050-155 SHEET 1 OF 1
PROJECT NPS Presidio Stormwater
LOCATION San Francisco, CA
COLLECTOR Jeff B Garcia DATE OF COLLECTION 2-17-94 3:27a

CHAIN-OF-CUSTODY RECORD

WHITE COPY - Original (Accompanies Samples) YELLOW COPY - Collector PINK COPY - Project Manager

Boring or Well Number	Sample Number	Depth	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	TPH 418.1	TPH 8015 (M)	METALS	WET Test	PNA 610/8100	PEST/PCBs 8080	HEX CHROME	ORGANIC LEAD	TCLP	413.1	ASBESTOS	BOD	COD	TSS/TDS	TKN	FIELD NOTES:	Total Number Of Containers	Laboratory Note Number
SL-2			3am	Composite							X							X		X	X	X	X	X			

COOLER CUSTODY SEALS INTACT ☐ NOT INTACT N/A

COOLER TEMPERATURE 13°C °C
DP

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

LABORATORY NOTES:

1994 FEB 17 AM 12:34

RECEIVED

ANALYTICAL LABORATORY:

LABORATORY CONTACT: Robin Cockerham

D&M CONTACT: Jeff Bausch PHONE: 415-896-5858

DAMES & MOORE

221 Main Street, Suite 600
San Francisco, California 94105-1917
(415) 896-5858 Fax: (415) 882-9261

JOB NO.: OL0550-155 SHEET 1 OF 1

PROJECT NPS Presidio Stormwater

LOCATION San Francisco

COLLECTOR: Jeff B, Gregg C DATE OF COLLECTION 2-17-94

L9402125

CHAIN-OF-CUSTODY RECORD

WHITE COPY - Original (Accompanies Samples) YELLOW COPY - Collector PINK COPY - Project Manager

Sample Number	Depth	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	PEST/PCB 8080	PNA 610/8310	DIESEL 8015M	TPH/DG 8015M	GAS/BTEX	TPH 418.1	pH	RCRA METALS	PP METALS (13)	TTLC METALS (17)	Asbestos	FIELD NOTES	Total Number Of Containers	Laboratory Note Number
SL-2		3:00	Stormwater	Grab									X			X			X			

COOLER CUSTODY SEALS INTACT ☒ NOT INTACT ☐

COOLER TEMPERATURE 13 °C

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY: (Signature)
		V. Parrell
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY: (Signature)

LABORATORY NOTES: 6 waters

RECEIVED

Clients Name: NPS Presidio
Address:
City, State, Zip: San Francisco, CA
Phone: 415-556-5858 Fax: 415-882-9261
Laboratory Contact: Robin Cockerham

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX: (707) 763-4065

JOB NO.: 02050-155 SHEET 1 OF 1

PROJECT: NPS Presidio Stormwater

LOCATION: Presidio San Francisco - Roads

COLLECTOR: Jeff B, Greg C DATE OF COLLECTION: 2-17-94, 3am

L9402125

CHAIN-OF-CUSTODY RECORD

WHITE COPY - Original (Accompanies samples) YELLOW COPY - Collector PINK COPY - Project Manager

Sample Number	Depth	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	PEST/PCB 8080	PNA 610/8310	DIESEL 8015M	TPH/DO 8015M	Gasoline 8015M	TPH 418.1	TH	RCRA METALS (8)	PP METALS (13)	TTLC METALS (17)	Asbestos	FIELD NOTES	Total Number Of Containers	Laboratory Note Number
SL-3		3:42	Stormwater	-								X	X	X								

COOLER CUSTODY SEALS INTACT ☑ NOT INTACT ☐

COOLER TEMPERATURE 14°C °C

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY: (Signature)

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY (Signature)

LABORATORY NOTES: 6 waters

Clients Name: NPS Presidio
Address:
City, State, Zip: San Francisco CA
Phone: 415-896-5832 Fax: 415-[illegible]-9261
Laboratory Contact: Robin Cockerham

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX: (707) 763-4065

JOB NO.: 02050-155 SHEET 1 OF 1

PROJECT: NPS Presidio Stormwater

LOCATION: SF

COLLECTOR: Jeff B Gregg C DATE OF COLLECTION: 2-17-94 3:40a

L9402125

CHAIN-OF-CUSTODY RECORD

WHITE COPY - Original (Accompanies Samples) YELLOW COPY - Collector PINK COPY - Project Manager

