4.2.2 Operations and Maintenance Costs

MRWPCA provided a breakdown of field activities covering weekly routine monitoring and basic maintenance conducted by their crew. This is designated as Code 1. Repairs are conducted as needed and are designated Code 2. A summary of Code 2 work was provided as shown in Table 4-7. MRWPCA provided a brief description of the nature of the work conducted, however, it is not known when or where the work was performed. It is also unclear if the work was the result of an emergency condition or a spill.

Table 4-7: Summary of Code 2 Work Conducted from October 2002 to September 2003

Time Frame	Description
October – December 2002	Installed new Flygt pump
	Replaced battery & charger
	Installed muffler on genset
	Tested alarms
	Critical advisory alarm
	Bubbler failed
	Power outage
	Installed check valve on generator fuel supply line
	Replaced generator starting battery
	Replaced both air compressor for bubbler
	Standby for City
	Adjusted bubbler
	Phone line problem/critical advisory alarm
	Power outage
	Power restored – check station
	Power outage
	Critical advisory alarm
January – March 2003	Test ran engine, pulled oil sample
	Worked on transfer switch
	Checked bubbler system, adjusted compressor outputs
	Critical advisory alarm
	Allowed access for Pac Bell
	Critical advisory alarm
	Installed new mission alarm system
	Replaced old motor starters
	Changed oil/filter checked engine
	Replaced muffler pipes & moved muffler
	Replaced fuel level indicator gauge on generator
	Critical advisory alarm

Time Frame	Description
	Power outage – checked station
	Installed radiator transition to aid in the generator radiator cooling
	Advisory alarm
April – June 2003	Checked phone line voltage
	Checked station after power outage
	Anchored bubbler line
	Replaced generator exhaust weather cap
	Checked SP#2 pulled rags
	Station pump down
	Pull SP#2 remove rags
	Pump 2 fail
	WW high level
	Called to station – pumps would not shut down
	Alarm on mission control unit
	Station in alarm – pumped down
	Responded to critical advisory alarm
July – September 2003	Hole in suction plate
	Replaced suction plate
	Critical advisory alarm – pulled pump removed rags
	Power outage checked generator
	Replaced battery

4.2.2.1 Annual Cost Data

MRWPCA provided cost data covering the routine operating and maintenance costs of the pump stations. The costs reported are as summarized in Table 4-8.

Table 4-8: Reported Code 1 and Code 2 Costs

Maintenance Activities	Oct-Dec 02	Jan-Mar 03	Apr-Jun 03	Jul-Sep 03	Period Total	FY 03 Total	Average Quarter
Operations and Minor Maintenance (Code 1)	$3,783	$4,929	$5,186	$4,047	$17,946	$18,758	$4,486
Maintenance and Repairs (Code 2)	$11,847	$18,732	$3,802	$2,973	$37,354	$48,900	$9,338
Totals	**$15,631**	**$23,661**	**$8,988**	**$7,020**	**$55,300**	**$67,658**	**$13,825**

Note: The costs are in 2004 dollars.

The variation of the total fiscal year operations and maintenance costs for Code 2 work are 31 percent greater for the fiscal year summary than for the period of study. During the first two reported quarters, the major maintenance component was significantly higher than the last two quarters. A significantly greater number of Code 2 work orders were reported for the first two quarters than the last two. Some of the work orders reflect work that will probably not need to be done again in the foreseeable future, such as mufflers, and transition ducting for the generators. However, other replacements, such as generator batteries, will be necessary every three to five years. Finally, the pump stations can be expected to experience random failures of equipment such as electrical switches, pump check, and isolation valves, and other equipment. These failures can be minimized by the use of predictive maintenance technologies.

4.2.2.2 Operations and Maintenance Cost Projections

Based on the information discussed previously, the following basic annual services cost estimate is formulated as follows:

- Routine Monitoring (Code 1): The level of monitoring and minor maintenance is probably appropriate for the stations. Other jurisdictions require that pump stations are visited/monitored daily, however, with the presence and functionality of the SCADA system, the weekly regime appears to be effective. No costs were identified and attributed to employees monitoring the system from the control room, so it is assumed that this cost is already included in the quarterly billing. The average quarterly cost of Code 1 Maintenance was $4,486.
- Major Maintenance (Code 2): The level of major maintenance is irregular from one quarter to the next. There is considerable evidence of improvements in progress that are apparently being charged against the Code 2 maintenance account. The study period revealed a high quarterly cost of Code 2 Maintenance $18,732, and a low quarterly cost of $2,973. The average quarterly cost of Code 2 maintenance was $9,330.

Assuming an annual escalation rate of 4 percent, the estimated operations and maintenance costs chargeable from MRWPCA for the next five years are shown in Table 4-9. The estimated annual operations and maintenance cost is $55,300 (2004 dollars), which does not include power costs.

Table 4-9: Projected Pump Station Operations and Maintenance Costs

Items	Average Quarterly	Annual	Year 1	Year 2	Year 3	Year 4	Year 5
Operations and Minor Maintenance (Code 1)	$4,486	$17,946	$18,664	$19,410	$20,187	$20,994	$21,834
Maintenance and Repairs (Code 2)	$9,338	$37,354	$38,848	$40,402	$42,018	$43,699	$45,447
Totals	**$13,825**	**$55,300**	**$57,512**	**$59,812**	**$62,205**	**$64,693**	**$67,281**

Note: The costs are in 2004 dollars.

4.2.3 Optimized Maintenance Program

The following recommendations have been developed for the City for an optimized pump station maintenance program.

4.2.3.1 Pump Monitoring and Testing

There are many possible ways of determining and evaluating the performance level of sewer pumps.

4.2.3.2 Regular Monitoring of Operating Hours and Number of Starts

The most basic method is to monitor the operating hours of pumps in a pump station over time to determine the individual run times. Generally, the operating hours are compared regularly, and if a significant deviation is detected, the pumps should be checked. This approach is regarded as a basic method of troubleshooting, and is most commonly integrated into the pump station patrol activities and documented on the patrol reports. If pump starts and stops can be tracked by a pump monitoring or SCADA system, the data can be captured and trended to give the control room and managers a tool for determining if performance is gradually degrading. In addition to pump operating hours, tracking pump starts can also provide useful information regarding the performance of the pumps.

4.2.3.3 Pump Draw Down Times

Periodically, the station pumps should be monitored at the site to determine the operating time between start and shutoff. The operating time between start and stop can be timed and the relative performance evaluated. Since the inflow rate can affect the data, the amount of inflow must be estimated by monitoring fill time, and adjusted to determine the actual pumping rate. Some pump monitoring systems and SCADA are set up to track time to fill and time to pump out, and can provide a warning if the calculated time to pump out is significantly less that the actual. This can performed as part of the regular weekly maintenance visits over a period of time. For example, one pump can be tested each month.

4.2.3.4 Flow Metering

The pump stations can be fitted with flow meters. Magnetic flow meters are non-intrusive and directly measure the fluid flow measurement. Such meters can give accurate and instantaneous flow values, and can also reveal leaking check valves and other problems. Flow meters can also be integrated with the SCADA system to provide trend data. Flow meters can be installed on the common discharge line or on the individual pump discharge lines. In most instances, a single flow meter can provide good results for a small station with two or three pumps.

4.2.3.5 Establishing Base Lines

Regardless of the method of pump performance measurement, it is important to carefully test new pumps and determine the actual base line performance of the pump station prior to placing them into service. The testing will require several test runs. If possible, the wet well should be filled with clean water and the pumps tested for several cycles to establish the level of performance.

4.2.3.6 Predictive Maintenance Technologies

Technologies such as thermographic monitoring of electrical systems and rotating equipment, vibration monitoring of rotating equipment, lube oil analysis and amperage demand trends for motors can disclose changes in performance before failures occur. Sufficient response times can be available to enable procurement of parts and scheduling of staff.

Because failures of pump station equipment pose threats of sewage spills, it is recommended that predictive maintenance technologies be utilized at appropriate frequencies.

4.2.3.7 Increase Coordination with MRWPCA

It is recommended the City to increase coordination with MRWPCA by doing the following:

- Request MRWPCA to provide pump station O&M reports to the City on a monthly-basis regarding the work that is planned, the work that has been completed, and any significant events that have occurred.
- Request MRWPCA to track labor and costs by individual pump station.

4.3 Force Mains

The force mains are located downstream of the City's pump stations. MRWPCA owns and operates the force mains that are downstream of PS #13 and #15. The City should implement a periodic force main inspection program to identify problems early to prevent SSOs.

4.3.1 Typical Operation and Maintenance Practices

Typical O&M practices include:

- Inspect air valves, if any.
- Walk the right-of-way periodically to check for leaks.
- Exercise valves located in pump stations.
- Sample at sewage discharge to determine total dissolved sulfides. Hydrogen sulfide can cause corrosion of concrete pipe and structures.

4.3.2 Current Maintenance Organization

The pump station O&M activities are managed by the Public Works Director/City Engineer. The City has no pump station staff.

4.3.3 Optimized Maintenance Program

There is a need for a force main inspection program. In addition to the typical O&M practices listed earlier in the section, the following is also recommended:

1. Define location of force mains.
2. Determine pipe material, liner (if any), and soil conditions.

3. Enter all data collected into the CMMS and the GIS. Keep data current. Implement systems to ensure that the data is both current and correct.
4. Provide periodic inspection and maintenance for all force mains.
5. Conduct pipe to ground potential testing to determine level of corrosion.
6. Consider installing a second force main at pump stations where a pump-around operation would be impractical.
7. Install dry manhole at critical locations to provide access to force main for inspection. For example, high spots in the alignment which is an area where corrosive gases can accumulate.

5 Capacity Assessment

Sewer overflows occur when and where the flows exceed the pipe capacities. This section will discuss the steps taken to evaluate the capacity of the City's collection system and the findings.

5.1 Flow Monitoring

Flow monitoring was conducted to collect data on actual sewer flows and to estimate inflow and infiltration (I/I).

5.1.1 Approach

Flow meters were installed inside sewers at representative locations in the service area. In order to establish the baseline condition, flows were measured for a period of two months at four locations between January and March, 2004. The selected locations received flow from the entire sewer system except for PS #15.5 flows. PS #15.5 collects sewer from a small public bathroom near the City's golf course and its flow is considered negligible. During wet weather events, sewer flows increase due to rainfall dependant inflow and infiltration (RD I/I) and the seasonal increase in ground water infiltration (GWI).

While these flow data provide essential parameters for the capacity analysis in this SSAMP, they are based on records collected at a limited number of locations over a limited time duration.

5.1.2 Flow Monitors and Rain Gauges

Flow monitoring locations were selected based on their hydraulic suitability, accessibility, and ability to capture the flow from the largest number of parcels in a basin.

A preliminary flow meter placement analysis was completed based on the maps and information provided by the City. All proposed flow monitoring sites were field verified for feasibility. The site visits were necessary before installation in order to observe the flow characteristics, possible hard and soft sedimentation, inconsistent hydraulic features (e.g. number of pipes entering and exiting the manhole, weirs, overflows, curved channels, etc.), grease build-up, as well as the possibility of variances between map data on pipe sizes and slopes and actual field conditions.

Initially, the scope of work for the SSAMP set the number of flow meters to be used for this project at two meters. Based on the analysis, it was determined that four meters would give a better overview of the flow situation in the City. Also, since there were no significant wet weather events during the first four weeks of flow monitoring, the flow monitoring period was extended another four weeks.

The topography and sanitary sewer system layout for the City lends itself to divide the collection system into two regions: the West Side and East Side. The West Side includes mostly low-density residential neighborhoods, and should see similar rainfall distribution throughout the region. The East Side includes higher-density residential housing as well as a small downtown and business district.

5.1.2.1 Flow Monitors

Four Sigma 910 flow monitors were installed on January 19, 2004 and removed on March 19, 2004. American Sigma 910 flow monitors are depth-velocity flow monitors. They can measure and record level, velocity and flow. They consist of a submersible ultrasonic sensor (commonly referred to as probe), connecting cable, and a remote enclosure with indicating, transmitting, and controlling electronics. The ultrasonic sensor is installed at the center of the bottom of the pipe.

To measure water level the sensor transmits ultrasonic pulses that travel through the water and reflect off the liquid surface. The instrument precisely measures the time it takes for echoes to return to the sensor. Flow velocity is also measured with an ultrasonic signal. This high frequency sound is reflected back to the sensor from particles or bubbles suspended in the liquid. If the fluid is in motion, the echoes return at an altered frequency creating a Doppler shift that is proportionate to flow velocity. Typical accuracy of traditional depth-velocity flow monitoring equipment is ± 5 to 30 percent.

Calibration was performed weekly during the first four weeks and biweekly during the last four weeks. Data was downloaded weekly. During the eight week flow monitoring period, no data was lost.

Figure 5-1 identifies key elements of the collection system, divides the system into potential flow monitoring basins, and identifies the flow monitoring and rain gauge locations. The colored flow monitors capture flows from the correspondingly colored sewers. Table 5-1 contains information about the flow monitoring locations. Appendix F contains the methods and procedures used to install the flow monitors.

Figure 5-1: Flow Monitor and Rain Gage Locations

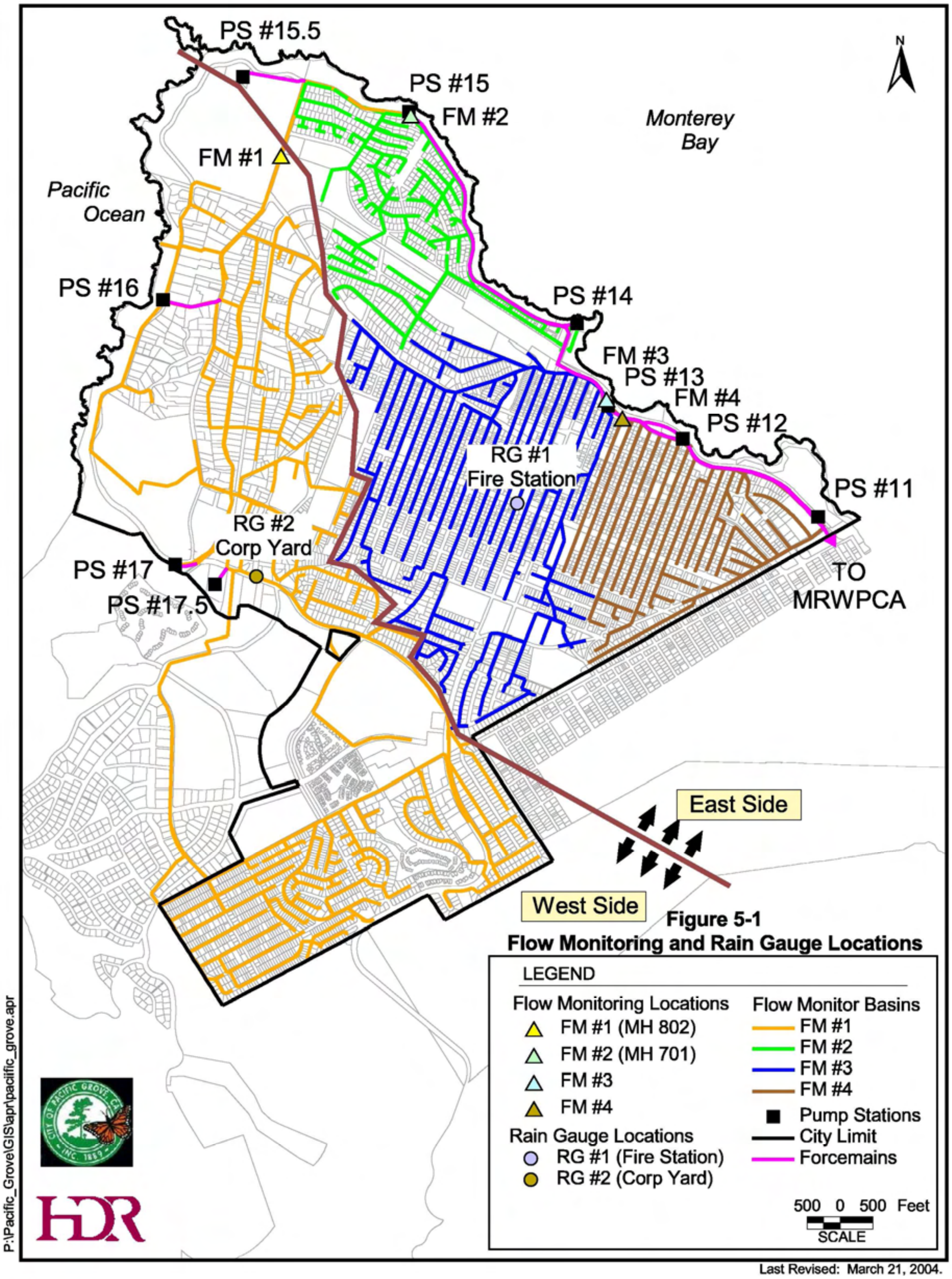


Table 5-1: Flow Monitoring Locations

Flow Monitor ID	Basin	Flow Monitoring Location (Manhole ID)	Location	Existing Connections Upstream of Monitoring Manhole
FM #1	1	MH 802	Ansilomar Avenue between Del Monte Boulevard and Lighthouse Avenue	2,094
FM # 2	2	MH 701	Ocean View Boulevard between Coral Street and Esplanade Street	6,08
FM # 3	3	MH 986	Ocean View Boulevard near 15th Street	2,028
FM # 4	4	MH 227	Ocean View Boulevard near 15th Street	1,019
			Total	**5,749**

- Flow Monitor #1 (FM #1)

FM #1 was located at Manhole 802 (MH 802) in Asilomar Avenue between Del Monte Boulevard and Lighthouse Avenue. The entire West Side (Basin 1) discharges into a 15-inch trunk line sewer with ideal flow characteristics. The run is straight with minimal turbulence, and was expected to provide accurate flow data.

The sewer lines downstream of FM #1 are trunk sewers and only the flow from PS #15.5 enters the trunk line before it discharges into PS #15. As PS #15.5 only serves a two toilet public restroom, the flows are thought to be negligent and no flow meter was proposed to measure for PS #15.5 flows.

- Flow Monitor #2 (FM #2)

FM #2 was located in MH 701 in Ocean View Boulevard between Coral Street and Esplanade Street. This sewer is 8-inches in diameter.

FM #2 measured the flow from Basin 2 that discharges into PS #15.

- Flow Monitor #3 (FM #3)

FM #3 was located in MH 986 in Ocean View Boulevard near 15th Street. This sewer is 15-inches in diameter. It is located two manholes upstream of PS #13.

FM #3 measured the flow from Basin 3.

- Flow Monitor #4 (FM #4)

FM #4 was located in MH 227 in Ocean View Boulevard near 15th Street. This sewer is 8-inches in diameter. It is located two manholes upstream of PS #13. FM #4 measured the flow from Basin 4 that discharges into PS #13.

Flow monitoring location observation forms are contained in Appendix G. Hourly flow monitoring data is contained in Appendix H. The graphical representation of the data is followed by the tabular data.

5.1.2.2 Rain Gauge Sites

Two rain gauges were installed, one located on the West Side and one on the East Side. The rain gauge sites were selected in order to accurately capture rainfall on both sides of the City.

Rain gauge locations need to have the following characteristics: secure location, flat surface, and absence of overhead obstructions (air space above and to the sides of the rain gauge should be clear).

The East Side rain gauge location, Fire Station RG, was located on the roof of the City's Fire Station (600 Pine Avenue). Data from the Fire Station RG was used used for analysis of Basins 2, 3, and 4. The West Side rain gauge, Yard RG, was located on the roof of City's Corporation Yard building (2100 Sunset Drive).

5.1.3 Flow Monitoring Results

The results of the flow monitoring program are discussed below.

5.1.3.1 Daily Flow Monitoring

For this SSAMP, the flow monitoring took place during the time of year that is not typically considered "dry weather." Therefore, the average daily flows found during this time period include groundwater infiltration (GWI) and possibly rainfall dependant I/I (RDI/I). In order to minimize the influences of GWI and RDI/I, average daily flows were determined from the flow monitoring data during days that were least affected by rainfall. This included the following days: January 20-23, 25-31; February 1; and March 2-18, 2004.

