Sewer System Improvement Program Report

DRAFT Report for SFPUC Commission Review
Prepared by Wastewater Enterprise Staff
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Contents

1. Introduction ........................................................................................................ 1
2. Sewer System Description and Challenges .......................................................... 2
   2.1 Collection System Description ........................................................................ 4
   2.2 Collection System Challenges ........................................................................ 7
   2.3 Treatment Facility Description ....................................................................... 9
   2.4 Treatment Facility Challenges ....................................................................... 9
3. Sewer System Operational Strategy ..................................................................... 11
   3.1 Regulatory Compliance Objectives .................................................................. 12
   3.2 Current Operations and Operational Strategy .................................................. 18
   3.3 Integrated Watershed Management .................................................................. 25
4. SSIP Guiding Principles ....................................................................................... 28
5. SSIP Goals and Levels of Service ........................................................................ 30
6. SSIP Strategies for Achieving Levels of Service ................................................... 30
   6.1 Provide a Reliable and Flexible System that can Respond to Catastrophic Events .................................................. 33
   6.2 Minimize Flooding ......................................................................................... 34
   6.3 Minimize Effects of System Operations on the Community ............................ 37
   6.4 Modify the System to Adapt to Climate Change ............................................ 38
   6.5 Achieve Economic and Environmental Sustainability ............................... 39
7. SSIP Project Costs ................................................................................................. 40
8. Next Steps ........................................................................................................... 41

Appendix ................................................................................................................ 41
  Auxiliary Information ........................................................................................... 41
  Glossary of Abbreviations .................................................................................... 45
Figures

Figure 1. San Francisco Major Drainage Basins and Wastewater Facilities ................................................................. 2
Figure 2. Annual System Performance for Level of Treatment .......................................................................................... 4
Figure 3. Annual System Performance for Effluent Total Suspended Solids ................................................................. 4
Figure 4. Features of the Combined Sewer System and Transport/Storage Box Sewer .................................................. 5
Figure 5. Location of the SFPUC Combined Sewer Discharge Sites ............................................................................... 6
Figure 6. Bayside Dry-Weather Operational Strategy .................................................................................................. 19
Figure 7. Bayside Wet-Weather Operational Strategy .................................................................................................. 22
Figure 8. Westside Dry-Weather Operational Strategy ................................................................................................ 23
Figure 9. Westside Wet-Weather Operational Strategy ................................................................................................ 24

Tables

Table 1. Collection System Inventory ............................................................................................................................. 4
Table 2. Useful Life Industry Standard for Conveyance Structures .................................................................................. 7
Table 3. Useful Life Industry Standard Treatment Plant Components ............................................................................. 10
Table 4. Bayside Federal, State, and Regional Requirements for Effluent Quality ....................................................... 12
Table 5. Westside Federal and State Requirements for Effluent Quality ......................................................................... 12
Table 6. Southeast Water Pollution Control Plant Dry-Weather Discharge Requirements ............................................. 14
Table 7. Oceanside Water Pollution Control Plant Dry-Weather Discharge Requirements ........................................... 15
Table 8. Bayside Treatment and Outfall Capacities ........................................................................................................ 21
Table 9. Wastewater Enterprise Goals and Levels of Service .......................................................................................... 31
Table 10. Summary of Treatment Facility Capital Projects to Ensure Reliability and Flexibility .................................. 35
Table 11. Collection System - Traditional Approach for Flood Control ................................................................. 37
Table 12. Proposed Project Cost Estimates ...................................................................................................................... 40
THE SFPUC MISSION: To provide its customers with high-quality, efficient, and reliable water, power, and wastewater services in a manner that values environmental and community interests and sustains the resources entrusted to its care. To that end, the specific purpose of the Wastewater Enterprise (WWE) is to protect public health and the environment by treating and discharging San Francisco’s wastewater, stormwater, and biosolids safely and cost effectively.

1. Introduction

The SFPUC’s Wastewater Enterprise responsibilities and mission are twofold: the management, operation, and maintenance of San Francisco’s mainland sewer system, and the operation and maintenance of the Treasure Island/Yerba Buena Island (TI/YBI) sewer system pursuant to a Treasure Island Development Authority/Navy Cooperative Agreement. Currently, these wastewater systems meet all discharge permit requirements of the State of California and U.S. Environmental Protection Agency (EPA). San Francisco’s mainland sewer system treats 100% of the sanitary and the majority of stormwater flow, while the TI/YBI sewer system treats 100% of all sanitary flow. All biosolids are treated and fully reused within both systems. However, while facets of the sewer system have been updated, many facilities and substantial parts of the collection system continue to age and deteriorate, limiting the reliability and flexibility of our system to provide public services. In addition, increased energy costs, and the need to reduce greenhouse gas emissions, future climate change challenges, and the consumption of natural resources, require that the SFPUC consider system upgrades and improvements.

The Sewer System Improvement Program (SSIP) is a collection of capital improvements that will help the Wastewater Enterprise meet the San Francisco Public Utilities Commission’s (SFPUC) endorsed level of service goals for regulatory permit compliance, system reliability and functionality, and sustainable operations of the City’s sewer system. The SSIP is the culmination of seven years of Sewer System Master Plan (SSMP) planning efforts and SSIP Commission workshops to develop system improvements that address the following systemwide challenges:

- aging infrastructure and poor condition of existing facilities with little remaining useful life;
- seismic deficiencies and lack of structural integrity;
- limited operating flexibility and lack of redundancy; and
- the ongoing need to protect the environment and public health, meet regulatory challenges, and conserve resources.

Background information for this report pertaining to the collection and treatment systems, their challenges, and operational strategies are presented in the following two sections, Sewer System Description and Challenges and Sewer System Operational Strategies. The description of guiding principles, goals, and levels of service that are inherent to the SSIP, along with the proposed capital improvement projects and implementation strategies that are recommended to meet the SFPUC-endorsed levels of service, begins on page 28. The preliminary SSIP project costs can be found on page 40. More detailed descriptions, technical memoranda, and other source material, that serve as the basis for this report, can be found at www.sfwater.org.
2. Sewer System Description and Challenges

The San Francisco wastewater collection and treatment system has been developed over the past 110 years (Figure 1). It is a vital part of the City’s infrastructure and is the result of major financial investments that have provided multiple benefits to the residents of San Francisco.

Figure 1. San Francisco Major Drainage Basins and Wastewater Facilities
The combined collection system of the San Francisco mainland has been designed to take advantage of the terrain and uses gravity, whenever possible, to convey sewage and stormwater from local neighborhoods to large collecting sewers and to the transport/storage (T/S) structures that line the bay and ocean fronts. The treatment facilities provide secondary treatment for all dry-weather flows and a mix of primary and secondary treatment for the majority of stormwater collected during small and medium storms. The TI/YBI area is served by a separate system, currently owned by the United States Navy and operated by SFPUC pursuant to a Treasure Island Development Authority/Navy cooperative agreement that primarily relies on pumping to convey sewage to the secondary facility for treatment and discharge.

The current mainland San Francisco sewer system effectively collects, conveys, treats, and discharges all of the dry-weather domestic wastewater and urban runoff flows and wet-weather flows. The system uses natural watershed areas wherever possible to take advantage of gravity flow for the collection, transport, treatment, and discharge of wastewater and stormwater.

The collection system is a network of sewers that collects residential, business, and industrial wastewater and stormwater runoff and conveys flows through the transport/storage system via eight major pump stations to one of three San Francisco treatment facilities. There are two centralized dry-weather treatment plants, the Southeast Water Pollution Control Plant (SEP) and the Oceanside Water Pollution Control Plant (OSP), and one wet-weather facility, the North Point Wet-Weather Facility (NPF).

The collection system components include:
- pipelines
- collection system lift stations
- transport/storage system
- influent pump stations.

The broad components of the wastewater treatment facilities include:
- liquid treatment processes
- solids treatment processes
- deepwater outfalls

The dual function of the collection system piping (i.e., collection and transport of wastewater and stormwater) allows the system to treat both point and nonpoint sources\(^1\) of pollution. Of an estimated total wastewater flow of more than 40 billion gallons per year, approximately 34 billion gallons per year receive full secondary treatment, 4.5 billion gallons per year receive primary or decant treatment and are discharged to deepwater outfalls, and 1.8 billion gallons per year receive decant treatment and are discharged through nearshore outfalls (i.e., combined sewer discharges — CSDs) (Figure 2). Nearly 92% of the total influent\(^2\) total suspended solids (TSS) load is removed through the wastewater treatment system, 6.4% is discharged to deepwater outfalls (bay and ocean), and 1.8% is discharged to the nearshore (i.e., CSDs and Islais Creek) (Figure 3).

The TI/YBI collection system consists of separate sanitary and stormwater sewers with a series of pump stations that transport the flows to either the treatment plant or stormwater discharge points.

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1 Sources of pollution that originate from many diffuse sources that deposit natural and human-made pollutants (e.g., fertilizers, oil, chemicals, and bacteria). These pollutants are picked up by runoff from rainfall flowing over and through the ground.

2 The flow that enters a treatment process.
2.1 Collection System Description

Ninety-two percent of mainland San Francisco is served by a combined sanitary-storm system that consists of 24,800 manholes, 25,000 catch basins, 19 small lift stations, and more than 976 miles of sewers ranging from 8 inches in diameter to large multi-compartmental structures measuring up to 44 feet by 25 feet (Table 1). The remainder of the city, along with the dry-weather flows (approximately 0.6 billion gallons per year) from other agencies served by the San Francisco plants, are separate sewers. TI/YBI also has a separate sewer system.

Local Sewers

San Francisco has approximately 781 miles of local sewers threading under all the streets that collect wastewater and stormwater and deliver the combined flow to the larger collecting sewers. The average age of these sewers is about 72 years with 173 miles of pipe being more than 100 years old. The vast majority of the local sewers (74% or 375 miles) is greater than 50 years old. These local sewers range in size from eight to 36 inches in diameter and are typically constructed of vitrified clay pipes (bell/spigot).

<table>
<thead>
<tr>
<th>Table 1. Collection System Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Local Sewers (36 inches or less)</td>
</tr>
<tr>
<td>Major Collecting Sewers</td>
</tr>
<tr>
<td>• Sewers (greater than 36 inches)</td>
</tr>
<tr>
<td>• Brick Sewers</td>
</tr>
<tr>
<td>• Transport/Storage Structures</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

3 City of Brisbane, Bayshore Sanitary District, and North San Mateo County Sanitation District.
4 Other materials include brick, reinforced concrete, ductile iron, and cast iron, plastic or spray mortar liners (interior lining of a larger “host” pipe/ sewer), and high-density polyethylene or other flexible pipe material.
Transport/Storage Structures

The box sewers and tunnels making up the underground T/S structures are located, like a moat, around the city perimeter. The primary purpose of the T/S structures is to provide storage in order to reduce the frequency and volume of wet-weather nearshore discharges (combined sewer overflows\(^5\), CSOs). The structures intercept and temporarily hold commingled sewage and stormwater that can be transported to the treatment facilities after a storm has passed (Figure 4). In addition to storage and retention, the T/S structures provide the equivalent of wet-weather primary (decant) treatment for nearshore discharges by settling solids and trapping floatable materials.

The T/S structures have 36 permitted nearshore discharge sites around the city perimeter (Figure 5). Discharges through these sites are called combined sewer discharges (CSDs) rather than CSOs, because the discharged flow has received decant treatment. The T/S structure performance complies with the City’s Long-Term Control Plan (completed as part of the 1974 Master Plan) and meets the requirements of the National Combined Sewer Overflow Control Policy.

Pump Stations, Force Mains, and Tunnels

The collection system has a total of 27 pump stations. The major all-weather pump stations are each equipped with auxiliary pumps that guarantee full pumping capacity even with the largest unit out of service. In the event of a power failure, all major pump stations have upstream storage in the T/S structures.

The major force mains\(^6\) are North Shore, Channel, and Westside. The North Shore Force Main connects the discharge of the North Shore Pump Station to the Channel T/S. The Channel Force

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\(^5\) A CSO is an untreated discharge of combined wastewater and stormwater to receiving waters as a result of wet-weather flow exceeding collection system and treatment plant capacity.

