T&E AGENDA: 02-22-07
ITEM: 3

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

Memorandum

TO: TRANSPORTATION & ENVIRONMENT COMMITTEE

FROM: John Stufflebean
Katy Allen
Jim Helmer

SUBJECT: **SEE BELOW**

DATE: 02/08/07

Approved Date

SUBJECT: **REPORT ON WATER POLLUTION CONTROL SYSTEM INFRASTRUCTURE CONDITION**

RECOMMENDATION

Accept this staff report analyzing the infrastructure needs of the City's sewer collection and treatment system.

OUTCOME

Accepting this report will assist the Committee and Council with decision-making during the annual budget process concerning the most feasible methods for addressing infrastructure and financing needs of the City's sewerage system to ensure continued economic development along with protection of public health and the local ecosystem.

EXECUTIVE SUMMARY

The various elements comprising the City's wastewater collection and treatment systems, which include the sanitary sewers, pumping stations and the Water Pollution Control Plant (Plant) are on an average 30 to over 50 years old. The age and the harsh environment under which these systems operate have resulted in system-wide vulnerabilities and high risk conditions for possible failures that could result in sanitary sewer overflows and regulatory permit violations. Increases in operation and maintenance costs that have outpaced growth in sanitary sewer service and use charge (SSUC) and sewer connection fee revenues have compounded this issue. City of San José SSUC fees have remained flat for nearly a decade prior to 2004, and sewer connection fees have not increased in over 20 years. Both SSCU and sewer connection fees are currently among the lowest compared to other large wastewater utilities in the Bay Area and nationwide averages.

Recent third-party evaluations of the collection and the treatment system highlight the need for significantly increased capital and maintenance investments. Lack of sufficient funding, for example, has required the deferral of several critical projects including rehabilitation of the electrical distribution systems and replacement of digester gas mains at the Plant and rehabilitation of 34,000 feet of trunk sewers and rehabilitation of nine sewer pump stations that are currently in degraded condition. In addition, outdated sewer maintenance equipment is resulting in insufficient cleaning and maintenance of several miles of sewers, mostly in residential areas, heightening concerns about potential sanitary sewer overflows.

In addition to the challenges posed by the current condition of the infrastructure and inadequate maintenance programs, these systems are faced with increasing regulatory requirements that mandate additional resource allocations for operation and maintenance of the sanitary sewer collection and treatment systems. Environmental Services, Transportation, and Public Works are working collectively to address these additional needs and implement strategic programs such as improved maintenance programs, infrastructure management programs and equipment replacement programs. In addition, these three departments are working with the City Manager's Budget Office and other agencies that use the Plant in identifying revenue sources to fund these needs, including financing alternatives to minimize impacts on the rate payers.

BACKGROUND

The City's sewerage system consists of 2,200 miles of piping, 12 pumping stations and one of the largest, advanced wastewater treatment facilities in the nation. By safely collecting wastewater from homes and industry for treatment and appropriate discharge or re-use, this system protects public health and safeguards the local ecosystem – including the iconic San Francisco Bay – while simultaneously enabling the continued growth and development of local business and industry.

As the City grew rapidly at certain periods over the past 30 years, large investments were made in infrastructure improvements to serve an increased population and an economic base that changed from canneries to high-tech. As these assets approach the end of their 30- to 40-year life cycle, the need to replace, rehabilitate and upgrade segments of the system becomes critical. Over the next 10 years, both the Plant and the collection system will need to complete numerous large-scale capital projects in order to maintain and ensure high quality service to San José neighborhoods, residents and industry.

The Sewer Service and Use Charge (SSUC) Fund was established on July 20, 1959, by Ordinance #7308 to account for the City of San José's portion of sewer service and use charge revenues that are to be used for the acquisition, maintenance, replacement and operation of the City's sewerage system. The SSUC Fund is one of 16 funds that comprise the City's Wastewater Treatment System Enterprise and is the primary source of revenue for most of them. The major funds dependent upon revenue from the SSUC Fund include the San José-Santa Clara

Treatment Plant Capital and Operating Funds, the Sewer Service and Use Charge Capital Fund (for capital rehabilitation of the collection system by the Department of Public Works), and the appropriation within the SSUC Fund for the Department of Transportation's maintenance and administration of the collection system. These four funds represent 73% of total annual expenditures dependent upon the SSUC Fund.

The primary source of revenue to the SSUC Fund is the fees paid through property related assessments within the residential, commercial, and industrial sectors. Prior to 2004-2005, these fees had remained unchanged for 10 years. In the 2004-2005 Adopted Operating Budget, Council approved a three-year rate increase strategy of 4.5% annually, raising residential rates from $18.96 to $21.63 per month during this period.

For the past several years, however, the SSUC Fund has experienced flat or declining revenues due primarily to two factors. First, the downturn in the economy and accompanying reduction in residential development reduced the Fund's growth rate to below 0.5%. Secondly, and more significantly, industrial and commercial migration from the area has substantially reduced revenues from these sectors. Only with the rate increases over the past three fiscal years has the Fund been able to return to its revenue levels of 1998 (see Chart, Attachment A).

In addition to the SSUC Fund, capital projects for both the Plant and the sanitary sewer system are funded with revenue from connection fee funds. The revenue for both of these funds reflects the one-time fees paid by new customers to the system. These funds are intended primarily for the expansion and enhancement of both systems, but in the case of the Plant's connection fee fund, expenditures for reconstruction and debt service are included in the ordinance. Both of these funds have not received a rate increase in over twenty years and current revenues are inadequate to meet future demands.

As a result, fund balances throughout the Enterprise have been drawn down over the past several years to cover the revenue shortfall. With the use of fund balances to cover operating costs in the wastewater funds, reserves for major capital replacement have diminished to the point where a five-year CIP program cannot be sufficiently funded and critical projects have been deferred.

As highlighted in the March 2006 Annual Funds Management Report, these factors continue to threaten the long-term financial strength of the SSUC Fund. This limits the City's ability to aggressively address the capital rehabilitation needs for both the sanitary collection system and the Plant. As infrastructure ages and reinvestment is limited, maintenance resources are diverted away from preventive maintenance and towards the repair of asset failures (see Chart, Attachment B). Future deferral of capital rehabilitation projects or daily maintenance efforts will only diminish the abilities of Public Works, Transportation, and Environmental Services to achieve and maintain reasonable asset integrity.

ANALYSIS

San José-Santa Clara Water Pollution Control Plant Capital Needs

In 1959, the City of San José entered into an agreement with the City of Santa Clara to jointly own and operate the wastewater treatment facility as the San José/Santa Clara Water Pollution Control Plant to provide its customers with sanitary sewer service. Under the agreement, the City of San José serves as the administering agency and is responsible for operating and maintaining the Plant.

As stated earlier, the Plant is one of the largest and most complex advanced wastewater treatment facilities in the nation. During the past 50 years, nearly $1 Billion in today's dollars have been invested to transform the Plant from a basic primary level treatment facility to a state-of-the-art advanced treatment plant. In the Bay Area, only the three treatment plants operated by San José, Sunnyvale and Palo Alto are required to provide an advanced level of treatment, due to the shallowness of the receiving waters at the south end of San Francisco Bay. The others, including those serving San Francisco and Oakland, are required to provide only the first two levels of treatment – physical and biological. Our Plant also provides filtration, to achieve 99.9% purity before flows are either discharged to the Bay or to the recycled water distribution pipeline. As with many similar facilities, much of the advanced level enhancements were financed through Federal grants and low-interest loans in response to the Clean Water Act of the 1970s. As the majority of the Plant's infrastructure reaches and exceeds 30 years of service, critical aspects such as electrical distribution systems, concrete structures, pumps, motors, piping and valves need to be replaced or rehabilitated. With less Federal funding available, many similar facilities are finding that this reinvestment in infrastructure can only be accomplished with local funding.

The difficulty in maintaining aging infrastructure is experienced daily as both operations and maintenance personnel face the challenge of operating and repairing equipment and facilities that are failing and less efficient. This requires a much greater dedication of resources towards corrective action and away from basic operations and preventive maintenance. This cycle of aging infrastructure coupled with deferred maintenance also raises the overall risk of failure since certain critical elements, such as electrical distribution, can disrupt the entire treatment process should a major incident occur.