The flow monitoring data shows a diurnal pattern, with the average flows of the flow monitors ranging from 0.14 to 0.93 million gallons per day (mgd) and peak flows during that period of 0.25 to 1.33 mgd. Table 5-2 presents a summary of the average daily flow monitoring results. Average flow monitoring data is included in Appendix I.

Table 5-2: Average Daily Flow Monitoring Results

Flow Monitor ID	Basin	Average Daily Flow (mgd)	Peak Daily Flow* (mgd)
FM #1	1	0.41	0.62
FM # 2	2	0.14	0.25
FM # 3	3	0.93	1.33
FM # 4	4	0.23	0.39
Totals		**1.71**	**2.59**

Note:
*Peak flow on days with no rainfall.

5.1.3.2 Wet Weather Flow Monitoring

Wet weather flow monitoring data analysis focused on the flow monitoring data surrounding storm events. Results of the flow monitoring data shows wet weather flows from the flow monitors ranging from 0.32 to 1.60 mgd.

Table 5-3 presents the results of the wet weather flow monitoring. Wet weather flow monitoring data is included Appendix J.

Table 5-3: Wet Weather Flow Monitoring Results

Flow Monitoring ID	Basin	Peak Wet Weather Flow (mgd)
FM #1	1	0.74
FM # 2	2	0.32
FM # 3	3	1.60
FM # 4	4	0.62
	Total	**3.28**

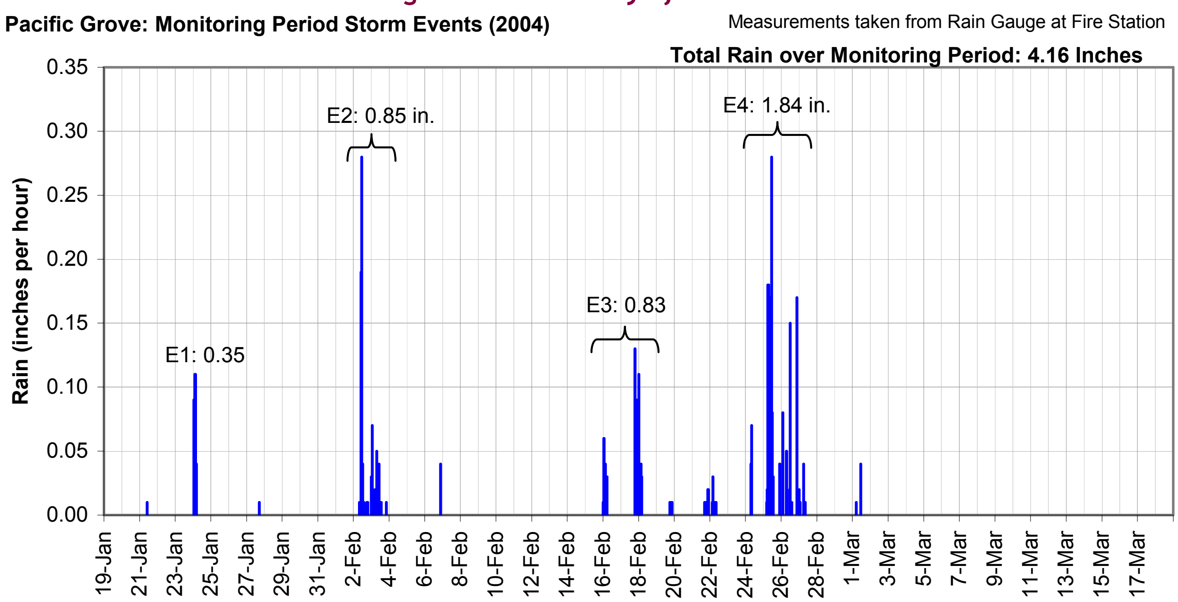
5.1.3.3 Rainfall Data

There were 4 storm events during the flow monitoring period (Table 5-4). Figure 5-2 graphically displays the four storm events.

Table 5-4: Summary of Storm Events

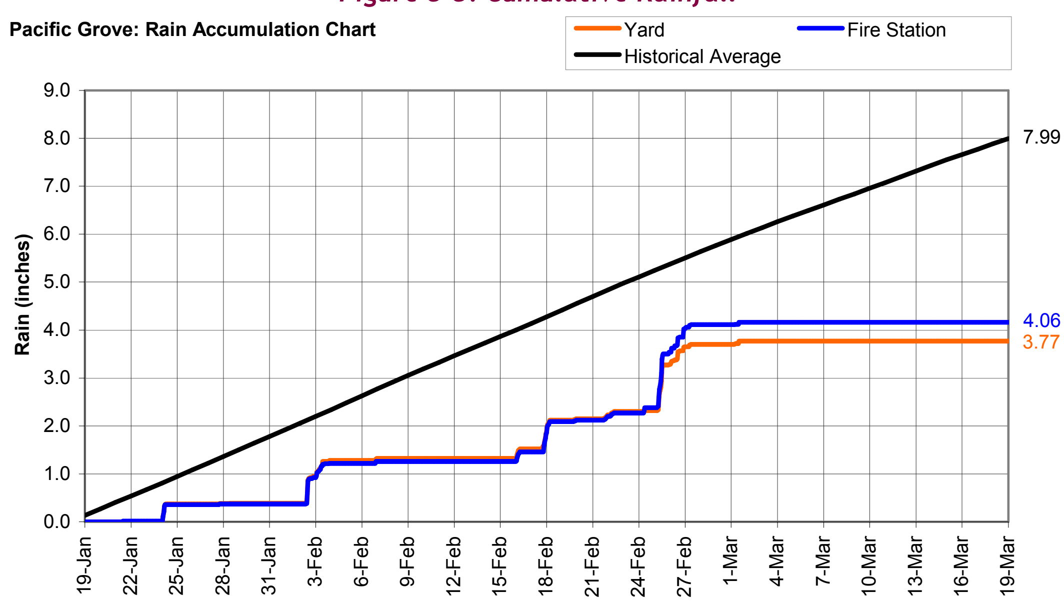
Storm Event No.	Fire Station Rainfall (inches)	Yard Rainfall (inches)	Event Period	Event Description	Soil Condition
E1	0.35	0.37	**4 Hours** 1/24 1:00 to 1/24 5:00	Light-to-moderate intensity over short duration.	Lightly-to-moderately saturated from storm events on 12/29/03 and 1/1/04.
E2	0.85	0.89	**1.1 Days** 2/2 8:00 to 2/3 10:00	Two high intensity hours followed by light intensity rainfall for one day.	Moderately saturated.
E3	0.83	0.80	**2.2 Days** 2/16 0:00 to 2/18 4:00	Two distinct light-to-moderate intensity rainfalls over short duration.	Moderately saturated.
E4	1.84	1.40	**3.0 Days** 2/24 7:00 to 2/27 8:00	High, moderate, and light intensity rainfall over long duration.	Moderately saturated.

Figure 5-2: Summary of Storm Events



The total rainfall during the flow monitoring period was 4.16 inches at the Fire Station RG and 3.77 inches at the Yard RG. Figure 5-3 shows that this is approximately half of normal levels based on the average rainfall of 7.99 inches for the period January – March (Western Regional Climate Center (WRCC) at Station 045795 in Monterey, California 1971 - 2000).

Figure 5-3: Cumulative Rainfall



The largest total rainfall for a 24-hour period occurred during storm event 4 (E4) from February 25, 2004 4:00 to February 26, 2004 3:00 with a total of 1.24 inches (Fire Station RG). The highest average rainfall intensity over a 6 hour duration was 0.16 inches/hour that occurred on February 25, 2004 6:00 to 11:00 (Fire Station RG).

The data from the Yard RG was used for analysis of Basin 1. Data from the Fire Station RG was used for analysis of Basins 2, 3 and 4.

The tabular rainfall data is located in Appendix H and the graphical representation is located in Appendix K.

5.1.3.4 R Factor Analysis

The R factor or R-value is the percentage of the rainfall volume that enters a collection system. Basins with R factors less than 5 percent[5] are often considered to be performing well or normal. R factors between 5 and 10 percent are considered greater than normal but not of significant concern. R factors greater than 10 percent indicate significant stormwater entry into the sewer system. Table 5-5 shows the results of the R factor analysis performed on storm event E4 (February 24-27, 2004). Basin 3 and 4 are the oldest areas of the City (pre-1910) and it was expected that their R factors would be greater than either Basin 1 or 2.

Table 5-5: R Factor Analysis for Storm Event E4

Flow Monitoring Location	Basin	Basin Area (sq. miles)	Total RDI / I (gallons)	R factor
FM # 1	1	1.63	143,000	0.3% *
FM # 2	2	0.36	330,000	2.9%
FM # 3	3	0.57	1,298,000	7.1%
FM # 4	4	0.31	533,000	5.4%
Totals		**2.87**	**2,304,000**	**2.5% ****

Notes:

* The R factor for this basin appears low due to the fact that there is are large unsewered open space areas in the basin. When this area is deducted, the R factor is equal to 0.4%

** Overall R factor for service area.

The flow monitoring and rainfall data were used to develop the projected flows that were used in the hydraulic analyses that are described later in this report.

Appendix L contains the wet weather I/I volume analysis.

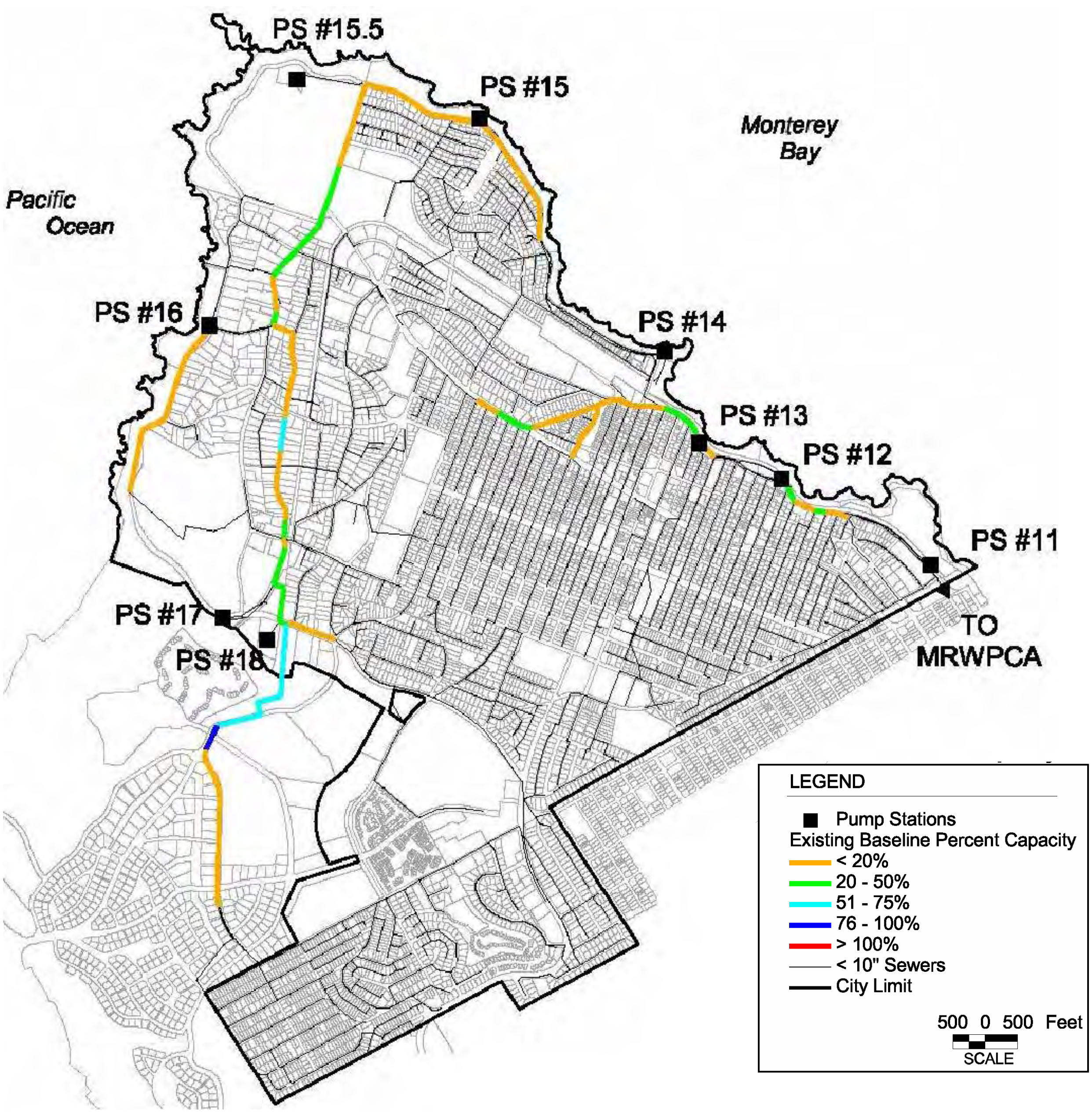
5.2 Wet Weather Field Investigation

A field reconnaissance investigation was performed by on February 26, 2004 from 12:30 a.m. and 4:30 a.m. This was at the tail end of Storm Event (E4). The purpose of this investigation

[5] Keefe, P.N. "Test Basins for I/I Reduction and SSO Elimination", 1998, WEF Wet Weather Specialty Conference, Cleveland, Ohio.

was to examine the I/I issues within the collection system. The inspection, ideally, is conducted during the extreme low flow hours (nighttime) so as to better track excessive clear-water flow within the collection system. The clear flow is indicative of I/I. Based on preliminary flow analysis, the investigation was conducted at areas which were suspected of having capacity issues (pipelines with baseline flows greater than 50 percent capacity as shown in Figure 5-4).

Figure 5-4: Baseline Percent Capacity Map

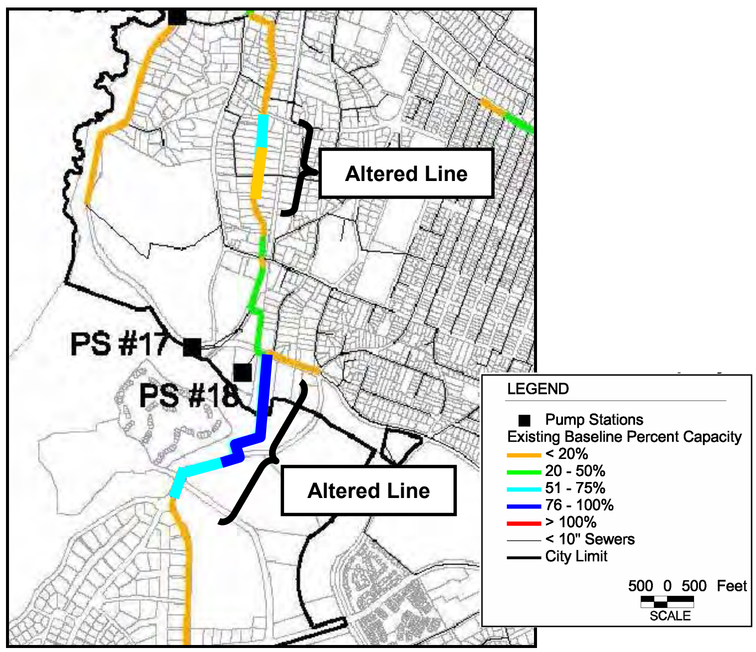


5.2.1 Wet Weather Observation Results

The field observations validated the results of the preliminary hydraulic analysis. The observations indicate that most of the capacity issues are located in the areas from 17-mile drive, just before the 90 degree turn into the Spanish Bay Golf Course, through Sunset Avenue at the City corporation yard. This stretch of pipeline had observed flows of 51 to 75 percent of capacity based on subjective observation.

Based on the observations of the field inspection, the baseline capacity map should be altered according to Figure 5-5.

Figure 5-5: Capacity Map (Estimated Based on Field Observations)



Note: this is a subjective analysis and the map below is estimated.

A second area of observation was in Basin 4. Basin 4 contains many parallel lines that serve approximately the same number of homes and feed into the same trunk sewer. A sewer line that has an infiltration problem may be identified by observing the flow from each line as it enters the trunk sewer. The locations observed were along Ocean Boulevard at the following cross streets: 14th Street, 13th Street, 12th Street, 11th Street, and Carmel Avenue. The lines servicing 12th Street and 14th Street contributed the most infiltration with an estimate of 15 and 20 gallons per minute of clear water observed.

The wet weather field investigation forms can be found in Appendix M.

5.3 Inflow Analysis

Sources of inflow include direct and indirect cross connections with storm drainage systems, roof downspouts, and various surface drains. The City's smoke and dye testing data was analyzed and recommendations were developed for the control of inflow.

5.3.1 Dye Testing

Dye testing was used to determine if a lateral or main line is open or closed (plugged). It consists of dropping the dye into the upstream access point (manhole or cleanout) of the suspected plug or blockage. A person is stationed at the downstream access point observes if the dye appears. If dye is observed at the downstream site, the line is not plugged. If the dye is not observed in a reasonable time period, the line is most likely plugged or connected elsewhere.

The City conducts dye testing as needed. It occurs a few of times a year. Currently there are no records of the dye testing. It is recommended that the City begins recording their dye testing efforts. This data should be entered into the CMMS database.

5.3.2 Smoke testing

Smoke testing is one of the best ways to detect sources of storm water inflow. Yard drains and roof leaders that are connected to the sewers will emit smoke when a smoke generator is placed in the sewer system. Trapped drains and sump pumps generally do not allow the smoke to pass, and thus are not detected by smoke testing.

A review of smoke testing data was performed. Smoke testing was performed in 1997, 1999, 2000, 2002, and encompassed the majority of the City's service area. There are a few random sewers that were not smoke tested due to inaccessibility. The smoke testing data includes the following (*denotes City jurisdiction):

- Area Drain
- Catch Basin*
- Cleanout
- Lateral*
- Sanitary Manhole*
- Storm Manhole*
- Downspout
- Sewer Main*
- In Building Plumbing
- Other (smoke in bathroom, smoke under the house, etc.)

The most common area where smoke emissions were detected was at cleanouts on private laterals. Cleanouts are the responsibility of the property owner. There were a total of 273 instances in which smoke emissions were observed. The City contacted the property owners whose smoke emissions indicated that the inflow may contribute relatively large quantities of flow using the estimated size of the drainage area to establish priorities. Table 5-6 is a summary of the smoke testing data.

Table 5-6: Summary of Smoke Testing Data

Year	Miles Tested*	Number of Smoke Emissions Observed	Number of Smoke Emissions Observed in City Jurisdiction*	Number of Smoke Emissions Not in City Jurisdiction	Number Notified	Corrections to Date
1997	13.5	103	N/A	N/A	24	11
1999	14.1	56	7	49	25	18
2000	18.1	96	12	84	13	4
2003	7.9	18	0	18	0	0
Totals	**53.6**	**273**	**19**	**151**	**55**	**21**

Note:
*City's jurisdiction includes defects found in manholes (sewer or storm), sewers, and cross connections.

It is recommended that the smoke testing be completed on the areas that were previously inaccessible. Also, it is recommended that any yard drains, sump pumps, catch basins, and roof leaders that are identified should be required to be disconnected.

5.3.3 Flow Monitoring Data Discussion

Inflow is usually recognized in flow monitoring data graphically by large magnitude, short duration spikes immediately following a rain event. The only flow monitoring site to show this type of behavior was FM #1 which was located in Basin 1. The flow spiked immediately following the storm events and quickly returned to average daily flow levels. Inflow in this basin is not a cause for concern because the R-factor of 0.30 percent is low.

5.3.4 Wet Weather Field Investigation

The field investigation also did not show any significant sources inflow. It did identify a storm drain manhole cover at Sinex and Crocker in the collection system that contained many holes in the lid. This is a source of inflow. It is recommended that this manhole cover be replaced with a conventional sewer manhole cover. Any other manhole covers of this type should also be replaced.

5.4 Flow Projections

Two flow projections were developed for use in evaluating the capacity of the sewers: existing peak wet weather flow and buildout peak wet weather flow. The wastewater flows were estimated using unit flow rates obtained from the flow monitoring data and parcel data.

5.4.1 Flow Components

Flows are composed of three components: baseline or base sanitary flow (BSF), groundwater inflow & infiltration (GWI), and rainfall dependent inflow & infiltration (RD I/I).