\(^6\) A pressurized pipe installed to accommodate the pump discharge from a wastewater pumping station.
Main connects the discharge of the Channel Pump Station to the SEP. This force main has failed four times since it was constructed in the late 1970s. It is a highly vulnerable component of the bayside sewer system because it is a major artery that has no redundancy. The Westside Force Main conveys the Westside Pump Station flows to the OSP. There are twelve active tunnels in the collection system. Most of these lack functional redundancy and are subject to failure in seismic activity.

Treasure Island/Yerba Buena Island

Currently, the TI/YBI separate collection system consists of 10 miles of various size pipelines that do not conform to SFPUC standards and 29 wastewater pump stations (2 located on YBI). Wastewater from YBI is pumped to TI via a 6-inch submarine force main. The stormwater collection system includes 6 stormwater pump stations and 50 shallow water outfalls (at TI). In general,
the pump stations for both wastewater and stormwater collection systems are in poor condition and need electrical upgrades and are frequently clogged due to high grease and trash loadings.

2.2 Collection System Challenges

In order for the SFPUC to continue to fulfill its mission, improvements to the collection system are recommended in the following areas:

- aging infrastructure
- system deficiencies
- operational efficiency
- community impacts

Aging Infrastructure

The two principal problems related to aging infrastructure are structural integrity and seismic reliability.

Structural Integrity

Structural defects in the underlying sewers are causing an increasing number of “sinkholes” in streets throughout San Francisco. From a detailed review of the empirical data from the Department of Public Works, it can be concluded that the failure rate for sewers increases with age. The useful life standard for sewer system structures is given in Table 2. Current SFPUC funding only allows for a sewer replacement cycle of more than 200 years.

Seismic Reliability

The following are the main seismic problem areas as derived from geotechnical evaluation:

- Portions of the 66-inch Channel Force Main (located between Islais Creek and Mission Creek) that have failed four times (once in 1989 during the Loma Prieta earthquake) are vulnerable to the effects of liquefaction in the event of a major earthquake.
- Portions of the North Point Main (carrier of combined flow from the Upper Channel area by gravity to the Jackson T/S) are susceptible to the effects of liquefaction in the event of a major earthquake.
- The Marina Boulevard T/S structure could experience lateral deformations in the range of 6 inches to 3 feet in the event of a major earthquake.
- The many connector sewers that run in the east-west direction and tie into the Fifth and Sixth Street sewers could be damaged due to the effects of liquefaction in the event of a major earthquake.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewers</td>
<td></td>
</tr>
<tr>
<td>Vitrified Clay Pipe</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Reinforced Concrete</td>
<td>50 -100</td>
</tr>
<tr>
<td>Cement Lined Ductile Iron</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Force Mains</td>
<td></td>
</tr>
<tr>
<td>Coated Steel</td>
<td>30 - 50</td>
</tr>
<tr>
<td>Reinforced Concrete</td>
<td>30 - 50</td>
</tr>
<tr>
<td>Reinforced Concrete Cylinder</td>
<td>30 - 50</td>
</tr>
</tbody>
</table>

Source: Code of Federal Register 40 CFR Ch.1 (7-1-00 Edition) ft. 35, subpt. E, App A
From an evaluation of the City’s collection system, it was noted that the degree of earthquake damage varies for the different types of sewer pipes related to the age, type of material, and presence of pile support. In general:

- older sewers are more prone to damage during both ground shaking and liquefaction due to degradation of the cement mortar;
- brick sewers have the greatest risk of failure for both ground shaking and liquefaction;
- piles, whether wooden or concrete, provide an extra defense against damage from earthquakes;
- cast-in-place and precast sewer lines performed similarly when subjected to earthquake damage; however, the cast-in-place line seems to have a longer lifespan;
- the surrounding soil dictates how much movement, therefore how much damage, can be expected; Bay Mud (i.e., the geologic layer) and artificial fill will often shift dramatically, but bedrock does not; and
- the type of joint dictates how much movement is allowed in a sewer line before damage occurs; a bell–and–spigot joint allows much more freedom to counteract the moving soil than a rigid joint.

System Deficiencies

The principal overall collection system deficiencies are related to the foreseen impacts of climate change. These impacts include flooding and bay water intrusion into the collection system through the CSD structures. Sea level rise and increases in storm intensity and frequency will aggravate these impacts. Low-lying subsided regions below -2 feet City Datum (9.33 feet North American Vertical Datum 1988) are most at risk for flooding, especially during the seasonal high tides (several times per year) coupled with a rain event. Sea level rise together with an increased frequency of high-intensity storms would exacerbate the types of flooding problems that currently exist in the city, such as:

- higher bay water levels that affect the upstream hydraulic grade line in sewers;
- land subsidence; and
- sewer blockages.

Operational Efficiency

Stormwater Management

The design criterion for combined sewer collection systems has generally been to provide sufficient stormwater collection capacity to prevent flooding. Changes in the patterns of city development, such as the addition of newly developed areas in old industrial zones, have resulted in reduced infiltration, with a concomitant increase in runoff. These changes have increased the volume of stormwater that enters the collection system, and in many cases has resulted in increased flooding. Flooding problems in San Francisco can be caused by either “systemic” or “local” issues. Systemic issues are due to major trunk line constrictions, subsided ground conditions, or higher outlet conditions that cause severe, widespread problems. Local issues are due to sewer line constrictions that affect small areas.

Community Impacts

The SFPUC is determined to minimize the impacts of flooding and collection system odors on local communities.
2.3 Treatment Facility Description

The bayside treatment facilities are the SEP and the NPF; the westside treatment facility is the OSP; the TI/YBI facility is the Treasure Island Wastewater Treatment Plant.

Southeast Water Pollution Control Plant

The SEP is located in the Bayview District, in a mixed industrial, commercial, and residential neighborhood. It provides secondary treatment (oxygen-activated sludge) for the wastewater from the Bayside Watershed and 1.65 mgd of flow from other agencies. The SEP was originally commissioned in 1952 and major upgrades/expansions were completed in 1982 and 1996. After the 1982 upgrades and consolidation of bayside treatment, the SEP was designed to treat all bayside dry-weather flows and up to 250 mgd of wet-weather flows. Treated wastewater is discharged to San Francisco Bay through two outfalls.

North Point Wet-Weather Facility

The NPF was commissioned in 1951. In the early 1980s it was connected to the SEP through a force main and the T/S system and decommissioned as a dry-weather plant. The NPF is now used as a primary treatment plant for wet-weather flows from the northeast portion of the Bayside Watershed that are discharged through four combination reinforced concrete/ductile iron pipes into the waters off northern waterfront.

Oceanside Water Pollution Control Plant

The OSP, located on the Great Highway between Lake Merced and the San Francisco Zoo, was commissioned in 1993. The OSP provides secondary treatment (oxygen-activated sludge) for the wastewater from the Westside Watershed and for 0.004 mgd of flow from North San Mateo County. All dry-weather, secondary treated effluent flows by gravity to the ocean through the Southwest Ocean Outfall (SWO). Up to 175 mgd of westside wet-weather flows receive secondary, primary, or decant treatment prior to discharge through the SWO.

Treasure Island Wastewater Treatment Plant

The existing 2 mgd (average dry weather flow) Treasure Island Wastewater Treatment Plant on TI was constructed in 1961 by the U.S. Navy and upgraded in 1969 and 1989. The treatment process includes a headworks, primary sedimentation, trickling filters, secondary clarification, chlorination, dechlorination, solids handling (digesters), and a deepwater outfall.

2.4 Treatment Facility Challenges

Both the SEP and the NPF were built more than 50 years ago and many of the challenges are related to aging infrastructure. Based on the useful life industry standard estimates for treatment plant components given in Table 3, several of the key process units at these facilities are in need of complete replacement. Some of the technologies employed by these processes are outdated and the structural integrity of some of the units is compromised. The design standards that governed the construction of the SEP did not take into account current concepts for mitigating negative impacts on the surrounding community. Even the OSP, which is the most

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7 The Southeast Bay Outfall (deep water) is constructed of ductile iron pipe at Pier 80 and has a capacity of 110 mgd. The Quint Street Outfall (shallow water), located on the south bank of Islais Creek, has a capacity of 150 mgd.
8 Installed in 1949 and located under Piers 33 and 35.
9 The SWO, commissioned in 1986, extends in a southwesterly direction from the shoreline to approximately four miles offshore. The outfall is a 12-foot diameter reinforced concrete pipe, buried 12 to 20 feet beneath the sea bed.
recently-constructed treatment facility in the city, is experiencing the effects of deferred maintenance, and its operational efficiency and reliability are being impacted. The Treasure Island Wastewater Treatment Plant facilities are not reliable and require complete replacement.

Improvements to the treatment facilities must address:
- aging infrastructure
- operational efficiency
- community impacts

Aging Infrastructure

Most of the components of the current SEP biosolids digester facility have been in service for nearly 60 years, which is well beyond their expected mechanical and structural life. Operating equipment installed during the expansion of the SEP in the early 1980s has reached the end of its expected useful life and needs to be replaced within the next five to 10 years. This aging infrastructure clearly poses a threat to continued regulatory compliance. The NPF was constructed at about the same time as the SEP, and it shares the same problems of aging infrastructure.

The Southeast Bay Outfall is the main deepwater outfall for the SEP and has been in operation since 1969. It was originally designed for an average flow of 20 mgd and a peak flow of 70 mgd. In wet weather, up to 110 mgd (more than 1.5 times the design capacity) is discharged through the Southeast Bay Outfall. By the year 2030, the Southeast Bay Outfall will be more than 60 years old. Based on U.S. EPA guidelines, the nominal life of a marine outfall is 50 years. The North Point Outfalls are used when the NPF is activated during wet weather to discharge primary effluent into the bay. The four outfalls have been in service for more than 50 years, and their age is an ongoing concern.

The OSP has unmet equipment maintenance needs that could threaten permit compliance. The SWO was put into service in 1986; however, the inflow of seawater has exacerbated the problems of attached marine growth and sediment accumulation.

Overall, the Treasure Island Wastewater Treatment Plant is in very poor condition and the major wastewater facility challenges are:
- all treatment plant processes are aged and lack redundancy;
- many treatment plant systems require complete renovation or replacement;
- an interim capital improvement program is needed to maintain the facilities until they are upgraded as the revenues generated from utility sales are not enough for the City to cover the required operations and maintenance costs;

### Table 3. Useful Life Industry Standard Treatment Plant Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures</td>
<td></td>
</tr>
<tr>
<td>Plant buildings, concrete process tankage, pump stations</td>
<td>40 - 60</td>
</tr>
<tr>
<td>Process Equipment</td>
<td></td>
</tr>
<tr>
<td>Mechanical equipment (pumps, bar screens etc)</td>
<td>15 - 25</td>
</tr>
<tr>
<td>Electrical Equipment</td>
<td></td>
</tr>
<tr>
<td>Motor control center, substations</td>
<td>15 - 25</td>
</tr>
<tr>
<td>Variable frequency drives</td>
<td>10 - 15</td>
</tr>
<tr>
<td>Auxiliary Equipment</td>
<td>10 - 15</td>
</tr>
<tr>
<td>Outfalls</td>
<td></td>
</tr>
<tr>
<td>Cement-lined ductile iron</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Reinforced concrete</td>
<td>50 - 100</td>
</tr>
</tbody>
</table>

Source: Code of Federal Register: 40 CFR Chapter 1 (7-1-00 Edition) foot 35, subpart E, Appendix A
TI facilities are in jeopardy of National Pollutant Discharge Elimination System (NPDES) permit violations; and

- the facilities have structural and seismic vulnerabilities.

The possibility of replacing the treatment plant during the first phase of redevelopment is currently being evaluated by The Treasure Island Development Authority (TIDA) and the SFPUC under the terms of an Exclusive Negotiating Agreement (the ENA). Under the ENA, the SFPUC will develop plans and review the feasibility of the alternatives for treating TI/YBI wastewater and providing recycled water for toilet flushing and irrigation. The parties to the ENA intend that TIDA through Treasure Island Community Development would provide the SFPUC with sufficient land area to support the proposed build-out of a new treatment plant, if such an alternative is identified after further technical and environmental review. In addition, in consideration for the SFPUC’s pursuit of these planning efforts, the agreement also contemplates the transfer of 4 to 6 acres of property to the SFPUC for use in the furtherance of the project’s and the SFPUC’s sustainability goals relating to utility services.

