SANITARY SEWER SYSTEM REPORT

JANUARY 2010
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GENERAL INFORMATION

The City provides sewer services for the residents and businesses. The City owns and operates the sewer collection system consisting of approximately 2,200 miles of sanitary sewer mains (which vary in size from 6 inches to 90 inches in diameter), including 10 miles of force mains, 15 pump stations, 45,000 manholes and over 202,000 laterals. The collected wastewater is conveyed to the City’s Water Pollution Control Plant (Plant) by major interceptor pipelines located in the northern part of San Jose.

Figure 1
I. Current Vision/Strategy

The City’s sanitary sewer collection system benefits from the generally uniform topography of the Santa Clara Valley which allows the majority of the waste water flows to be conveyed to the Plant using gravity sewer lines with minimal use of lift stations and force mains.

Increasing regulatory oversight of both the storm and sanitary sewer systems, including the Plant, will bring new challenges to divert urban runoff to the sanitary system rather than allow those flows to enter the creeks and rivers. Current discussions may lead to the modification of five storm water pump stations in North San Jose to allow the diversion of some or all of the summer infiltration and “first flush” flows to the treatment plant via the sanitary collection system. In addition, the collection system will be considered as part of the Plant’s Non Pollution Discharge Elimination System (NPDES) permit in the near future.

Minimizing sanitary sewer overflows (SSO) and supporting economic development are both well served by the active management and planning of the collection system through the use of condition and capacity management programs and strategies. Including sustainable design, green technologies and best management practices further enhances the collection systems ability to serve South Bay residents and businesses.

The standard design life of sanitary sewers is commonly believed to approximately 100 years. Eighty-two percent of the system, approximately 1,750 miles, was constructed between 1950 and 1979 (between 27 and 57 years old). Thus, a significant portion of system has reached or will reach the 100-year age milestone within the next fifty years. At this point it is unclear as to whether the sewers will trigger a significant increase in replacement costs in the near future, or continue to operate well beyond the 50 year design life.

Moreover, majority of the collection system (80%) is made up of small (6 and 8 inch) diameter sewers which are believed to be the source of the majority of the SSOs. For these reasons, staff is proposing a comprehensive study to analyze and predict the condition of the sewer system.
II. Major Areas of Focus

1. System Management and Planning

   a) Capacity Management

   Sanitary sewer collection systems are designed to handle up to peak daily flows, based on current and predicted/planned future demands. Standard for design capacity is generally peak daily flows that are approximately 2.5 times the average daily flows. Due to unforeseen increase in demands/flows or unavailable sufficient data at the time of the design of an original system, there are capacity deficiencies throughout the system. Capacity is also decreased due to operational problems such as sedimentation buildup, oil and grease buildup.

   In order to prepare a comprehensive capacity improvement program, a sanitary sewer master plan is needed. Staff has recently completed master plans for the North, Central, and South portions of the City. The total cost estimated for the 37 capacity improvement projects in this first phase master plan was $104 million (in 2004 dollars). Due to funding limitation, only eight high priority (first two priority groups) projects were programmed into the 2009-2013 Capital Improvement Program. The rest of the recommended projects will be considered in the future Capital Improvement Program when funding becomes available.

   The master plan preparations for the remaining East and West portions are currently in progress, with estimated completion at the end of 2010.

   Compounding these problems is the issue of system expansion. As the City expands the collection system through development, on average about 50 miles per year, the workload grows while the resources to address the expanding maintenance demand have not increased.

   During the FY 08-09, over 80 sites have been monitored for dry- and wet-weather flow data. Over 500 sanitary sewer manhole elevations have been surveyed to develop network models/scenarios based on the City’s Geographic Information System, City’s land-use, water consumption, flow data, etc.

   b) Asset Management

      i. Collection System:

      The City of San Jose’s sanitary sewer collection system consists of approximately 11.9 million feet (2,200 miles) of pipe ranging from 6 to 90-
inches in diameter. The first documented sewer construction dates back to the 1890s with the Main Outlet Sewer also known as the 60-Inch Brick sewer. Approximately 72% of the existing system was constructed within the 25-year period between 1956-1980. Therefore, a majority of the system is between 30-55 years old. The distribution of the City’s sanitary sewer age is shown in Chart 1.