With this challenge becoming more evident and difficult to manage over the past several years, the Environmental Services Department acquired the professional engineering services of CH2M Hill for a third-party analysis of the Plant's current asset condition. This analysis was intended to be a high level look at the overall condition of the Plant and as well as a high level review of historic capital replacement and repair funding, and any associated funding gap. A summary of the CH2M Hill Findings and Recommendations follows.

Findings

- A current 5-year CIP backlog of $250 million worth of critical projects exists at the Plant.
- Many mechanical, electrical, and structural assets at the Plant are in poor condition due to age and wear.
- Potential seismic vulnerabilities were identified in some buildings and structures that require further evaluation.
- Compared to data published by the U.S. Environmental Agency and Congressional Budget Office, capital investments at the Plant have been significantly under funded over the past 10 years.
- Service fees are low relative to other large wastewater utilities in the Bay Area and to national averages.

Recommendations

- Maintaining reliable and safe wastewater service necessitates implementation of the recommended 5-year CIP.
- Evaluations should be completed to assess potential seismic vulnerabilities in detail.
- Unless a master plan is developed that contains alternative recommendations, other projects not listed in the 5-year CIP may be required to maintain adequate wastewater service.
- Implementing the identified projects will require a significant increase in capital expenditures relative to investments made over the past 10 years.
- Financing the recommended projects may require significant increases in revenue. A detailed financial analysis should be performed to determine revenue requirements.
- **Development of a master plan is essential for refining these recommendations and determining what the most efficient and effective long-term alternatives are for providing wastewater service.**

A copy of the executive summary from CH2M Hill's report is attached (Attachment C).

The majority of projects listed in the attachment by CH2M Hill have been previously listed in the Plant's CIP budget. However, due to several years of reducing or deferring projects in order to balance the five-year budget, many of these projects have been scheduled in years beyond the current funding horizon.

One of the most critical and costly projects noted in the CH2M Hill report is the previously identified Electrical Reliability Project. This project would address the Plant's antiquated

electrical system infrastructure for which most elements have been in continuous use for more than 30 years, exceeding the typical 25-year life expectancy. The Plant cannot operate without electricity. A major power failure resulting from an aged high voltage power cable or switchgear can cause significant operational problems potentially resulting in the spill of untreated sewage off Plant grounds and violations of the Plant's federal discharge permit (sometimes referred to as the NPDES permit or National Pollution Discharge Elimination System permit). The estimated cost for this project is $90 million and includes the upgrade of low, medium and high voltage switchgears, motor control centers and substations. It also includes replacement of aging engine driven generators and replacement of critical electric cabling. Completion of this project will provide significantly improved Plant reliability and will reduce the risk of power failures.

Other high priority projects identified in the report included upgrades to the Plant solids treatment system and replacement of piping and valves. The solids treatment system consists of 16 anaerobic digesters and thousands of feet of digester gas (methane) lines and isolation valves. Three of the digesters are in such bad shape as a result of corrosion that they cannot be put back in service. Loss of any additional digesters due to corrosion or mechanical failure would place the Plant in jeopardy of adequately treat solids, again placing it in violation of its discharge permit. The digester gas pipeline that transports the explosive digester gas from the digesters to the gas compressors is in poor condition as leaks have become more frequent over the last several years. The gas line cannot be taken out of service and there is no redundancy. It is critical that this line and associated valves be replaced.

All the treatment processes at the Plant are connected by isolation valves and pipelines ranging from ½-inch PVC piping to 120-inch diameter concrete pipe. The piping carries a variety of substances including air, water, chlorine and digester gas. The vast majority of the Plant's piping is underground with the rest in tunnels or pipe trenches. Most of the piping is made of concrete, iron or steel and therefore subject to corrosion. As the Plant has aged, so has the piping and valves. Piping leaks are becoming more frequent and hundreds of valves are leaking or becoming difficult to operate. Much of the piping and valves are difficult to access since they are underground or are located at the tops of tunnels or basements. It is essential that the Plant start to methodically access, plan and replace the miles and miles of piping and the thousands of valves at the Plant.

One utility industry benchmark used by CH2M Hill places the annual reinvestment needed to maintain current Plant service levels at between $56 – 69 million annually, not including inflation. This assumes a 30 – 37 year average life for the Plant and an engineering replacement value for the Plant of $2.1 billion. This is an order of magnitude benchmark that can be used for comparative purposes. Over the past 10 years, the Plant has averaged $11.3 million in actual capital replacement not including debt service. This leaves a gap of $40 million-plus per year when compared to this reinvestment benchmark.

CH2M Hill identified and recommended $249 million in critical repairs that should be accomplished over the next 5 years for an average of $50 million per year. Again, compared to

the Plant's capital expenditures over the past 10 years, this leaves a funding gap of around $39 million per year. The conclusion reached by CH2M Hill and supported by the Administration is that the Plant's capital plant infrastructure replacement has been significantly under funded. It should be noted that approximately 1/3 of the funding gap would be offset by Tributary agencies contribution for their share of treatment plant.

In addition to the $249 million in critical repairs, CH2M Hill identified an additional $747 million in lower priority capital replacement needs that still will be needed to meet current Plant service levels. These needs will be reviewed and prioritized as part of the Plant Master Plan, scheduled to be completed in late 2009.

Sanitary Sewer Collection System Capital Needs

The Public Works Sanitary Capital Program is responsible for the evaluation and prioritization of sewer rehabilitation, replacement and capacity improvement projects throughout the City's 2,200 miles of sewer collection system. The collection system also conveys flows from tributary agencies including the West Valley Sanitation District and County Sanitation Districts. The current estimated replacement value of this system is approximately $4 billion. The majority of expenditures over the past 20 years have been associated with the construction of a Fourth Major Interceptor, rehabilitation or replacement of three older interceptors and rehabilitation of major trunk lines.

The current 5-year CIP allocates the majority of the funding ($68 million) towards rehabilitation and replacement projects, with a smaller portion ($37 million) allocated for capacity improvement projects. Future 5-year CIP budgets will include an increased focus towards capacity improvement projects. Capacity projects are essential to support economic development, including the projected capacity needs for the Vision North San José Area, Evergreen/East Hills Vision Area, Edenvale and the North Coyote Valley.

In order to allocate additional funding for essential capital projects at the San José/Santa Clara Water Pollution Control Plant, the Public Works Sanitary Capital annual funding allocation from Fund 541 was decreased in FY 2004-05 from $16 million to $14.4 million. The $14.4 million annual transfer remains in effect throughout the current 5-year CIP. This overall decrease in capital funding has led to the deferral of some projects, including capacity improvement projects and sewer trunk and interceptor rehabilitation and replacement projects.

In 2004, Public Works completed the Phase I Capacity Master Plan for the north, central and southern areas of the City. The Master Plan uses current planning documentation and state-of-the-art flow modeling techniques to develop an updated capacity assessment of the sewer system and provides an effective tool for planning and design of future improvements to the City's sewer system infrastructure. The Phase II Capacity Master Plan will begin in 2007 to evaluate the east and west areas of the City, and to update the Phase I recommendations based upon new

General Plan amendments and current planning for major areas such as North San José, Evergreen and North Coyote Valley.

Among the findings of the Phase I Master Plan were:

- 37 new capacity projects totaling over 135,000 feet of sewer pipelines ranging from 10 to 72 inches in diameter will be warranted in the north, central and south areas to accommodate the San José 2020 General Plan and redevelopment plans. These projects are values at over $104 million.
- An additional 34,000 feet of trunk sewers will require rehabilitation at an estimated cost of $18 million.
- Approximately $25 million in capacity projects to address the full and complete build-out of the Vision North San José Area.

Public Works staff will continue to conduct condition and capacity evaluations for key growth areas of the City in order to prioritize capacity and rehabilitation projects to ensure reliable sewer service and support development.

The Department of Public Works estimates an average annual capital need of $22 million for the next ten years for reasonable rehabilitation and enhancement of the City's sewer collection system. This represents an increase of 50% over current funding levels. Recognizing that capacity demand is directly related to growth and development, a continuous refinement in flow monitoring and capacity analysis is key to selecting the appropriate project to ensure reliable capacity.