Operational Efficiency

Operating equipment installed during the expansion of the SEP in the early 1980’s has reached the end of its expected useful life and needs to be replaced within the next five to 10 years. The equipment at NPF is in similar need of updating. Even though the OSP is the newest of the City’s treatment facilities, it is beginning to experience condition-related maintenance and operational problems due to premature corrosion. Together, a lack of routine preventative maintenance (caused in part by serious underfunding during a 6-year rate freeze), and the harsh marine environment, have started to take their toll on both mechanical and electrical equipment.

Community impacts

When the SEP commenced operation in the early 1950’s, the surrounding neighborhood had many more industries, including slaughterhouses and tanneries. The character of the neighborhood was not inappropriate for locating a sewage treatment plant. Today, the SEP is surrounded by a much changed neighborhood consisting of a mixture of light industry and residential development. The negative residential neighborhood impacts of the SEP include: odor, noise, and visual impacts associated with an industrial facility. The City has pursued numerous upgrades at SEP to address these impacts.

3. Sewer System Operational Strategy

The current operational goals of the WWE are to:

- comply with the operational permits at all times including, but not limited to, the NPDES permits issued by the U.S. EPA and the State of California and the Air permits;
- maintain the sewer system (collection system and treatment facilities) in a state of good repair;
- operate all facilities (i.e., pump stations and treatment facilities) to maximize discharge through deep-water outfalls and to minimize the frequency and volume number of near-shore discharges (i.e., combined sewer discharges);
- continue to ensure that there are no unauthorized dry-weather discharges into the receiving waters of the State; and
- have no odor emissions beyond the perimeters of the WWE facilities.
3.1 Regulatory Compliance Objectives

The U.S. EPA, through the Clean Water Act and the State of California regulates SFPUC wastewater effluent and stormwater discharges and protects State and Federal receiving water quality (Tables 4 and 5). The NPDES permit program provides the framework that allows the SFPUC to discharge treated wastewater effluent and surface stormwater flows to State and Federal receiving waters. The National Oceanographic and Atmospheric Administration is responsible for protecting and managing the natural and biological resources in designated sanctuary waters\textsuperscript{10}. The Gulf of the Farallones National Marine Sanctuary issues a permit to the SFPUC that allows required NPDES receiving water monitoring activities in the Monterey Bay National Marine Sanctuary waters.

San Francisco’s combined sewer system operates under three wastewater NPDES permits. For the mainland system there are different regulations for dry- and wet-weather discharges. During dry weather, the combined sewer system flow is essentially domestic wastewater, with small contributions from industrial wastewater and urban runoff. During wet weather, the combined flow of wastewater and stormwater is governed by storm patterns and intensity. There is also a stormwater NPDES permit that regulates stormwater flows for the portion of the City’s separate sewer systems under the purview of the SFPUC.

The SFPUC NPDES permits include:

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### Table 4. Bayside Federal, State, and Regional Requirements for Effluent Quality

| Federal |  
| --- | --- |
| • Clean Water Act (33 U.S.C. § 1251 et seq.) |  
| • National Pollutant Discharge Elimination System (NPDES) |  
| • Water Quality Standards Regulations |  
| • National Toxics Rule (40 CFR 131) |  
| • California Toxics Rule (40 CFR 131) |  
| • Section 303(d) and Total Maximum Daily Load Process |  
| • National Combined Sewer Overflow Control Policy (CSO Policy) |  
|  
| State |  
| • Porter-Cologne Water Quality Act |  
| • Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Implementation Policy) |  
|  
| Regional |  
| • San Francisco Bay Water Quality Control Plan (Basin Plan) |  

*Notes: Code of Federal Regulations - CFR; Combined Sewer Overflow - CSO*

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### Table 5. Westside Federal and State Requirements for Effluent Quality

| Federal |  
| --- | --- |
| • Clean Water Act (33 U.S.C. § 1251 et seq.) |  
| • National Pollutant Discharge Elimination System (NPDES) |  
| • Water Quality Standards Regulations |  
| • Section 303(d) and Total Maximum Daily Load (TMDL) Process |  
| • National Combined Sewer Overflow Control Policy |  
|  
| State |  
| • Porter-Cologne Water Quality Act |  
| • California Ocean Plan |  

*Notes: Code of Federal Regulations - CFR*

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\textsuperscript{10} The SWO discharges into an area adjacent to, but outside the boundary of, the Monterey Bay National Marine Sanctuary.
• **Three wastewater NPDES permits** — The 2008 Bayside Permit (NPDES Permit No. CA0037664) is issued and enforced by the San Francisco Bay RWQCB for the SEP, NPF and other bayside facilities that discharge into the San Francisco Bay; the 2008 San Francisco Bay POTW and Industrial Mercury Watershed Permit (NPDES Permit No. 0038849) that implements the San Francisco Bay Mercury Total Maximum Daily Load Requirements; and the 2009 Oceanside Permit (NPDES Permit No. CA0037681) is issued and enforced by both the RWQCB and the U.S. EPA since the OSP discharges through the SWO into federally regulated waters of the Pacific Ocean.

• **One stormwater NPDES permit** — The Municipal Separate Storm Sewer System (MS4) NPDES permit is issued by the RWQCB to regulate the stormwater discharge from the City’s separate sewer systems. Because a small portion of San Francisco is served by separate sewer systems, the implementation of the MS4 permit requirements occurred under Phase II of the stormwater program, following the earlier Phase I implementation for cities with a large separate sewer system.

The Treasure Island Wastewater Treatment Plant wastewater effluent is regulated under NPDES Permit No. CA0110116 which is issued to the U.S. Navy. This discharge is regulated for mercury under the Mercury Watershed Permit. Stormwater flows from TI/YBI are regulated under the MS4 Stormwater NPDES permit.

**Bayside Dry-Weather Discharge Requirements**

All bayside dry-weather discharges receive secondary treatment, as required by the Clean Water Act, and must achieve pollutant removal to meet San Francisco Bay water quality objectives as defined in the RWQCB San Francisco Bay Water Quality Control Plan (Basin Plan) and the Federal water quality standards in the National Toxics Rule and the California Toxics Rule. Following disinfection at the SEP, the dry-weather effluent is discharged into the bay through the deepwater Southeast Bay Outfall\(^\text{11}\).

The current 2008 Bayside Permit includes secondary treatment standards and numerical water quality-based effluent limits for dry-weather discharges from the SEP. Effluent limits for those pollutants in the SEP dry-weather effluent that indicated a potential to exceed water quality objectives are summarized in Table 6. Additional dry-weather secondary treatment technology permit requirements include 85% removal of BOD\(_5\) and TSS. Effluent monitoring for all priority pollutants must be continued throughout the term of the permit to characterize compliance with water quality objectives.

**Westside Dry-Weather Discharge Requirements**

All Westside Watershed dry-weather flows receive secondary treatment at the OSP, as required in the Clean Water Act. The OSP effluent must achieve pollutant removal to meet water quality objectives defined in the California Ocean Plan. The OSP final effluent is discharged into the ocean through the SWO, which is permitted with a dilution factor of 150:1.

Table 7 summarizes the current 2009 Oceanside Permit secondary treatment technology requirements and the mercury and chronic toxicity water quality based effluent limits for the OSP dry-weather effluent. Additional dry-weather secondary treatment technology permit requirements include 85% removal of BOD\(_5\) and TSS. Effluent monitoring for all priority pollutants must be continued throughout the term of the permit to characterize effluent compliance with water quality objectives. Effluent monitoring for all priority pollutants must

\(^{11}\) The RWQCB applies a dilution factor of 10:1 for nonbioaccumulative pollutant water quality-based effluent limits in the 2008 Bayside Permit. A 36:1 dilution credit for the Southeast Bay Outfall is permitted in determining the monthly and daily effluent limits for ammonia.
be continued throughout the term of the permit to characterize effluent compliance with water quality objectives.

Bayside and Westside Wet-Weather Discharge Requirements

During wet weather, San Francisco’s combined sewer system collects, stores, treats, and discharges all stormwater runoff, except for a few areas within the city that are served by a separate sewer system. All wet-weather discharges within the combined sewer system must comply with requirements of the 2008 Bayside Permit and 2009 Oceanside Permit that both include the National Combined Sewer Overflow Control Policy (CSO Policy). Stormwater flows within separate sewer systems must comply with the requirements outlined in the State’s Municipal Separate Storm Sewer System Permit.

The CSO Policy does not require combined wet-weather flows to meet secondary treatment standards or numerical effluent limits, but outlines a phased approach that requires combined sewer municipalities to implement the policy’s Nine Minimum Controls and to develop and implement a Long-Term Control Plan (LTCP) that manages stormwater flows and minimizes the effects of stormwater-induced CSDs.

### Table 6. Southeast Water Pollution Control Plant Dry-Weather Discharge Requirements

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Units</th>
<th>Average Monthly</th>
<th>Average Weekly</th>
<th>Maximum Daily</th>
<th>Instantaneous Minimum</th>
<th>Instantaneous Maximum</th>
<th>Average Annual</th>
</tr>
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<tbody>
<tr>
<td>BOD$_5$</td>
<td>mg/L</td>
<td>30</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
<td>30</td>
<td>45</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>Oil and Grease</td>
<td>mg/L</td>
<td>10</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>pH</td>
<td>Standard</td>
<td>-</td>
<td>-</td>
<td>6.0</td>
<td>9.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chlorine – Total Residual</td>
<td>mg/L</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Copper</td>
<td>µg/L</td>
<td>53</td>
<td>76</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lead</td>
<td>µg/L</td>
<td>36</td>
<td>89</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Silver</td>
<td>µg/L</td>
<td>7</td>
<td>22</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zinc</td>
<td>µg/L</td>
<td>490</td>
<td>720</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cyanide</td>
<td>µg/L</td>
<td>20</td>
<td>43</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dioxin-TEQ</td>
<td>mg/year</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.6</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>µg/L</td>
<td>84</td>
<td>240</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bis(2-ethylhexyl) phthalate</td>
<td>µg/L</td>
<td>55</td>
<td>110</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ammonia</td>
<td>mg/L</td>
<td>190</td>
<td>290</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tributyltin</td>
<td>µg/L</td>
<td>0.032</td>
<td>0.065</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
The Nine Minimum Controls, as outlined in the CSO Policy, include:

1. Conducting proper operation and regular maintenance programs for the combined sewer system and CSO outfalls.
2. Maximizing use of the collection system for storage.
3. Reviewing and modifying pretreatment programs to ensure that CSO impacts are minimized.
5. Prohibiting CSOs during dry weather.
6. Controlling solids and floatable materials in CSOs.
7. Developing and implementing pollution prevention programs that focus on containment reduction activities.
8. Ensuring the public receives adequate notification of CSO discharges and their impacts.
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

The CSO Policy describes two approaches to show compliance with successful LTCP implementation. The presumption approach presumes that a controlled combined sewer system will meet the water quality-based requirements of the Clean Water Act if the implemented LTCP accomplishes any one of the following:

- limits the number of discharge events to between four and six per year;
- captures a minimum of 85% of the combined flows;
- removes the mass of pollutants identified as causing water quality impairment; and
- provides the equivalent of primary clarification and disinfection, if necessary, to any of the remaining discharges.

The demonstration approach requires that a controlled combined sewer system with an implemented LTCP that does not meet the requirements of the presumption approach may be adequate to meet the water quality-based requirements of the Clean Water Act if it is demonstrated through sampling that water quality standards are met and designated uses are protected.
San Francisco has implemented the Nine Minimum Controls and completed an LTCP as part of the 1974 Master Plan. The LTCP design used 70 years of historical rainfall records to determine the system capacity needed to protect beneficial uses by collecting, storing, and treating all combined flows. The T/S structures that were built surrounding the city are designed to handle all stormwater flows within the City’s combined sewer system and provide sufficient storage and treatment to manage wet-weather combined flows in order to protect beneficial uses. All wet-weather flows receive the equivalent of primary wet-weather treatment (decant treatment) through solids settling and the retention of floatable materials within the T/S boxes.