![Current System Age](image)

Chart 1

A crude but straightforward approach for a replacement and/or rehabilitation program is to replace/rehab sewers on or prior to their expected design life. Quite simply, using a typical design life of 100 years, every sewer in the system should be replaced/rehabilitated every 100 years. Applying this approach, the City would need to replace/rehabilitate an average of 1% or approximately 119,000 feet of sewer per year.

As indicated in Chart 2, the majority of the system will be 100 years or older by 2070. The City’s current replace/rehabilitate rate is approximately 30,000 feet per year. This rate will only be able to address sewers prior to reaching the end of their design lifespan up to 2055. At this point, the rate of sewers aging beyond their design lifespan far exceeds the rate of replacement/rehabilitation.

Implementing an annual program which replaces/rehabilitates 1% (119,000 feet) of the system will be adequate to address the majority sewers prior to the end of their design lifespan. Due to the surge of sewers installed between 1956-1980 about 10% will be between 100-120 years old before being replaced or rehabilitated.
Utilizing a composite rate for replacement/rehabilitation of $300 per linear foot, approximately $36M would be required to replace/rehabilitate 1% of the system on an annual basis.

This analysis is solely based on the age of the sewers and can be considered as a “just replace it before it gets too old” asset management approach. However, there are other significant factors which need to be factored into a replacement/rehabilitation program. These factors including, pipe material, diameter, criticality, depth and location, in addition to age will be considered by the Condition Assessment program which was initiated in Fiscal Year 2008-2009.

ii.) Pump Stations and Odor Control Facilities:

The average age of the City’s 18 sanitary sewer pump and odor control stations is over 35 years. These facilities are listed in Table 1 and with their respective locations shown on Figure 2. The standard for the design life of the mechanical and electrical components of a pump station is 10 to 25 years. It is reasonable to expect that a pump station be rehabilitated with new pumps, motors and control systems every 25 years. The City currently has 8 stations that are beyond this limit without significant rehabilitation, or funding for rehabilitation. The total cost to rehabilitate and/or replace these pump stations can be ranged between $5 million-$10 million. The Department of Transportation (DOT), which operates and maintains the collection system including pump stations, is preparing a prioritized list of sanitary pump stations should funding for rehabilitation become available.
<table>
<thead>
<tr>
<th>Name</th>
<th>Year Built</th>
<th>Year Rehabilitated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basking Ridge</td>
<td>2006</td>
<td></td>
</tr>
<tr>
<td>Communication Hill</td>
<td>2007</td>
<td></td>
</tr>
<tr>
<td>Gateway</td>
<td>1988</td>
<td></td>
</tr>
<tr>
<td>Junction</td>
<td>1979</td>
<td></td>
</tr>
<tr>
<td>Lamplighter</td>
<td>1984</td>
<td></td>
</tr>
<tr>
<td>Margaret</td>
<td>1952</td>
<td></td>
</tr>
<tr>
<td>Montague</td>
<td>1976</td>
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</tr>
<tr>
<td>Nordale</td>
<td>1960</td>
<td></td>
</tr>
<tr>
<td>Nortech</td>
<td>1983</td>
<td></td>
</tr>
<tr>
<td>Riddle Park</td>
<td>1982</td>
<td></td>
</tr>
<tr>
<td>San Felipe</td>
<td>1989</td>
<td></td>
</tr>
<tr>
<td>Spreckles</td>
<td>1975</td>
<td></td>
</tr>
<tr>
<td>Tea Garden</td>
<td>1986</td>
<td>1997</td>
</tr>
<tr>
<td>Zoo</td>
<td>1967</td>
<td></td>
</tr>
<tr>
<td>Willow</td>
<td>2003</td>
<td></td>
</tr>
<tr>
<td>Canoas Ferrous</td>
<td>1962</td>
<td>2009</td>
</tr>
<tr>
<td>Chloride Injection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canoas Soil Bed Filter</td>
<td>1994</td>
<td></td>
</tr>
<tr>
<td>Zanker Soil Bed Filter</td>
<td>1995</td>
<td></td>
</tr>
</tbody>
</table>
c) **Condition Assessment**