Sample Number	Date	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	PEST/PCB 8080	PNA 610/8310	DIESEL 8015M	TPH/DG 8015M	BTEX	TPH 418.1	pH	RCRA METALS	PP METALS (13)	TTLC METALS (17)	Asbestos	COD	TKN	FIELD NOTES	Total Number Of Containers	Laboratory Note Number
SL-4		3:10a										X	X	X		X			X	X	X			

COOLER CUSTODY SEALS INTACT ☑ NOT INTACT ☐

COOLER TEMPERATURE 13° °C

RECEIVED FEB 17 1994

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY: (Signature) D. Parrell

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY: (Signature)

LABORATORY NOTES: 6 waters

Clients Name: NPS Presidio
Address:
City, State, Zip: San Francisco CA
Phone: 415-896-5558 Fax: 415-882-9261
Laboratory Contact: Robin Cukerman

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX: (707) 763-4065

JOB NO: 020510-155 SHEET 1 OF 1

PROJECT NPS Presidio Stormwater

LOCATION San Francisco, CA

COLLECTOR Jeff B Greg C DATE OF COLLECTION 2-17-94 3:10a

CHAIN-OF-CUSTODY RECORD

19402125

WHITE COPY - Original (Accompanies Samples) YELLOW COPY - Collector PINK COPY - Project Manager

Sample Number	Depth	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	PEST/PCB 8080	PNA 610/8310	DIESEL 8015M	TPH/DD 8015M	413.1	GCD	TKN	TPH 418.1	PH	RCRA METALS (8)	PP METALS (13)	TTLC METALS (17)	Asbestos	BOD	TSS	Phenols	FIELD NOTES	Total Number Of Containers	Laboratory Note Number
SL-5		2:30	Stormwater	Grab								X	X	X								X	X	X			

COOLER CUSTODY SEALS INTACT ☑ NOT INTACT ☐

COOLER TEMPERATURE 14°C °C

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY: (Signature) [signature]

RELINQUISHED BY (Signature) DATE/TIME RECEIVED BY: (Signature)

LABORATORY NOTES: 6 waters

Clients Name: NPS Presidio
Address:
City, State, Zip: San Francisco, CA
Phone: 415-556 5858 Fax: 415-556-9261
Laboratory Contact: Ruby Cockerham

3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX: (707) 763-4065

JOB NO.: 02050-155 SHEET 1 OF 1

PROJECT NPS Presidio Stormwater

LOCATION Presidio, San Francisco - Open Space

COLLECTOR Jeff B, Greg C DATE OF COLLECTION 2-17-94 2:30pm

CHAIN-OF-CUSTODY RECORD

WHITE COPY - Original (Accompanies Samples) YELLOW COPY - Collector PINK COPY - Project Manager

Boring or Well Number	Sample Number	Depth	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	TPH 418.1	TPH 8015 (M)	METALS	WET Test	PNA 610/8100	PEST/PCBs 8080	HEX CHROME	ORGANIC LEAD	TCLP	pH	ASBESTOS	413.3	BOD	COD	TSS	TKN	FIELD NOTES:	Total Number Of Containers	Laboratory Note Number
SL-5			2:50	Composite							X										X	X	X	X	X			

COOLER CUSTODY SEALS INTACT ☐ NOT INTACT n/a

COOLER TEMPERATURE 14°C °C

DP.

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

LABORATORY NOTES:

RECEIVED 1994 FEB 17 PM 12:34

ANALYTICAL LABORATORY:

LABORATORY CONTACT: Robin Cockerham

D&M CONTACT: Jeff Bersch PHONE: 415-896 5858

DAMES & MOORE
221 Main Street, Suite 600
San Francisco, California 94105-1917
(415) 896-5858 Fax: (415) 882-9261

JOB NO.: 02050-155 SHEET 1 OF 1

PROJECT NPS Presidio Stormwater

LOCATION San Francisco

COLLECTOR Jeff B. Greg C DATE OF COLLECTION 2-17-94

L9402125

CHAIN-OF-CUSTODY RECORD

WHITE COPY - Original (Accompanies Samples) YELLOW COPY - Collector PINK COPY - Project Manager

Sample Number	Depth	Time	Sample Type	Container Type	VOA 601/8010	VOA 602/8020	VOA 624/8240	Semi Vol 625/8270	PEST/PCB 8080	PNA 610/8310	DIESEL 8015M	TPH/DO 8015M	Chlorides 413.1	TKN 351.2	Temperature	pH	Total Metals	PP METALS (13)	TTLC METALS (17)	Asbestos		FIELD NOTES	Total Number Of Containers	Laboratory Note Number
SL-6		3:50p										X	X	X			X			X	X			
												DP												
												DP										3 exp-41301		

COOLER CUSTODY SEALS INTACT ☑ NOT INTACT ☐

COOLER TEMPERATURE 14°C °C

DP.