5.4.1.1 Baseline

Baseline or base sanitary flow (BSF) is composed of wastewater produced by residential, commercial, industrial, and institutional land uses. BSF is calculated by:

$$\text{BSF per Connection} = \left(\frac{\text{ADWF @ FM}}{\text{\# of Connected Parcels Upstream of FM}}\right) - \text{GWI}$$

Abbreviation Key:

ADWF = Average Dry Weather Flow
FM = Flow Monitor

BSF, for the City, ranges from 200 to 460 gallons per day (gpd) per parcel. Since the flow monitoring was conducted during a time of year that is not usually considered dry weather, the variation in unit flow rates may be the result of inflow and infiltration. Therefore, for the purposes of this report, the baseline flow will be assumed to include groundwater inflow & infiltration (GWI) and the unit flow rates will be the considered the average flows during the flow monitoring period.

As part of this SSAMP, a review of previous studies and reports was performed. Previous studies include ones prepared for the City and the MRWPCA. The goal of the review was to determine if unit flow rates were available and useable for the flow projections task.

The following documents were referenced in this task:

- Prepared for the City of Pacific Grove:
  - Sewer Rehabilitation Project - Subbasin 202/Manhole 114 to 117, CH2M HILL, January 1990.
  - Smoke Return Reports, DD&A Consultants, July 1978.
- Prepared for Monterey Regional Water Pollution Control Agency:
  - Facilities Plan for North Monterey County - Sewer System Evaluation Survey Report, Engineering-Science, September 1979.

- Stage 1 - Consolidation Project of the Regional Sewerage System, Engineering-Science, March 1975.
- Final Facilities Plan Report for North Monterey County, Engineering-Science, January 1978.
- Final Facilities Plan for North Monterey County - Interim Report No. 2 - Infiltration/Inflow Analysis, Engineering-Science, June 1976.

The available studies and reports did not include any useable data related to flow coefficients or wet weather flows. The 1978 Final Facilities Plan Report for North Monterey County contained a flow coefficient of 75 gallons per day per capita (gpdc) average dry weather flow. This number is considered low. Typically values are 80-100 gpdc. Since the 75 gpdc estimate is on the low end and from a report dated 1978, the flow monitoring data was used for determining baseline flows.

Table 5-7 presents the average flow rates for the City.

Table 5-7: Unit Flow Rates and Peaking Factors

Basin	Average Flow per Parcel* (gpd)	Observed Peaking Factor**
1	200	1.8
2	230	2.3
3	460	1.7
4	230	2.7

Notes:
*During flow monitoring period. Assumed to include GWI.
**PF for largest storm event during flow monitoring period.

5.4.1.2 Groundwater Inflow & Infiltration

Groundwater inflow & infiltration is I/I not directly related to a storm event. Infiltration is defined as storm and/or groundwater that enters the sewer system through defects such as cracked pipes, offset joints, leaky manholes, etc. Inflow is defined as storm and/or groundwater that enters the sewer system through improperly connected storm drains, down spouts and sump pumps. Stormwater is the source of most inflow and groundwater is the source of most infiltration. Since I/I is composed of "clean" water, it needs to be minimized because of cost of treatment, conveyance, and capacity issues.

As discussed in the previously, the average flows during the flow monitoring period is assumed to include GWI.

5.4.1.3 Rainfall dependent inflow & infiltration

Rainfall dependent inflow & infiltration (RD I/I) is I/I directly related to storm events. For this SSAMP, a peaking factor was established for wet weather flow. Peaking factors are calculated by:

PF = PWWF / ADWF

Abbreviation Key:

PF = Peaking Factor
ADWF = Average Dry Weather Flow (average flow during flow monitoring period)
PWWF = Peak Wet Weather Flow (of largest storm during flow monitoring period)

During the flow monitoring period, the observed PF ranged from 1.7 to 2.7 for the largest storm event. This storm event, as discussed previously, was smaller than a 2 year frequency storm event. Our desired design storm is a 10 year 24 hour storm event as defined by data received from the Monterey County Water Resources Agency. Therefore, a conservative assumption was made and the peaking factor used in the hydraulic analysis was the peaking factor of the monitored storm event with an increase of 50 percent. This method accounts for the flow differences between the observed storm and the design storm. The assumed 50 percent increase is based on HDR experience and engineering judgment.

Since the peaking factors for a storm event does not increase linearly with the rainfall intensities, the peaking factors were not similarly increased. For this SSAMP, the RDI/I was not increased for the buildout condition based on the assumption that new sewers would offset the increase of I/I as the existing system ages. New sewers have improved construction methods and better standards, which leads to less I/I than existing sewers.

Table 5-8 contains the peaking factors for the City.

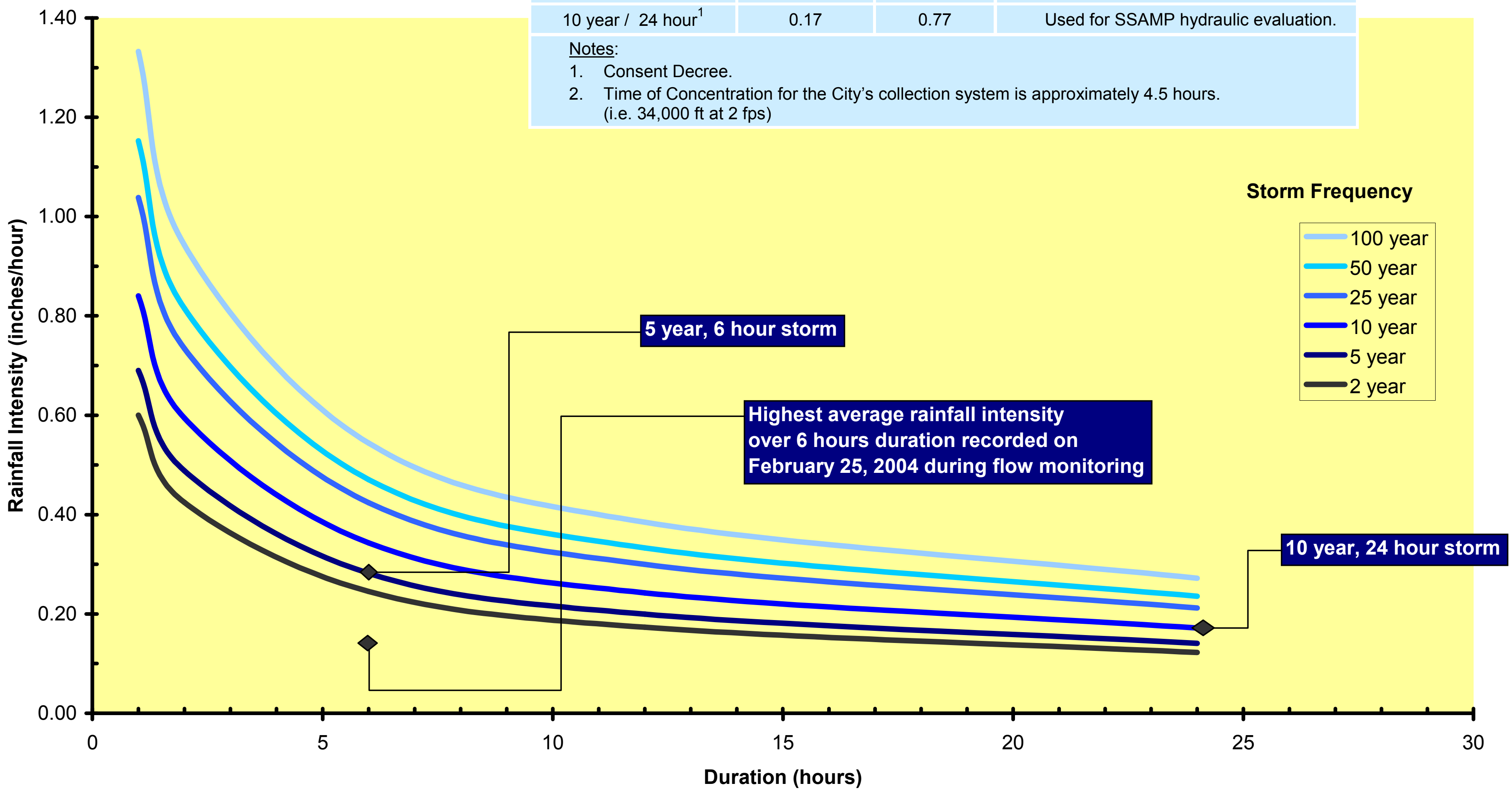
5.4.2 Intensity Duration Frequency

To aid the City in determining the Intensity-Duration-Frequency (IDF) of a storm event, Figure 5-6 was developed. To determine the frequency and duration of a storm event (i.e. 10 year 6 hours), the intensity and duration (from rain gauge data) of a particular storm event is used. The frequency is determined by where the two values intersect in the graph. For example, if a storm event had an average intensity of 0.28 inches/hour for 6 hours, it is a 5 year 6 hour storm. The source data for the IDF curves are contained in Appendix N.

Figure 5-6: Intensity-Duration-Frequency (IDF) Curves

Storm (Return Period / Duration)	Intensity (inches/hour)	Rainfall (inches)	Comments
5 year / 6 hour	0.28	1.27	Commonly used design storm
10 year / 24 hour[1]	0.17	0.77	Used for SSAMP hydraulic evaluation.

Notes:
1. Consent Decree.
2. Time of Concentration for the City's collection system is approximately 4.5 hours. (i.e. 34,000 ft at 2 fps)



5.4.3 Flow Projections

Two flow projections were developed for use in evaluating the capacity of the sewers: existing peak wet weather flow and buildout peak wet weather flow.

5.4.3.1 Peaking Factors and Estimated Existing Peak Wet Weather Flows

The existing peak wet weather flows were projected by applying a peaking factor to the average daily flows that were observed during the flow monitoring period. There was no opportunity to determine the average dry weather flow due to the timing of this project. The average daily flows were measured between January and March and they are a combination of the base sanitary flow (BSF) and the ground water infiltration (GWI). They may also include a minor amount of rainfall derived inflow and infiltration (RDI/I).

The observed average daily flows ranged from 200 to 460 gallons per day per parcel. The observed peaking factors were increased by 50% to account for the increased flows that would be associated with the design storm. The 50% increase is based on engineering judgment and experience from other projects. It is considered to be conservative as it is being applied to average daily flows that include seasonally elevated levels of GWI and possibly some RDI/I. The resulting peaking factors and peak wet weather flows are shown by basin on Table 5-8. This information was used to calculate the PWWF contribution per parcel and the contribution from each parcel was applied to the line segments in the hydraulic model.

Table 5-8: Peaking Factors (PF) and Estimated Existing Peaking Wet Weather Flows

Basin Number	Observed Peaking Factor	Estimated Peaking Factor for Design Storm Event*	Design Storm Existing Peak Wet Weather Flow (mgd)
1	1.8	2.7	1.13
2	2.3	3.4	0.48
3	1.7	2.6	2.41
4	2.7	4.0	0.95
		Total	**4.97**

Note:
*Observed PF x 150%.

5.4.3.2 Projected Buildout Peak Wet Weather Flows

The buildout peak wet weather flows were projected by increasing the number of connections in each basin to include both infill of 132 vacant parcels and the addition of 1,600 secondary housing units. The same peaking factors from Table 5-8 were applied to the average daily flow contribution for each parcel. The projected buildout PWWF is shown for each basin in Table 5-9. See Appendix O for details.

Table 5-9: Projected Buildout Peak Wet Weather Flows

Basin Number	Estimated Peaking Factor for Design Storm Event*	Design Storm Buildout Peak Wet Weather Flow (mgd)
1	2.7	1.49
2	3.4	0.61
3	2.6	2.73
4	4.0	1.20
	Total	**6.02**

Note:
*Observed PF x 150%.

5.5 Flow Modeling

A computer model was developed of the sewers that are greater than 10 inches diameter and critical 6- and 8-inch diameter sewers. The flow projections developed in the previous section was used to populate the model. The model was used to evaluate the capacities of the sewers to carry existing and projected buildout peak flows.

5.5.1 Hydraulic Model

Hydraulic capacity analysis is only necessary for the modeled sewers because the other 6- and 8-inch sewers do not have enough contributing parcels to be of a concern.

5.5.1.1 Hydraulic Model Description and Development

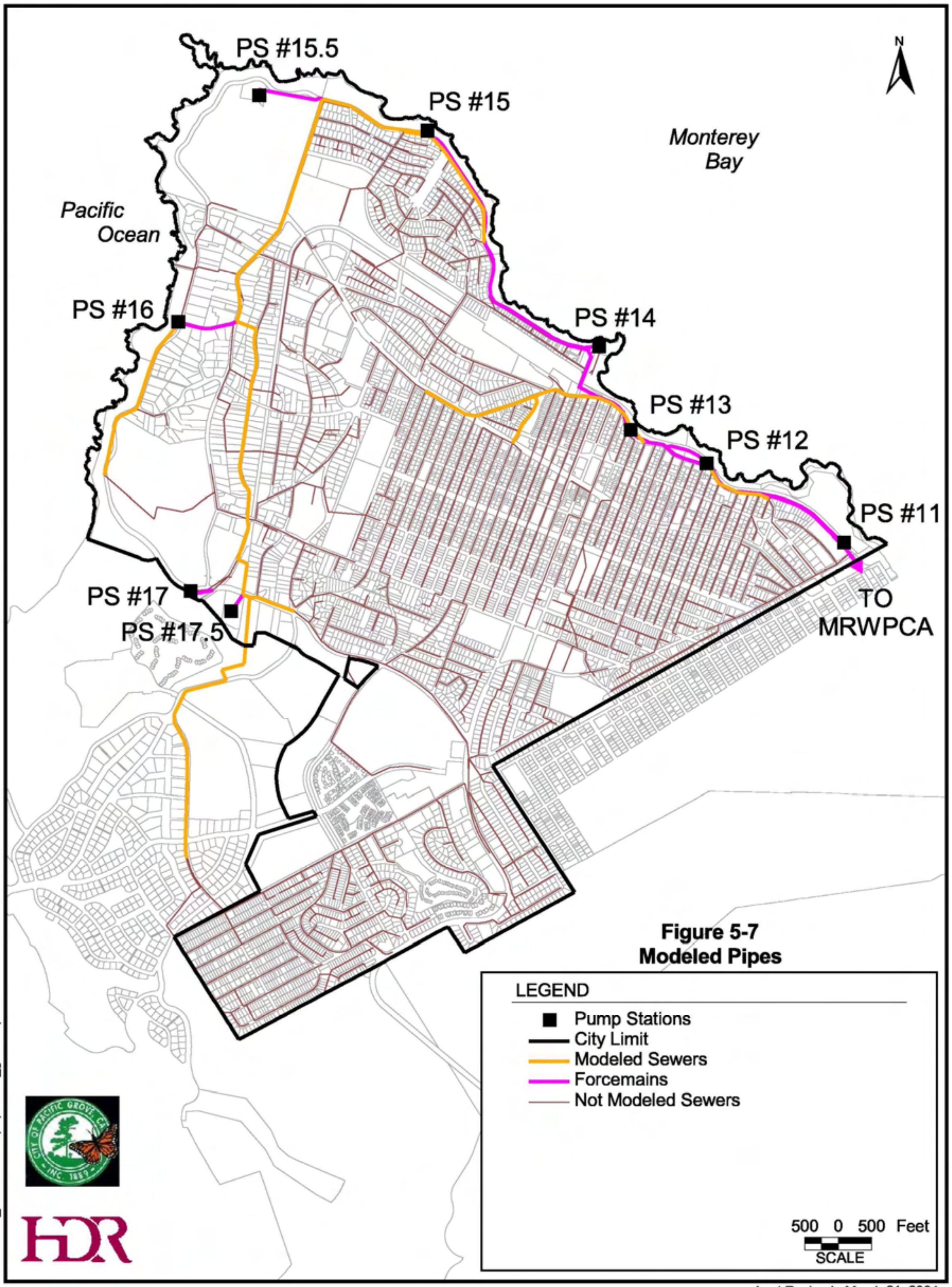
The hydraulic model developed for the City is a static model. A Microsoft Excel spreadsheet was developed to perform the hydraulic calculations for the capacity of each sewer.

The model contained 102 pipe segments (Figure 5-7). Manning's equation, with an assumed roughness value of 0.013, was used to calculate the full pipe capacity of each pipe segment. For pipes with unknown invert elevations, an average slope was calculated between known upstream and downstream elevations. For pipes without invert data for the entire reach, an assumed slope of 0.002 ft/ft was used.

To evaluate the collection system, the flow in each basin needed to be distributed along the length of the sewer network. In each basin, developed parcels were assigned to the manhole where those parcels would discharge their flow. These developed parcels were used to calculate the cumulative wastewater flow in downstream line segments.

In each basin, existing and buildout average and peak wet weather flows were calculated for every line segment included in the hydraulic model.

Figure 5-7: Modeled Pipes



Last Revised: March 21, 2004.

5.5.2 Capacity Deficiencies

This section presents the results of the hydraulic analysis for existing and buildout average dry weather and peak wet weather flows. Table 5-10 provides a summary of the hydraulic evaluation criteria.

Table 5-10: Summary of Hydraulic Evaluation Criteria

Task	Existing Condition	Buildout Condition
Design storm	Return Period = 10 years Duration = 24 hours	Return Period = 10 years Duration = 24 hours
Deficiency Criteria	PWWF (1) > 100% Pipe Capacity	PWWF (1) > 75% Pipe Capacity (3)
Design Criteria for replacement sewer (4)	Size new pipe for buildout condition.	PWWF (1) < 75% Pipe Capacity ADWF (2) Velocity > 2 fps
Develop phasing of improvements	Assign first priority to deficient sewers under this condition	Assign priority to deficient sewers based on infill development timing: Priority 1: Impending structural failure (highest priority) Priority 2: Capacity exceeding 100% Priority 3: Capacity exceeding 75%

Notes:

1. PWWF = peak wet weather flows
2. ADWF = average dry weather flows
3. This allows for a factor of safety of 25% of the full pipe flow.
4. Assumed replacing deficient sewer instead of constructing parallel relief sewer because the typical right-of-way is limited.

5.5.2.1 Existing Average Dry Weather Flow

The hydraulic analysis shows that the City's sewer system has adequate capacity to accommodate existing average daily flows.

5.5.2.2 Existing Peak Wet Weather Flows

The hydraulic analysis shows that the City's sewer system does not have adequate capacity to accommodate existing peak wet weather flows. There are 15 deficient sewers with modeled flows greater than full pipe capacity totaling 3,900 feet or 0.7 miles. The deficient sewers are listed in Table 5-11 and shown in Figure 5-8.