The design and performance of the T/S structures and the operation of the City’s combined sewer system and wet-weather facilities meet the requirements of the presumption approach for compliance with the CSO Policy.

**Bayside Wet-Weather Flows and Discharge Requirements**

The 2008 Bayside Permit defines flows greater than 110 mgd to the SEP due to rain as wet-weather discharges. During wet weather, the SEP no longer operates as a publicly owned treatment works but rather as a wet-weather facility. Additional wet-weather treatment is provided at the NPF, a wet-weather treatment facility. The NPF provides primary treatment with disinfection for up to 150 mgd of combined wastewater and stormwater flow. When the capacity of the SEP and NPF wet-weather facilities is exceeded, excess wet-weather flows result in CSDs from nearshore CSD structures.

Bayside wet-weather discharges must comply with the requirements of the CSO Policy, as previously described. The 2008 Bayside Permit states that the treatment process at the SEP, NPF, and Bayside Wet-Weather Transport/Storage and Diversion Structures meet the minimum treatment specified by the U.S. EPA CSO Policy 150 FR 18688 as of April 11, 1994.

**Westside Wet-Weather Flows and Discharge Requirements**

The 2009 Oceanside Permit defines flows greater than 43 mgd due to rain as wet-weather discharges. During wet weather, the OSP no longer operates as a publicly owned treatment works, but rather as a wet-weather treatment facility.

Similar to the bayside wet-weather discharges, wet-weather discharges from the OSP, decant through the SWO, and the westside nearshore CSDs must also comply with requirements of the CSO Policy.

In summary, the State Water Resources Control Board and the U.S. EPA have determined that the City’s integrated approach to controlling storm flows is consistent with the CSO Policy. Although no permit limits are included for wet-weather flows, representative samples of nearshore CSD events from the Vicente portion of the westside T/S structure must be monitored for \( \text{BOD}_5 \), TSS, ammonia, oil and grease, \( \text{pH} \), metals, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, and pesticides.

**Treasure Island Discharge Requirements**

The Treasure Island Wastewater Treatment Plant secondary treatment standards that are specified in the NPDES permit include effluent limitations for \( \text{BOD}_5 \), TSS, oil and grease, \( \text{pH} \), total residual chlorine, and total coliform bacteria. Secondary treatment technology permit requirements include 85% removal of \( \text{BOD}_5 \) and TSS. Effluent monitoring for all priority pollutants must be continued throughout the term of the permit to characterize compliance with water quality objectives.
Biosolids Regulations

Appropriate treatment and disposition of biosolids\textsuperscript{12} is mandated by reference to 40 CFR 503 in the Bayside, Oceanside, and TI/YBI NPDES permits. San Francisco must also abide by State and regional regulations as they are applied to individual land application sites and landfill requirements.

Federal Regulations

The U.S. EPA regulates biosolids use under 40 CFR 503 that addresses land application, surface disposal, and incineration of biosolids. These regulations are self-implementing and include monitoring, certification, and reporting requirements. Agencies are required to send an annual report to the U.S. EPA summarizing and certifying their compliance with the rule.

The U.S. EPA regulations at 40 CFR 503 establish metal concentration limitations, pathogen density reduction requirements, vector attraction reduction requirements, and site management practices for land application of biosolids. These regulations also establish requirements for surface disposal and incineration of biosolids. The U.S. EPA regulations at 40 CFR 503 establish metal concentration limits, total hydrocarbon emission limits, and management practices. The use or disposal of nonhazardous incinerator ash is not covered by these regulations; other federal regulations (40 CFR 257 and 40 CFR 258) cover these practices.

State Regulations

The State Water Resources Control Board has adopted the statewide Waste Discharge Requirement (WDR) for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities (General Order 2004-0012-DWQ). This General Order goes beyond the requirements of the 40 CFR 503 by requiring additional biosolids testing, soil testing, groundwater sampling, and wind and dryness limitations.

The Delta Protection Commission adopted regulations that prohibit biosolids land application within the Primary Zone of the Delta, as defined in Section 12220 of the California Water Code. The Primary Zone includes portions of Solano, Yolo, Sacramento, San Joaquin, and Contra Costa counties. The five counties have incorporated the requirements of the Delta Protection Commission within their land use plans and zoning codes.

Biosolids reuse and disposal in landfills falls under the jurisdiction of the California Integrated Waste Management Board. In addition to regulating the co-disposal of biosolids in landfills and use of biosolids for alternative daily cover, the California Integrated Waste Management Board also regulates biosolids composting facilities.

Regional and Municipal Regulations

Air Quality Management District regulations can affect biosolids management programs by requiring permits and emission control systems at landfills, land application sites, and cogeneration, heat drying, composting, and thermal conversion facilities. Most local/regional influences on biosolids management practices, however, originates at the county level. San Francisco currently land applies biosolids in Solano, Sonoma, and Merced counties. Some counties require a Conditional Use Permit be obtained for a site, which triggers an environmental review in accordance with the California Environmental Quality Act and allows the county to apply site-specific conditions to the proposed operation.

\textsuperscript{12} Biosolids is the accepted term for sewage sludge that has been highly treated and tested to ensure that it complies with Federal standards prior to being beneficially reused.
Other counties have enacted biosolids ordinances to address local concerns. The ordinances range from complete banning of biosolids land application to allowing Class A or Class B biosolids to be applied. Each county’s requirements are unique; some ordinances ban the use of high-quality products like compost or fertilizer pellets derived from biosolids. In general, the trend in California has been toward increasingly restrictive local regulation or bans for the land application of biosolids. The current ordinance in Solano County, which receives approximately 20% of San Francisco’s biosolids for land application, expires in October 2012. This ordinance will only allow the land application of Class B biosolids after October 2012 if an agency has adequately demonstrated progress toward production of either Class A Exceptional Quality biosolids or is using a waste-to-energy process.

3.2 Operations and Maintenance

System Operations

The WWE operates its facilities in compliance with the relevant NPDES and Air permits and strives to maximize wastewater and stormwater treatment and discharge through deep-water outfalls.

Bayside

Dry Weather

All dry-weather flows from the five bayside drainage basins, as well as eastside municipal customers located outside the city limits, are treated at the SEP and the effluent is pumped by the Booster Pump Station to the Southeast Bay Outfall for discharge into the bay.

Dry-weather flow from the northeastern portion of the Bayside Watershed is pumped from the North Shore Pump Station through the North Shore Force Main to the Channel T/S structure. This flow, as well as the gravity flow from the Channel Drainage Basin sewers, is transported through the Channel Force Main directly to the SEP. Dry-weather flows from the Potrero Hill and 20th Street areas are pumped by the Mariposa Pump Station to a gravity sewer at 21st and Illinois streets that is part of the Islais Creek Drainage Basin. Dry-weather flow from the Islais Creek Drainage Basin is transported by gravity to the vicinity of the SEP and is lifted into the plant by the Southeast Lift Station.

Additionally, dry-weather flow from the upper Yosemite area gravitates to the SEP through the Hunters Point Tunnel. Dry-weather flow from the lower Yosemite areas combines with dry-weather flow from Sunnydale and is pumped to the Islais Creek Drainage Basin through the Hunters Point Tunnel by the Griffith Pump Station. The Bruce Flynn Pump Station is currently being operated during dry weather to provide a consistent influent flow regime at the SEP. See Figure 6 for the bayside dry-weather operational strategy.

Wet Weather

In addition to the dry-weather pump stations and major force mains already identified, wet-weather combined wastewater and stormwater flows from the east side of San Francisco are also conveyed to the SEP by two wet-weather pump stations — the Sunnyside and the Bruce Flynn Pump Stations. The Sunnyside Pump Station receives flow from the Sunnyside T/S structure and pumps it to the upstream end of the Candlestick Tunnel, which in turn flows by gravity to the Yosemite T/S structure. This flow is ultimately pumped again by the Griffith Pump Station to the vicinity of the SEP through the Hunters Point Tunnel. The Bruce Flynn
San Francisco Sewer System Improvement Program Report

Bayside Dry-Weather Operational Strategy

Figure 6. Bayside Dry-Weather Operational Strategy

Notes: North Shore T/S structures consist of the Marina T/S, North Point Tunnel, and the Jackson T/S.
Pump Station provides additional capacity to supplement the Southeast Lift Station during wet weather, lifting flow into the SEP from the Islais Creek T/S structure.

During wet weather, the SEP wet-weather facilities are engaged to provide primary treatment to an additional 100 mgd of combined wastewater and stormwater flow, beyond the dry-weather capacity. At full capacity, the SEP provides primary treatment to all flows up to 250 mgd and secondary treatment to a maximum flow rate of 150 mgd. Wet-weather effluent discharges are maximized through the deepwater Southeast Bay Outfall, which has a capacity of 110 mgd. Flows in excess of 110 mgd are discharged into Islais Creek through the shallow-water Quint Street Outfall. All plant discharges into Islais Creek receive full secondary treatment; at full capacity, the 110-mgd discharge through the Southeast Bay Outfall receives primary treatment, with 10 mgd also receiving secondary treatment.

When the SEP approaches its secondary treatment capacity of 150 mgd and T/S box levels increase, a portion of the flow from the North Shore Drainage Basin is routed by way of the North Shore Pump Station to the NPF for primary treatment. Treated flow is then discharged through four gravity outfalls that extend to the end of Piers 33 and 35. The NPF transfers all wastewater solids to the SEP for treatment.

The bayside facilities (SEP and NPF) have a treatment design capacity that total 400 mgd. Once the capacities of the treatment facilities and the combined sewer system storage are maximized, the surplus flow discharges at permitted nearshore sites. These 29 bayside nearshore sites are the CSD structures. A summary of the bayside dry- and wet-weather treatment and outfall capacities is provided in Table 8. Figure 7 illustrates the bayside wet-weather operational strategy.

Westside

Dry Weather

All dry-weather flow collected from the Westside Watershed and some small flows from northern San Mateo County are treated at the OSP and discharged by gravity approximately four miles off shore in the Pacific Ocean through the SWO.

Dry-weather flows from the Richmond and Sunset drainage basins are transported by gravity, collected in the westside T/S structure, and then pumped by the Westside Pump Station through the 48-inch force main to the OSP. Lake Merced Drainage Basin and minor Northern San Mateo County flows are served by the Lake Merced Tunnel that terminates in the southern end of the westside T/S structure, commingles with the westside T/S flow and is treated at the OSP. See Figure 8 for the westside dry-weather operational strategy.

Wet Weather

During wet weather, the OSP provides primary treatment for flows up to 65 mgd and secondary treatment to a maximum flow rate of 43 mgd. The blended primary and secondary treated wet-weather effluent is discharged directly to the SWO by gravity. As the secondary capacity of the OSP is exceeded, additional OSP wet-weather facilities are engaged. To achieve a 175 mgd SWO discharge capacity only 21 of the available diffusers are required. Additional flows up to 110 mgd in the westside T/S structure receive decant treatment before being pumped out through the SWO. Once the storage capacity of the system is reached, flows exceeding 175 mgd are discharged from the seven permitted westside CSD structures. Figure 9 illustrates the westside wet-weather operational strategy.

13 Except for some minor pump stations in the Sea Cliff area for localized flows.
Table 8. Bayside Treatment and Outfall Capacities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Treatment Level</th>
<th>Flow</th>
<th>Outfall Capacity</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Southeast Bay</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quint Street</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>North Point</td>
</tr>
<tr>
<td><strong>Dry Weather</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southeast Water</td>
<td>Secondary</td>
<td>63 mgd average</td>
<td>110 mgd</td>
</tr>
<tr>
<td>Pollution Control Plant</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Wet Weather</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southeast Water</td>
<td>Secondary</td>
<td>150 mgd capacity</td>
<td>10 mgd</td>
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<tr>
<td>Pollution Control Plant</td>
<td></td>
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<td>150 mgd</td>
</tr>
<tr>
<td>Primary</td>
<td>100 mgd capacity</td>
<td></td>
<td>100 mgd</td>
</tr>
<tr>
<td>North Point</td>
<td>Primary</td>
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<tr>
<td>Wet-Weather Facility</td>
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<tr>
<td>Total Wet-Weather</td>
<td></td>
<td></td>
<td>170 mgd</td>
</tr>
<tr>
<td>Treatment Capacity</td>
<td>400 mgd capacity</td>
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<td></td>
</tr>
</tbody>
</table>

Treasure Island/Yerba Buena Island

Utilizing two lift stations, all pumped sanitary flows from YBI are transported via a submarine force main to TI. Sanitary flows from TI travel via gravity sewers and/or force mains to the Treasure Island Wastewater Treatment Plant for secondary treatment and then discharge through a deepwater outfall. There are 27 sanitary pump stations, including 11 lift stations, on TI. The average dry weather flow is 0.37 mgd. Higher wet-weather flows are observed (up to 1.5 mgd) from inflow and infiltration into the collection system.

