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## Abbreviations

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>CAC</td>
<td>Citizens’ Advisory Committee</td>
</tr>
<tr>
<td>City</td>
<td>City and County of San Francisco</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon Dioxide</td>
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<tr>
<td>CSD</td>
<td>Combined Sewer Discharge</td>
</tr>
<tr>
<td>CSO</td>
<td>Combined Sewer Overflow</td>
</tr>
<tr>
<td>DDT</td>
<td>Dichlorodiphenyltrichloroethane</td>
</tr>
<tr>
<td>EDCs</td>
<td>Endocrine Disrupting Compounds</td>
</tr>
<tr>
<td>GHGs</td>
<td>Greenhouse Gases</td>
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<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
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<tr>
<td>LID</td>
<td>Low Impact Development</td>
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<tr>
<td>MG</td>
<td>Million Gallons</td>
</tr>
<tr>
<td>mgd</td>
<td>Million Gallons per Day</td>
</tr>
<tr>
<td>MLLW</td>
<td>Mean Lower Low Water</td>
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<tr>
<td>N₂O</td>
<td>Nitrogen Dioxide</td>
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<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
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<tr>
<td>NPF</td>
<td>North Point Wet-Weather Facility</td>
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<tr>
<td>NPOs</td>
<td>North Point Bay Outfalls</td>
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<tr>
<td>OSP</td>
<td>Oceanside Water Pollution Control Plant</td>
</tr>
<tr>
<td>PCBs</td>
<td>Polychlorinated Biphenyls</td>
</tr>
<tr>
<td>PDO</td>
<td>Pacific Decadal Oscillation</td>
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<tr>
<td>PM</td>
<td>Particulate Matter</td>
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<td>R&amp;R</td>
<td>Renewal and Replacement</td>
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<tr>
<td>RWQCB</td>
<td>Regional Water Quality Control Board</td>
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<tr>
<td>SEO</td>
<td>Southeast Bay Outfall</td>
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<tr>
<td>SEP</td>
<td>Southeast Water Pollution Control Plant</td>
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<tr>
<td>SFPUC</td>
<td>San Francisco Public Utilities Commission</td>
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<tr>
<td>SPUR</td>
<td>San Francisco Planning and Urban Research Association</td>
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<tr>
<td>SSIP</td>
<td>Sewer System Improvement Program</td>
</tr>
<tr>
<td>SSMP</td>
<td>Sewer System Master Plan</td>
</tr>
<tr>
<td>SWALE</td>
<td>Sustainable Watershed Alliance</td>
</tr>
<tr>
<td>SWO</td>
<td>Southwest Ocean Outfall</td>
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<tr>
<td>TAC</td>
<td>Technical Advisory Committee</td>
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<tr>
<td>TI</td>
<td>Treasure Island</td>
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<tr>
<td>TRC</td>
<td>Technical Review Committee</td>
</tr>
<tr>
<td>T/S</td>
<td>Transport/Storage</td>
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<tr>
<td>U.S. EPA</td>
<td>United Stated Environmental Protection Agency</td>
</tr>
<tr>
<td>UV</td>
<td>Ultraviolet Radiation</td>
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<tr>
<td>VOCs</td>
<td>Volatile Organic Compounds</td>
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<tr>
<td>WWE</td>
<td>Wastewater Enterprise</td>
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<tr>
<td>YBI</td>
<td>Yerba Buena Island</td>
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Executive Summary

The Sewer System Master Plan (SSMP) was developed to analyze the current and future needs of sewer system of the City of San Francisco. The SSMP is based on a collective vision of how to improve the sustainability of the sewer system and to implement an Integrated Urban Watershed Management approach that encompasses land management, development, and transport aspects of urban planning.