Sanitary Sewer System Maintenance Needs

The Department of Transportation (DOT) is responsible for maintaining the entire 2,200 miles of sewer collection system and pump stations. This includes routine inspection and cleaning of lines as well as response to blockages and overflows for correction and cleanup. This also includes the full maintenance of all the pumps stations and the associated motors, engines, and electrical systems. There a several key issues challenging DOT to properly maintain the system and ensure its effective short and long-term functionality, including the age and condition of the system, system-wide expansion, new environmental mandates for maintenance and operations, and the state of DOT's equipment fleet and maintenance schedules.

Approximately 80% of the City's sewer pipes were installed between 1950 and 1979, meaning that a large portion of the system – about 1,750 miles – is between 37 and 57 years old. As the age of a sewer pipe exceeds 25 to 30 years, it is more likely to sag, crack, separate at joints, and become more susceptible to blockages. This aspect is further complicated in that a majority of these sewer pipes are in residential areas where very few rehabilitation projects have occurred, requiring more frequent cleaning and a systematic approach to rehabilitation. In addition to this, the average age of the City's 16 sanitary sewer pump stations is over 30 years. To ensure proper

operation, it is reasonable to expect that a pump station be rehabilitated with new pumps, motors and control systems every twenty years. The City currently has nine stations that are well beyond this point and three that will be 20 years old by 2010 that have never undergone any level of rehabilitation. The cost to perform this pump station work is estimated at over $2 million.

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. This growth will require a continual commitment to provide additional resources as needed to perform routine maintenance and repair and rehabilitation of the sewer pipes and pump stations.

One of the greater challenges in the very near future are the new environmental mandates associated with the maintenance of the collection system expected in 2008. The City of San José, in coordination with the Bay Area Clean Water Agencies, is working with the California Regional Water Quality Control Board to develop and implement a Sanitary Sewer Management Plan (SSMP). The primary outcomes of the SSMP are to significantly reduce the occurrence of sanitary sewer overflows and protect our local and regional waterways. The SSMP, once fully adopted in 2008, will establish the standards, procedures, and protocols for all elements of the City's sanitary sewer collection program. The net result will require a significant increase of resources for DOT in both personnel and equipment in order to meet higher and more stringent requirements associated with the maintenance of the collection system.

All of these issues are stressing the ability for DOT to adequately sustain an effective and compliant maintenance program at a time when the City's equipment fleet has become outdated, inefficient, and in need of replacement. This is most visible in the current pipe cleaning program. With a current cleaning capacity of 500 miles per year, only 200 unique miles are cleaned in a given year with the balance of 300 miles dedicated to repeat cleaning of problematic sections that have a high susceptibility to blockages. This leaves larger sections each year without regular cleaning and inspection creating an even greater risk of blockages in those areas with the threat of backups, overflows and spills that can cause costly property damage, devastating environmental impacts, and high fines from the State.

In terms of the City's sewer maintenance equipment, on average, it is over ten years old, and many pieces are utilized at least two shifts everyday. Much of the equipment is unreliable, generally in poor to very poor condition, and in need of replacement. More important is that the equipment is outdated and inefficient in performing sewer maintenance activities such as line cleaning, clearing blockages, and cleaning up spills. With existing equipment, additional staff is required to perform cleaning activities that limit production and cleaning cycles. The equipment is also physically demanding on maintenance personnel and more prone to causing injuries.

Resolving these issues related to the state of the City's equipment is the most pressing one for DOT. An investment in newer, more effective and efficient equipment, along with a adequately funding equipment replacement program, is essential in ensuring the proper function of the

City's sewer collection system and achieving compliance with the pending SSMP mandates. It is estimated that approximately $3 million is needed over the next five years for new equipment with an ongoing investment of $500,000 for regular equipment replacements.

CONCLUSION

As referenced in the support materials, each program has a significant backlog of capital projects as well numerous pending projects. The estimated unmet capital needs within the sewer collection and treatment systems are approximately $49.5 million annually. A portion of the funding needs are paid for by other tributary agencies, reducing San José's portion of the funding gap.

	Current Average Funding	Average Annual Need	Annual Funding Gap	San José Annual Funding Gap
Treatment Plant	11,300,000	50,000,000	39,000,000	27,000,000
Collection System	14,475,000	25,000,000	10,525,000	10,525,000
Totals	25,775,000	75,000,000	49,525,000	37,525,000

Environmental Services, Transportation and Public Works are working collectively to address these additional needs. The ability to meet the challenge of aging infrastructure and increasingly stringent regulations along with limitations on resources will require significant changes. In an effort to address this challenge, the departments have begun initiating several strategic changes to help ensure success. These include proposed changes such as:

- Establishment of an ongoing, comprehensive infrastructure management program at the Plant
- Establishment of an enhanced preventive maintenance program at the Plant
- Conversion and expansion of the sewer maintenance equipment fleet
- Establishment of an ongoing maintenance equipment replacement program

In addition, the three departments are working with the City Manager's Budget Office in identifying revenue sources to fund these needs, including financing alternatives to minimize impacts on the rate payers.

To continue to postpone projects guarantees only increased future costs and decreased asset integrity. Although the current gap is significant, it is not insurmountable if met with aggressive efforts to recapture a concentrated commitment to preserve the quality of the City's infrastructure. With sufficient resources and support, it is likely that all aspects can overcome the capital funding gaps within the next decade.

PUBLIC OUTREACH

At the time the City Council determines a need to review a proposed increase in Sewer Service and Use Charges; the City would be required to issue a Proposition 218 rate notice to affected rate payers with a mandatory 45-day review period and process for filing formal protests. Any proposed increase in connection fees would also be noticed to affected parties. In addition, the Plant's Master Planning effort will involve a range of stakeholder meetings, briefings, and materials.

COORDINATION

This report had been coordinated with the departments of Environmental Services, Transportation, Public Works, the City Manager's Office and the City Attorney's Office.

COST AND BUDGET IMPLICATIONS

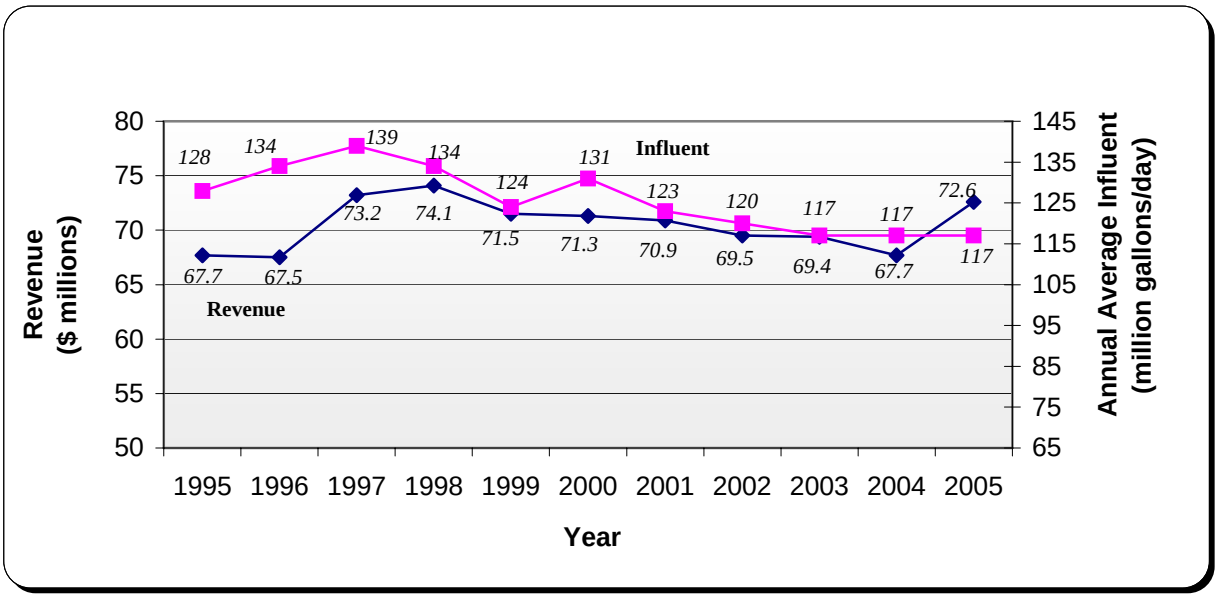
There are no cost implications at the present time. These issues and funding options will be addressed during the annual budget process.