In wet weather, stormwater on YBI flows by gravity into San Francisco Bay through 26 outfalls. Stormwater on TI is transported by both gravity and pumping (6 pump stations) through 24 outfalls into the bay.

System Maintenance

In the past, routine operation and maintenance of SFPUC’s wastewater assets (pumps, pipes, equipment, tanks, and buildings) were carried out on an as-needed basis (maintenance, repairs, replacement). This basic level of asset management, however, was generally reactionary and did not strategically apply limited financial and human resources on the most critical and high-risk assets. The SFPUC has embraced and is currently applying a rigorous asset management program to target planned improvements and to direct wisely scarce renewal and replacement funds. Both activities are discussed below.

Asset Management

A critical tool in managing any sewer system is a methodology for assessing risks and priorities for operations and infrastructure improvements. SFPUC’s structured asset management program has replaced previously ad hoc and informal decision making with an integrated set of processes to minimize the life cycle cost of infrastructure assets, at an acceptable level of risk, while continuously delivering established levels of service. This program ensures that the sewer system’s most pressing needs are met. Asset management is a continuous business practice with processes for investigations, assessments, evaluations, prioritizations, and decision making. The anticipated benefits of implementing asset management include an in-depth
**Figure 7. Bayside Wet-Weather Operational Strategy**

Notes: North Shore T/S structures consist of the Marina T/S, North Point Tunnel, and the Jackson T/S.
knowledge of SFPUC assets, which leads to the ability to optimize maintenance activities, mitigate risk, prioritize projects and funding within the available budget (e.g., based on risk reduction to cost ratio), and predict future demands.

A robust asset management program includes the use of:

- geographical information systems to incorporate information about age, condition, and location of infrastructure assets;
- system and facility modeling;
- computerized maintenance and operating procedures that include scheduled maintenance, and work plans; and
- integrated technology.

Effective asset management program implementation includes the use of:

- investigations, assessments, evaluations, and prioritizations;
- decision-making tools; and
- data management and predictive modeling applications.

These processes provide for an iterative system whereby capital investments and operations and maintenance protocols are continually refined over time.

The anticipated benefits of implementing effective asset management include:

- a broader knowledge of WWE assets;
the ability to optimize maintenance activities, mitigate risk, prioritize projects and funding, and predict future demands; and
• a sustainable system operation by implementing projects that meet the greatest needs of the system.

Renewal and Replacement

Renewal and replacement (R&R) identifies those activities that maintain the existing systems and facilities. The projects range from strict replacement to major rehabilitation/redesign of process equipment to enhance performance or to extend the service life of a facility. Such costs tend to be recurring in nature.

Collection System Rehabilitation

The existing collection system R&R activities have mostly focused on replacing typical gravity sewers throughout the city. Occasionally, this program has also included any necessary rehabilitation of tunnels and major sewer lines in addition to the local sewers. The current
annual spending for this type of work equated to more than a 200-year replacement cycle. As discussed above, this replacement cycle is no longer deemed sufficient for replacement of aging sewers, which has allowed the average age of sewers to rise, leading to the increasingly frequent need for repairs or replacements.

A more robust and consistently funded collection system rehabilitation program will bring the City’s major sewer lines, brick sewers, tunnels, and T/S structures into a state of good repair, helping to meet the SSIP goal relating to reliability. It is anticipated that increased data collection coupled with the principles of asset management will assist in prioritization of individual projects to minimize the cost burden on the City overall.

Treatment Facility Rehabilitation

As outlined above, current funding levels for maintenance of the treatment facilities has not been adequate to maintain the significant investment the City has in its wastewater infrastructure assets. The older treatment facilities (e.g., the SEP, the NPF, and Treasure Island Wastewater Treatment Plant) have serious structural and equipment deficiencies that, if unaddressed, threaten the ability for the City to consistently meet its discharge permit requirements. Some of the structures are at risk, should there be a major seismic event. Much of the equipment is antiquated and in need of replacement. In addition the OSP has unmet equipment maintenance needs that could threaten permit compliance.

Capital projects for the treatment facility sites alone will not fully meet the goals and level of service of the SSIP — a commitment of funding for R&R activities is required to ensure reliable facilities that meet all permit requirements and are not perceived as a neighborhood nuisance.

3.3 Integrated Watershed Management

The City’s wastewater management system consists of streets, curbs and gutters, inlets, catch basins, pipes, trunk lines, transport storage structures, pumping systems, treatment plants, solids handling facilities and discharge outlets. Components of this system are present in virtually every neighborhood in San Francisco and closely follow the city’s natural drainage patterns formed by soils, topography, and gravity. The SFPUC operates this system using an integrated watershed management approach to:

- protect the water quality of the San Francisco Bay and Pacific Ocean;
- maximize sewer system performance by slowing and reducing the amount of stormwater entering the sewer;
- revitalize natural watershed functions;
- promote infiltration and groundwater recharge;
- promote use of stormwater for nonpotable purposes;
- reduce the amount of power & chemicals needed to manage stormwater;
- enhance the environmental quality of San Francisco’s neighborhoods; and
- adapt our City for climate change.

In addition to the day-to-day operations of the collection and treatment facilities discussed above, SFPUC undertakes the activities described in this section for the purpose of achieving these objectives.
Strategic Planning for Control, Treatment, Discharge, Diversion, and Reuse of Sewage and Stormwater

As implemented by the SFPUC, sewer system strategic planning integrates all design elements and alternatives to optimize system performance and achieve established levels of service. Planning for the repair, replacement, operations, and management of all aspects of the system, including development of policies, strategies, procedures, and projects, optimizes the performance of the system while offering opportunities to reduce the ecological footprint of the system. The benefits of integrated watershed planning include improved long-term efficiencies associated from collaborative planning, increased focus of staff and financial resources to collaborate on priority projects and improved, site-specific solutions, and increased opportunities for community participation and leadership for long-term stewardship.

For the SFPUC, the drainage basin is the central planning unit. Sewer system issues are addressed in the context of the entire drainage basin and the whole range of activities and opportunities available within it are examined. For example, if it were to be shown that a section of the collection system needed addition capacity to operate efficiently, the traditional planning approach would simply require constructing larger sewers. SFPUC’s integrated watershed approach requires consideration of the need to construct larger sewers together with evaluating opportunities in the watershed for reducing the quantity and flow rate of water entering the collection system by methods such as the infiltration, capture, storage, treatment, and reuse of stormwater. Seeking opportunities for sustainable facilities and operations within the wastewater infrastructure is a key component of integrated watershed management planning. Such opportunities include maximizing the capture and treatment of sewage and stormwater, reuse of stormwater and wastewater, use of low impact design infrastructure, and pollution prevention.

Integrated wastewater planning is based on several basic objectives:

- building system resiliency;
- seeking opportunities for sustainable options using triple-bottom-line analysis of environmental, economical, and social impacts;
- using adaptive management methods through data collection and continuous learning based on outcomes; and
- evaluating resources and priorities with asset management methods.

Stormwater Controls

The stormwater management controls consist of the City’s recently enacted Stormwater Management Ordinance and the SFPUC’s stormwater regulations, known as the Stormwater Design Guidelines, and comply with Federal and State stormwater permit requirements. The ultimate purposes of the stormwater management controls are to maximize pervious surfaces, minimize stormwater runoff, and treat stormwater runoff using Low Impact Design (LID) techniques. New and redevelopment projects that disturb greater than 5000 square feet of ground surface are required to incorporate on-site stormwater management in the projects; the stormwater management controls guidelines will affect the way a project is designed, from the inception to the final design and construction of the project. Developers must design projects to retain, detain, or reuse the stormwater generated on-site using the Stormwater Design Guidelines to achieve those goals. SFPUC will review projects and enforce the controls to ensure that all stormwater projects have proper maintenance plans.
New developments in San Francisco that will incorporate SFPUC’s stormwater management controls include the Transbay Terminal, Treasure Island, and Hunters Point Shipyard.

Watershed Stewardship

Watershed stewardship plays a critical role in achieving the SFPUC’s long-term goals for integrated watershed management. The design and development community, nonprofit community, and San Francisco residents can be effective partners in working toward enhanced watershed function and water quality protection. Their participation is facilitated by the following SFPUC activities:

- watershed stewardship grants;
- watershed stewardship curriculum;
- rainwater harvesting program;
- LID speakers series; and
- demonstration projects.

Source Control Program (Pollution Prevention and Industrial Pretreatment)

SFPUC’s long-standing Source Control Program is effective in minimizing pollutants entering the City’s sewer system from businesses, homes, and stormwater runoff. The Source Control Program has two elements — the Industrial Pretreatment Program (Pretreatment Program) and the Water Pollution Prevention Program (P2 Program) — and is the first line of defense in protecting the water quality of the bay and ocean waters, in assuring compliance with State and Federal wastewater discharge permits and water quality standards, and in protecting residents and City workers from potential exposure hazards.

The Pretreatment Program focuses on controlling wastewater discharges from industrial and commercial establishments through permitting, monitoring, and enforcement. The program is also responsible for monitoring, preserving, and improving the beneficial reuse of municipal biosolids, industrial sludge, and other wastewater residuals.

The P2 Program focuses on providing education and technical assistance to residents, students, small businesses, and City employees. Key areas addressed are: lawn and garden care without the use of chemicals; home cleaning with less toxic cleaners; auto care and maintenance tips to reduce stormwater pollution; proper disposal of pet wastes, household and garden care chemicals, and hazardous wastes; and control of sediment and pollutant runoff from construction sites and outside storage areas of local businesses.

Climate Change Adaptation

Increases in sea level have occurred to the extent that during extremely high tides some of the bayside overflow weirs on the combined sewer discharge structures become briefly submerged. The flow of bay water into the system during such events can degrade the sewer system, the treatment processes and the quality of effluent discharged from the treatment plants. According to predictions, the duration and frequency of bay water flow into the sewer system will increase in the coming years. The SFPUC’s integrated watershed management approach to planning will address climate change adaptation as further information on the effects of sea level rise is developed.

Climate change concerns include the potential changes in weather patterns and the intensity and duration of rainfall. Currently, no data clearly supports a particular trend in rainfall patterns; however, storm trends will be monitored and assessed for each City watershed.
Research and Development of New and Sustainable Technologies

SFPUC’s integrated watershed management approach to planning includes the development and implementation of new and sustainable technologies. Staff is reviewing new developments in sewage treatment, solids management and reuse, energy production from waste gases and fats, oil, and grease, and other research efforts related to sewer systems.

Monitoring and Development of New Regulatory Compliance Criteria

The SSIP is based on system requirements necessary to ensure compliance with current and reasonably foreseeable future criteria for the regulation of sewage discharges and biosolids disposal. The Wastewater Enterprise Planning and Regulatory Compliance Division tracks pending and potential regulatory requirements, and participates in the development of both regulatory criteria and compliance implementation plans. System operations are re-evaluated in accordance with the NPDES permit cycle process, which may result in changes to capital improvement projects.

4. SSIP Guiding Principles

Guiding principles for sewer system operations reflect the core values, aspirations, and the vision of the public and the SFPUC for the wastewater collection, treatment, and discharge facilities. These principles focus development of SSIP goals and objectives, levels of service, planning decisions, and capital improvement projects.