The three overarching themes for the SSMP are:
1. To be consistent with the San Francisco Public Utilities Commission mission, and specifically the Wastewater Enterprise purpose that is to protect the public health and the environment by managing San Francisco’s wastewater, stormwater, and biosolids safely and cost-effectively.
2. To achieve long-term sustainable sewer system operations as evaluated and defined by consideration of engineering, social, environmental, and economic criteria.
3. To implement a systematic approach to planning and managing the sewer system watershed as an integrated whole (i.e., Integrated Urban Watershed Management).
The SSMP originated after the proposed bond request in 2001 for wastewater capital improvements was withdrawn. The public requested that the 2001 bond capital improvements be presented in the broader context of how to improve the management of the sewer system citywide.

This SSMP was initiated in 2005, and public input was received through meetings, home mailings, and the SFPUC Web site. The public offered suggestions and acted as a sounding board throughout the process to encourage the SSMP team to look at how the wastewater system was managed. The public has been a steadfast critic and supporter.

Sewer System Master Plan Evolution

The San Francisco wastewater collection and treatment system has been developed over the past 110 years. It is a major financial investment in infrastructure, and provides multiple benefits. However, these facilities have been underfunded over the preceding decade or more. If no additional money is invested in the collection system, over 75% of the system will be over 100 years old by 2030. As the service life of sewers exceeds 100 years, the rate of failure is more imminent, and may result in failure rates many orders of magnitude higher than the current rate. If
failure rates continue to increase, the public will be impacted by an increasing number of sinkholes in city streets.

The three treatment plants also face the possibility of significant failure due to aging infrastructure. The Southeast Water Pollution Control Plant digesters are roughly 60 years old and use antiquated treatment processes, which make maintenance labor intensive; one of the digester roofs collapsed in 1996 and the digester is no longer functional. Structural failures could inhibit the ability of the SFPUC to meet the current biosolids regulatory requirements and impact San Francisco’s future ability to dispose of San Francisco biosolids in the marketplace.

These significant infrastructure issues demand that the City invest in a renewal and replacement program. The U. S. Environmental Protection Agency (U.S. EPA) estimates that the nation must invest around $390 billion over the next 20 years to replace existing wastewater systems and build new ones, as many systems have reached the end of their useful life. In the 2005 Infrastructure Report Card, U.S. wastewater systems are given a grade of D-, and it is noted that in less than a generation from now, the United States could have a poorer overall wastewater collection and treatment infrastructure than existed before the 1972 Clean Water Act (Association of Civil Engineers, 2005). The SFPUC Wastewater Enterprise is not alone or unique in the number or type of current and future challenges that must be addressed to maintain and upgrade the City’s sewer system infrastructure.

This Master Plan proposes a long-term direction for the next 20 years. A formal planning process assessed the need for redirection and investment in the existing system to accommodate planned growth, meet anticipated regulatory requirements, identify repair and replacement needs, and develop innovative ways to improve service and reduce costs of the existing wastewater treatment and conveyance facilities. The last systemwide Master Plan was completed in 1974.

Planning Period and Forecast

Projections to 2030 were made to determine future population, flows, and loads based on (1) population information provided by the Association of Bay Area Governments and accepted by San Francisco’s Planning Department; (2) flows projected by the San Francisco Water Department based on water usage within the city; and (3) flows projected by the outside agencies that are discharging into San Francisco’s sewer system based on agreements made with the U.S. EPA during the grant programs of the 1970s and 1980s.

Challenges

Many elements of the system, though currently functional, are reaching the end of their useful life and must be replaced or repaired to maintain a high level of service and meet the SFPUC’s objectives. Considerable opportunities exist to address and achieve sewer system objectives through innovative and sustainable means and methods. The following challenges must be addressed:

- Increased need for investment in repair and replacement of aging and unreliable infrastructure
- Increased concern of seismic risks to sewer system integrity
- Localized flooding caused by subsidence in fill areas and new development in low-lying areas
- Climate change impacts, especially sea level rise and changing rainfall patterns
- Increased public sensitivity to negative community impacts of the sewer system facilities
- Increased residential development in industrial areas
- Increased operations and maintenance costs
- Increased scarcity of water and the need to pursue potable water offsets
• More stringent restrictions for Class B biosolids at reuse sites
• Development of new cost-effective and sustainable technologies

Recommendations to Address Immediate Needs

The recommendations described in this report presents a vision for sustainable sewer system management that both outlines corrective measures to address critical near-term needs and defines a roadmap for sustaining the vital services of wastewater management for the City of San Francisco. The SSMP establishes a new direction for the SFPUC that balances the required system performance with social, economic, and environmental priorities. The recommendations of this report are designed to integrate and improve the City’s sewer system for the 21st century.