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)

LABORATORY NOTES: 8 waters

Clients Name: NPS Presidio Stormwater

Address:

City, State, Zip: San Francisco CA

Phone: 415-896-5858 Fax: 415-882-7261

Laboratory Contact: Robin Cockerham

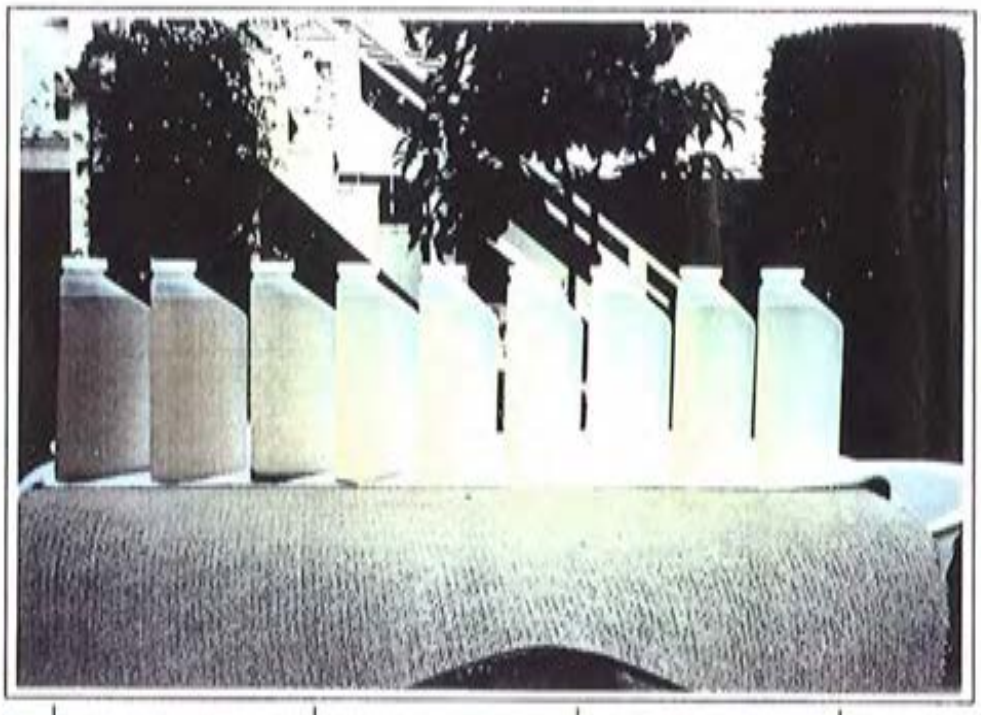
3700 Lakeville Highway, Petaluma, CA 94954
P.O. Box 808024, Petaluma, CA 94975-8024
Telephone: (707) 763-8245
FAX: (707) 763-4065

JOB NO.: 02050-155 SHEET 1 OF 1

PROJECT NPS Presidio Stormwater

LOCATION San Francisco

COLLECTOR Jeff B Gregg C DATE OF COLLECTION 2-17-94 3:50p



0 1.0 2.0 3.0

TIME (HOURS)

Photograph of 1-liter storm water samples collected by an automated sampler at location SL-4 on February 6, 1994.

Bottle at far left represents the first flush; time since onset of rainfall increases left to right in 20 minute increments.

Note visible change in water quality as the runoff event progresses.

VARIATION OF RUNOFF WATER QUALITY WITH TIME

Municipal Park Service
641 | XXXXX | DSC | APRIL 1994
D&M 02050-155-038

Golden Gate National Recreation Area
Presidio Of San Francisco
STORM WATER MANAGEMENT PLAN

DAMES & MOORE

FIGURE K-1