*Table 5-11: Existing Peak Wet Weather Capacity Deficiencies**

Basin	Upstream Manhole**	Downstream Manhole **	Street Location	Length (feet)	Existing Diameter (inches)	Percent Capacity***
3	-9	-9	Ocean View Blvd.	28	12	483%
4	991	-9	Ocean View Blvd.	18	6	257%
4	131	991	Ocean View Blvd.	135	6	257%
1	508	507	Magella Rd.	376	8	211%
1	503	502	Easement between 17 Mile Dr. & Sunset Dr.	453	8	183%
1	505	503	Easement between 17 Mile Dr. & Sunset Dr.	342	8	172%
1	814	813	Crocker Ave.	449	15	166%
1	502	501	Easement between 17 Mile Dr. & Sunset Dr.	551	8	146%
1	506	505	Easement between 17 Mile Dr. & Sunset Dr.	179	8	144%
1	507	679	17 Mile Dr.	348	8	142%
1	679	506	18 Mile Dr.	281	8	136%
4	139	131	Ocean View Blvd.	203	6	136%
3	424	416	Lighthouse Ave.	172	6	127%
3	416	410	Lighthouse Ave.	166	6	121%
3	430	424	Lighthouse Ave.	172	6	110%
			Total	**3,874**		

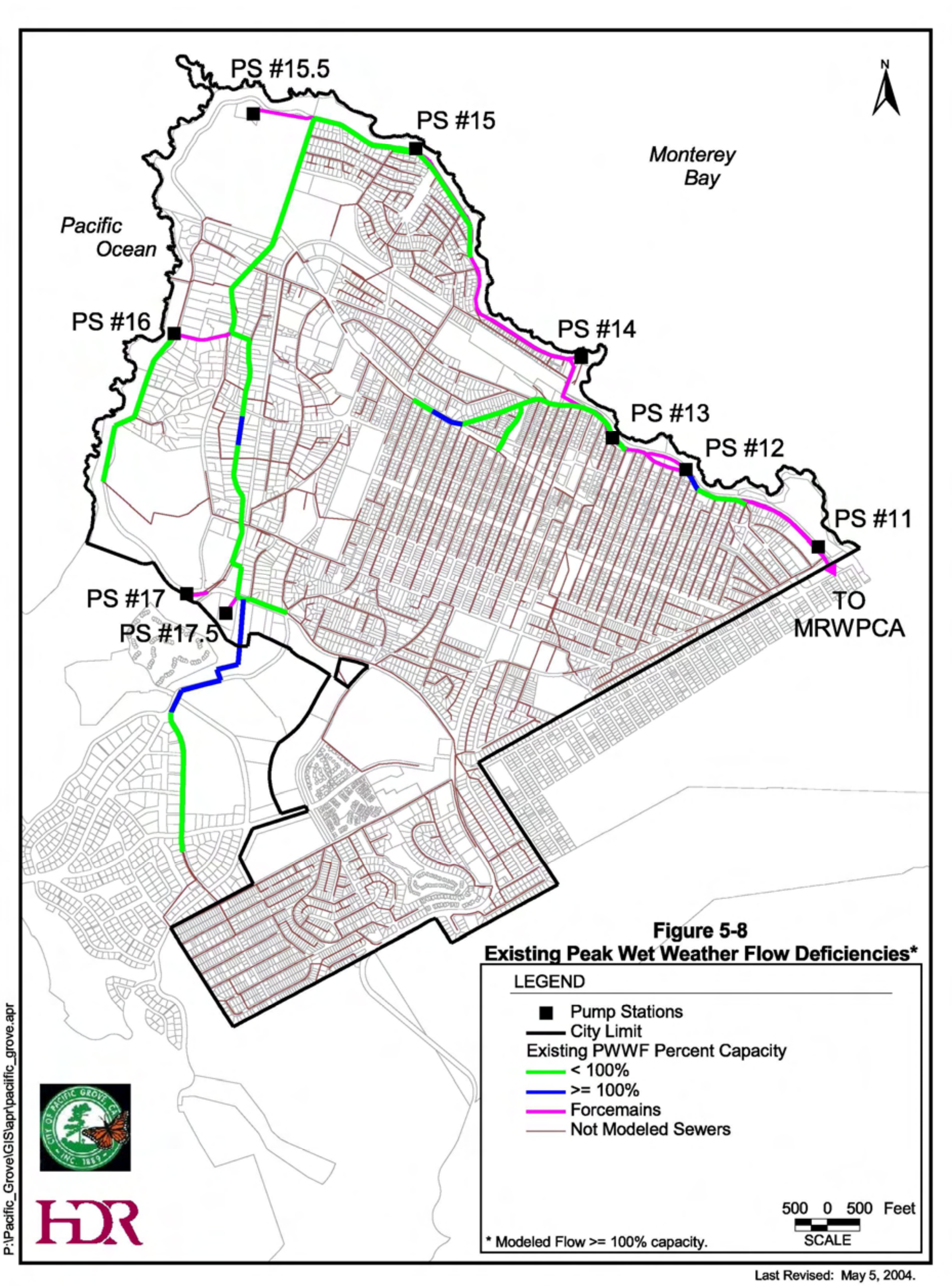
Notes:

*For existing conditions, a pipe segment is considered deficient if the flows exceeded the full pipe capacity.

**-9 indicates manhole without an assigned ID.

***Percent Capacity = (Modeled Q) / (Q full pipe) * 100%

Figure 5-8: Existing Wet Weather Flow Deficiencies



5.5.2.3 Buildout Peak Wet Weather Flows

The hydraulic analysis shows that the City's sewer system does not have adequate capacity to accommodate buildout peak wet weather flows. There are 31 deficient sewers with modeled flows greater than 75 percent of pipe capacity totaling 7,700 feet or 1.5 miles. The deficient pipes are listed in Table 5-12 and shown in Figure 5-9. Appendix P contains the hydraulic model results.

*Table 5-12: Buildout Peak Wet Weather Capacity Deficiencies**

Basin	Upstream Manhole**	Downstream Manhole**	Street Location	Length (feet)	Existing Diameter (inches)	Percent Capacity***
3	-9	-9	Ocean View Blvd.	28	12	586%
4	991	-9	Ocean View Blvd.	18	6	325%
4	131	991	Ocean View Blvd.	135	6	325%
1	508	507	Magella Rd.	376	8	278%
1	503	502	Easement between 17 Mile Dr. & Sunset Dr.	453	8	241%
1	505	503	Easement between 17 Mile Dr. & Sunset Dr.	342	8	226%
1	814	813	Crocker Ave.	449	15	217%
1	502	501	Easement between 17 Mile Dr. & Sunset Dr.	551	8	193%
1	506	505	Easement between 17 Mile Dr. & Sunset Dr.	179	8	189%
1	507	679	17 Mile Dr.	348	8	187%
1	679	506	18 Mile Dr.	281	8	179%
4	139	131	Ocean View Blvd.	203	6	171%
3	424	416	Lighthouse Ave.	172	6	142%
3	416	410	Lighthouse Ave.	166	6	136%
1	819	818	Crocker Ave.	251	15	125%
3	430	424	Lighthouse Ave.	172	6	123%
1	803	802	Easement between Crocker Ave. & Ansilomar Ave.	433	15	116%
4	165	150	Ocean View Blvd.	162	6	114%
1	-9	-9	Ocean View Blvd.	36	15	112%
3	-9	986	Ocean View Blvd.	174	12	108%
3	303	-9	Ocean View Blvd.	193	12	101%
3	-9	-9	Ocean View Blvd.	38	12	100%
1	806	805	Easement between Crocker Ave. & Ansilomar Ave.	449	15	99%
2	701	-9	Ocean View Blvd.	57	10	98%
1	821	820	Crocker Ave.	509	15	97%
1	822	821	Sunset Dr.	159	12	96%
1	500	822	Sunset Dr.	472	12	96%
1	501	500	Sunset Dr.	106	12	96%

Basin	Upstream Manhole**	Downstream Manhole**	Street Location	Length (feet)	Existing Diameter (inches)	Percent Capacity***
1	805	804	Easement between Crocker Ave. & Ansilomar Ave.	465	15	91%
4	171	165	Ocean View Blvd.	161	6	84%
3	305	303	Ocean View Blvd.	201	12	83%
			Total	**7,738**		

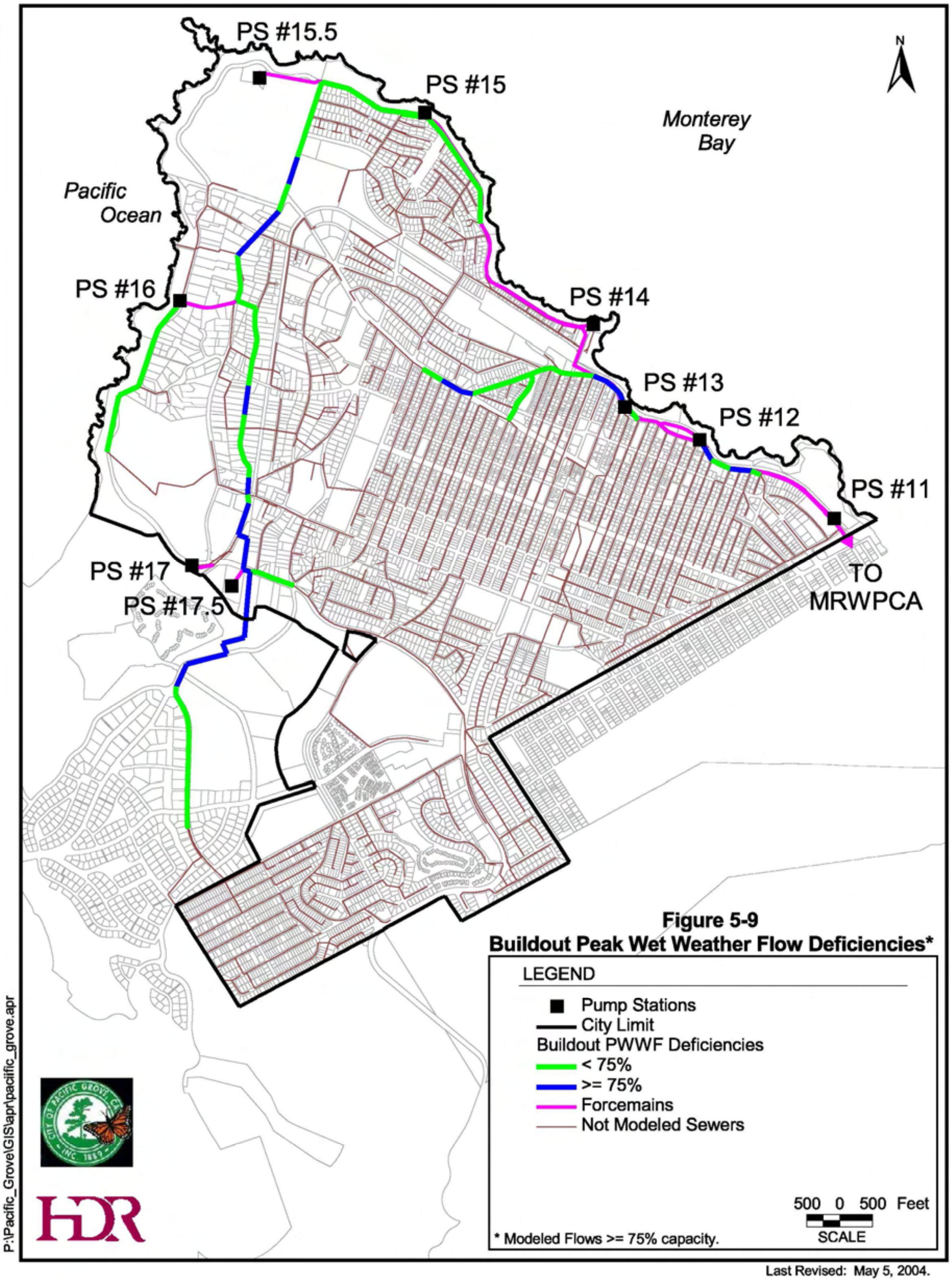
Notes:

*For buildout conditions, a pipe segment is considered deficient if the flows exceeded 75 percent of the full pipe capacity.

**-9 indicates manhole without an assigned ID.

**Percent Capacity = (Modeled Q) / (Q full pipe) * 100%

Figure 5-9: Buildout Wet Weather Flow Deficiencies



5.6 Capital Improvement Projects

Capital improvement projects were developed for the capacity deficiencies. These projects will be referred to as the capacity projects.

It is recommended that pipe segments with hydraulic deficiencies be replaced and upsized and not paralleled. This is due to limited right-of-ways and for operations and maintenance reasons. An exception to this would be line segments that are located in a landslide area and crossing under railroads. In those instances, parallel or relief sewers are recommended.

Consistent with the current best industry practices, the minimum diameter for the replacement sewers should be 8-inches. The slope of the replacement sewer is assumed to be a minimum of 0.002 ft/ft or match the deficient sewer, whichever is steeper. This is to ensure that a minimum cleansing velocity of 2 feet per second is achieved. The replacement sewers should be sized based on the PWWF flow and the flow should not exceed 75 percent capacity.

There are a total of nine capacity projects. Capacity Projects #1, 2, 3, and 4 are deficient under existing PPWF conditions and are of a higher priority for replacement. All buildout PWWF capacity deficient sewers are included in the capacity projects with two exceptions. The two pipe segments (MH 701 to -9 and MH -9 to -9) are short pipes, 57 feet and 36 feet, respectively, that are directly upstream of PS #15. They are probably affected by pumping station operating conditions and are therefore, not included in the capacity projects.

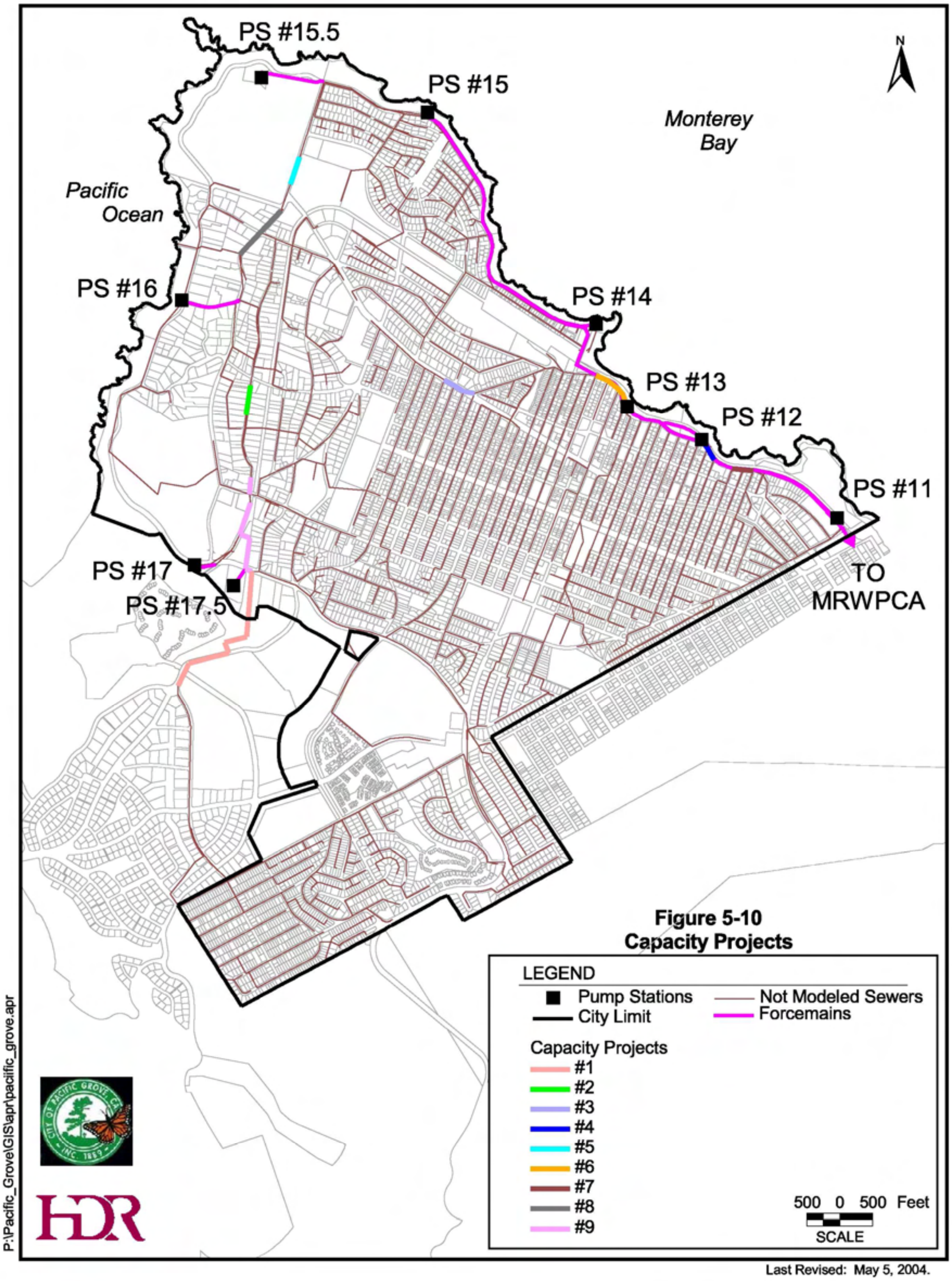
Table 5-13 lists the capacity projects and Figure 5-10 is a graphical representation.

Table 5-13: Capacity Projects

Capacity Project	Basin	Street Location	Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)	Buildout PWWF Percent Capacity
#1	1	Magella Rd.	508	507	376	8	278%
		17 Mile Dr.	507	679	348	8	187%
		17 Mile Dr.	679	506	281	8	179%
		Easement between 17 Mile Dr. & Sunset Dr.	506	505	179	8	189%
		Easement between 17 Mile Dr. & Sunset Dr.	505	503	342	8	226%
		Easement between 17 Mile Dr. & Sunset Dr.	503	502	453	8	241%
		Easement between 17 Mile Dr. & Sunset Dr.	502	501	551	8	193%
Capacity Project # 1 Total					**2,530**		
#2	1	Crocker Ave.	814	813	449	15	217%

Capacity Project	Basin	Street Location	Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)	Buildout PWWF Percent Capacity
Capacity Project #2 Total					**449**		
#3	3	Lighthouse Ave.	430	424	172	6	123%
		Lighthouse Ave.	424	416	172	6	142%
		Lighthouse Ave.	416	410	166	6	136%
Capacity Project #3 Total					**510**		
#4	4	Ocean View Blvd.	139	131	203	6	171%
		Ocean View Blvd.	131	991	135	6	325%
		Ocean View Blvd.	991	-9	18	6	325%
Capacity Project #4 Total					**356**		
#5	1	Easement between Crocker Ave. & Ansilomar Ave.	803	802	433	15	116%
Capacity Project #5 Total					**433**		
#6	3	Ocean View Blvd.	305	303	201	12	83%
		Ocean View Blvd.	303	-9	193	12	101%
		Ocean View Blvd.	-9	-9	38	12	100%
		Ocean View Blvd.	-9	986	174	12	108%
		Ocean View Blvd.	-9	-9	28	12	586%
Capacity Project #6 Total					**633**		
#7	4	Ocean View Blvd.	171	165	161	6	84%
		Ocean View Blvd.	165	150	162	6	114%
Capacity Project #7 Total					**323**		
#8	1	Easement Crocker Ave. & Ansilomar Ave.	806	805	449	15	99%
		Easement (Crocker Ave. & Ansilomar Ave.	805	804	465	15	91%
Capacity Project #8 Total					**913**		
#9	1	Sunset Dr.	501	500	106	12	96%
		Sunset Dr.	500	822	472	12	96%
		Sunset Dr.	822	821	159	12	96%
		Crocker Ave.	821	820	509	15	97%
		Crocker Ave.	819	818	251	15	125%
Capacity Project #9 Total					**1,498**		
Capacity Projects Total					**7,720**		

Figure 5-10: Capacity Projects



6 Condition Assessment

Condition assessment of facilities is the foundation of asset management decision making. Condition assessment has been completed for 18% of the gravity sewers and the seven pump stations owned by the City.

6.1 Gravity Sewers

Closed circuit television (CCTV) inspection data was evaluated in order to determine the condition of the gravity sewers.

6.1.1 Television Inspection Methodology

CCTV was used to identify sewers that are in need of repair or replacement, spot repairs, correction of faulty lateral connections, situations where piping intersections that prevent the passage of sewer cleaning and inspection equipment. CCTV was also used to identify areas requiring increased maintenance.

Contractors were hired to perform CCTV inspection of some of the City's sewer facilities. It is the goal of the City to inspect their entire system using CCTV by the end of 2005.

Inspection of the oldest area of the City (pre-1910) has been mostly completed. In October of 2002, approximately 60 line segments were inspected and in March and April of 2003, approximately 200 additional line segments were inspected. A line segment is defined as the length of pipe from manhole to manhole. There are 245 unique line segment inspection records contained in the CCTV database. The CCTV inspection was completed for 146 line segments.

The next CCTV inspection effort (130,000 feet or approximately 40 percent of gravity sewers) is scheduled during the summer of 2004. The remainder of the collection system is scheduled for inspection in 2005.

6.1.1.1 Condition Grades Based on CCTV

The condition grades for the completed line segments are shown on Figure 6-1 and Table 6-1. It shows that approximately 20 percent of the CCTV inspected pipe segments are Condition Grade D or F. Line segments in Condition Grade F should be repaired or rehabilitated as soon as possible. The line segments included in this condition assessment are among the oldest (pre-1910) in the collection system. It would be reasonable to predict that the newer line segments are in better condition. However, until the City completes CCTV inspection in 2005, the 20 percent is the best available data at this time.