JOHN STUFFLEBEAN
Director
Environmental Services Department

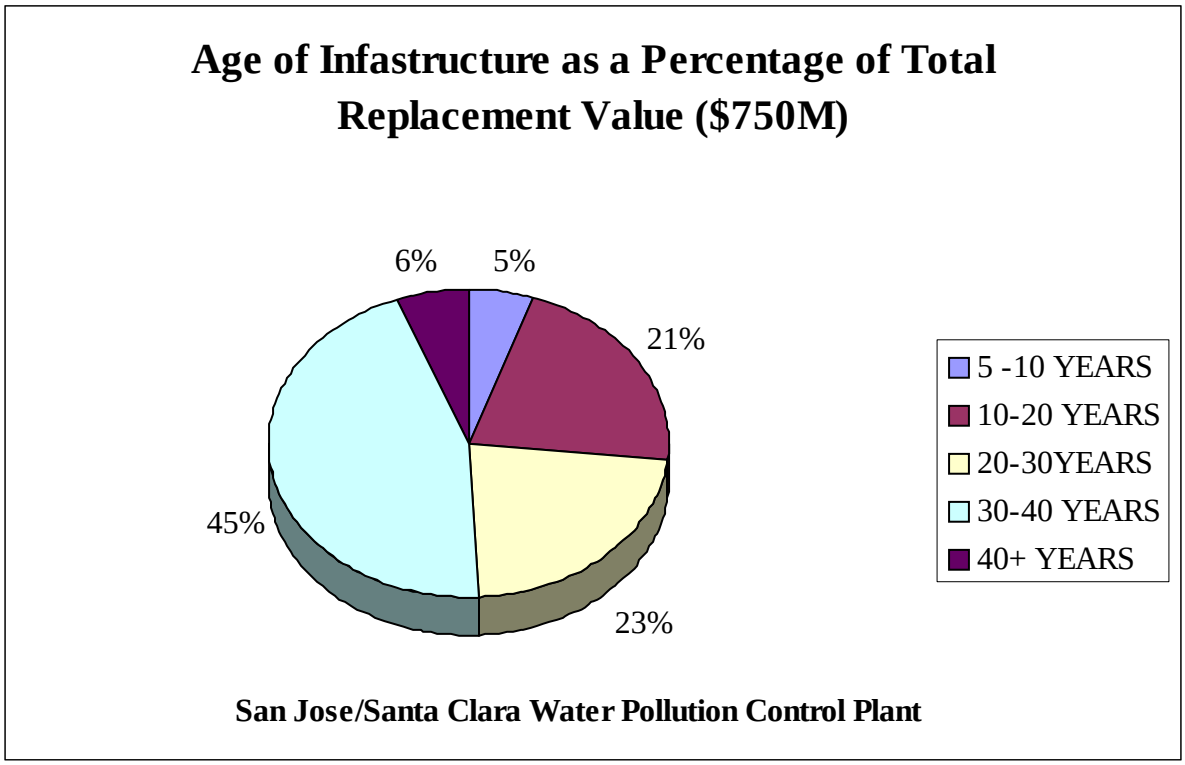
KATY ALLEN
Director
Public Works Department

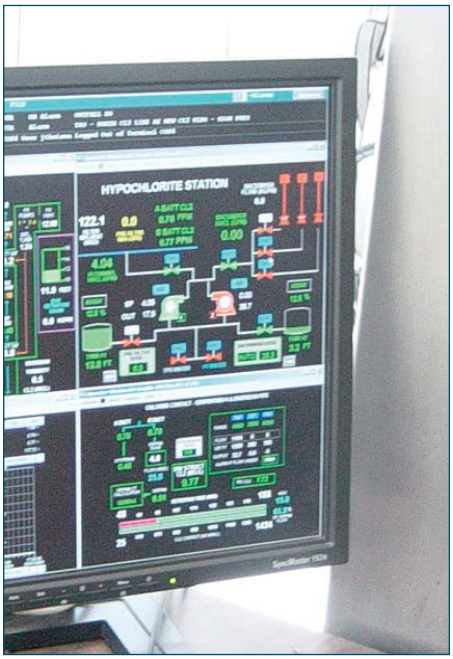
JAMES R. HELMER
Director
Department of Transportation

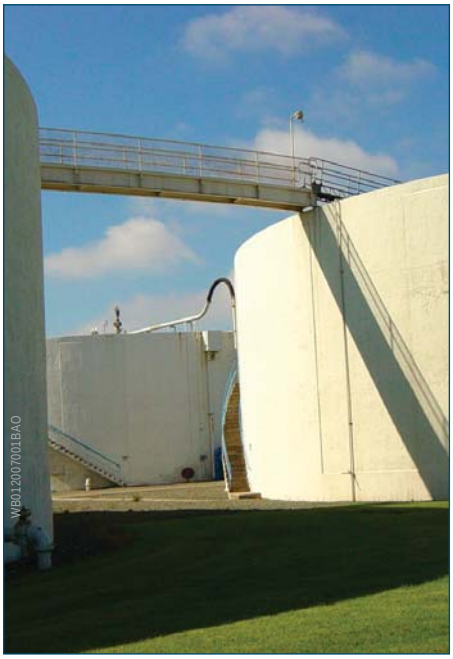
Attachment A



Attachment B







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EXECUTIVE SUMMARY

PRESENTED TO

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

CITY OF SAN JOSÉ
ENVIRONMENTAL SERVICES DEPARTMENT

INFRASTRUCTURE CONDITION ASSESSMENT

PREPARED BY

CH2MHILL

FEBRUARY 2007

Executive Summary

ES.1 Introduction

The San José-Santa Clara Water Pollution Control Plant (Plant) provides essential protection of public health and the environment as mandated under the Clean Water Act. It serves about 1.34 million people in central Santa Clara County and plays a vital role in protecting natural resources in San Francisco Bay.

The first elements of the Plant were constructed in 1956, making the plant 50 years old (Figure ES-1). New and improved treatment facilities have been added to the plant over the years to serve a growing population and to comply with new regulations. However, there is concern that increased capital investment may be necessary to maintain the required level of service.

Figure ES-1.
Aerial View of the San José-Santa Clara Water Pollution Control Plant

The Environmental Services Department (ESD) of the City of San José commissioned this study to complete an assessment of the condition of infrastructure at the Plant and to identify capital improvements required to maintain adequate wastewater service for existing customers under current regulations and operating permits.

This study focuses on capital investments needed to address current deficiencies at the Plant. It does not address future needs that may result from the following:

- Demographic changes in the services area
- New regulations
- Improvements to optimize existing facilities
- Improvements to replace outdated and inefficient technology

In addition, it does not address ongoing costs for operation and maintenance of the Plant. ESD may develop a separate master plan for the Plant to address these needs.

ES.2 The San José-Santa Clara Wawter Pollution Control Plant

The Plant is located in northern San José on the edge of San Francisco Bay. It provides tertiary treatment of wastewater from domestic, commercial, and industrial sources from several cities and special districts.

The wastewater treatment process consists of screening and grit removal, primary sedimentation, secondary biological treatment (including nitrification of ammonia), secondary clarification, filtration, disinfection, and dechlorination. Biosolids (i.e., the residual solid material removed from the

wastewater during the treatment processes) are thickened, anaerobically digested, and stabilized in lagoons. The biosolids are then dried using solar drying beds and subsequently used as cover material at the Newby Island Landfill.

The Plant has an average dry weather influent flow (ADWIF) design capacity of 167 million gallons per day (mgd), and the peak hourly flow capacity is 271 mgd. In 2005, the Plant treated an annual average daily flow of 119 mgd. Most of the treated effluent from the Plant flows into Artesian Slough, a tributary to Coyote Creek and South San Francisco Bay.

To protect salt-water ecosystems in South San Francisco Bay, ESD is required to implement an action plan in lieu of limiting average dry weather effluent flow (ADWEF) to 120 mgd. The action plan includes recycling and conservation components and a contingency plan that can be implemented in the event that ADWEF increases above 120 mgd. As part of the action plan, a recycled water program was initiated to divert treated effluent away from the Bay.