Guiding Principles

- Protect public health, safety, and the environment.
- Ensure the long-term sustainability and reliability of the sewer system.
- Minimize sewer system burdens on all sectors of the community and ensure that no sector of the community bears a disproportionate share of the burdens of system operations.
- Promote environmental stewardship, including the sustainable use of natural resources.
- Address the effects of climate change on the wastewater collection and treatment facilities.
- Where technically and economically feasible, develop and implement new technologies to treat wastewater and biosolids in an efficient, sustainable, and environmentally benign fashion.
- Maximize employment and educational opportunities.

The guiding principles received considerable input and review from the WWE staff and reflect the concerns voiced by the SFPUC Commissioners and members of the public during the workshops. They substantially incorporate public comments, numerous discussions with the Technical Advisory Committee14 and principles proposed by the Sustainable Watersheds Alli-

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14 Originally named the Technical Review Committee, the TAC was formed in 1995 and has served in a technical review and advisory role for San Francisco wastewater projects for the past 14 years. The original committee comprised six members. In 2005, SFPUC staff, TAC members and public stakeholders agreed to expand the TAC to eight members to include experts on biosolids, odors, and collection system alternatives (e.g., Low Impact Design).
Ance and San Francisco Planning and Urban Research Association. At the heart of SFPUC’s guiding principles are the voter-adopted provisions of the City Charter. Article VIIIB of the Charter established policy directives for the SFPUC, including:

- complying with State and Federal water quality requirements;
- not placing a disproportionate environmental burden on any community;
- providing clean water services to San Francisco while maintaining stewardship of the system;
- establishing equitable rates sufficient to meet and maintain operation, maintenance, and financial health of the system;
- providing reliable clean water services and optimize the sewer system’s ability to withstand disasters;
- protecting and managing lands and natural resources used by the Commission to provide utility services consistent with applicable laws in an environmentally sustainable manner;
- using state-of-the-art innovative technologies where feasible and beneficial; and
- creating opportunities for meaningful community participation in development and implementation of the Commission’s policies and programs.

Commission Workshops

The five-member SFPUC Commission provided policy-level direction and review throughout the planning process and at key milestones. WWE staff presentations to the SFPUC were open to the public. Commission study sessions and workshops held between 2005 and 2008 provided an overview of the planning process and the results of baseline public opinion research.

Over the last nine months, workshops focused on refining the SFPUC’s goals and developing measurable levels of service to assist the staff and public to clearly define the projects in the SSIP. At the conclusion of this process, the Commission will consider endorsement of clearly defined levels of service as guidance for further planning and design of capital improvement projects. Based upon the levels of service, the scope, schedule, and budget for capital improvements will be refined and developed in sufficient detail for final approval.

Evaluation of Proposed Systemwide Changes

During the multi-year planning process, the project team evaluated several proposed major systemwide changes to the configuration and operating strategy of the San Francisco wastewater collection system and treatment facilities. While portions of several of the proposals may be incorporated in the SSIP, wholesale adoption of the four major suggestions was determined to be infeasible and not necessary for the achievement of system goals. City management, the TAC, and public comment from prior and current planning efforts helped shape consideration of these issues. Additional considerations included system flexibility and reliability and potential future regulatory developments pertaining to bay discharge. The analysis included:

1. separating sewers;
2. decentralizing treatment;
3. eliminating bay discharges; and
4. relocating bayside flows from the Southeast Water Pollution Control Plant.

The four proposed changes were carefully considered. The portions of the approaches that showed promise, appeared feasible, and are anticipated to be realized in the SSIP include:
potential separation of sewers in redevelopment area;
de decentralization of stormwater treatment using a watershed approach to stormwater management; and
development of local water reclamation facilities.

Details of the analysis are provided in the Appendix of this report.

5. SSIP Goals and Levels of Service

SSIP goals consistent with the guiding principles were developed to address the deficiencies in the current sewer system, the foreseeable future challenges, and to ensure that the SFPUC continues to meets its core mission.

Goals

- Provide a compliant, reliable, resilient and flexible system that can respond to catastrophic events.
- Minimize flooding.
- Provide benefits to impacted communities.
- Modify the system to adapt to climate change.
- Achieve economic and environmental sustainability.

Each goal is linked to defined metrics (levels of service) to provide a quantifiable means of setting design criteria and project scopes. Monitoring the performance of the suite of projects designed to achieve a specific goal will give SFPUC staff, the Commissioners, and the public the tool to determine the success of the SSIP. It should be noted that the SFPUC objectives for sustainability, cost-effectiveness, and affordability will be universally incorporated into all alternatives and projects included in the SSIP.

Table 9 summarizes the SSIP goals with their corresponding levels of service and implementation strategies and the SSIP proposed projects, plus references the existing WWE and City programs that address the levels of service.

6. SSIP Strategies for Achieving Levels of Service

This section contains the proposed strategies and capital improvement projects that will ensure attainment of the levels of service goals. Table 9 provides a description of the program goals, proposed levels of service, and their corresponding strategies.
<table>
<thead>
<tr>
<th>Wastewater Enterprise Goals</th>
<th>Wastewater Enterprise Levels of Service</th>
<th>Implementation Strategies</th>
<th>Proposed SSIP Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full compliance with State and Federal regulatory requirements applicable to the treatment and disposal of sewage and stormwater.</td>
<td>Construct facilities to maintain functions necessary for regulatory compliance.</td>
<td>Treatment Plant Improvements, Treasure Island Treatment Plant, Outfall Improvements, and Biosolids Digester Facility.</td>
<td></td>
</tr>
<tr>
<td>Critical functions are built with 100% redundant infrastructure.</td>
<td>Construct facilities to maintain 100% dry-weather treatment redundancy.</td>
<td>Biosolids Digester Facility and Treatment Plant Improvements.</td>
<td></td>
</tr>
<tr>
<td>Critical dry-weather facilities will be on-line within 72 hours of a major earthquake.</td>
<td>Implement seismic upgrade for critical facilities. Increase storage at pump stations located in liquefaction areas.</td>
<td>Treatment Plant Improvements, Outfall Improvements, Channel Tunnel, and Biosolids Digester Facility.</td>
<td></td>
</tr>
<tr>
<td>Minimize Flooding</td>
<td>Control and manage flows from a storm of a three hour duration that delivers 1.3 inches of rain.</td>
<td>Develop projects to address identified collection system problems utilizing grey infrastructure and Low Impact Design (LID) criteria.</td>
<td>Flood Control Projects, Channel Tunnel, and Low Impact Design.</td>
</tr>
<tr>
<td>Be a good neighbor.</td>
<td>Implement visual improvement to facilities.</td>
<td>Treatment Plant Improvements, Biosolids Digester Facility, and Low Impact Design projects.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use operational controls to minimize Collection System Odor.</td>
<td>Collection System Odor Control.</td>
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<td></td>
<td>Provide community benefits including jobs and educational opportunities.</td>
<td>In support of projects, establish various programs including local hiring and job readiness programs focusing on disproportionately impacted communities and correcting for past impacts.</td>
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</tr>
<tr>
<td>Modify the System to Adapt to Climate Change</td>
<td>Screen Staging Alternatives to select appropriate locations for anticipated sea level rise.</td>
<td>Flood Control, Collection System Improvements, Low Impact Design, Biosolids Digester Facility, and Treatment Plant Improvements.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Develop and implement an adaptation plan for existing infrastructure to address expected sea level rise within the service life of the asset (i.e., 16 inches by 2050, 25 inches by 2070, 55 inches by 2100).</td>
<td>Flood Control projects, Low Impact Design, Backflow Prevention and Channel Tunnel.</td>
<td></td>
</tr>
<tr>
<td>Achieve Economic and Environmental Sustainability</td>
<td>Beneficial reuse of 100% Biosolids.</td>
<td>Develop plans to upgrade WWE Biosolids Facilities.</td>
<td>Biosolids Digester Facility.</td>
</tr>
<tr>
<td></td>
<td>Use nonpotable water sources to meet 100% of WWE facilities nonpotable water demands.</td>
<td>Incorporate conservation measures and stormwater, groundwater, recycled water, and greywater reuse facilities into projects.</td>
<td>Treatment Plant Improvements, Biosolids Digester Facility and Low Impact Design projects.</td>
</tr>
<tr>
<td></td>
<td>Beneficially use 100% of methane generated by SFPUC treatment facilities.</td>
<td>Incorporate anaerobic digestion or other beneficial methane reuse options into the Biosolids Digester Facility.</td>
<td>Biosolids Digester Facility.</td>
</tr>
<tr>
<td></td>
<td>Stabilize life-cycles costs to achieve future economic stability.</td>
<td>Provide triple bottom line review to all SSIP projects.</td>
<td>Biosolids Digester Facility, Treatment Plant Improvements, Flood Control, Odor Control, Low Impact Design, Treasure Island and Outfall Repairs.</td>
</tr>
</tbody>
</table>

Table 9. Wastewater Enterprise Goals and Levels of Service Aligned with Implementation Strategies and Proposed SSIP Projects
6.1 Provide a Compliant, Reliable, Resilient, and Flexible System that can Respond to Catastrophic Events

**Levels of Service**

- Full compliance with State and Federal regulatory requirements applicable to the treatment and disposal of sewage and stormwater.
- Critical functions are built with 100% redundant infrastructure.
- Critical dry-weather facilities will be on-line within 72 hours of a major earthquake.

Any element of the collection system in San Francisco can sustain structural damage during an earthquake, but the risk, and therefore the importance and priority, depends upon condition (i.e., age and material of structure, type of connecting joints and support, and characteristics of the surrounding soil), as well as, critical function of the asset and/or existence of redundancy to allow the redirection of flows in the event of a catastrophic failure. Strengthening critical structures and providing alternative flow routing will minimize possible impacts to the public health and receiving waters in the immediate aftermath of a significant earthquake.

The treatment facilities may also be crippled in a major earthquake. Seismic strengthening and provision of redundant treatment units and ancillary equipment will allow dry-weather treatment levels to be re-established within 72 hours. As presented above, the older treatment facilities (e.g., the SEP and the NPF) have serious structural and equipment deficiencies that, if unaddressed, threaten treatment facility reliability and, by extension, the ability for the City to consistently meet its discharge permit requirements. The Treasure Island treatment facility must be entirely replaced to meet the reliability demanded by the projected build-out of the island. Finally, the deepwater outfalls must be inspected and rehabilitated to extend their service life.

**Strategies to Meet Levels of Service**

The capital improvement projects will be developed to provide for seismic upgrade for critical facilities, replace aging infrastructure to ensure reliability, and provide appropriate collection system and treatment facility redundancy. The overall goal will be to provide for coordinated planning, design and construction to ensure that the major collection system conveyance structures and treatment facilities are returned to a state of good repair to ensure permit compliance and to weather a major catastrophic event (i.e., equivalent of the 1906 earthquake) and be returned to service within 72 hours.

**Capital Improvements to Meet Levels of Service**

**Collection System** — Provide from partial to full redundancy for Channel Force Main and strengthen other system force mains.

**Treatment Facilities** — A series of capital improvement projects will ensure that the treatment facilities can continue to give reliable routine service for dry-weather and wet-weather treatment and perform as described after a major seismic event. A proposed list of projects is presented in Table 10. Examples are described as follows.
SEP

The antiquated SEP biosolids digester facility needs to be replaced. The new facility will produce high-quality biosolids (Class A) and enhance energy recovery. Aging major process equipment, which has exceeded its useful life, needs to be replaced with modern, more efficient, easily maintainable, and reliable equipment (i.e., wet-weather headworks, upgrades to screening and grit removal, oxygen generation or primary and secondary clarifier mechanisms). Seismic and structural upgrades throughout the plant will minimize damage from earthquakes.

NPF

The NPF will be rehabilitated to ensure its continued service for wet-weather treatment. Improvements to the NPF include refurbishment of the aging infrastructure and seismic and structural upgrades.

OSP

Rehabilitation of critical unit processes at OSP to maintain a state of good repair and upgrade biosolids process.

TI/YBI

New or upgraded treatment facility will be designed and constructed to accommodate anticipated wastewater needs. Treatment options and final design are to be determined.

Outfalls

All of the outfalls will be inspected, evaluated to assess their condition, and repaired to ensure continued function through 2030.

6.2 Minimize Flooding

Levels of Service

- Control and manage flows from a storm of a three-hour duration that delivers 1.3 inches of rain.