Figure 6-1: CCTV Assessment Results

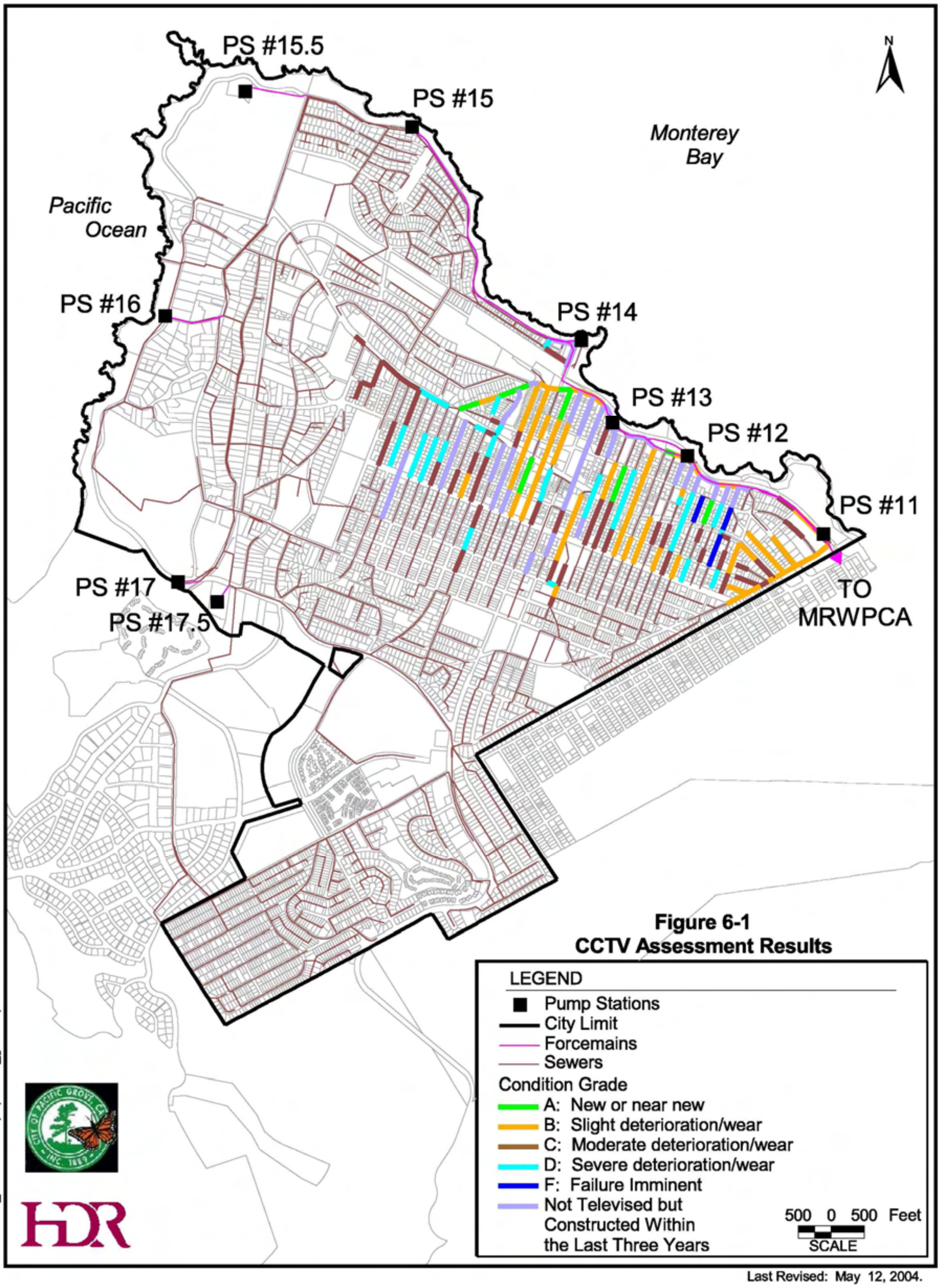


Table 6-1: Condition Grades (>95% pipe CCTV inspected)

Condition Grade	Line Segments* Analyzed**	Length (feet)	Percentage of Total***	Length Extrapolated to Entire System (feet)
A	23	7,914	15%	45,879
B	58	18,342	35%	106,327
C	49	15,154	29%	87,847
D	30	8,598	17%	49,841
F	5	1,677	3%	9,724
Totals	**165**	**51,685**	**100%**	**299,619**

Notes:
*Line segment = manhole to manhole.
**2003 Replacement Projects have been eliminated from this table.
***By Length.

For the purpose of developing this SSAMP, it is conservatively assumed that the pipes that were analyzed in the condition assessment are representative and 20 percent of the City's sewer system is in need or rehabilitation or replacement. This data will be used to develop the capital improvement program.

Sewer lines are normally expected to have a useful life of 50 to 100 years. This varies depending on the year constructed, pipe material, construction quality, quality of wastewater (hydrogen sulfides), etc. The sewers in the City appear to have to a useful life of 100 years or longer.

A prioritized action table (Table 6-2) was developed for the CCTV inspected pipe segments.

Maintenance actions are to be determined by the feedback matrix process that was discussed in the Operations and Maintenance section.

Table 6-2: Prioritized Action

Recommended Action	Number of Line Segments	Percentage of CCTV Inspected Line Segments
Reinspect at Condition Grade interval	87	49%
Maintenance*	10	6%
Spot Repair**	39	22%
Spot Repair & Maintenance	2	1%
Spot Repair & Maintenance & complete inspection	2	1%
Spot Repair and complete inspection	14	8%
Rehab/Replace	24	13%
Complete Inspection***	99	****
Totals	**245**	**100%**

Notes:
*Contains heavy roots, heavy grease, and repairable defects.
**Less than 3 instances of defects such as broken pipe, collapsed pipe, and hole in pipe in line segment.
***Line segments without End inspection at downstream manhole, End inspection at upstream manhole, etc., defect code.
****Not included in the percentage calculation of the 178 pipes assigned condition grades.

6.1.1.2 Criticality

The most critical collection system assets are those with the greatest consequence of failure (e.g. the discharge of large volumes of sewage). The following assets are listed in order of criticality:

1. Pump Stations
2. Force mains
3. Gravity sewers in remote locations where the likelihood is that an overflow would go un-noticed for an extended period of time
4. Waterfront gravity mains where there is little chance of containment
5. Gravity mains in commercial and school areas
6. Other gravity mains graded in priority from most critical at the lowest elevation to least critical at highest elevation.

These criticality assignments should be factored into the maintenance frequencies and CIP priorities.

6.1.2 Analysis of Television Inspection Data

The CCTV inspection databases that have been produced by the City's two CCTV inspection contractors were combined and the relevant data was entered into a single Microsoft Excel spreadsheet. Each line segment was assigned an identification number consisting of the upstream and downstream manhole numbers, joined by an underscore. When the data had been consolidated and duplicates removed, inspections were available for 245 gravity line segments in the sewer system.

Of the 245 sewers, 178 were inspected for greater than 95 percent of the length listed on the City's sewer maps. The assumption was made that these line segments' condition can be determined from the CCTV. Of the 178 line segments with greater than 95 percent inspected, 146 contained end of inspection codes which indicate that the sewer had been completely inspected. The inspected length of the 178 segments totaled approximately 54,300 feet (10.3 miles), or slightly more than 18 percent of the system. The remaining sewers were not completely inspected because of obstructions that prevented the CCTV camera from continuing. The incomplete line segments must either undergo cleaning or spot repair in order to mitigate the obstruction and allow complete CCTV inspection of the sewer to be completed. This activity should be given a high priority.

The CCTV database includes observations recorded during the inspection of each individual line segment. A set of unique alpha-numeric codes were assigned to record the observations including structural and maintenance defects. Approximately 6,500 observation codes were recorded for the 178 inspected line segments. A sample of the standard alpha-numeric codes is shown in the Table 6-3. The complete list of standard alpha-numeric defect codes is contained in Appendix Q.

Codes were added to the list so that every observation in the raw data corresponded to one of the standard codes. Each of the defect codes was assigned a point value for use in prioritizing the need for maintenance, rehabilitation, and repair. The point value was assigned to each standard code based on values in the raw data and from similar projects.

Table 6-3: Standard Defect Codes

Defect Code	Defect Code Description	Points per Defect Occurrence
BM	Buried manhole not shown on print	0
BR	Begin recording from upstream manhole	0
C	Longitudinal crack	100
C1	Longitudinal fracture	200
CG1	Camera blocked, inspection abandoned	100
CP	Collapsed pipe	1000
E	End inspection at downstream manhole	0
ISJ	Infiltration seeping at joint	200
I3	Infiltration gushing	500
L2	Break-in connection	100
LD	Service connection, defective	250
LG	Service connection with grease	150
LI	Service connection with infiltration	400

Defect Code	Defect Code Description	Points per Defect Occurrence
LP	Lateral protruding	250
R1	Roots, medium	250
R2	Roots, heavy	350
R3	Roots, light	150

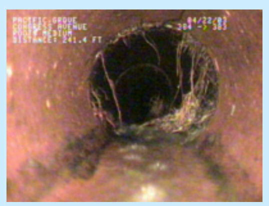
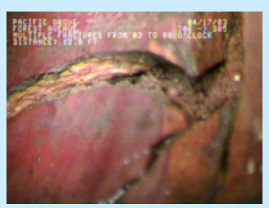
The frequency of defect codes in an indicator of the condition of the collection system. The most common defect codes are summarized in Table 6-4. The analysis of the frequency is discussed below.

Table 6-4: Most Common Observations in Pacific Grove Sewers

Defect Code	Number of Occurrences	Defect Code Description
LC	991	Lateral service connection, capped
R3	557	Roots, light
OJ	481	Offset joint, slight
S	230	Sag begins
L8	164	Intruding break-in connection
H	151	Hole in pipe
C	146	Longitudinal crack
EL	142	Erosion, light
OJ1	139	Offset joint, medium
C5	128	Circumferential fracture
LCJ	120	Longitudinal crack at joint
LRH	111	Service connection with roots, heavy
R1	102	Roots, medium
R2	100	Roots, heavy

The defect points were summed for each of the 178 line segments with greater than 95 percent inspected and the defect points per foot were calculated by dividing the defect point total by the inspected length. This relative condition value was used to rank line segments. The CCTV inspection logs were reviewed for one third of the line segments and letter condition grades from A (new or near new condition) to F (failure eminent) were assigned. The definitions associated with the letter condition grades are shown on Table 6-5. The video results were reviewed for the line segments on or near the border between the letter condition grades to verify the accuracy of the CCTV inspection logs. The completed condition assessment results are presented in Appendix R and the summary table of the condition assessment results are presented in Table 6-1.

Table 6-5: Sewer Condition Grade Definition and Action Table

Condition Grade	Sample Pictures	Condition Category/Description	CCTV Inspection Defect Points / Foot[1]	Asset Management Action(s)
A		New or Near New	<1	Schedule and conduct proactive maintenance[2] on line segment at 60 month frequency. Use feedback from proactive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 25 years. No preventive maintenance[2] or repairs[4] warranted.
B		Slight Deterioration/Wear. Line segments in this condition category exhibit one or more of the following defects: minor corrosion, minor cracks, light root growth at a few joints, light grease deposition, light grit/debris deposition.	1-9	Schedule and conduct proactive maintenance[2] on line segment at 60 month frequency. Schedule line segment for more frequent preventive maintenance[2] if feedback from proactive maintenance[2] or SSO incidence indicates that more frequent line cleaning is needed to prevent SSO. Use feedback from proactive/preventive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 15 years; adjust re-inspection frequency between 5 years and 15 years based on feedback from proactive/preventive maintenance. No repairs[4] warranted.
C		Moderate Deterioration/Wear. Line segments in this condition category exhibit one or more of the following conditions: moderate corrosion, moderate cracks, moderate root growth at one or more joints, moderate grease deposition, moderate grit/debris deposition, sags greater than half pipe in depth.[2]	>9-19	Schedule and conduct preventive maintenance[2] on line segment at an initial frequency of 12 months. Adjust preventive maintenance[2] frequency between 2 months and 36 months based on feedback from preventive maintenance: Increase frequency for line segments with “moderate” or “heavy” results. Maintain frequency for line segments with “light” results. Decrease frequency to next frequency following 3 consecutive “clear” results. Use feedback from preventive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 10 years; adjust frequency between 1 and 10 years based on feedback from proactive/preventive maintenance. Schedule and apply chemical root control (if warranted). Schedule and conduct repairs[4] if warranted to prevent SSO or reduce required maintenance. Schedule and conduct line rehabilitation or replacement if warranted to prevent SSO or reduce required maintenance.
D	 	Severe Deterioration/Wear. Line segments in this condition exhibit one or more of the following conditions: severe corrosion, severe cracks, severe root growth at any joint, severe grease deposition, severe grit/debris deposition, sags greater than full pipe in depth.	>20	Schedule and conduct preventive maintenance[2] on line segment at an initial frequency of 6 months. Adjust preventive maintenance[5] frequency between 2 months and 12 months based on feedback from preventive maintenance: Increase frequency for line segments with “moderate” or “heavy” results. Maintain frequency for line segments with “light” results. Decrease frequency to next frequency following 3 consecutive “clear” results. Use feedback from preventive maintenance[2] to indicate need to re-assess condition via CCTV inspection[3]. Line segments in this Condition Category should be re-inspected at least every 5 years; adjust frequency between 1 and 5 years based on feedback from preventive maintenance. Schedule and apply chemical root control (if warranted). Schedule spot repairs[4] if warranted to prevent SSO or reduce required maintenance. Place rehabilitation/replacement project for line segment on CIP for 5 years in future; adjust project schedule each year based on feedback from ongoing preventive maintenance and condition assessment. Implement rehabilitation/replacement project based on adjusted schedule.
F		Failure Imminent. Line segments in this condition category exhibit any of the following conditions: severe corrosion with loss of structural stability, large sections of pipe wall mission, voids in adjacent soil, loss of support (erosion of adjacent soil, landslide, or earth movement).	N/A	Develop and implement site-specific contingency plan[6] to prevent or mitigate SSO in event of failure. Schedule and conduct maintenance to prevent SSO. Schedule and implement immediate spot repair, or rehabilitation/replacement project.

Notes:

1. The defect points are based on the Pacific Grove Defect Code and Defect Point Table (Appendix Q).
2. Proactive maintenance and preventive maintenance include sewer line cleaning and sewer line de-rooting and any other appropriate maintenance measures needed to clean and clear sewer lines. The feedback will follow the standards shown in Sewer Cleaning Feedback Matrix (Table 4-2).
3. The City will use Closed Circuit Television (CCTV) inspection as the default method for assessing the condition of its sewers. The City may employ an alternative sewer line inspection methodology in the future if such alternative methodology provides functionally equivalent information as CCTV inspection.
4. Defects that have been corrected by spot repairs can be eliminated from the line segment point total and the line segment can be reassigned a new condition grade if post-repair condition warrants reassignment.
5. Schedule spot repairs or other corrective actions to eliminate offset joints and/or protruding laterals when they interfere with maintenance or condition assessment activities.
6. Site-specific contingency plans should include consideration of containment, pump-around, soil stabilization, and/or frequent inspection.
7. Standard sewer maintenance frequencies will be 2 month, 3 month, 6 month, 12 month, 36 month, and 60 month.

There were 991 instances of "lateral service connection, capped." This is a high frequency indicating that service laterals have not been connected to the factory connections that were installed with the sewers. There are two problems associated with this condition. First, break-in connections were used to make the service lateral connections. Break-in connections are undesirable because they can damage the pipe wall, they do not form a water-tight/root-tight joint, and they may protrude into the mainline reducing capacity and inhibiting the passage of sewer cleaning and inspection equipment. 164 protruding break-in connections were observed. Second, the capped wye can fail over time providing an entry point for infiltration and roots.

There were 759 instances of "root intrusion." While the majority consisted of light roots, these line segments will require preventive cleaning and/or the application of root control chemical in order to minimize stoppages and overflows. As previously discussed in the maintenance optimization section, a root cutter for the combination cleaner is recommended for purchase.

There were 620 instances of "Offset joints." The 139 instances of offset joint medium should be corrected with an appropriate priority.

There were 436 instances of "cracks or holes in the pipe." While all of these defects provide an entry point for roots and infiltration, the holes in pipe and cracks at joint should be given the priority for repair.

There were 111 instances of "service connection with roots, heavy." These line segments will require preventive cleaning and/or the application of root control chemical in order to minimize stoppages and overflows. Some agencies have tried notifying property owners of the presence of roots in their lateral; however, without the ability to enforce action to remove the roots the property owners choose to wait until their service lateral is plugged to take action.

Based on the defect score and viewing of CCTV of select pipes, a condition grade table was developed. A condition grade was subsequently assigned to each pipe segment. Table 6-5 contains the condition grades and Table 6-1 presents a summary of the findings.

6.1.3 Recommended Actions

The recommended actions based on CCTV data analysis include:

- Reinspection at condition grade interval: Line segments with Condition Grade A, B, and C (selective).
- Maintenance: Line segments containing defect codes such as heavy roots, root mass, etc.
- Spot repairs: Line segments containing defect codes such as severe offset joint, broken pipe, hole in pipe, etc.
- Rehabilitation/replacement: Line segments containing more than 3 spot repairs (more cost effective to rehabilitate/replace than to fix more than 3 spot repairs).

- Complete inspection: Line segments that did not contain an end of inspection defect code.

Appendix R contains the recommended actions for the 178 line segments with greater than 95 percent of their length inspected.

6.2 Pump Stations

The purpose of the pump station evaluation was to document the physical condition of the pump stations owned by the City and to develop a list of condition-based projects for inclusion in the capital improvement program (CIP).

6.2.1 Pump Station Site Visits

On December 15, 2003, the seven stations owned by the City (Table 6-6) was visited, photographed, and the pumps were test operated to verify functionality. Wherever possible, upstream manholes were opened and examined to observe internal conditions. Data sheets were completed on each station and brief notations were made concerning any significant attributes or conditions found during the visit. The data sheets are contained in Appendix S.

Table 6-6: Pump Stations Owned by the City

Pump Station Name	Pump Station ID Number	Location
Eardley	11	Ocean View & Eardley Streets
9th Street	12	Ocean View & 9th Streets
Lovers Point	14	Ocean View & 17th Streets
Crespi Pond	15.5	8th Hole Pacific Grove Golf Course off of Ocean View Avenue
Arena	16	Sunset Avenue & Arena Street
Beachcomber	17	Sunset Avenue in front of Beachcomber Hotel Street
Russell Service Center	17.5*	Russell Service Center, Sunset Avenue
Note: *Sometimes referred to as Pump Station 18 by MRWPCA		

The stations suffer from the effects of salt water deterioration due to corrosion. The stations hardware shows varying degrees of attack from salt spray. This is understandable due to the proximity of the coastline. Five of the stations were within 200 feet of the ocean.

Two of the seven stations visited are dry well-wet well type. Dry well-wet well stations feature a below ground equipment room that contains the pumps, piping and valves. The dry well is usually situated adjacent to the wet well and separated by a common wall. The remaining five stations are wet pit type stations. Wet pit station characteristically have no above ground structures to house piping, valves, or controls other than vaults and metal enclosures. Wet pit stations also feature the pumps set below the water line in the wet well.

Most stations appeared to be in good condition. Evidence of external corrosion due to exposure to seawater could be found at all locations, however, there was little evidence of severe deterioration except as described later in this report. Overall, the facilities appear to be well maintained and functional. Two stations appeared to be in need of upgrading: (1) PS #15.5 has a shallow wet well and appeared to be in an advanced state of deterioration and (2) PS #11's wet well has a problem with the way that the pumps are installed and connected. According to the field crew, the piping must be disassembled and the pumps removed while a person is inside the wet well.

6.2.1.1 Wet wells

The wet wells appeared to be in fair to good condition, with some evidence of corrosion and grease buildup in a few of the stations. Some of the wet wells have overflow connections inside which can allow wastewater to flow out of the wet well to the ocean. These should either be alarmed or plugged. No trash racks were found in the stations. Trash racks can prevent debris from clogging a sewer pump but they also can contribute to the maintenance effort and cause odor problems.