Formal condition assessment program is needed to address the structural integrity of pipes, force mains, manholes, junction structures and pump stations. Evaluating the physical condition of a sanitary sewer requires closed circuit television work followed by office analysis and documentation. Because it is physically and financially impractical to perform a comprehensive video review of the entire system, the City’s current practice of assessment are limited to those that are generated from deficiencies found in the operational characteristics, capacity problems and/or based on staff’s historical knowledge.
Department of Public Work (DPW) is in the process of initiating a pilot Sanitary Sewer Condition Assessment (SSCA) program which will allow the collection of sample information related to the physical condition of our pipelines. Data will be reviewed, analyzed, and ranked based on a risk analysis approach utilizing information such as the pipe size, location, design flow, and physical conditions. As a result, rehabilitation budgets and preventive maintenance and improvement programs can be planned and prioritized.

In addition, a SSCA program will allow the City to identify and quantify any capacity or conveyance losses due to the system’s physical condition. It will allow staff to identify illegal or inactive sanitary connections, which result in additional flows to the Plant, as well as sources of grit and fat, oil and grease contributing to the system.

Television inspection by utilizing closed circuit TV (CCTV) of the sewers is the first step to obtain data of the conditions of the system. Based on a recent bid of $1.50 per linear foot of pipe to be inspected, an annual budget of $2 million will be needed to completely inspect the collections system in 10 years or $4 million per year for a 5-year inspection program.

d) Integration with Plant

With the recent completion of the 60-inch IB and Fourth Major Interceptor Phase V/VA projects the interceptor system between the Plant and US Highway 101 is considered fully built. This system conveys approximately 80% of the sewage treated at the Plant on a daily basis. With a replacement value of over $200M it is of utmost importance to maintain and operate this system in the most efficient manner as possible.

One of the major components anticipated is a systematic plan and procedure to flush the interceptor system, shown in Figure 3, on an annual basis. This annual flushing will remove grease/settled solids and restore the system to its design capacity. Performing this operation on an annual basis under a controlled environment will prevent the Plant from becoming inundated with grease and solids during the first heavy rain event each season.
e) Tributary Agency Coordination

The City’s interceptor system and some main pipelines (trunk) are jointly used by City of Santa Clara, West Valley Sanitation District, County Sanitation District 2-3, Cupertino Sanitation District, and Burbank Sanitation Districts. These agencies, shown in Figure 4, have entered into agreements with the City to share portion of the cost for maintenance, operation, and replacement for the use of the sewer lines based on their sewer capacity discharge.

The cost sharing agreement with West Valley Sanitation District was updated in 2002 and remain active until 2020. Staff is in the process of updating the remainder of the agreements. As pockets of areas become annexed to the City, staff is facing the challenges of updating the system base map, agreements and costs to bring the collection system up to par with the City’s standards.
f) **Base Map Accuracy**

The DPW’s Geographic Information System (GIS) Section maintains GIS files of manholes, sewers, flushing inlets, pump stations and other sewer features in the collection system. The base map for publicly maintained sewer system coverage is mostly complete. However, about 30% of the pipe and manhole attribute data are not available due to missing construction records. For example, the Downtown San Jose area comprises a large portion of the
missing attribute data also because the assets were built more than 100 years ago.

Information regarding privately owned sewers is also being entered into the GIS database. These sewers are not maintained by the City, but their information is helpful for sewer master plan modeling purposes.