The SSMP report is a culmination of the work that focused on the San Francisco sewer system to determine what was working, what was not working, and what could be done better. The recommendations from the master planning effort are broad and identify a way forward to address immediate system needs. The Master Plan also addresses future considerations.

The recommendations for addressing the immediate system needs are detailed below.

Integrated Urban Watershed Management

Specific programs and policies should be developed across department lines that will support the Integrated Urban Watershed Management program, based on the total watershed, to integrate absorption and reuse of stormwater into the urban setting.

Aging Collection System

• It is recommended that the aging sewers replacement program be brought into line with prudent practice, which is to replace the sewers on a 100-year cycle. The current replacement cycle is about 240 years. It is proposed that an accelerated replacement program be implemented to bring the system into compliance over the next 30 years.
• In conjunction with the SFPUC sewer replacement program, it is recommended that a side sewer policy be developed to delineate the responsibility between the City and homeowner.

Aging Treatment Systems

• An asset management program for all three treatment facilities is recommended to determine the condition and risk of failure for all facility components. Much of the aging equipment, similar to the aging sewers, is in need of replacement. The Federal Register 40 CFR Chapter 1 has the following guidelines for useful life: Structures - 40 to 60 years; Mechanical Equipment - 15 to 25 years; Electrical Equipment - 10 to 25 years; and Outfalls - 50 to 100 years. While most of the liquid treatment structures at the Southeast Water Pollution Control Plant (SEP) have an expected life remaining of 20 to 30 years, much of the equipment (e.g., the secondary clarifiers mechanisms) is in need of replacement.
• The single largest aging infrastructure in need of replacement is the solids handling facilities and digesters at the SEP. The digesters went into service in the early 1950’s and have been in continuous service for 60 years.
• In conjunction with the replacement of the SEP digesters, it is recommended that treatment improvements of the solids be made to meet the U.S. EPA Class A requirements, and that market studies and continuous adaptation strategies be developed for reuse of the solids.
• All offshore deepwater outfalls need to be inspected, cleaned, and repaired.

Flood Reduction

• Sewer system flood control projects are needed throughout the city, and should be developed for each watershed. The flood
control projects provide a great opportunity to incorporate low impact development (LID) projects. Flood control projects in the low-lying fill areas of the city (e.g. south of Market Street) need to consider pump station solutions and include sea level rise over the life of the project when considering the effectiveness of the solution.

- Develop and implement LID projects and policies to further the goal of stormwater management, reduction, and reuse. This effort will involve developing a project review and cost-to-benefit analysis of all sewer pipe projects to include LID.
- Policies are needed in relation to sewer system flood control in areas that may be subject to flooding simply because the street grade is not in conformance with the City’s "official grade."
- Funding and contracts/staffing for sewer cleaning need to be sustained to maintain sewer system capacity.
- The subdivision regulations need to be revised to consider design guidelines that are applicable across the city and take into consideration sea level rise and potential changes in precipitation patterns.
- The 29 bayside combined sewer discharge (CSD) structures need to be retrofitted in the near term with backflow prevention devices to prevent the occasional intrusion of bay water into the sewer system due to high tides and ongoing sea level rise.