For many years, San Francisco has used intensity-duration-frequency curves developed in 1941 as the basis of its five-year “design storm” (also expressed as 1.3 inches in 3 hours). Rainfall data from 1974 to 2004 was complied and evaluated as part of the SSIP planning process. This analysis validated the relevance and of 1941 “design storm” and reaffirmed the continued use of this standard as a basis of design for local sewers. Rigorous application of this standard will ensure that rainfall of this intensity or less will be contained within the piping of the collection system. While the design standard is still relevant, the actual performance for portions of the existing system has shifted due to changes in land-use patterns and bayside fill subsidence.

Strategies to Meet Level of Service

In addition to current operational strategies to reduce and desynchronize peak flows and volumes through stormwater regulatory controls and system cleaning and maintenance, providing additional collection system capacity will facilitate achievement of the level of service. Extensive collection system modeling has assisted the SFPUC in identifying key conceptual capital improvement projects that will improve the system’s ability to control and manage storm flows.
## Table 10. Summary of Treatment Facility Capital Projects to Ensure Reliability and Flexibility

<table>
<thead>
<tr>
<th>Project</th>
<th>Details</th>
</tr>
</thead>
</table>
| **Southeast Water Pollution Control Plant**  | **Influent Pump Station Refurbishment**  
Site demolition, new construction, odor control equipment, sluice gates, submersible pumps, pipes, and valves.  
**New Wet-Weather Headworks**  
Building construction, bar screens, grit chamber, pumps, pipes, and valves.  
**Primary Clarifiers Refurbishment**  
Refurbish concrete, new sludge collectors, scum collectors, sampler, pumps (scum and sludge), pipes, and valves.  
**High-Purity Oxygen Upgrades**  
High Purity Oxygen equipment and installation.  
**Secondary Clarifiers Refurbishment**  
Secondary clarifier dome, mechanical algae brush system, mechanical clarifier sludge collector, scum system, scum pump, and hydraulic structures.  
**New Secondary Effluent UV Disinfection**  
Demolish old wet-weather headworks, equipment, new construction, UV system process equipment, sluice gates, pumps.  
**Seismic/Electrical/Instrumentation**  
Various electrical, instrumentation, and seismic upgrades as needed to existing buildings.  
**New Biosolids Digestion Facility**  
- New gravity belt thickeners  
- New pretreatment to achieve Class A  
- New digesters  
- New/or rehabilitated dewatering facility  
- New biogas handling system  
- New energy recovery facility  
- New odor and chemical systems  |
| **Oceanside Water Pollution Control Plant**  | **Additional Grit Removal**  
Building construction, process equipment (bar screen, grit chamber, grit removal classifier), pumps.  
**New Gas Handling System**  
Design/install new gas handling system & waste gas burner - ensure all meters installed to meet permit reporting requirements.  
**Electrical/Instrumentation**  
As needed to upgrade facilities.  
**High-Purity Oxygen Refurbishment**  
Rebuild and refurbish oxygen generating equipment to extend service life  
**Upgraded Biosolids Digestion Facility**  
Building construction, process equipment (boiler, pumps, heat exchanger, centrifuge, CAMBI™-type thermal hydrolysis, cake pumps).  |
| **North Point Wet-Weather Facility**        | **Primary Clarifiers Refurbishment**  
Sludge cross collector sluice gates and scum gates.  
**New Chemical Facilities**  
Sodium hypochlorite tanks/container/feed control should be evaluated for repair/replacement; add tank level indication to DCS. New ferrous tanks/containment/pumps/unloading station/controls.  
**Seismic/Electrical/Instrumentation Upgrades to Existing Buildings**  
Various electrical, instrumentation, and seismic upgrades as needed to existing buildings.  |
| **Treasure Island Water Pollution Control Plant**  | **New Treatment Facility**  
New or upgraded facility to serve wastewater needs.  |
| **Outfalls**                                | **Southeast Bay Outfall Repairs**  
Rehabilitation of SEO — reinstallation of diffusers and other repairs as needed after thorough inspection.  
**North Point Outfalls Repairs**  
Rehabilitation of NPO to ensure continued service. No increase in discharge volume is proposed.  
**Southwest Ocean Outfall Backflow Prevention**  
Installation of backflow prevention devices on the active SWO diffusers to minimize current problem of seawater intrusion and circulation, which can limit discharge and increase the risk of fouling.  |
The projects will assist in meeting the level of service for each the targeted drainage and sub-drainages area. Each specific capital improvement project will be developed in tandem with both “green” stormwater management strategies and traditional stormwater control techniques (“grey” infrastructure).

Capital Improvements to Meet Level of Service

**Low Impact Design** — New techniques for managing urban stormwater runoff are becoming accepted as the preferred method for cities to manage the impacts of development on receiving water bodies. Low Impact Design (LID) techniques are also called green infrastructure or stormwater best management practices. Strategic daylighting of creeks that have been entombed in the combined collection system can dramatically reduce volumes of stormwater entering the combined collection system and reclaim existing capacity. LID can also include systems to slow down the flow of water, while providing other amenities such as increased green areas and systems designed to trap rainwater for storage and reuse. Cistern systems can be designed to capture rainwater for irrigation or reuse within buildings. Rainwater capture would have the additional benefit of reducing potable water demand if the stormwater was reused.

Capital projects have been defined to achieve flooding relief through the daylighting of four creeks:
- Islaís Creek
- Yosemite Creek
- Pine Creek
- Brotherhood Creek

The Better Streets Plan creates a unified set of design criteria that will improve the stormwater management performance of streets through the use of green infrastructure. City streets that are excavated as part of infrastructure projects will be retrofitted to meet the Better Streets criteria. Capital funding has been allocated to implement the “Better Streets Plan” so that 15% of city streets by 2040 will incorporate design features such as tree basins, bioretention, and permeable pavement to capture, treat, reduce, and slow the volumes of stormwater entering the sewer system or a receiving water body. These features will create multi-purpose designs that beautify, increase pedestrian safety, and provide either passive or active recreational opportunities.

To reduce stormwater runoff and potable water demand, the WWE will implement an incentive program that encourages people to disconnect their downspouts from the combined sewer system. The disconnected downspouts would be connected to infiltration LID measures (e.g., rain gardens) or rainwater harvesting cisterns. The allocated funding will reimburse up to 50% of the retrofit costs and will result in downspouts being disconnected from 25% of buildings.

**Collection System Traditional Infrastructure** — An expanded capital improvement program for traditional stormwater infrastructure projects will correct long-standing flooding problems. The standard techniques for addressing chronic flooding problems include:
- Replacement of “bottlenecks” or flow restrictions
- Construction of pump stations in low-lying areas and in topographically isolated areas to transfer flows within the collection system
- Installation of larger sewers and tunnels to transfer flows and provide flood relief and storage

Table 11 summarizes the traditional infrastructure approach to address five drainage area flooding problems. These projects have not been finalized and will be further developed in tandem with “green” stormwater management strategies.
6.3 Provide Benefits to Impacted Communities

**Levels of Service**

- Limit odors to within treatment facility’s fence lines.
- Be a good neighbor.

The control of plant odors is a major operating issue for WWE personnel and represents the most frequent complaint of neighbors. In addition to changes in operations (i.e., eliminating long storage times, adding chemical upstream of treatment facilities), modifying existing facilities and installing state-of-the-art odor control units on all foul air sources will facilitate the elimination of odors beyond the treatment facilities’ fence line.

**Strategies to Meet Levels of Service**

Develop projects to capture and treat emission sources of the new biosolids digester facility and existing treatment facilities to minimize odors. As practicable, new emissions sources will be located to minimize impacts to residential neighbors and near-by businesses. Provide community benefits including jobs and educational opportunities.

**Capital Improvements to Meet Levels of Service**

All emission sources of the new biosolids digester facility will have state-of-the-art odor control devices and will be located to minimize impacts to residential neighbors. Included in the upgrade of the SEP is a project to cover and treat the emissions from the secondary clarifiers. In support of projects, establish various programs including local hiring and job readiness programs focusing on disproportionately impacted communities and correcting for past impacts.

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<table>
<thead>
<tr>
<th>Drainage Area</th>
<th>Proposed Infrastructure Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunnydale/Visitacion</td>
<td>Series of large-size pipes and structures within the project area. A tunnel connecting basin to existing Sunnydale transport/storage structure.</td>
</tr>
<tr>
<td>Mission District</td>
<td>Construct/install a series of large-size pipes and structures within the project area. A tunnel may be necessary to complete the downstream connection at Marin St.</td>
</tr>
<tr>
<td>Channel</td>
<td>Series of five storage and pump station facilities.</td>
</tr>
<tr>
<td>Richmond</td>
<td>Improvements to the drainage system to alleviate, air/flow surcharging, including improvements to beach near shore discharges, and sewer pipes.</td>
</tr>
<tr>
<td>Upper Alemany</td>
<td>Construct various sized reinforced concrete boxes, a pump station and sump for the local system (Upper Alemany) and companion projects in Ingleside and Northwest Bayview.</td>
</tr>
</tbody>
</table>
6.4 Modify the System to Adapt to Climate Change

Levels of Service

- New infrastructure must accommodate expected sea level rise within the service life of the asset (i.e., 16 inches by 2050, 25 inches by 2070, and 55 inches by 2100).

Rising sea level is already having a noticeable impact on the collection system. During extreme high tide events, bay water overtops some of the CSD weirs and flows into the collection system. If the future sea level rise follows the higher estimates, then the mean higher high water tide will overflow the lowest CSD weirs daily by the year 2050 and will reclaim low-lying fill areas. This will require reconfiguration or elimination of the bayside CSD structures and coordinated planning regarding siting of SFPUC assets.

Strategies to Meet Level of Service

The most immediate need is to develop projects to protect sewer system assets from the adverse effects of sea level rise. As the SFPUC either plans new or upgrades existing facilities, sea level rise predictions will guide final siting decisions.

The development of a climate adaptation plan to consider alternatives that will eliminate or accommodate bay water backflow as well as prevent upstream flooding is essential for planning for sea level rise, and could address:

- a comprehensive review of existing CSD structures to determine the feasibility of selectively raising weir height (e.g., Sunnydale, Brannan and Howard Streets);
- installation of pump stations to lift the flow to CSD structures with higher weir elevations;
- the increase wastewater pumping to the treatment facilities for treatment and discharge through deepwater outfalls;
- increased collection system storage; and
- use of Low Impact Design elements for runoff modification and stormwater retention and infiltration.

These measures will be necessary to address the need to provide for adequate wet-weather operation (under the anticipated higher downstream water elevations than for which the current system was designed) while simultaneously preventing upstream flooding.

Capital Improvements to Meet Level of Service

To protect sewer system assets from the adverse effects of sea level rise, it is proposed to install a system of rubber backflow prevention devices on the CSD weirs to allow one-way-only flow out of the transport/storage structure and to install local pump stations. Implementation of these measures will protect wastewater facilities and local fill areas from baywater intrusion and will likely provide sufficient protection through 2030.
6.5 Achieve Economic and Environmental Sustainability

**Levels of Service**

- Beneficial reuse of 100% biosolids.
- Use nonpotable water sources to meet 100% of WWE facilities nonpotable water demands.
- Beneficially use 100% of methane generated by SFPUC treatment facilities.
- Stabilize life-cycle costs to achieve future economic stability.

Today’s sewer system is the result of infrastructure choices made 100 years ago, and it is likely that the decisions made now will have similarly long-term effects. Because of the uncertainty of energy and potable water supplies and the challenge of climate change, SFPUC must build and operate systems that are economically and environmentally sustainable.

**Strategies to Meet Levels of Service**

“Triple bottom line” sustainability criteria will be used during the planning and design phases of new WWE facilities.

**Capital Improvements to Meet Level of Service**

The biosolids digester facility will be designed and constructed to ensure the ability to reuse 100% of the biosolids produced by the facility and will include state-of-the-art gas handling systems to enhance the capture and reuse of methane.
Capital improvement projects will be developed to substitute nonpotable water for appropriate facility needs and to exploit power generation opportunities, where feasible.

7. Project Costs

The SSIP proposed project costs estimates for the capital improvement projects described above are provided in Table 12.