The current Master Plan (Phase II and Update) Study identified pipes and manholes with missing or “inaccurate” elevation data to be field investigated and surveyed. There will be an effort to incorporate verified data from the investigation and survey into the GIS database.

g) **SEWERINFO Decision Support System**

As vast information such as are video images of the sewers, flow monitoring data, maintenance histories are collected to support asset management, computerized modeling and database softwares are needed to store the data and to allow for efficient implementation of information processing and sharing between planning, engineering, operating and maintenance departments. A separate server dedicated to serve the aforementioned needs is anticipated as part of a new sewer decision support system called “SEWERINFO.”

SEWERINFO will combine a database repository, geographical analysis, data management, data visualization, auditing and manipulation, and reporting to provide a single environment that integrates multiple datasets and data sources to provide detailed and accurate analyses and reports. SEWERINFO will integrate GIS data, land-use and parcel information, general plan information, maintenance data, digital terrain model data, aerial photography, hydraulic modeling data, locations and elevations, CCTV inspection data, time-varying data, flow-monitoring data, smoke and dye test data, and multiple other datasets and data formats to provide a seamless backdrop to perform analysis and generate reports for needed sewer improvement. The architecture for the SEWERINFO process is shown below in Figure 5.

It is anticipated that the results of the analyses and the reports will be published on the City’s intranet through a one-stop information portal to provide up-to-date and relevant information about the City’s sanitary sewer infrastructure to engineers, GIS staff, and upper management across City departments. This will enable the City to make cost-effective decisions on how to allocate sewer resources prudently and improve service to its citizens.

A one-time cost to acquire server and associated hardware/software for SEWERINFO System is about $80,000.
On May 2, 2006, the State Water Board adopted Order No. 2006-0003 – Statewide General Waste Discharge Requirement for Sanitary Sewer Systems. The Order requires public sanitary sewer agencies to develop and implement a system-specific Sewer System Management Plan (SSMP) to provide proper and efficient management, operation, and maintenance of sanitary sewer systems to minimize SSO. Additionally, the SSMP must contain a spill response plan that established standard procedures for immediate response to an SSO.

To comply with the State Water Board’s requirements, DOT, in collaboration with DPW and Environmental Services Department (ESD) prepared the SSMP document, and the City Council approved the SSMP on August 13, 2008 for implementation.
2. **Support Economic Development**

   a) **Appropriate Rate and Fee Structures**

   The collection system revenues are primarily generated by the current users who pay a monthly rate of $31.00 per household to the Sewer Service and Use Charge. The other revenue source is the Sewer Connection Fee Fund which charges a one-time nominal fee to a new customer to be connected to the City’s system. In general, these fees are approximately $447 per lot for single-family unit or $1,991 per acre for multi-dwelling units.

   The City has been collecting sanitary connection fees since the 1950’s. Prior to the mid 1950’s, sewer construction was financed by the City’s general fund. In 1969, City Ordinance No. 14746 established separate connection fees for sanitary sewer and storm drainage to be paid by developers. In 1976, City Ordinance No. 18045 was approved requiring all developers, businesses, and individual property owners who applied for connection to the City’s sanitary and storm sewer systems to pay a sewage treatment plant (STP) fee in addition to the sanitary and storm connection fees.

   These aforementioned fees have not been updated since 1990s and are far behind what is necessary to support essential system capacity expansion for growth. In 2008, DPW, in coordination with ESD, conducted a study to review the Sanitary Sewer Connection and the STP fees to evaluate and develop methodologies for determining equitable connection fees for the aforementioned utilities. The results of the study are being outreach to the developer communities and will be brought forward to Council for approval in the near future.

   b) **Sewer Level of Service Policy**

   In June 1982, City Council adopted a Sanitary Sewer Level of Service Policy (“Policy”). The primary purpose of the Policy is to ensure that the City will not have sewage spills due to insufficient capacity in the collection system; and that there is adequate capacity in existing sewer mains before development occurs which could compromise the ability of the system.