A few of the wet wells are lined. According to MRWPCA staff, PS #14 and PS #17 are coated with a paint-on type coating, and PS #16 has T-Lok PVC coating installed. The remainder is not coated. During the site visit, the wet well at PS #12 showed some evidence of concrete spalling. It may benefit from having a lining installed in order to make cleaning easier. MRWPCA staff recommends that a liner or coating be installed at PS #12. However, the exact condition of the wet well is largely unknown and should be investigated further.

6.2.1.2 Pumps

The largest pumps observed were the 10 horsepower pumps at PS #16. The other stations feature submersible pump and motor combinations less than 10 horsepower. Many of the wet wells feature slide rails for ease of lifting the pumps out for maintenance or repair.

6.2.1.3 Motors

Only one station utilized separate motors with associated pumps. All other stations featured submersible (combined motor/pump) pump assemblies.

6.2.1.4 Control System (Alarms)

MRWPCA has been upgrading the smaller pump stations with SCADA compatible Remote Terminal Units (RTUs) that provide nearly instant and continuous communication with the central control room at MRWPCA's wastewater treatment facility. The larger stations feature PLC control and radio and phone-based communications. At present all stations feature radio or phone communications with the MRWPCA central control room.

6.2.1.5 Control System (Level Control)

Most stations feature a dual level control strategy with an air bubbler system providing depth information as well as pump control, and a system of floats that start the pumps at high wet well level.

6.2.1.6 Electrical System (Power)

Most of the stations feature electric power feed from PG&E. One station, PS #17.5, obtains its power from the Russell Service Center. Each station is provided with 220 Volt 3-phase power. All stations, except PS # 15.5, were fitted with an alternate electrical supply connection with transfer switch.

6.2.1.7 Ventilation

The ventilation systems used for the two dry well type pump stations consist of small squirrel cage fans ventilating the lower (pump) level of the station interior. There are no fixed atmospheric monitoring equipment in any of the stations.

6.2.1.8 Odor Control

None of the stations feature odor control equipment or systems.

6.2.1.9 Standby Power

Three stations feature a permanent small standby generator:

- Pump Station #12 has a 45 KW SDMO Generator package. The engine is a diesel powered John Deere Model # 4045DF150. The generator is a Leroy Somer 56 KVA, 45 KW, 240 volt, 3 phase.
- Pump Station #14, has a DMC Generator package with a diesel powered John Deere Model # 4039T engine. The generator is rated for 40KW, 240 volt, 3 phase.
- Pump Station #16 has an Onan generator package with a natural gas powered Ford Model # 460-LSG-875R engine. The generator is rated for 60 KW, and is an Onan model # 60ENL22122E, 240 volt, 3 phase.

PS #12, #14, and #16 engines (Table 6-7) appear to be above the 50 HP limit for Air Quality Management District's threshold for permits according to the Monterey Bay Unified Air Pollution Control District rules for standby natural gas and diesel fired stationary engines. An engine is exempt from permitting, if installed prior to January 1, 1985. Also, MRWPCA has changed PS #12 from natural fuel to diesel fuel.

Table 6-7: Pump Station with Greater than 50 HP Engines

Pump Station	Nominal KW	Generator HP	Engine HP
PS #12	45	60	67
PS #14	40	53	60
PS #16	60	80	89

6.2.2 Current Conditions and Identified Replacement Needs

A summary of current conditions and the identified replacement needs are described below:

- Station Structures

  The station structures appeared to be in functional condition and configured correctly to meet the needs of the station. No immediate upgrades were identified for most stations with the exception of PS #11. Due to the nature of the upgrades to the wet well and valve pit, the entire PS #11 may need to be redesigned. The two Flygt pumps at PS #11 were installed in 1997 and 2002 and can be reused. The control panel can also be salvaged and reused because it was rebuilt in 2003.

- Electrical Components

  The electrical equipment appeared to be in functional condition and sized and configured correctly for the needs of the station. No immediate upgrades were identified, with the exception of PS #15.5 which needs a generator plug for standby power to facilitate connection of a generator at the station in the event of a power outage. The station serves a rest room facility only, and can be easily pumped out using a Combination Cleaner truck. At present, a generator must be manually wired in to provide emergency pumping. Adding a plug connection would simplify the use of standby power at the station if needed.

- Mechanical Components

  The pumps and valve equipment appeared to be in functional condition and sized and configured correctly for the needs of the stations. Some valves were observed to be in deteriorated condition and some pumps are also believed to be in need of replacement due to deteriorated condition.

  The valve vault at PS #11 appears to be in need of considerable upgrade due to poor access and lack of working area around the valves.

  The valves at PS #15.5 are in poor condition because they are located inside the wet well and exposed to the high humidity of the wet well.

- Wet Well

  The wet wells appeared to be in functional condition and sized and configured correctly for the needs of most stations. Problems were identified with the wet wells of PS #11 and #15.5. The wet well at PS #11 appears to need considerable reconstruction and possible replacement. The location of the wet well partially encroaches on a traffic lane making long term access difficult and the pump piping must be manually disconnected inside the wet well. This condition requires that the wet well be entered during replacement or maintenance activities. The wet well at PS #12 is reported by staff to be in need of lining or coating due to corrosion of the concrete walls. There are also decks in the wet well at PS

#12 and MRWPCA recommends having the decks removed when the station is lined or coated. The wet well at PS #15.5 is shallow and contains the check and isolation valves.

- Standby Generators

  The stand by generators appeared to be in functional condition and sized and configured correctly for the needs of the station. The generator engines appear to require an operating permit from the Monterey Bay Unified Air Pollution Control District.

  The deactivated gas service equipment including the regulator, meter, and piping at PS #12 is still on-site even though the service has been deactivated. This service should be completely removed and the service lateral retired at the gas main in accordance with PG&E standards.

  The field crews identified a potential need to replace/repair the generator engine at PS #14 due to location and exposure to the effects of seawater exposure and resulting corrosion.

  PS #16 is the only station that features a natural gas fueled generator. There was some discussion during the site visit of the need to convert the generator at PS #16 to diesel fuel. Diesel fuel is preferred by the crew. The benefit of diesel fuel is that is able to be operated if an earthquake event causes a local disruption to the gas supply. Although not strictly necessary, the conversion will bring the installation into conformity with the other generator sets.

- Control Systems

  The control equipment and alarms appeared to be in functional condition and sized and configured correctly for the needs of the station. PS #15.5 was the only station that did not feature a full SCADA connection, but instead relies on a radio transmitter to communicate with the control room. No immediate upgrades were identified for the other stations. MRWPCA is trying to upgrade all stations to the RTU standard. These RTU's are presently installed in Pump Station #18, and #17. It is unclear which of the other stations will require this type of upgrade, however it appears that PS #11, PS #12, PS #14, and PS #16 already have current generation PLC equipment with full communications capabilities.

6.2.3 Pump Station Capacity Evaluation

Taking reliability and redundancy into consideration, the firm capacity of a pump station is defined as the pumping capacity of the station when the largest pump is out of service. Since each of the City's pump station has two identical pumps, the firm capacity of the pump station is the rated capacity of one pump.

Since no field test data is available, the firm capacities of the pump stations are estimated based on nameplate information and the pump curves published by the manufacturers, and then compared with the estimated existing and buildout peak wet weather flows. It is determined that all pump stations are adequate for the existing flows. With the exception of pump station #12, all pump stations are adequate for the buildout flows.

To confirm the findings, it is recommended one pump be tested each month as previously described in Section 4 and improvements be developed as necessary. Table 6-8 presents a summary of the pump station capacity evaluation.

Table 6-8: Summary of Pump Station Capacity Evaluation

Pump Station	Buildout PWWF (mgd)	Firm Capacity (gpm)	Firm Capacity (mgd)
11	0.20	500	0.72
12	0.93**	520	0.75
14	0.003	80	0.12
15.5*	0.001	-	-
16	0.16	500***	0.72
17	0.002	50	0.07
17.5	0.001	19	0.03

Notes:
*Serves small public bathroom. Firm capacity is adequate.
**Includes 219 secondary units which contribute 0.2 mgd. Secondary units assigned based on proportion of buildout parcels. Re-evaluate during triennial review.
***Estimated firm capacity based on horsepower, terrain, and head estimates.

6.3 Force Mains

6.3.1 Recommended Approach

It is recommended that the City immediately implements an inspection program that includes the following:

1. Define location of force mains.
2. Determine pipe material, liner (if any), and soil conditions.
3. Enter all data collected into the CMMS and the GIS. Keep data current. Implement systems to ensure that the data is both current and correct.
4. Provide periodic inspection and maintenance for all force mains.
5. Conduct pipe to ground potential testing to determine level of corrosion.
6. Consider installing a second force main at pump stations where a pump-around operation would be impractical.

7. Conduct external inspections of the force mains using non-destructive testing wherever possible (some force mains may require the removal of a coupon for inspection). Repeat every 3 years if evidence of corrosion is discovered. If no evidence of corrosion is discovered, repeat every 5-10 years.
8. Install dry manhole at critical locations to provide access to force main for inspection. For example, high spots in the alignment which is an area where corrosive gases can accumulate.

6.4 Capital Improvement Projects

The recommended capital improvement projects (CIP) for gravity sewers, pump stations, and other projects are discussed below.

6.4.1 Gravity Sewers

It is recommended that line segments with a recommended action of rehabitation/replacement and a Condition Grade C, D, or F be included in the CIP.

Table 6-9 contains the gravity sewer projects that are based on condition.

Table 6-9: Gravity Sewer Condition Projects

CCTV Pipe ID	Condition Grade	Length (feet)
285_284	C	477
127_126	C	360
122_131	C	164
009_001	C	138
343_342	C	256
135_134	C	384
463_462	C	272
019_018	C	131
141_140	D	450
216_215	D	367
164_163	D	374
142_141A	D	235
133A_133	D	128
310_308	D	507
357_356	D	354
446_445	D	341
427_426	D	375
239_237	D	282
418_417	D	343
419_418	F	375

CCTV Pipe ID	Condition Grade	Length (feet)
176A_175	F	259
174_172	F	372
153_152	F	421
176_176A	F	250
	Total	**7,616**

6.4.2 Pump Stations

The pump station capital improvements are based on the identified needs previously discussed. In addition, one reliability improvement for consideration includes the possible acquisition of spare pumps for the stations. The costs associated with purchasing and installing the submersible wet pit pumps may be favorable when compared with the risks associated with having to wait for new equipment deliveries. The level of spares kept in inventory depends on the number of identical pumping units installed in the stations. Based on the information received from MRWPCA, the pump station pump data is summarized in Table 6-10. It appears that a spare may be required for each station since the performance levels of the pump stations appear to be different.

Table 6-10: Summary of Pumping Equipment

Station	Pump Type	Model/Frame	Brand	HP	GPM	Head (ft)	Cost
PS #11	Sub-Wet	NP 3127X-438 4"	Flygt	10	500	48.2	$5,200 (p)
PS #12	Sub-Dry	NT-3127-422 6"	Flygt	7.5	520	34	$6,500 (p)
PS #14	Sub-Wet	Unknown	Flygt	3	80	20	$3,200 (b)
PS #15.5	Sub-Wet	Unknown	-	-	-	-	$3,200 (b)
PS #16	Vert-Centrifugal	Unknown	Wemco	10	-	-	$5,350 (b)
PS #17	Sub-Wet	Cp-3127X-485 4"	Flygt	7.5	150	50	$4,925 (b)
PS #17.5	Sub-Wet	4X12TF, 4"	ESSCO	3	100	19	$3,200 (b)

Notes:
(p): Previous purchase.
(b) Budget value based on vendor quote.

PS #16 will probably be upgraded to the same standards as PS #12 pumps for ease of maintenance and rag handling capability. The PS #12 configuration is very similar to PS #16. If the pumps at PS #16 are scheduled for replacement in the future, one pump can serve as a spare for both PS #16 and PS #12 if the size and power requirements are the same. At present, the costs associated with providing a spare pump and motor combination for PS #16 is expected to be greater due to the larger size and incompatibility with other stations. The only other station that might be able to share a spare pump is PS #11.

A capital improvement program was developed at an estimated cost of $504,000 (2004 dollars). The capital improvement projects and estimated costs are listed in Table 6-11.

Table 6-11: Summary of Pump Station Capital Improvements Program

Pump Station	Capital Improvements	Cost
PS #11	New wet well, pumps, piping, valve pit, and valves	$300,000
PS #12	Remove Gas Service, reline wet well with AMERON ARRLOW-Lock 6X8x16 Deep=544SF @$40/SF	$22,000
PS #14	Relocate/Refurbish Generator	$50,000
PS #15.5	Replace Wet Well, Piping, New Valve Vault	$50,000
PS #16	Convert Generator to Diesel	$50,000
All	7 Spare Pumps	$32,000
	Total	**$504,000**

Note: 2004 dollars.

7 Ordinance and Legal Documents Review

The following recommendations were developed based on HDR experience and the review of the City ordinances and legal documents related to the operations, maintenance, and management of the sewer collection system.

7.1 Recommended Additions to City Ordinances

- Mandatory private lateral inspection at remodel or ownership change.
- Mandatory private lateral replacement if it does not meet Standards or it overflows to other property.
- New laterals to serve one property only. No multiple connections. If existing multiple connections exist, they must be separated if problems occur.
- New connections must tie into existing capped lateral (if available).
  - The existing capped laterals can be located by CCTV and the locations entered into the CMMS.
- Develop operation and maintenance standards for private sewer systems.
- Establish sewer service charge for secondary units

7.2 Recommended Design and Construction Standards

- Minimum design standards (laterals).
  - Establish standard details for connections, cleanouts, etc.
  - Do not allow connection to protrude into the main
  - Specify minimum slope (1% per Uniform Plumbing Code)
- Minimum design standards (mains).
  - No sewer main shall be less than eight (8) inches in diameter (Section 9.20.030 Sewer mains).
  - Specify minimum slope
  - 0.1 foot drop across manhole
  - Specify allowable pipe materials, recommend including PVC pipe.

7.3 Lateral Repair and Replacement Program

In an effort to prevent sewer overflows, a lateral grant program would be very valuable. There are two types of lateral programs: lateral grant and lateral insurance programs. Lateral grant programs are funded by the operating budget of the sewer collection system entities. Lateral insurance programs are funded either by an addition to the sewer bill or property taxes.

Discussion with City staff shows that a property tax assessment would be problematic in today's environment. An insurance program does not offer any distinct advantages.

Based on the data collected from other agencies as summarized in Table 7-1, it is estimated that the City would need an annual budget of $40,000 for their lateral grant program. As with other grant programs, the maximum grant amount will be $2,000, and not greater than 50 percent of the lateral repair/replacement cost. This would allow 20 lateral repairs or replacement each year. The above estimate does not include the loss of income from permits (because permit fees are typically waived) and the cost of staff time required for application review and inspection. Further details are contained in Appendix T (Lateral Repair and Replacement Program Technical Memorandum).

Table 7-1: Estimated Lateral Program Cost

Sewer Collection Entity	Type	No. of Households[1]	No. of Reimbursement per year[2]	Percentage of Total Households	Lateral Program Cost per Year[2]
Castro Valley Sanitary District	Grant	18,000	50	0.28%	$100,000[3]
City of San Luis Obispo	Grant	19,300	75	0.39%	$150,000
City of Mishawaka	Insurance	21,600	20	0.09%	$90,000
City of Florissant	Insurance	21,000	87	0.41%	$261,000
Average			**58**	**0.29%**	**$150,250**
Sewer Collection Entity	**Type**	**No. of Households**	***Projected*[4] No. of Reimbursement per year**	**Percentage of Total Households[5]**	***Projected*[6] Lateral Program Cost per Year**
City of Pacific Grove	**Grant**	**7,319**	**21**	**0.29%**	**$40,000**

Notes:
1. 2000 Census Data.
2. Fiscal year 2003.
3. $50,000 allocated for fiscal year. Assumed request for an additional $50,000 to be released mid-fiscal year is granted.
4. Average % of Total Households x No. of Households.
5. Match average of percentage of total households.
6. Projected No. of Reimbursements x $2,000 per reimbursement. Figure rounded to the nearest $10,000.

7.4 Other Recommendations

- Update agreement regarding pump station operation and maintenance with MRWPCA
  - Define responsibilities
  - Define Level of Service
  - Responsibility for NDPES reporting
  - Develop written emergency response protocols

  - Require periodic submission of operating information

- Federal Source Control Regulations
  - Continue to contract with MRWPCA for source control.
  - Maintain the existing FOG Control program.
  - Require pretreatment
  - Review and improve source control requirements for dry cleaner establishments

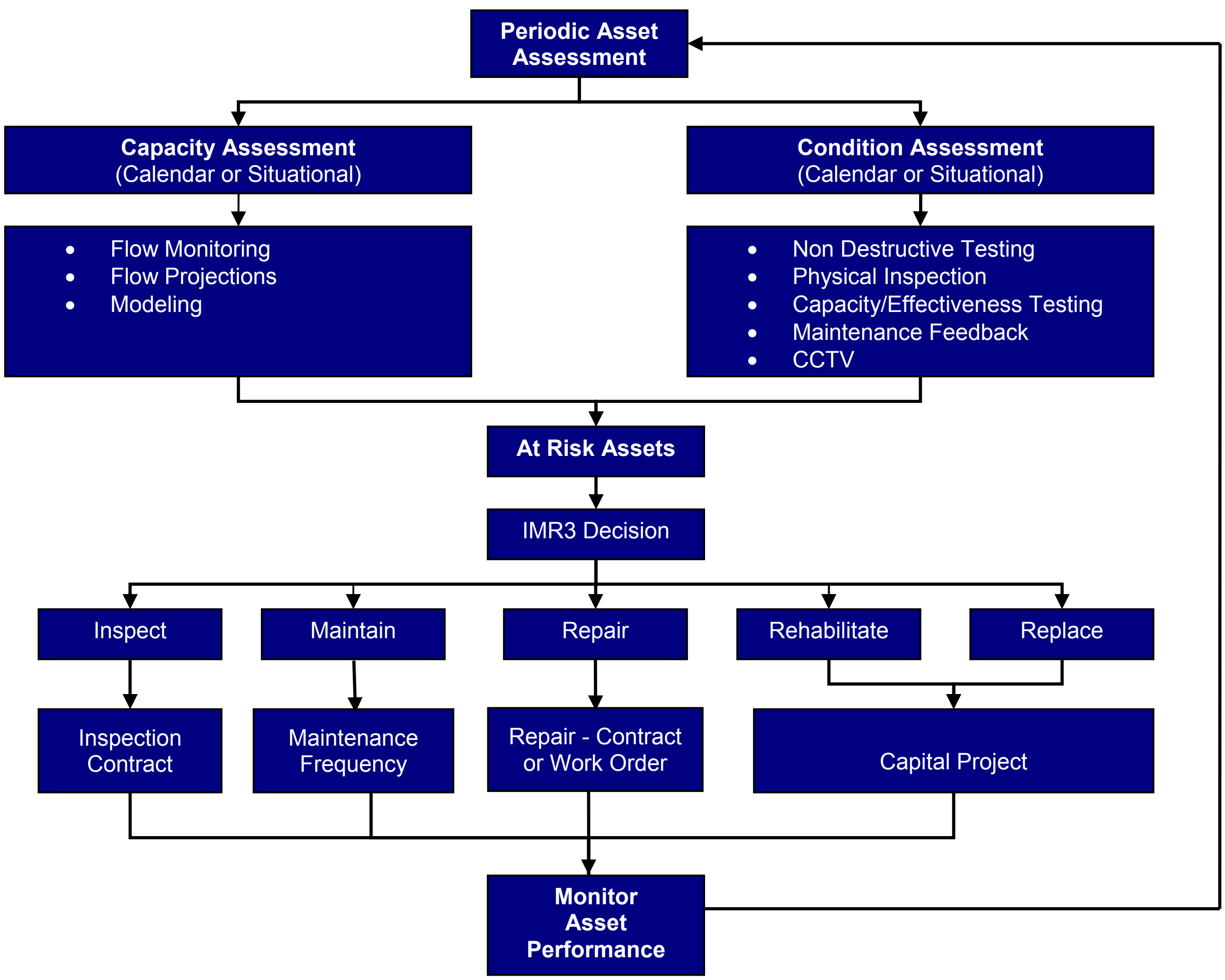
8 Capital Improvement Program

The capital improvement program combines all of the capacity, condition, and pump station projects. The asset management process is a formal process that identifies the City's current and future capital needs.