Since May 1998, recycled water has been supplied from the Plant for non-potable purposes to over 500 customers throughout the service area via the South Bay Water Recycling (SBWR) Program. Uses of recycled water include irrigation of golf courses, parks, playgrounds, and farms, and various industrial uses, such as cooling of power plants. An average of about 17 mgd is recycled during dry weather. During wet weather conditions, the recycled water demand drops to about 5 mgd.

ES.3 Methodology

The condition of existing infrastructure was ascertained through inspections conducted by engineering, operations, and maintenance personnel from CH2M HILL who specialize in wastewater treatment facilities. The inspections were conducted over a five-day period, during which conditions of individual assets were recorded. During the inspection period, operations and maintenance supervisors were interviewed to identify known issues affecting the condition, reliability, and safety of individual assets. Other sources of information used to determine the conditions of the assets included various reports prepared during the past ten years and construction drawings for the facilities.

Once inspections and data collection were completed, capital projects were identified that can be implemented to maintain the expected level of service. Planning-level capital cost estimates were prepared for each project, and a tentative implementation plan was developed. A risk management and minimization strategy was used to prioritize projects in the implementation plan.

ES.4 Conditions of Assets

The investigations found that conditions of assets at the Plant range from poor to excellent. In general, the conditions correlate with the age and type of assets. Mechanical and electrical systems, which are expected to have relatively short useful lives, and older structures were found to be in generally fair to poor condition. On the other hand, structures constructed after 1980 were found to be in relatively good condition.

In general, assets in the greatest need of improvement can be categorized as follows:

- Electrical power infrastructure

- Mechanical piping and equipment
- Structures that have potential seismic vulnerabilities
- Older structures damaged by corrosion

Based on observed conditions of assets, a list of capital improvement projects was developed. The potential projects are intended to preserve existing facilities and maintain the current level of service.

ES.5 Investment in Aging Infrastructure

Public infrastructure includes many vital facilities and systems that serve many needs, including needs for transportation, energy, communication, water, and sanitation. As infrastructure ages, ongoing capital investments are required to maintain service.

ES.5.1 A National Perspective on Investment in Wastewater Infrastructure

Over the past several years, several governmental and non-governmental organizations have studied investments in wastewater infrastructure throughout the United States to determine what level of spending is needed to maintain the level of service required to comply with regulations, demographic changes, and periodic replacement of aging assets. The most prominent of these studies were prepared by:

- US Environmental Protection Agency (USEPA)
- Congressional Budget Office (CBO)
- National Association of Clean Water Agencies (NACWA)
- American Society of Civil Engineers (ASCE)

USEPA Gap Analysis: In September 2002, USEPA issued a report titled *The Clean Water and Drinking Water Gap Analysis*[1], which assesses "whether there is a quantifiable gap between projected clean water and drinking water investment needs over the twenty-year period from 2000 to 2019 and current levels of spending."

The report estimates that components of wastewater treatment plants can be expected to last from 15 to 50 years, depending on the type of asset. Mechanical and electrical assets can be expected to last 15 to 25 years, while concrete structures are expected to last up to 50 years.

The report further estimates that needs for clean water capital expenditures nationwide range from $331 billion to $450 billion during the analysis period and that these needs may be under funded by $73 billion to $177 billion (22 to 39 percent) unless revenues increase.

The USEPA's report further found that "much of the gap is the product of deferred maintenance, inadequate capital replacement, and generally aging infrastructure" as well as "continuing growth and development pressures." Moreover, "the analysis suggests that a large gap will result if the challenge posed by an aging infrastructure network – a significant portion of which is beginning to reach the end of its useful life – is ignored."

CBO Study: In November 2002, CBO issued a report titled *Future Investment in Drinking Water and Wastewater*

[1] *The Clean Water and Drinking Water infrastructure Gap Analysis*, U.S. EPA, Office of Water, EPA-816-R-02-020, September 2002.

Infrastructure. Although it used somewhat different methods to estimate needs for capital investment in wastewater infrastructure, the findings were similar to the USEPA report: significant increases in funding are required to maintain the desired level of service.

The CBO report is based on assumed annual depreciation of assets ranging from 2.7 to 3.3 percent per year, which suggests that wastewater infrastructure can be expected to last 30 to 37 years, on average. In other words, according to this assumption, capital investment amounting to 2.7 to 3.3 percent of the total capital value of wastewater infrastructure would be required annually to maintain current service. The depreciation rate does not include inflation, which must also be factored into capital replacement costs.

NACWA: NACWA is an association of wastewater utilities across the United States that includes City of San José's Environmental Services Department among its members. For several years, NACWA has been studying issues related to capital financing of wastewater infrastructure in association with the Water Infrastructure Network (WIN). WIN is a coalition of local elected officials, drinking water and wastewater service providers, state environmental and health program administrators, engineers and environmentalists.

In February 2001, WIN published a report titled *Water Infrastructure Now: Recommendations for Clean and Safe Water in the 21st Century*. This report concludes, "over the next 20 years, America's water and wastewater systems will have to invest $23 billion a year more than current investments to meet the national environmental and public health priorities in the Clean Water Act and Safe Drinking Water Act and to replace aging and failing infrastructure."

The WIN report was assessed as part of the 2002 CBO report. CBO's analysis found that "the estimate from the [CBO's] high-cost scenario is very similar to the one produced by WIN, when the latter is measured in comparable terms."

ASCE Infrastructure Report Card: The ASCE issues biannual assessments of infrastructure in America. In the last report card, ASCE gave wastewater infrastructure a D-, indicating that it is in poor condition overall. In 2001 and 2003, ASCE's report card gave wastewater infrastructure a D. Therefore, according to ASCE, wastewater infrastructure has continued to degrade over the past 5 years.

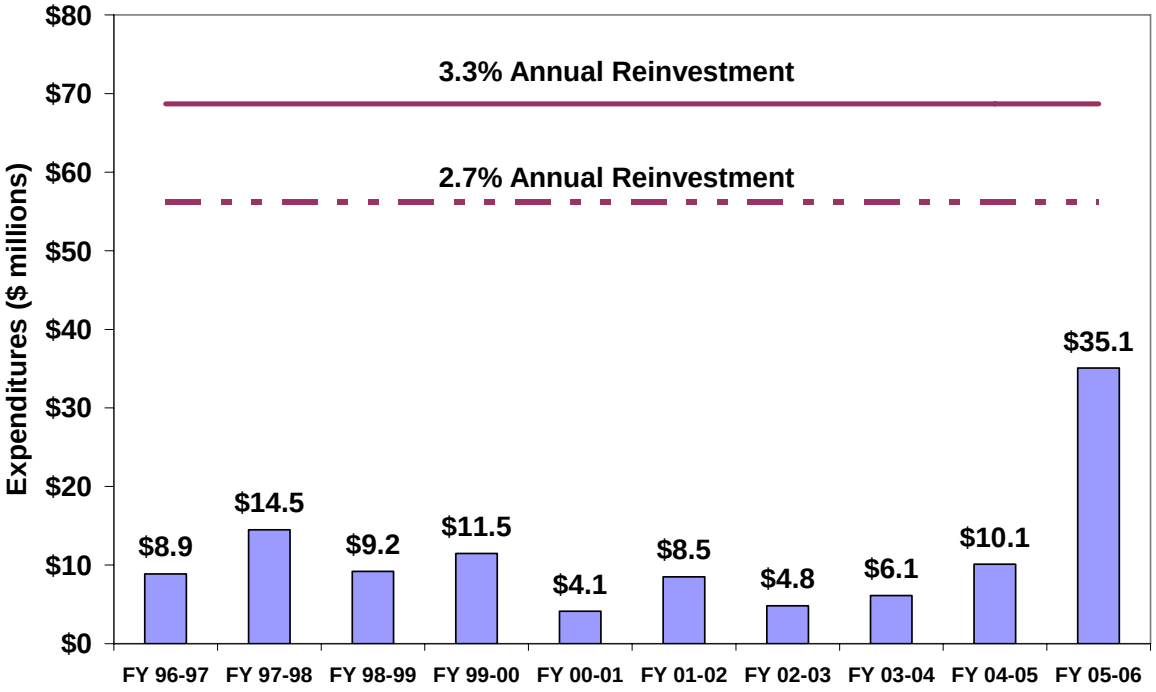
Among the reasons given for the D-grade, ASCE reported in its 2005 assessment that "the physical condition of many of the nation's 16,000 wastewater treatment systems is poor due to a lack of investment in plant, equipment and other capital improvements over the years."