   There are six levels of service (LOS) that are used to determine under what conditions new developments are allowed to connect to the existing sewer system. The LOS are defined based on comparison of flows to existing sewer capacity. However, there are ambiguities in the definitions of the LOS in the 1982 Policy, as well as inconsistencies with the City’s Sewer Capacity Impact Analysis. Efforts are underway to revise the LOS with input from the Master Plan work and development communities.
3. **Sustainability/Green Vision**

   a) **Inflow and Infiltration (I & I) Reduction Program**

   The I&I Reduction Program is another element of the Sanitary Sewer System Capital Improvement Program (CIP). This program is intended to rehabilitate portions of the sewer system where groundwater and other sources of water (besides sewage) enter the sewers. It is known that certain areas of the City are prone to I&I. Samples of infiltration are shown in Figure 6. The goal of the I&I Reduction Program is to decrease the flow to the Plant and help continue to meet the discharge flow cap. The program operates in conjunction with the Flow Monitoring Program to identify areas of the system that have substantial I&I, construct improvements to reduce I&I, then measure the reduction in flow following those improvements. Example of project funded by this program is the Downer Canoas Sanitary Sewer Rehabilitation Project which is estimated to be delivered at $4 million.

   ![Figure 6](image)

   b) **Fats/Roots/Oil/Greases (FROG)**

   Fats, roots, oils and greases are major contribution to wastewater collection system maintenance costs. FROG clogs the collection system causing SSOs, foul odor, failed pump stations and excessive accumulation at the treatment plant. Examples of FROG accumulations are shown in Figure 7. Pipe rehabilitation, which is managed by DPW, can reduce root intrusion. However, to efficiently manage the FOG element, currently under DOT and ESD managed programs, comprehensive education and outreach program in combination with strict regulation and enforcement is vital.
c) **Interceptor & Trunk Sewer Cleaning**

Currently, the City’s maintenance program does not include cleaning of large diameter (30-inch and above) sewers. During the construction of the one of the 84-inch interceptors located in northern San José (near the Plant) in December 2005, City Council approved a $760,000 change order to allow the contractor to perform massive diversion and cleaning of one of the four 84-inch diameter interceptors, removing about 850 tons of debris from the system by hydraulic scouring and manually removing debris from the interceptor.

A year later, DOT requested PW to administer a sewer cleaning contract to adequately address the potential sewer overflow and odor issues along the Downer Canoas Trunk line located in southern San José. The $750,000 project utilized a Sewer Hog/Grit Gator System shown in Figure 8 to remove the accumulation of debris is this trunk line. This process did not require a sewer by-pass and ultimately eliminated the 5 foot daily surcharge (sewage level above the crown of the pipe) to the depth of half a pipe full.
Cleaning large diameter sewers can be costly with cost ranging from $70-120 per linear foot of pipe. However, the cost is considered a worthy investment to prevent claims and/or lawsuits arising from sewer back-ups and overflows. It also minimizes the health hazards due to exposure to raw sewage.

d) Odor Control Stations

In 1982, a study was conducted on the City’s north interceptor system in response to odor complaints. The study recommended the City investigate causes and develop feasible methods to reduce odors emanating from these interceptors. The cause of the odors was primarily attributed to the release of hydrogen sulfide gas (H₂S) into the air at each of the five interceptor junction structures along Zanker Road between Freeways 101 and 237. The release of the odor was aggravated by the turbulent flow within the structures.

There are currently two odor abatement stations in the City utilizing soil bed filters, also known as biofilter: one is located at the IJS B, on Zanker Road, north of East Plumeria Drive and one is located on Curtner Avenue at Rt 87. The third odor treatment station located on Blossom Hill Road at Chesbro Avenue (Downer Canoas Ferrous Chloride Station) which interjects ferrous chloride into the sewer flow to reduce the odor. DOT currently maintains and operates these stations.

During 06-07 FY a pilot project was initiated to utilize hydrogen peroxide as a third method of odor abatement for the north interceptor system. It is a combination treatment that integrates iron salts with hydrogen peroxide (H₂O₂). Currently, the iron salt is added upstream by DOT at the Downer Canoas Ferrous Chloride Station. The injection of hydrogen peroxide into the sewer at a point downstream of ferrous chloride injection station will reactivate the ferrous chloride thus allowing for continued reduction of H₂S formation.