<table>
<thead>
<tr>
<th>Project</th>
<th>Project Cost Estimate (millions) 2010 Dollars</th>
<th>Project Cost Estimate (millions) Based on Time of Construction</th>
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<tr>
<td><strong>Treatment</strong></td>
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<tr>
<td>Biosolids Digester Facility</td>
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<td>Treatment Plant Odor Control</td>
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<td>$100</td>
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<tr>
<td>Southeast Treatment Plant Upgrades</td>
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<td>$650</td>
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<td>Oceanside Treatment Plant Upgrades</td>
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<td>North Point Facility Upgrades</td>
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<td>Outfall Rehabilitation</td>
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<td>Treasure Island Treatment Plant</td>
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<td><strong>Treatment Subtotal</strong></td>
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<td>$2,790 - $3,590</td>
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<tr>
<td><strong>Collection System</strong></td>
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<tr>
<td>Collection System Odor Control</td>
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<tr>
<td>Low Impact Design Green Streets, Downspout Incentive, Daylight Creeks</td>
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<td>$600 - $800</td>
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<td>Backflow Prevention</td>
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<td>$45</td>
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<tr>
<td>Channel Tunnel</td>
<td>$500 - $700</td>
<td>$800 - $1,000</td>
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<td>Visitation Valley, Mission, Richmond, South of Market Flood Control</td>
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<tr>
<td>Alemany/Ingleside Flood Control Phase 1</td>
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<td><strong>Collection System Subtotal</strong></td>
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<td><strong>Total</strong></td>
<td>$3,460 - $4,210</td>
<td>$5,585 - $6,785</td>
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8. Next Steps

This report describes the guiding principles, goals, and levels of service, for the SSIP. The capital improvement projects recommended to meet the levels of service are described, with the project costs estimates for executing those projects. Based on this report, the Commission may consider and endorse the proposed program’s goals and levels of service (Table 9), which will enable staff to move forward with program implementation by initiating project planning and design, including the environmental review process.

Appendix

Auxiliary Information

Separation of Sewers

*Should the combined collection system be converted to a separate sewer system?* Systemwide sewer separation is not recommended because the existing system treats all dry-weather sewage, all dry-weather runoff, and all stormwater.

While there exists the traditional perception that combined sewer systems have greater impacts on the receiving water, the City’s unique system has demonstrated superior performance compared with typical combined sewer systems and possibly compared with typical separate sewer systems, by capturing and treating the majority of wet-weather flows (see Figure 2). Urban stormwater has been recognized as a significant source of water pollution in recent years, especially with nonconventional pollutants. For example, the primary source of dioxins in San Francisco’s wastewater is from stormwater runoff. Stormwater alone can at times have sufficiently high bacterial concentrations that require beach closings. Unlike separate sewer systems, the City’s existing system is able to capture the majority of runoffs, especially the pollutant-laden first flush and provide a certain level of pollutant removal. Recent regulatory developments have made sewer separation much less attractive, as there are increasing demands for separate sewer systems to increase efforts in source control, reduce discharge, and provide stormwater treatment, all of which the city’s current system provides.

No other system in California provides a similar level of pollutant removal. Separation of all sewers would be a massive, long-lasting, disruptive undertaking that provides no significant environmental benefit. Localized sewer separation in new developments will be considered when water reuse or stormwater reduction is possible.

Key considerations in coming to this conclusion included:
- excessive financial burden to the City and residents ($2 to $4 billion);
- significant public disruptions for 50 years or longer;
- high risk of unsuccessful implementation of modifications on private properties; and
- no significant benefit to the environment.

Decentralization of Treatment

*Should the centralized treatment plants be replaced with a decentralized treatment system?* While many innovative approaches to decentralized treatment are being implemented throughout the U.S. and other nations, continued use of centralized treatment facilities is recommended in San Francisco because of economies of scale, the complex logistics for operation and maintenance, significant
permitting difficulties, and the higher energy use and greenhouse gas emissions of a decentralized system.

Constructing and operating small-scale plants is not an uncommon practice in sprawling suburbs, but it is not a common practice for fully urbanized cities (i.e., New York City, Chicago, etc). Building and operating up to a total of 200 plants in a dense urban area poses significant challenges. The majority of the City’s neighborhoods are built out and finding and acquiring feasible treatment sites would be very difficult even with the most compact treatment processes. Even with full automation, the monitoring, troubleshooting, and maintenance of these facilities would require a large qualified staff. Each plant would be considered a wastewater treatment/water reclamation facility and would be regulated by health and environmental agencies. Water quality monitoring of up to 200 plants for regulatory compliance would require a hundred-fold increase in laboratory analyses as compared to existing treatment plant requirements.

New piping systems would need to be constructed throughout the city, if effluent discharge or sludge transport is necessary. Sludge pumping from these plants to a centralized solids handling facility would also be a highly complex and energy-intensive operation. In addition, resources would still be needed to operate and maintain the solids handling and wet-weather facilities on the current scale.

The decentralized scheme would be a departure from the economies of scale. The construction cost for each 1-mgd plant could be between $10 million and $50 million, depending on site conditions. This would put the total construction cost in the range of $2 billion to $10 billion. The operating and maintenance costs for this many plants with compact, energy-intensive processes would also be much higher (probably an order of magnitude) than for centralized treatment.

By departing from the economies of scale and adopting compact treatment technologies, the decentralization scheme would consume more energy and other resources as compared to the existing system. As a result, it would also increase greenhouse gas emissions.

There are opportunities to shift the distribution of flow between the two centralized facilities or recommission out-of-service facilities for dry-weather treatment that will be considered in continuing planning efforts. Future planning efforts will also evaluate decentralized local facilities to address local recycled water needs and localized stormwater management.

Key considerations for not considering further a scheme for decentralizing the City’s wastewater treatment for the purpose of replacing centralized plants were:

- estimated construction cost of $2 billion to $10 billion and very high operating and maintenance costs;
- no prior experience of such an operating scheme;
- highly complex logistics for operation and maintenance;
- significant permitting and water quality monitoring requirements; and
- much greater energy use and greenhouse gas emissions.

Elimination of Bay Discharges

Should all current distribution of discharge of treated effluents and combined sewer discharges (CSDs) be realigned so that the entire sewer system discharges to the ocean? Modeling has shown that, if all discharges were directed to the ocean, Citywide peak wet-weather flows would exceed the SWO ca-
capacity and therefore would require the construction of a second ocean outfall. The continued discharge of wet-weather effluent to the bay is therefore recommended, although conveyance of the SEP dry-weather effluents to the SWO and elimination of the Southeast Bay Outfall dry-weather discharge was considered a feasible option. As a variant, part or all of the SEP treatment could be relocated to the west side of the City (most likely to the OSP site), depending on site availability. Bayside wet-weather discharges can be reduced by implementing stormwater harvesting and LID elements.

The main impetus for eliminating Bay discharges would be regulatory driving forces regarding specific constituents (e.g., ammonia loading) that may be determined in the future to have a deleterious impact on the San Francisco Bay ecosystem. Even though bay water quality has improved dramatically since the implementation of wastewater treatment and the Clean Water Act, the Central and Lower San Francisco Bay are currently listed by the U.S. EPA as impaired for a number of organic and inorganic pollutants, as well as exotic species and sediment toxicity. In future NPDES bayside permits, discharge standards may become more stringent, requiring the application of advanced treatment technologies to ensure effluent compliance. Alternatively, some or all of the bayside flows could be diverted to the existing SWO for ocean discharge, thereby reducing or eliminating dry-weather and wet-weather bayside discharge.

To eliminate the bay deepwater discharges through the existing Southeast Bay Outfall and North Point Outfalls treated dry- and wet-weather effluents from the SEP and North Point Wet-Weather Facility would need to be conveyed to the SWO for discharge. A second option would be to locate part or all of the bayside treatment capacities at an expanded OSP. Bayside wastewater would then be diverted to the OSP, through a conveyance structure, for treatment and discharge through the SWO. For either option, the current SWO maximum discharge flow would be increased by 400 mgd (the sum of the SEP and the NPF capacities) to 575 mgd.

Construction of conveyance structures across the city would be highly disruptive to the public. Additionally, ratepayers would have to take up the burden of financing this costly project. Construction of the conveyance and/or treatment facility would be very costly. The scenario of eliminating bayside CSDs would be even more expensive, as upgrades throughout the bayside wet-weather system and even to the SWO would be required. All of these upgrades would take more than 10 years to implement and would cost ratepayers billions of dollars. Energy consumption would be greater than the current operating scheme, especially for wet weather, since part of the bayside flow would be pumped multiple times before eventually discharging through the SWO. The OSP effluent, currently discharged by gravity to the SWO, would also need to be pumped during wet weather due to the elevation of the hydraulic grade line.

It should be cautioned that, although the regulatory risks for ocean discharge are relatively low, a proposal to increase the quantity of SWO discharge could also attract regulatory and public scrutiny, especially with respect to impacts to the Monterey Bay National Marine Sanctuary. The public may also perceive the strategy negatively, that the problems (discharge of pollutants) are only being moved elsewhere rather than being resolved (removed by treatment). Finally, there are opinions in the environmental/conservation field that the historic flow patterns to the receiving waters (bay and ocean) should be preserved and not be shifted from one to another, in order to retain the hydrological and habitat conditions.

The scenario of redirecting all bay discharge to SWO was considered infeasible as it contains several fatal flaws. Key considerations in coming to this conclusion included:

- peak wet-weather flows exceeding SWO capacity, requiring an additional ocean outfall;
- bayside CSDs would not be completely eliminated, unless another outfall is built; and
associated wet-weather system upgrades would require very high estimated construction costs.

Also, eliminating wet-weather discharge at the North Point Outfalls would have fairly low feasibility for the following reasons:
- difficulty constructing a 150-mgd conveyance alignment from the North Point Wet-Weather Facility to the westside;
- pumping discharge to the westside would consume excessive energy; and
- significant investment would be required in a conveyance facility that would only be used 200 to 500 hours per year.

Relocation of Bayside Flows from the SEP

*Should the current configuration of bayside treatment facilities be altered to either completely eliminate facilities at 750 Phelps Street or reduce the volume of flow treated at this location?* A decision on the reconstruction or relocation of the liquid treatment facilities is premature, because it is at least 20 or more years before the SEP facilities are at the end of their useful life and would need to be replaced. Relocating the SEP facilities now would not maximize useful life on infrastructure invested in by the ratepayers. A more prudent use of limited funds would be to make significant investment in odor control and architectural and landscape improvements to minimize or eliminate the impacts of the treatment facility on the local community and to allocate current resources to be focused on the impending critical needs — the aging and failing infrastructure of the collection system and failing biosolids digester facility. In the future, when the SEP facility does need to be replaced, the system configuration would be evaluated and changed, as needed.
## Glossary of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>City</td>
<td>City and County of San Francisco</td>
</tr>
<tr>
<td>CSD</td>
<td>Combined Sewer Discharge</td>
</tr>
<tr>
<td>CSO</td>
<td>Combined Sewer Overflow</td>
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<tr>
<td>MG</td>
<td>Million Gallons</td>
</tr>
<tr>
<td>mgd</td>
<td>Million Gallons per Day</td>
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<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
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<td>NPF</td>
<td>North Point Wet-Weather Facility</td>
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<td>O&amp;M</td>
<td>Operations and Maintenance</td>
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<td>OSP</td>
<td>Oceanside Water Pollution Control Plant</td>
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<td>Renewal and Replacement</td>
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<td>Regional Water Quality Control Board</td>
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<td>SEP</td>
<td>Southeast Water Pollution Control Plant</td>
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<td>San Francisco Public Utilities Commission</td>
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<td>Sewer System Improvement Program</td>
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<td>SSMP</td>
<td>Sewer System Master Plan</td>
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<td>TAC</td>
<td>Technical Advisory Committee</td>
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<td>SWO</td>
<td>Southwest Ocean Outfall</td>
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<td>TI/YBI</td>
<td>Treasure Island/Yerba Buena Island</td>
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<td>T/S</td>
<td>Transport/Storage Structures</td>
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<tr>
<td>U.S. EPA</td>
<td>United Stated Environmental Protection Agency</td>
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<tr>
<td>WWE</td>
<td>Wastewater Enterprise</td>
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