8.1 Asset Management Process Description

The Asset Management Process consists of periodically assessing the capacity and condition of the City's collection system using available information and special studies and implementing appropriate actions in response to identified needs with the goal of maintaining or improving level of service while minimizing asset lifecycle cost. The asset management process is shown in Figure 8-1.

Figure 8-1: Collection System Asset Management Process Diagram



8.1.1 Capacity Assessment

Capacity assessment should be conducted periodically or when circumstances change indicating the need to revise the capacity assessment. The City should revisit the capacity assessment as part of the triennial review of the SSAMP. The circumstances that would warrant reviewing the capacity assessment are considered unlikely due to the character and extent of development within the City. Examples that would warrant revisiting the capacity assessment would include the addition of a major discharger, expansion of service area, change in secondary unit estimates, change in development timing, or change in design storm criteria.

8.1.2 Condition Assessment

Condition assessment is either underway or as yet to be conducted for all City collection system assets. Condition assessment of the gravity sewers is underway with the goal of completing television inspection of the entire collection system by 2005. A formal condition assessment for the force mains should be completed as soon a practicable. Capacity testing of pumping equipment and emergency generators should be conducted annually. SCADA data on pump station operation (where available) should be reviewed daily. Once the condition of the collection system assets is known, then the condition should be re-evaluated either on the schedules recommended elsewhere in this report or when situations dictate. Examples of situations that would dictate condition assessment include maintenance feedback indicating the condition of the asset had changed or an unexpected failure of an asset.

The capacity and condition assessment activities will identify "At-Risk Assets." These are the assets whose current capacity or condition may lead to a failure (equipment failure, capacity failure, stoppage, or overflow). At-Risk Assets should be the subject of a formal decision regarding the actions that are required to prevent failure. This decision is commonly referred to as the "IMR3 Decision." As indicated in Figure 8-1, the outcomes of this decision are: do nothing, conduct an inspection or test, implement or change the maintenance, repair the asset, or rehabilitate or replace the asset. The factors to be considered in this decision are: desired level of service, consequence of failure, maintenance history, current capacity, current condition, and projected future costs.

Once the corrective actions have been taken, then the performance of the individual assets is monitored to assure that the asset is performing as planned. This activity typically requires information systems, both paper and electronic, to implement.

8.2 Capital Project Prioritization

The proposed criteria for use in prioritizing capital projects are: regulatory requirements, level of service, consequence of failure, City Staff priority, and project cost. City Staff would rate each of the identified projects based on the values shown in Table 8-1. The capital projects with the highest ranking score are the highest priority projects. They should be undertaken first.

Table 8-1: Project Prioritization Criteria and Ranking Factors

Prioritization Criteria	Definition	Ranking Factor
Regulatory Requirements	Not applicable to this asset or asset meets current regulatory requirements	0
	Asset does not meet future regulatory requirements	1
	Asset does not meet current regulatory requirements or will predictably cause an SSO	2
Level of Service	Not applicable to this asset or asset meets current level of service requirements	0
	Asset does not meet future level of service requirements	1
	Asset does not meet current level of service requirements	2
	Project improves asset performance with respect to level of service	3
Consequence of failure	No consequence of failure	0
	Minor consequence of failure	1
	Moderate consequence of failure	2
	Significant consequence of failure	3
City Staff Priority	Not a priority	0
	Low priority	1
	Moderate priority	2
	High priority	3
Project Cost	Project increases lifecycle cost of asset	0
	Project reduces lifecycle cost of asset	1
	Project is cost justified	2
	Project payback < 2 years	3
	Project payback < 6 months	4

8.2.1 Identified Projects

The following projects have been identified during the capacity assessment, the condition assessment, and/or in response to the O&M Optimization recommendations.

8.2.1.1 Capacity Projects

Table 8-2 lists the capacity projects.

Table 8-2: Capacity Projects

Capacity Project	Length (feet)	Project Cost ($2004)
# 1	2,530	$479,000
# 2	449	$85,000
# 3	510	$97,000
# 4	356	$67,000
#5	433	$82,000
#6	633	$120,000
#7	323	$61,000
#8	913	$173,000
#9	1,498	$284,000
Totals	**7,720**	**$1,462,000**

Note: Rehab/Replacement @ $1 million per mile in 2004 dollars.

8.2.1.2 Condition Projects

Table 8-3 lists the condition projects.

Table 8-3: Condition Projects

CCTV Pipe ID	Final Condition Grade	Pipe Length (feet)	Project Cost ($2004)
285_284	C	477	$90,000
127_126	C	360	$68,000
122_131	C	164	$31,000
009_001	C	138	$26,000
343_342	C	256	$48,000
135_134	C	384	$73,000
463_462	C	272	$52,000
019_018	C	131	$25,000
141_140	D	450	$85,000
216_215	D	367	$69,000
164_163	D	374	$71,000
142_141A	D	235	$45,000

CCTV Pipe ID	Final Condition Grade	Pipe Length (feet)	Project Cost ($2004)
133A_133	D	128	$24,000
310_308	D	507	$96,000
357_356	D	354	$67,000
446_445	D	341	$65,000
427_426	D	375	$71,000
239_237	D	282	$53,000
418_417	D	343	$65,000
419_418	F	375	$71,000
176A_175	F	259	$49,000
174_172	F	372	$70,000
153_152	F	421	$80,000
176_176A	F	250	$47,000
Totals		**7,616**	**$1,442,000**

Note: Rehab/Replacement @ $1 million per mile in 2004 dollars.

8.2.1.3 Other Projects

Table 8-4 lists the pump station projects. Force main inspection program is another recommended project.

Table 8-4: Pump Station Projects

Pump Station	Capital Improvements	Cost
PS #11	New wet well, pumps, piping, valve pit, and valves	$300,000
PS #12	Remove Gas Service, reline wet well with AMERON ARRLOW-Lock 6X8x16 Deep=544SF @$40/SF	$22,000
PS #14	Relocate/Refurbish Generator	$50,000
PS #15.5	Replace Wet Well, Piping, New Valve Vault	$50,000
PS #16	Convert Generator to Diesel	$50,000
All	7 Spare Pumps	$32,000
All	Force Main Inspection Program	$30,000
	Total	**$534,000**

Note: 2004 dollars

Table 8-5 lists the other recommended projects, which includes a spot repair and protruding lateral lump sum repair cost.

Table 8-5: Spot Repair and Protruding Lateral Repair Costs

Defect Code	Number of Occurrences*	Cost per Occurrence ($2004)	Total Cost ($2004)
Protruding Lateral (Intruding break-in connection)	164	$1,000	$164,000
Offset joint, medium	339	$3,000	$1,017,000
Hole in pipe	151	$3,000	$453,000
*See Section 6.1.2.			

8.2.2 Assigning Project Priorities

Based on the City's financial condition, the projects were prioritized as follows: first priority given to Condition Grade F line segments, force main inspection program, spare pumps, and spot repairs/protruding laterals; second priority given to capacity projects that are deficient under existing conditions, and pump station #11 and #12 projects. Third priority (and not included in the 3 year CIP) is given to Condition Grade C and D line segments, remaining capacity projects, remaining pump station projects, and remaining spot repairs/protruding laterals.

Reevaluation should occur as structural defects are discovered or as flow conditions in the City changes (development of vacant parcels and/or secondary units).

8.3 Three Year Capital Improvement Program (2005 to 2007)

This section contains the Three Year Capital Improvement Program. It is a prioritized list of projects that are separated into each of the next three fiscal years. The prioritization was developed based on the City's financial situation and criteria discussed in the previous sections. The remaining identified capital projects are considered future year projects and their priority should be re-evaluated during the triennial review.

Table 8-6: Three Year Capital Improvement Program

Fiscal Year	Project	Length (feet)	Project Cost ($2004)
2005	Condition Grade F (419_418)	375	$71,000
2005	Condition Grade F (176A_175)	259	$49,000
2005	Condition Grade F (174_172)	372	$70,000
2005	Condition Grade F (153_152)	421	$80,000
2005	Condition Grade F (176_176A)	250	$47,000
2005	7 Spare Pumps		$32,000
2005	Force Main Inspection Program		$30,000

Fiscal Year	Project	Length (feet)	Project Cost ($2004)
2005	Spot Repair/Protruding Laterals Lump Sum*		$143,000
2005 Totals		**1,677**	**$522,000**
2006	Capacity Project #1	2,530	$479,000
2006	PS #12		$22,000
2006 Totals		**2,530**	**$501,000**
2007	Capacity Project #2	449	$85,000
2007	Capacity Project #3	510	$97,000
2007	Capacity Project #4	356	$67,000
2007	PS #11		$300,000
2007	Spot Repair/Protruding Laterals Lump Sum*		$246,000
2007 Totals		**1,315**	**$795,000**
Totals		**5,522**	**$1,818,000**

*25 percent of spot repairs/protruding laterals to be fixed during 3 year CIP

9 Financial Analysis

This section discusses the cost of the recommended Capital Improvement Program and describes the recommended action on program financing and user fees.

9.1 Capital Improvements Program

An analysis of Pacific Grove's existing inventory of sewer pipes in the collection system shows that a portion is due for rehabilitation and replacement as expected for a system that has been in service for over 100 years. Figure 9-1 describes the current pipe inventory by decade installed, and the portions that are at risk from 2000 forward. The curve described by this data is often called a "Nessie Curve". At risk mileage is determined by life expectancy and pipe inspection results. The life expectancy of a pipe is determined based on installation date and material. Table 9-1 presents the typical life expectancy of sewer pipes.

Figure 9-1: Nessie Curve

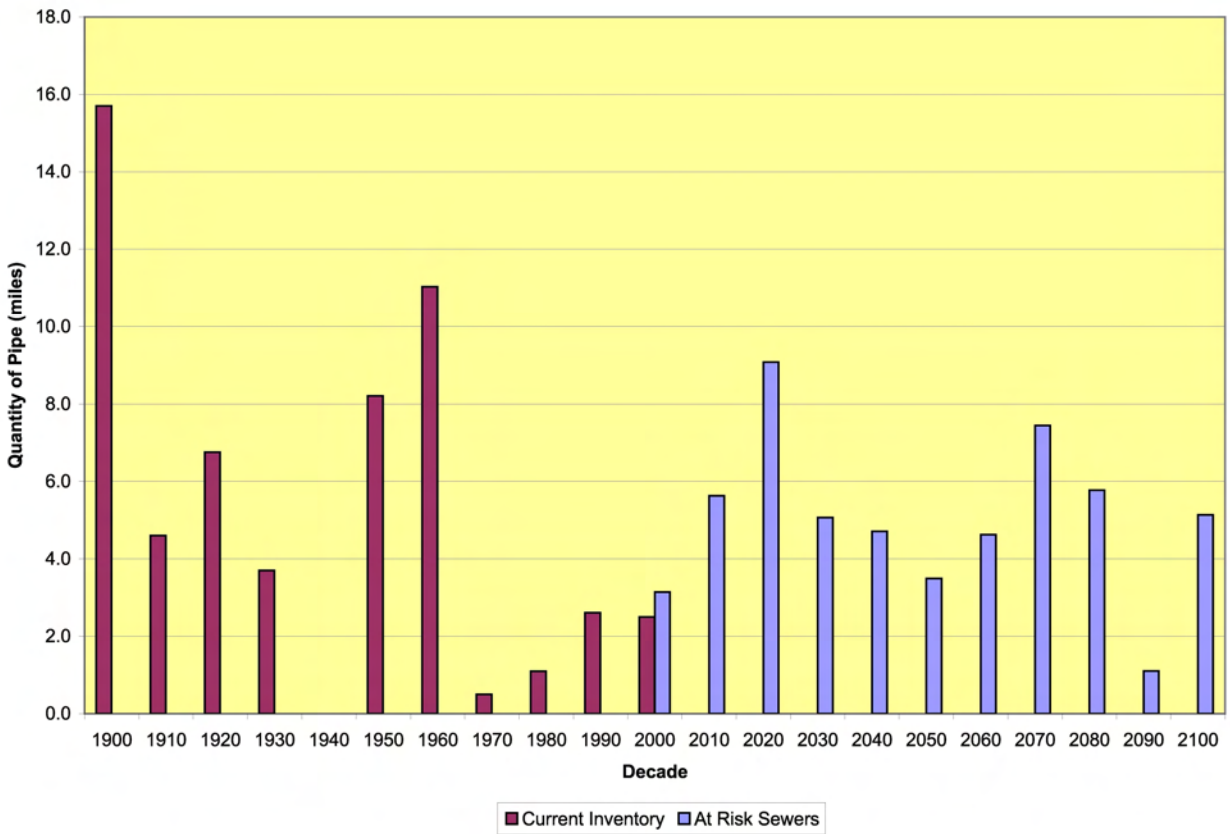


Table 9-1: Typical Life Expectancy of Sewer Pipes

Material	Installation Date	Life Expectancy (Years)
Vitrified Clay Pipe	Pre-1955	50
Vitrified Clay Pipe	Post-1955	75 to 100
ACP	--	75
Polyvinyl Chloride Pipe	--	100

As discussed previously in Section 6, analysis of the CCTV inspection data showed that the vitrified clay pipe (VCP) sewers in the City have a life expectancy of 100 years with 20 percent in need rehabilitation or replacement. Twenty percent of the sewers exceed the 100-year life and are considered to be “at-risk” facilities. The at-risk facilities are scheduled for rehabilitation or replacement.

Given the age and type of the existing stock and the projected backlog, a rehab and replacement program has been developed to manage the at-risk stock through 2100. Table 9-2 describes the existing stock by type and decade installed, the at-risk totals, recommended rehabilitation and replacement, the backlog difference between the rehabilitation and replacement recommendation and the total at-risk mileage, and the costs associated with this recommendation.

Table 9-2: Projected Capital Improvement Program

Decade Installed Beginning		Clay Pipe (miles)	PVC Pipe (miles)	Other Pipe (miles)	Total Pipe (miles)	At Risk Clay Pipe(1) (miles)	At Risk PVC Pipe(2) (miles)	At Risk Other Pipe(3) (miles)	At Risk Total (miles)	Capacity(4) Improvements for PWWF (miles)	Rehabilitation / Replacement Model: Rehab/ Replacement (miles)	Backlog(5) (miles)	Backlog, Portion of Total	Annual CIP(6) (2004 $)
Past	1900	14.7	1.0		15.7									
	1910	4.6	0.0		4.6									
	1920	6.7	0.1		6.8									
	1930	3.7	0.0		3.7									
	1940	0.0	0.0		0.0									
	1950	8.2	0.0		8.2									
	1960	10.6	0.2	0.2	11.0									
	1970	0.5	0.0		0.5									
	1980	0.4	0.7		1.1									
	1990	0.1	2.5		2.6									
Present	2000	0.7	1.8		2.5	2.9	0.2		3.1	0.7	2.3	1.5	2.7%	383,333
Future	2010					5.3	0.3		5.6	0.8	5.5	2.5	4.4%	550,000
	2020					10.1	0.5		9.1		7.0	4.6	8.1%	700,000
	2030					5.0	0.0		5.1		7.0	2.6	4.6%	700,000
	2040					4.4	0.1	0.2	4.7		7.0	0.3	0.6%	700,000
	2050					3.5	0.0		3.5		3.8	0.0	0.0%	380,000
	2060					4.6	0.0		4.6		4.0	0.6	1.1%	400,000
	2070					7.4	0.1		7.4		5.0	3.1	5.5%	500,000
	2080					5.5	0.2		5.8		5.0	3.9	6.9%	500,000
	2090					0.4	0.7		1.1		4.9	0.1	0.1%	490,000
	2100					1.0	4.2		5.1		5.2	0.0	0.0%	520,000
	Totals	**50.2**	**6.3**	**0.2**	**56.7**	**50.2**	**6.3**	**0.2**	**55.2**	**1.5**	**56.7**		**Average**	**530,000**

Assumptions:

1. Clay pipes will be at risk at 100 years old or when serious deficiencies are found by condition assessment, and they will be replaced before the end of useful life at 120 years.
2. PVC pipes will be at risk at 100 years old, and they will be replaced before the end of useful life at 120 years.
3. Other pipes (unknown pipe material) will be replaced before the end of useful life at 75 years.
4. Capacity improvements do not overlap with any of the at risk pipes requiring rehabilitation or replacement.
5. Backlog will be maintained at less than 10% of total pipe length in the collection system, and reduced to zero at the end of planning period.
6. Rehab/Replacement @ $1 million per mile in 2004 $.

9.2 Current Operating and Capital Expenses

9.2.1 Operating Expenses

Table 9-3 presents three years of operating expenses for the Sewer Enterprise Fund. Budgeted and actual operating expenses are described for fiscal years 2002 and 2003 and budgeted costs for 2004 and actuals 2004 to February 25, 2004 are also given. The fiscal year for the City begins in July. These are summed into total operating costs for each year. Totals from 2002 and 2003 are inflated to their 2004 values based on inflation for comparative purposes, and an estimate of the 2005 operations cost is listed. The City provided estimates for ongoing annual operating costs up to 2010 in the current year dollars.

9.2.2 Capital Expenses

Table 9-4 presents three years of capital expenses for the Sewer Enterprise Fund. Budgeted and actual capital expenses are described for fiscal years 2002 and 2003 and budgeted costs for 2004 and actuals 2004 to February 25, 2004 are also given. These are summed into total capital costs for each year. Finally, totals from 2002 and 2003 are inflated in their 2004 values based on inflation for comparative purposes.

9.2.3 Sewer Enterprise Capital Costs

Table 9-5 presents the ongoing sewer enterprise capital costs excluding sewer improvements and pump station improvements. Excluding these capital expenses allows for the development of a capital expenses baseline to which the SSAMP recommended capital expenses (described in previous sections) can be added.

Excluding sewer and pump station improvements, the City has historically spent between $134,000 and $278,000 per year on capital expenses, including pump station major maintenance costs, and equipment. An ongoing capital costs baseline was provided by the City.

9.2.4 Sewer Enterprise Fund Revenues

Table 9-6 presents three years of sewer enterprise fund revenues. Anticipated and actual revenues are described for fiscal years 2002 and 2003 and anticipated revenues for 2004 and actuals 2004 to February 25, 2004 are also given. These are summed into revenues for each year. These are then segregated into revenues derived by fees, which the City can have a direct impact on by changing fees, and other revenues (called here "non-fee revenues".) Furthermore, totals from 2002 and 2003 are inflated in their 2004 values based on inflation for comparative purposes and an estimate of revenues for 2005 is given.