III. Current CIP Budget

1. Revenues
   - Fund 545 - Sewer Service and Use Charge (SS&UC) Fee is the primary funding source for the 2010-2014 Proposed Sanitary Sewer System CIP is For 2009-2010, the transfer of $17.225 million represents a $2.75 million increase from the annual transfer amount programmed in the 2010-2014 Adopted CIP. In the out-years of the proposed CIP, this transfer remains at the $14.475 million annually.

   The following is a summary of recent rate increases:

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<tbody>
<tr>
<td>Rate</td>
<td>4.5%</td>
<td>4.5%</td>
<td>4.5%</td>
<td>9.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
</tbody>
</table>
• **Fund 540 - Sanitary Sewer Connection Fees**: The Sanitary Sewer Connection Fee is charged for connecting to the City’s sewer system. The fees collected may only be used for the construction and reconstruction, including land acquisition, of the San José sanitary sewer system. The fee is based on the number of single and multi-family residential units built and the acres developed on commercial and industrial properties. The sanitary sewer connection fee was last evaluated in 1990 and therefore outdated in terms of construction costs and regulations. In June 2008 Council awarded a contract to Financial Consulting Services (FCS) Group, Inc., to evaluate and develop methodologies for determining equitable connection fees for Sanitary Sewer Connection Fee among other fees such as Storm Drainage and Sewer Treatment Plant (STP) fees. The study will bring forth recommendations to Council by the December, 2009.

• **Revenue trends**: As the development activities are projected to decrease throughout the 2009-2013 Proposed CIP, primarily due to the local housing slowdown, a corresponding overall decrease to Sanitary Sewer Connection Fee revenues are assumed. These revenues total $3.7 million in the 2010-2014 Proposed CIP, which represents an 11.2% decrease from the 2009-2013 Adopted CIP.

2. **Investments**

   a) **Capacity-enhancement projects** are selected by utilizing a computerized sewer flow model (which utilizes the San José 2020 General Plan to project sewage flows in the system), City maintenance records, and flow monitoring to identify sewer capacity constraints. Expenditures for capacity-enhancement projects total $67.5 million or 69% of the construction expenditure for the 2010-14 CIP.

   b) **Rehabilitation projects** are selected based on hydrogen sulfide studies (that analyze pipe corrosion), condition assessment studies, maintenance records and reports, and actual pipe failures, whether due to pipe corrosion or other physical deficiencies. The actual condition of candidate projects is verified by internal videotape inspections, which are then evaluated to establish project priorities. Expenditures for rehabilitation projects total $30 million over the next five years, or roughly, 31% of construction projects in the 2010-14 CIP.

3. **Resources**

   The Sanitary sewer Engineering Section of DPW, consists of five Capital Improvement teams and one Master Planning and Policy (MP&P) team. Typically, each team is lead by a Project Manager who leads a team of Project Engineer and Engineering Technicians. In addition, the MP&P team also consists
of a full-time GIS Specialist. Together, the Section composes of more than 50 years of experience with the City’s collection system.

CONCLUSION

As the population within the tributary area continues to increase the size of the collection system also increased. However, there is no correlation in increased maintenance activities to address the growth of the collection system. It is essential to monitor both the condition and capacity of the system in order to reduce SSO’s and support economic development.

Aligning with the outcome, “Reliable Utility Infrastructure” identified by the Environmental & Utility core service areas (CSA), the strategies for best-practiced management of the collection system focused in the following areas:

1. On-going performance of capacity to efficiently support economic development.
2. On-going performance of condition assessment of the system, focusing in smaller diameter pipes to reduce sanitary sewer overflows and back-up to residences and businesses.
3. Increased investments in rehabilitation/renewal of the aging system.
4. Increased investments in technologies to support asset management.