ES.6 Benchmarking the San José-Santa Clara Water Pollution Control Plant

ES.6.1 Capital Investments over 10 Years

Capital investments in Plant infrastructure made over the past 10 years were analyzed and compared to factors for reinvestment in wastewater treatment infrastructure used in the CBO's study (Figure ES-2). Actual investments were adjusted to 2005 dollars using the Engineering News Record Construction Cost Index (ENR CCI) and compared to assumptions for reinvestment (or

FIGURE ES-2. Actual Capital Expenditures vs. CBO Factors



depreciation) rates used by CBO in its 2002 study.

Figure ES-2 shows comparisons between actual capital investments and costs that would be incurred at reinvestment rates of 2.7 and 3.3 percent of the total capital value of the Plant. The total capital value of the Plant was estimated to be $2.1 billion based on current construction cost data and market conditions, indicating that **reinvestment at a rate of 2.7 to 3.3 percent would equate to capital expenditures of $56 million to $69 million annually**.

In comparison, actual annual spending from the capital improvement budget has ranged from $4.1 million to $35.1 million, with an average of $11.3 million over the past 10 years. The $35.1 million investment in FY 05-06 was for the construction of the new Headworks and Wet Weather Facility that will replace the existing Headworks and provide additional wet weather reliability. This project has heavily depleted capital reserves and funding for other rehabilitation and replacement projects.

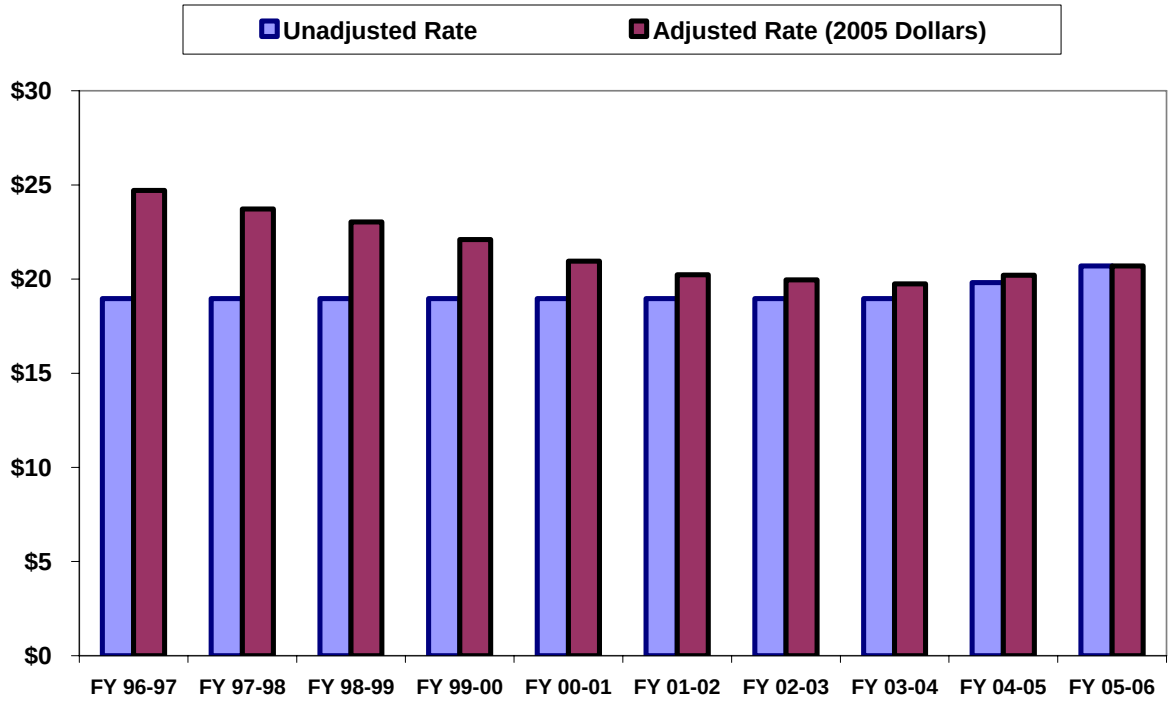
In the past 10 years, investments have been almost entirely used to replace aging assets; except for investments in the SBWR system, they have not increased the capacity of the Plant or provided higher levels of treatment. Therefore, on average, **actual investment has been $45 to $57 million per year lower than the depreciation rate assumptions used in CBO's study.**

ES.6.2 Revenue from Service Fees

As part of the study, revenue from wastewater service fees was assessed and compared to fees charged by other wastewater utilities.

Figure ES-3 shows the fees charged for a single-family residential connection over the past 10 years in San José. Values are

Figure ES-3. San Jose Monthly Sewer Service Rates



presented for unadjusted rates and rates that are adjusted for inflation to 2005 dollars using the Consumer Price Index (CPI) for the San Francisco-Oakland-San José area published by the U.S. Bureau of Labor Statistics (BLS). Over the period, unadjusted rates for residential accounts increased from $18.96 per month to $20.70 per month (a 9.2 percent increase). However, after adjusting for inflation, rates have actually decreased from $24.71 to $20.70 (a 16.2 percent decrease).

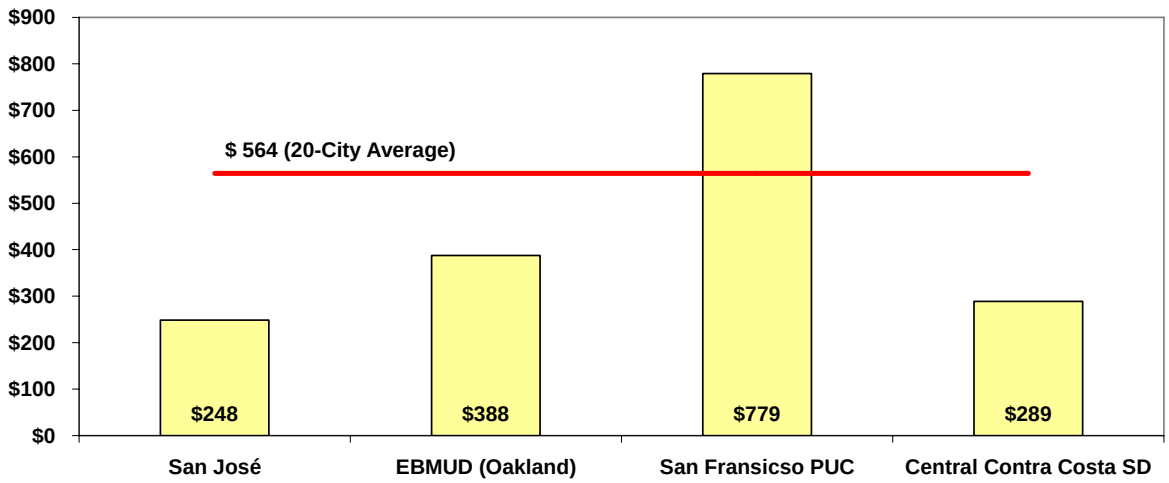
Wastewater service fees were then compared to fees charged in the 20 largest U.S. cities and 3 large wastewater utilities in the Bay Area (Figure ES-4). The analysis indicates that **sewer service fees in San José are 32 to 86 percent of fees charged by other large wastewater utilities in the Bay Area and are 44 percent of the average for the 20 largest cities, based on 2006 data** (CH2M HILL, 2006).

Several of the 20 largest cities, including San Francisco, operate combined systems that are designed to collect and treat both sewage and storm water runoff. The others, including San José, are designed to treat sewage only. Despite these differences, average sewer rates are approximately equivalent for the two types of systems. The average for all 20 cities (including both combined and separate systems) is about $564 per year, while the average for cities with separate systems is about $567 per year. Sewer rates in San José ($248 per year) are significantly below both of these averages.