Table 9-3: Three Years of Operating Expenses

Division	Account	Account Title	02		03		04	
			Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year to 2/25/04	Total Fiscal Year Budgeted Amount
611	5101	Base Salary	186,180	182,000	209,868	260,411	131,073	212,542
	5102	Overtime	3,268	6,700	3,630	8,000	466	8,000
	5104	Salaries Retroactive Pay	5,588	6,000	0	0	0	0
	5105	Part-Time Salaries	0	1,700	0	0	0	0
	5106	Uniform Allowance Pay	0	100	0	0	0	0
	5111	Part-Time Salaries	0	0	0	0	0	0
	5121	FICA-Medicare Benefits	2,800	2,900	2,904	3,776	1,841	3,082
	5122	Retirement (PERS)	3,971	3,800	5,193	4,105	7,169	10,593
	5123	Health Insurance Cost	211	700	217	231	234	210
	5124	Unemployment Cost	304	400	319	391	58	76
	5125	Deferred Compensation	266	1,000	0	0	0	0
	5126	Workers' Compensation	6,812	9,400	7,429	7,445	9,238	14,865
	5127	Life/Disability Insurance	881	2,100	0	0	0	0
	5128	Other Employee Benefits	1,135	0	2,305	5,105	1,524	2,672
	5201	Contract Services	0	0	150,091	157,000	26,737	174,000
	5202	Professional/Consultant Services	0	0	0	0	15,303	50,000
	5204	Engineering/Design Services	126,722	207,800	10,158	10,000	3,000	29,500
	5207	Maintenance Services	0	0	963	800	988	800
	5212	Telephone	4,714	4,000	5,539	4,500	2,959	4,500
	5215	Registration Costs	1,594	3,000	49	1,000	30	1,000
	5216	Attendance Costs	268	1,000	300	3,000	815	3,000
	5222	Utilities	15,381	16,700	13,534	15,000	7,036	15,000
	5223	Bldg Repair, Maintenance	0	0	0	0	0	4,000

Division	Account	Account Title	02		03		04	
			Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year to 2/25/04	Total Fiscal Year Budgeted Amount
	5226	Equipment Repair	7,510	22,000	4,631	20,000	16	20,000
	5227	Vehicle Repair	7,827	7,800	6,885	6,000	1,641	6,000
	5231	Insurance	0	8,000	8,000	8,000	4,000	8,000
	5232	Insurance Claims	0	0	0	0	0	20,000
	5291	Special Department Expense	0	0	0	0	375	15,000
	5309	Other Supplies	15,232	12,900	14,257	13,000	4,782	13,000
	5311	Vehicle Fuel	4,578	4,500	5,551	5,500	2,701	5,500
	5312	Vehicle Tires	0	1,400	0	1,400	0	1,400
	5352	Chemical Supplies	14,565	15,300	17,873	15,000	0	15,000
	5411	Bldg Depreciation	55,621	0	0	0		0
	5412	Improvements Depreciation	0	0	0	0		0
	5413	Equip Depreciation	27,139	0	0	0		0
	5491	Indirect Cost Allocation	105,500	100,000	150,000	150,000	0	150,000
	6001	Equipment	1,714	235,000	0	22,000	410	17,300
		Sewer Operations	**599,783**	**856,200**	**619,694**	**721,665**	**222,397**	**805,040**
		Sewer Operations 2004	**629,772**	**899,010**	**635,186**	**739,707**	**222,397**	**805,040**

Table 9-4: Three Years of Capital Expenses

Division	Account	Account Title	02		03		04	
			Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year to 2/25/04	Total Fiscal Year Budgeted Amount
612	5201	Contract Services	0	0	23,003	25,000	17,297	25,000
	2502	Professional/Consultant Services	0	0	0	0	5,547	20,000
	5204	Engineering/Design Services	35,647	210,000	0	105,000	86,169	65,000
	5205	Legal Services	0	0	0	0	0	0
	5411	Building Depreciation	0	0	52,452	0		0
	5413	Equipment Depreciation	0	0	39,619	0		0
	5441	Franchise Taxes	40,000	40,000	47,500	47,500	0	50,000
	5801	Lease Payments	43,594	43,000	0	0	0	0
	5802	Bond - Principal Payments	0	0	0	15,000	0	25,000
	5803	Bond - Interest Payments	0	0	68,846	68,900	0	68,300
	5804	Amortization Expenses	0	0	3,583	0	0	0
	6012	Public Works Vehicles	0	0	0	20,000	0	25,000
	6051	Sewer System Improvements	0	890,000	0	800,000	1,021,088	465,000
	6052	Pump Station Improvements	47,839	90,300	(47,839)	92,000	4	25,000
		Sewer Capital Improvement	**167,080**	**1,273,300**	**187,163**	**1,173,400**	**1,130,106**	**768,300**
		Sewer Capital Improvement 2004	**175,434**	**1,336,965**	**191,842**	**1,202,735**	**1,130,106**	**768,300**

Table 9-5: Three Years of Capital Expenses Excluding Sewer and Pump Station Improvements

Division	Account	Account Title	02		03		04	
			Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year Expense Amount	Total Fiscal Year Budgeted Amount	Total Fiscal Year to 2/25/04	Total Fiscal Year Budgeted Amount
612	5201	Contract Services	0	0	23,003	25,000	17,297	25,000
	2502	Professional/Consultant Services	0	0	0	0	5,547	20,000
	5204	Engineering/Design Services	35,647	210,000	0	105,000	86,169	65,000
	5205	Legal Services	0	0	0	0	0	0
	5411	Building Depreciation	0	0	52,452	0		0
	5413	Equipment Depreciation	0	0	39,619	0		0
	5441	Franchise Taxes	40,000	40,000	47,500	47,500	0	50,000
	5801	Lease Payments	43,594	43,000	0	0	0	0
	5802	Bond - Principal Payments	0	0	0	15,000	0	25,000
	5803	Bond - Interest Payments	0	0	68,846	68,900	0	68,300
	5804	Amortization Expenses	0	0	3,583	0	0	0
	6012	Public Works Vehicles	0	0	0	20,000	0	25,000
	6051	Sewer System Improvements	0	890,000	0	800,000	1,021,088	465,000
	6052	Pump Station Improvements	47,839	90,300	(47,839)	92,000	4	25,000
		SEWER CAPITAL IMPROVEMENT	**167,080**	**1,273,300**	**187,163**	**1,173,400**	**1,130,106**	**768,300**
		SEWER CAPITAL IMPROVEMENT 2004	**175,434**	**1,336,965**	**191,842**	**1,202,735**	**1,130,106**	**768,300**
		Totals Excluding Sewer System and Pump Stations Improvements (6501, 6502)	**127,595**	**356,665**	**239,681**	**310,735**	**109,014**	**278,300**
		Totals Excluding Sewer System and Pump Stations Improvements (6501, 6502) 2004	**133,974**	**374,498**	**245,673**	**318,503**	**109,014**	**278,300**

Table 9-6: Three Years of Sewer Enterprise Fund Revenues

Fund	Account	Account Title	02		03		04	
			Total YTD Receipt Amount	Total YTD Budgeted Revenue Amount	Total YTD Receipt Amount	Total YTD Budgeted Revenue Amount	Total Fiscal Year to 2/25/04	Total YTD Budgeted Revenue Amount
76	4011	Bond Proceeds	1	1,365,000	0	400,000	0	0
	4339	Clean Beaches Initiative Grant			76,524	0	232,576	0
	4470	Sewer Connection Fees	5438	5,000	1,968	5,000	4,731	3,000
	4471	Sewer Service Surcharge	610364	784,000	872,202	950,000	512,519	1,000,000
	4517	Grease Trap Reimbursement	1898	2,000	70	2,000	284,433	0
	4651	Interest Earned	29837	0	14,430	10,000	3,248	1,000
	4704	Sewer Debt Equalization	21073	21,000	0	0	0	0
76 Sewer Fund			**668,611**	**2,177,000**	**965,194**	**1,367,000**	**1,037,507**	**1,004,000**
76 Sewer Fund Excluding Fees			**52,809**	**1,388,000**	**91,024**	**412,000**	**520,258**	**1,000**
76 Sewer Fund Excluding Fees 2004			**55,449**	**1,457,400**	**93,300**	**422,300**	**520,258**	**1,000**
76 Sewer Fund Fees Only			**615,802**	**789,000**	**874,170**	**955,000**	**517,249**	**1,003,000**
76 Sewer Fund Fees Only 2004			**646,592**	**828,450**	**896,024**	**978,875**	**517,249**	**1,003,000**

9.3 Projected Operating Costs

Given the estimated operating and capital expense baselines, which are based upon the Sewer Enterprises' historical expenditures, this section develops estimated operational expenses for 2004 through 2010, and the next section examines future capital expenses. These are developed by starting from the historical baseline and adding in recommended additions, based on HDR's review of operational and capital needs. The total operational costs are then compared with projected revenues to develop a total enterprise model for 2004-2010.

9.3.1 Assumptions

Several assumptions are included in the enterprise model; these assumptions are included in the projected operating cost model as well as the capital cost and revenue portions of the model. Assumptions included in the operating, capital, and/or revenue portions of the enterprise model are as follows:

- There are 7,100 connections and the number of connections will increase by 866 in 2011 and again by 866 in 2021. (1,600 secondary units + 132 vacant parcels)
- Rehab/Replacement @ $1 million per mile in 2004 dollars.
- Inflation is estimated as 2.5%. Actual inflation is likely to be lower in the near term, and higher in the long run.
- Estimates of On-Going Expenses based on Historical Data.
- 0.5% interest over inflation on reserve funds.
- Repayment of 1.32 million bond is included in on-going costs.
- Rate Increase describes City's portion of the current rate collection only.
- Rate Increase is 60% in 2005, 75% in 2006, and 100% thereafter.
- Assumes no MRWPCA rate increases.
- Constructions costs and Operations and Maintenance costs inflate at the same rate.

It should be noted that the Enterprise Model presented here is not a budget for the City's sewer enterprise fund, but a model of the fiscal impact of recommended changes. As such, the model estimates likely cost items, including cost increases and revenue changes, but cannot guarantee specific cost items. It should also be noted that it reflects an estimated inflation rate of 2.5% which may be higher than the actual rate of inflation in 2005 and 2006, but is lower than the historically CIP average of about 3%.

9.3.2 Projected Operations Expenses

Table 9-7 describes estimated operation expenses for 2005-2010. Included in this portion of the enterprise model are the following:

- The operational expense baseline described above.
- Legal expenses related to the lawsuit (Ecological Rights Foundation vs. the City of Pacific Grove) for fiscal years 2004-2006.
- Operational expenses related to the lateral reimbursement program.
- Expenses for CCTV costs not included in the current baseline.

Table 9-7: Sewer Enterprise Model - Operations

Sewer Enterprise Model	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Operations	827,560	848,249	869,455	891,192	913,471	936,308
Operations Legal	100,000	100,000				
Operations - Lateral	40,000	40,000	40,000	40,000	40,000	
Operations - CCTV	100,000	102,500	22,050	22,601	23,166	23,745
Total Operations	**1,067,560**	**1,090,749**	**931,505**	**953,793**	**976,638**	**960,054**

9.4 Projected Capital Costs

Table 9-8 describes estimated capital expenses for 2005-2010. Included in the capital portion of the enterprise model are the following:

- The capital expense baseline described above.
- Estimated costs for recommended line replacement of 2.3 miles by 2010.
- Pump station repairs over 10 years and the purchase of seven spare pumps.
- Funds for the implementation of CMMS software in 2006.
- Replacement of existing capital equipment, including rodder and jetter on lease purchase.
- Lease purchase of new types of capital equipment for spot repairs including backhoe, trailer, dump truck, concrete saw with trailer, and air compressor.

Table 9-8: Enterprise Model - Capital

Sewer Enterprise Model	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Capital	108,647	136,924	226,516	232,179	237,983	243,933
Capital Line Replacement	460,000	483,000	495,075	507,452	520,138	632,500
Capital Pump Station	1,000,000	33,600	47,200	48,380	49,590	50,829
Capital CMMS Implementation		52,500	26,875	27,547	28,236	28,941
Capital Equipment Replacement			32,250	78,890	80,862	82,883
Capital Construction Equipment			63,425	65,011	66,636	68,302
Total Capital	**1,568,647**	**706,024**	**891,341**	**959,458**	**983,444**	**1,107,389**

9.5 Projected Total Costs

Table 9-9 describes estimated total expenses for 2005-2010. Total expenses included the operating and capital expenses described above.

Table 9-9: Enterprise Model - Total Expenses

Sewer Enterprise Model	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Operations	827,560	848,249	869,455	891,192	913,471	936,308
Operations Legal	100,000	100,000				
Operations Lateral	40,000	40,000	40,000	40,000	40,000	
Operations CCTV	100,000	102,500	22,050	22,601	23,166	23,745
Total Operations	**1,067,560**	**1,090,749**	**931,505**	**953,793**	**976,638**	**960,054**
Capital	108,647	136,924	226,516	232,179	237,983	243,933
Capital Line Replacement	460,000	483,000	495,075	507,452	520,138	632,500
Capital Pump Station	1,000,000	33,600	47,200	48,380	49,590	50,829
Capital CMMS Implementation		52,500	26,875	27,547	28,236	28,941
Capital Equipment Replacement			32,250	78,890	80,862	82,883
Capital Construction Equipment			63,425	65,011	66,636	68,302
Total Capital	**1,568,647**	**706,024**	**891,341**	**959,458**	**983,444**	**1,107,389**
Transfer from Previous Year ("Emergency Fund")	-	1,793	15,574	261,195	423,780	544,412
TOTAL EXPENSE	**2,636,207**	**1,796,773**	**1,822,846**	**1,913,251**	**1,960,082**	**2,067,442**

9.6 Projected Revenues

Table 9-10 describes estimated revenues for 2005-2010. Revenues are based on information provided by the City and the revenue baseline described above. These are separated into non-fee revenue, revenue derived from fees, and interest revenue derived from cash savings, where available.

Table 9-10: Enterprise Model - Revenues

Sewer Enterprise Model	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Non-fee Revenue	1,038,000	8,000	8,000	8,000	8,000	8,000
Revenue Derived from Fees	1,030,000	1,030,000	1,030,000	1,030,000	1,030,000	1,030,000
Revenue from 2004 Fee Increase	570,000	772,500	1,030,000	1,030,000	1,030,000	1,030,000
Interest Income		54	467	7,836	12,713	16,332
TOTALREVENUES	**2,638,000**	**1,810,554**	**2,068,467**	**2,075,836**	**2,080,713**	**2,084,332**

9.7 Projected Enterprise Balance without Fee Increase

Table 9-11 describes the projected enterprise balance based upon the expenses described above and the existing revenue sources. The table presents the fiscal impact of the recommended changes without fee increases.

Table 9-11: Enterprise Model - Balance without Fee Increase

Sewer Enterprise Model	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Operations	827,560	848,249	869,455	891,192	913,471	936,308
Operations Legal	100,000	100,000				
Operations Lateral	40,000	40,000	40,000	40,000	40,000	
Operations CCTV	100,000	102,500	22,050	22,601	23,166	23,745
Total Operations	**1,067,560**	**1,090,749**	**931,505**	**953,793**	**976,638**	**960,054**
Capital	108,647	136,924	226,516	232,179	237,983	243,933
Capital Line Replacement	460,000	483,000	495,075	507,452	520,138	632,500
Capital Pump Station	1,000,000	33,600	47,200	48,380	49,590	50,829
Capital CMMS Implementation		52,500	26,875	27,547	28,236	28,941
Capital Equipment Replacement			32,250	78,890	80,862	82,883
Capital Construction Equipment			63,425	65,011	66,636	68,302
Total Capital	**1,568,647**	**706,024**	**891,341**	**959,458**	**983,444**	**1,107,389**
TOTALEXPENSE	**2,636,207**	**1,796,773**	**1,822,846**	**1,913,251**	**1,960,082**	**2,067,442**
Non-fee Revenue	1,038,000	8,000	8,000	8,000	8,000	8,000
Revenue Derived from Fees	1,030,000	1,030,000	1,030,000	1,030,000	1,030,000	1,030,000
TOTALREVENUES	**2,068,000**	**1,038,000**	**1,038,000**	**1,038,000**	**1,038,000**	**1,038,000**
BALANCE	**(568,207)**	**(1,326,980)**	**(2,111,826)**	**(2,987,077)**	**(3,909,159)**	**(4,938,601)**

9.8 Recommended Fee Increase

As Table 9-11 above demonstrates, the sewer enterprise cannot incorporate the recommended capital improvements and operational changes suggested given the current revenue structure without running a significant deficit. For this reason, a fee increase of 100 percent of the City's portion of the collected sewer rate is recommended.

This increase would be phased in over three years starting in fiscal year 2005. The first year would include a 60 percent fee increase, the second year would include a 75 percent increase, and the final year would include a 100 percent increase from the 2004 baseline.

Table 9-12 describes the fiscal impact of a phased-in 100 percent fee increase on the Sewer Enterprise Model. Given a phased 100 percent fee increase, the sewer enterprise will be in balance through 2010.

Table 9-12: Enterprise Model- Fiscal Impact of Fee Increase

Sewer Enterprise Model	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Operations	827,560	848,249	869,455	891,192	913,471	936,308
Operations Legal	100,000	100,000				
Operations Lateral	40,000	40,000	40,000	40,000	40,000	
Operations CCTV	100,000	102,500	22,050	22,601	23,166	23,745
Total Operations	**1,067,560**	**1,090,749**	**931,505**	**953,793**	**976,638**	**960,054**
Capital*	108,647	136,924	226,516	232,179	237,983	243,933
Capital Line Replacement	460,000	483,000	495,075	507,452	520,138	632,500
Capital Pump Station	1,000,000	33,600	47,200	48,380	49,590	50,829
Capital CMMS Implementation		52,500	26,875	27,547	28,236	28,941
Capital Equipment Replacement			32,250	78,890	80,862	82,883
Capital Construction Equipment			63,425	65,011	66,636	68,302
Total Capital	**1,568,647**	**706,024**	**891,341**	**959,458**	**983,444**	**1,107,389**
TOTAL EXPENSE	**2,636,207**	**1,796,773**	**1,822,846**	**1,913,251**	**1,960,082**	**2,067,442**
Non-fee Revenue	1,038,000	8,000	8,000	8,000	8,000	8,000
Revenue Derived from Fees	1,030,000	1,030,000	1,030,000	1,030,000	1,030,000	1,030,000
Revenuefrom2004FeeIncrease	570,000	772,500	1,030,000	1,030,000	1,030,000	1,030,000
Interest Income		54	467	7,836	12,713	16,332
TOTAL REVENUES	**2,638,000**	**1,810,554**	**2,068,467**	**2,075,836**	**2,080,713**	**2,084,332**
Transfer from Previous Year ("Emergency Fund")	-	1,793	15,574	261,195	423,780	544,412
BALANCE	1,793	15,574	261,195	423,780	544,412	561,302

*Capital includes: contract services, prof/consultant services, engineering/design services, legal services, bldg depreciation, equip depreciation, franchise taxes, lease payments, bond - prin pmts, bond - interest pmts, amortization expenses, and pub wks vehicles.

9.9 Enterprise Model 2011-2101

A general cost model is described in Table 9-13 for the 10 decades, 2011-2101, for which capital line replacements have been recommended.

It is recommended that the Enterprise Model be updated during the triennial review.

Table 9-13: Enterprise Model - 2011-2101

Sewer Enterprise Model	Fiscal Year									
	2011	2021	2031	2041	2051	2061	2071	2081	2091	2101
Operations	10,533,467	11,850,150	13,331,419	14,997,847	16,872,577	18,981,650	21,354,356	24,023,650	27,026,607	30,404,932
Operations Legal										
Operations Lateral										
Operations-CCTV										
Total Operations	**10,533,467**	**11,850,150**	**13,331,419**	**14,997,847**	**16,872,577**	**18,981,650**	**21,354,356**	**24,023,650**	**27,026,607**	**30,404,932**
Capital	2,744,246	3,087,277	3,473,186	3,907,334	4,395,751	4,945,220	5,563,373	6,258,794	7,041,144	7,921,287
Capital Line Replacement	7,115,625	7,367,500	7,542,500	7,717,500	4,284,500	4,610,000	5,887,500	6,012,500	6,014,750	6,513,000
Capital Pump Station	312,600									
Capital CMMS Implementation	325,591	366,290	412,076	463,586	521,534	586,726	660,067	742,575	835,397	939,821
Capital Equipment Replacement	450,500	411,750	463,219	521,121	586,261	659,544	741,987	834,735	939,077	1,056,462
Capital Construction Equipment	415,958	368,296	414,333	466,125	524,390	589,939	663,681	746,642	839,972	944,968
Total Capital	**11,364,520**	**11,601,113**	**12,305,314**	**13,075,666**	**10,312,437**	**11,391,429**	**13,516,608**	**14,595,246**	**15,670,339**	**17,375,538**
TOTALEXPENSE	**21,897,987**	**23,451,263**	**25,636,734**	**28,073,513**	**27,185,014**	**30,373,079**	**34,870,963**	**38,618,896**	**42,696,946**	**47,780,470**
Non-fee Revenue	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000
Revenue Derived from Fees	11,556,310	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854
Revenuefrom2004FeeIncre ase	11,556,310	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854	12,965,854
Interest Income	190,074	613,803	1,566,077	2,148,392	2,174,369	2,474,688	1,908,683			
TOTALREVENUES	**23,382,694**	**26,625,511**	**27,577,785**	**28,160,101**	**28,186,077**	**28,486,396**	**27,920,391**	**26,011,708**	**26,011,708**	**26,011,708**
Transfer from Previous Year("Emergency Fund")	561,302	2,046,009	5,220,256	7,161,308	7,247,896	8,248,959	6,362,276	(588,296)	(13,195,484)	(29,880,722)
BALANCE	2,046,009	5,220,256	7,161,308	7,247,896	8,248,959	6,362,276	(588,296)	(13,195,484)	(29,880,722)	(51,649,484)

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