**Seismic Safety**

- One specific recommendation is to provide redundancy to the Channel Force Main. The current recommendation is to build a tunnel between the existing Channel Transport/Storage System and the Islais Creek Transport/Storage System. The tunnel will be less likely to be damaged in a seismic event, will provide a lower energy conveyance system for all flows, and will provide storage that will further reduce overflows to the bay.
- The condition of all pump stations and force mains need to be evaluated for reliability and redundancy. Consideration should be made to provide seismically improved redundant force mains and connections.
Odor Control

- All of the wastewater facilities need to have improvements with respect to odor control.
- The improvements include structural improvements such as vents on the collection system and covers, ventilation, and treatment at the treatment plants. Some of the solutions may involve chemical addition. All of the solutions require constant monitoring and maintenance.

Water Reuse

- It is recommended that the WWE work with the Water Enterprise in the development of water reclamation projects.
- It is proposed to look for opportunities to develop water reclamation facilities on the bay side that are distributed, such that the source of wastewater and the recycled water demand are sited together with due consideration of the sustainability criteria.

Internal Direction

Future Sustainability — All capital projects need to be evaluated through a sustainability matrix that includes the triple bottom line of environmental, social, and economic considerations. To be effective all air, land, and water impacts must be considered in the matrix. Ideally, the level of treatment chosen must not cause degradation of the whole environment.

Environmental Justice — It is recommended that all implemented projects are fair to people of all races, cultures, and incomes, and that no group bears a disproportionate share of negative environmental consequences resulting from the operation, programs, and/or policies of the SFPUC.

Asset Management — Develop and implement an asset management program across the WWE. The asset management program will combine condition assessment and risk of failure analysis to help prioritize specific projects. This program is especially important to the collection system. If no investment is made to repair or replace the aging sewers, then a third of them could fail as early as 2030, substantially increasing the number of sinkholes that will also need repair.

Budget Reporting — It is recommended that the WWE budget be realigned around the Enterprise’s objectives. This realignment would make it possible to better benchmark the actual costs to achieve the necessary treatment, as required by the State and Federal regulators. Currently, the budget is aligned around the divisions and not tracked well by function.
Recommendations for Future Considerations

Because regulatory and facility design and implementation activities require a considerable lead time, it is important to plan for the future in a formal methodical fashion. The next planning effort for the sewer system should begin well before 2030. Many future issues of concern were considered in the development of the SSMP recommendations and are reviewed below.

**Issues resulting from sea level rise due to climate change** — Based on current projections, sea level rise may reach 55 inches by 2100. At that rate, by as early as 2030, it is expected that the bayside CSD structures will begin to have bay water above the overflow weir elevations on a daily basis. This means there will be increased localized flooding near the CSD structures during storms. The seven westside CSD weirs will still be above the estimated sea level rise by 2100, but the shoreline will be subject to more erosion if not protected. It is anticipated that before 2030, planning should be undertaken for projects to pump down the sewer hydraulic grade line to prevent flooding throughout the bay side.

**Issues resulting from increasing rainfall due to climate change** — It is predicted that rainfall intensity may increase. Unlike sea level rise, which has been documented to be rising continuously over the last 150 years, there is no such clear documentation for rainfall intensity. Since the projection for change in rainfall needs more study, consideration should be made for the possible change in rainfall patterns and intensity in future design guides.

**The SEP and the bay outfalls will be near the end of their useful life after 2030** — Plans and funding will be needed to address the needs of these facilities. Because the SEP will need major rehabilitation in the 2030 time frame, studies must be undertaken before that time to assess feasible options. It is expected that changes in technology will occur that may change the solutions from what might be done today.

**Regulatory issues need to be monitored continuously** — Changes in regulatory requirements and technologies should be addressed as they develop. It is not known at this time what specific change may occur. Thus, the City needs to be flexible and adaptive.

**Sewer System Improvement Program**

The Sewer System Improvement Program (SSIP) is a capital improvement plan that will be developed to implement the project recommendations. The development of the SSIP is the next phase in providing more specific definition of the projects, the first phase being the SSMP Report.

Changes to the policies and operation and maintenance budgets including the renewal and replacement program budgets will need to be developed in addition to the SSIP.