ES.7 Capital Investment Needs

The investigations identified a wide variety of capital projects that can be implemented to maintain reliability and safety of the Plant. Planning-level capital

FIGURE ES-4. Comparison of Yearly Single-family Residential Sewer Service Fees



Notes: Some wastewater utilities base sewer rates on potable water consumption. In such cases, values used in the 20-City average are based on average residential water consumption of 171.8 gallons per person per day (AWWARF, 1999) and an average household size of 2.6 people (US Census Bureau, 2005). San José and CCCSD use flat rates that are independent of potable water consumption. Values shown for EBMUD and SFPUC are based median water consumption rates. SFPUC operates at combined sanitary and storm sewer system, so rates for SFPUC also include costs for managing storm water that are not charged by other local utilities.

cost estimates were developed for each these projects.

The estimates prepared for this report are order-of-magnitude estimates as defined by the American Association of Cost Engineers. An order-of-magnitude estimate is made without detailed engineering data. Typically, an order-of-magnitude estimate is expected be accurate within +50 to -30 percent of the estimated cost.

The cost estimates assume that projects would be implemented over a 10-year period. This period was chosen to account for inflation in costs during the implementation period. It may be decided that only selected high-priority projects would be implemented within this period, while lower priority projects may be implemented over a longer period. This approach provides a means to estimate and compare cost for all of the identified capital improvement projects while maintaining flexibility for implementing lower priority projects.

Table ES-1 presents a summary of the estimated costs for each major process area. The cost summary includes the construction costs, escalation to the midpoint of construction, indirect capital costs, and the total capital costs.

- **Construction Costs**: Estimated construction costs represent costs that would be incurred if the project were bid today under current market conditions. This cost includes contractor's overhead, profit, mobilization, bonds, insurance and contingency.
- **Escalation to Mid-Point of Construction**: Escalation may range from 3 to 8 percent per year. In recent years, costs of construction have increased faster than the overall rate of inflation. Therefore, a conservative escalation rate of 7 percent per year,

compounded to the mid-point of construction (48.3 percent total) is included in the cost estimates. This rate may decrease in the future if changes in construction costs move toward the overall rate of inflation.

- **Indirect Capital Costs**: Indirect capital costs include costs that would be incurred to complete a project that are not paid directly to construction contractors. Such costs include permitting, planning, engineering, construction management, legal requirements, and project administration. Indirect costs are estimated at 35 percent of the escalated construction cost.

As indicated in Table ES-1, approximately $997 million in capital improvements have been identified plant wide. This cost represents improvements needed to address identified deficiencies and to maintain the current level of service.

Figure ES-5 provides a breakdown of the types of work involved in the identified projects. Projects involving mechanical, instrumentation and control (I&C), and electrical infrastructure make up about 37.2 percent of the total estimated costs, while structural and architectural projects make up about 13.4 percent of identified improvements. This follows USEPA's assessment that mechanical and electrical systems have shorter expected lives than structures.

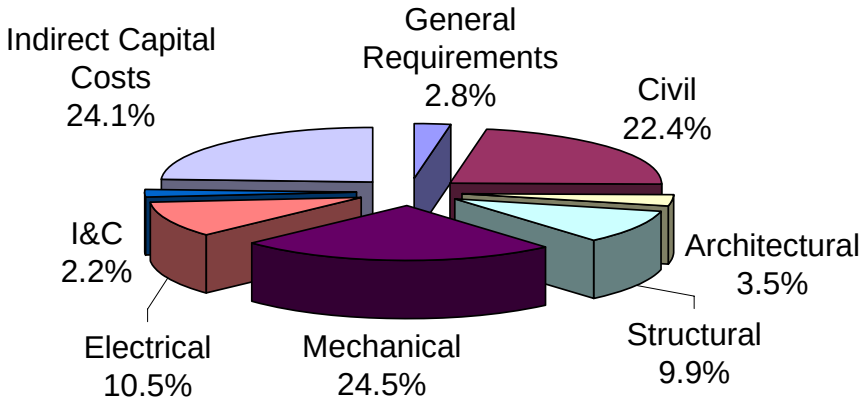
Much of the costs associated with civil infrastructure (22.4 percent of the total) are for replacement of buried piping around the Plant and rehabilitation of the residual solids management facilities.

General requirements (2.8 percent of the total) include items such as insurance and bonds that must be acquired by construction contractors.

TABLE ES-1
Summary of Capital Cost Estimates

Asset Category	Construction Cost (millions)	Escalation to Mid-Point of Construction (millions)	Indirect Capital Costs (millions)	Total Capital Cost (millions)
Sitework	$51.0	$24.6	$26.5	$102.2
Preliminary Treatment	$18.3	$8.8	$9.5	$36.6
Primary Treatment	$63.7	$30.8	$33.1	$127.6
Secondary Treatment	$89.8	$43.4	$46.6	$179.8
Nitrification Treatment	$38.9	$18.8	$20.2	$77.9
Tertiary Treatment	$38.8	$18.7	$20.1	$77.6
Disinfection	$7.4	$3.6	$2.9	$13.9
Outfall	$4.5	$2.2	$2.3	$8.9
Sludge Thickening	$8.6	$4.1	$4.5	$17.2
Anaerobic Digestion	$43.8	$21.1	$22.7	$87.6
Digester Gas System	$5.0	$2.4	$2.6	$10.0
Residual Solids Management	$111.2	$53.7	$21.0	$185.8
Support Facilities	$35.6	$17.2	$18.4	$71.1
Totals	**$516.5**	**$249.3**	**$230.4**	**$996.8**

FIGURE ES-5. Breakdown of Types of Work for Capital Projects



ES-8 Risk Management

The identified projects were prioritized to manage and minimize risk. Risk was measured as a function of the likelihood of a failure, triggers that may require replacement assets, and the consequences that would result from failure of an asset.

Probability of failure was determined using the following factors:

- Overall condition of the asset
- Reliability of the asset
- Existence of planned redundancy (i.e., standby/backup systems)

Triggers for replacement of assets include:

- Inadequate capacity or over utilization
- Obsolescence (e.g., lack of availability of spare parts)
- Excessive maintenance requirements

Consequences of failure were measured using the following factors:

- Service reliability
- Compliance with regulations and permits
- Health and safety of Plant employees and the community
- Ability to return to service after a failure
- Financial impacts
- Disruption to the community

Based on these factors, assets were ranked by risk as listed in Table ES-2.

ES-9 Interim Capital Improvement Planning

If a master plan is developed, the list of recommended projects may change significantly. However, it is expected that developing and starting implementation of a master plan would take about 5 years. In the interim, there are immediate needs that must be addressed to maintain acceptable wastewater service. To aid in planning for interim capital improvement projects, high-priority projects within each area of the Plant were identified that can be implemented over the next 5 years (Table ES-2). These projects have an estimated capital cost of about $249 million.

The recommended 5-year CIP addresses the most significant risks associated with the Plant's high-voltage and medium-voltage power distribution systems, which are in poor condition, are over utilized, and have significant consequences of failure. If the Plant's power distribution systems fail, the Plant cannot operate.

The anaerobic digestion systems and yard piping are also high-priority items due to poor condition and lack of standby capacity. Additional high-priority items were identified throughout the Plant as indicated in Table ES-2.

Maintaining acceptable wastewater service will require implementation of the other projects (those not included in the recommended 5-year CIP) as well unless a master plan is developed that contains different recommendations.

ES-10 Conclusions and Recommendations

The following conclusions were made from the investigations and analyses prepared for this report:

- Many mechanical, electrical, and structural assets at the Plant are in poor condition due to age and wear.
- Potential seismic vulnerabilities were identified in some buildings and structures that require further evaluation.
- Compared to assumptions used by USEPA and CBO in recent studies of wastewater infrastructures needs, capital investments at the Plant have been under funded over the past 10 years.
- Sewer service fees in San José are low relative to other large wastewater utilities in the Bay Area and nationwide averages.

Based on these conclusions, the following recommendations are made:

- Maintaining reliable and safe wastewater service necessitates implementation of the recommended 5-year CIP.
- Evaluations should be completed to assess potential seismic vulnerabilities in detail.
- Unless a master plan is developed that contains alternative recommendations, other projects not listed in the 5-year CIP may be required to maintain adequate wastewater service.
- Implementing the identified projects will require a significant increase in capital expenditures relative to investments made over the past 10 years.
- Financing the recommended projects may require significant increases in revenue. A detailed financial analysis should be performed to determine revenue requirements.
- Development of a master plan is essential for refining these recommendations and determining what the most efficient and effective long-term alternatives are for providing wastewater service.

Master planning can further integrate the projected needs for repair and replacement of aging infrastructure presented in this document with other high-priority and long-term facility needs in order to effectively manage risk and utilize available resources and funding.

Furthermore, it is important to keep in mind that this study assesses the current condition of Plant infrastructure; the recommended projects will extend the life of existing infrastructure but do not address future needs that may result from demographic changes in the services area, new regulations, improvements to replace outdated technology, or addressing other known issues. These unaccounted factors may ultimately result in potentially higher costs than the estimates presented in this report.

The presented costs are order-of-magnitude estimates that will need to be updated and reassessed based on a detailed analyses and plans prepared at the time of implementation.

TABLE ES-2
Potential Capital Improvement Projects

Risk Rank	Area	Type	Asset ID	Total Capital Cost	Recommended 5-Year CIP (millions)
1	00C	Site	Site Power Distribution (Med- & High-voltage)	$ 50.8	$ 50.8
2	12G	Support Facilities	Electrical Sub-Station M1-M2	$ 19.2	$ 19.2
3	10A	Digester Gas Systems	Digester Gas System	$ 9.9	$ 9.9
4	12E	Support Facilities	Electrical Sub-Station 1	$ 9.6	$ 9.6
5	12F	Support Facilities	Electrical Sub-Station 2	$ 9.6	$ 9.6
6	00B	Site	Yard Piping	$ 47.6	$ 23.8
7	07A	Outfall	Outfall Channel	$ 2.1	$ -
8	09A	Anaerobic Digestion	Digesters 1 - 3	$ 14.5	$ 7.3
9	09F	Anaerobic Digestion	Digesters 12 - 16	$ 22.8	$ 11.4
10	09B	Anaerobic Digestion	Digester 4	$ 4.8	$ 2.4
11	09C	Anaerobic Digestion	Digesters 5, 6	$ 9.7	$ 4.9
12	09D	Anaerobic Digestion	Digesters 7, 8	$ 9.7	$ 4.9
13	09E	Anaerobic Digestion	Digesters 9 - 11	$ 13.7	$ 6.9
14	09G	Anaerobic Digestion	Digester Sludge Export Station	$ 12.4	$ 12.4
15	05A	Tertiary Filtration	Filtration Influent Pump Building	$ 16.0	$ -
16	02B	Primary Treatment	P&E Building - Raw Sewage Pump Station	$ 8.8	$ 2.0
17	06C	Disinfection	Rail Spur Unloading	$ -	$ -
18	02F	Primary Treatment	Primary Effluent Pump Station	$ 2.2	$ -
19	11A	Residual Solids Management	Lagoons 28 - 59	$ 38.6	$ -
20	03G	Secondary Treatment	Secondary Blower Building	$ 51.2	$ 10.0
21	01F	Preliminary Treatment	New Headworks & Wet Weather Facility	$ 34.8	$ -
22	01E	Preliminary Treatment	Detritors	$ 0.5	$ -
23	11B	Residual Solids Management	Drying Beds	$ 21.1	$ 5.0
24	05B	Tertiary Filtration	Filtration Treatment	$ 48.1	$ 10.0

TABLE ES-2
Potential Capital Improvement Projects

Risk Rank	Area	Type	Asset ID	Total Capital Cost	Recommended 5-Year CIP (millions)
25	01D	Preliminary Treatment	Aerated Grit Chambers	$ 0.5	$ -
26	05C	Tertiary Filtration	Chlorine Contact Tanks	$ -	$ -
27	11C	Residual Solids Management	Digester Cleaning Lagoons 1-3	$ 21.5	$ 5.0
28	02C	Primary Treatment	West Primary Clarifiers	$ 24.1	$ -
29	07C	Outfall	Recycled Water Transmission Pump Station	$ 6.9	$ -
30	01B	Preliminary Treatment	Overflow Structure	$ -	$ -
31	02A	Primary Treatment	P&E Building - Cogeneration	$ 44.1	$ 4.0
32	08A	Sludge Thickening	Sludge Control Bldg	$ 8.5	$ 4.0
33	01A	Preliminary Treatment	Inlet Control Structure	$ 0.6	$ -
34	11E	Residual Solids Management	Flow Equal. Basin	$ 2.6	$ -
35	05E	Tertiary Filtration	Backwash Settling	$ 5.7	$ -
36	03H	Secondary Treatment	Blower Generator Building	$ 15.6	$ 1.0
37	12B	Support Facilities	Miscellaneous Support Facilities	$ 2.6	$ 1.0
38	03C	Secondary Treatment	Secondary Clarifiers A1 - A5 and B1 - B5	$ 13.3	$ 5.0
39	04C	Nitrification Treatment	Nitrification Clarifiers A1 - A6 and B1 - B6	$ 24.8	$ 1.0
40	03F	Secondary Treatment	Secondary Clarifiers A12, A13, B12, B13	$ 9.0	$ -
41	03D	Secondary Treatment	Secondary Clarifiers A6 - A8 and B6 - B8	$ 8.0	$ -
42	03E	Secondary Treatment	Secondary Clarifiers A9 - A11 and B9 - B11	$ 5.4	$ -
43	04D	Nitrification Treatment	Nitrification Clarifiers A7, A8, B7, B8	$ 8.4	$ -
44	06D	Disinfection	Disinfection Building	$ -	$ -
45	07B	Outfall	Sulfur Dioxide Building	$ -	$ -
46	05F	Tertiary Filtration	Treated Backwash Pump Station	$ 4.8	$ -

TABLE ES-2
Potential Capital Improvement Projects

Risk Rank	Area	Type	Asset ID	Total Capital Cost	Recommended 5-Year CIP (millions)
47	04E	Nitrification Treatment	Tertiary Blower Building	$ 22.0	$ 3.0
48	02D	Primary Treatment	East Primary Clarifiers 1	$ 21.6	$ 7.5
49	02E	Primary Treatment	East Primary Clarifiers 2	$ 21.6	$ 7.5
50	02G	Primary Treatment	Scum Pump Station (1)	$ 0.2	$ -
51	02H	Primary Treatment	Scum Pump Station (2)	$ 0.2	$ -
52	04A	Nitrification Treatment	Nitrification Tanks A and B Sides (1975)	$ 16.8	$ 1.0
53	04B	Nitrification Treatment	Nitrification Tanks A and B Sides (1984)	$ 5.9	$ -
54	03A	Secondary Treatment	Secondary Treatment Aeration Tanks A	$ 38.7	$ 1.0
55	03B	Secondary Treatment	Secondary Treatment Aeration Tanks B	$ 38.7	$ 1.0
56	11F	Residual Solids Management	RSM Operations Center	$ 2.0	$ -
57	08B	Sludge Thickening	Sludge Concentration Tanks	$ 8.8	$ -
58	05D	Tertiary Filtration	Backwash Equalization	$ 3.1	$ -
59	12P	Support Facilities	Stormwater and Flood Protection Facilities	$ 30.2	$ -
60	11D	Residual Solids Management	Inactive Lagoons 5 - 25	$ 100.1	$ 1.0
61	02I	Primary Treatment	Scum Handling	$ 4.7	$ -
62	11G	Residual Solids Management	Plant Storage Facility	$ -	$ -
63	06A	Disinfection	Ammonia System	$ -	$ -
64	06B	Disinfection	Hypochlorite and Bisulfite Facility	$ 13.9	$ 6.5
65	03I	Secondary Treatment	Aeration Building (1)	$ -	$ -
66	03J	Secondary Treatment	Aeration Building (2)	$ -	$ -
67	11H	Residual Solids Management	Northeast Pump Station	$ -	$ -
68	01C	Preliminary Treatment	Bar Screens	$ 0.3	$ -

TABLE ES-2
Potential Capital Improvement Projects

Risk Rank	Area	Type	Asset ID	Total Capital Cost	Recommended 5-Year CIP (millions)
69	07D	Outfall	Recycled Water Fill Station	$ -	$ -
70	00A	Site	Civil Infrastructure	$ 3.9	$ -
Grand Total				**$ 996.8**	**$ 249.4**