



Richmond Municipal Sewer District
WASTEWATER COLLECTION SYSTEM
UPDATED MASTER PLAN

December 31, 2019



Prepared By



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& ASSOCIATES

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TABLE OF CONTENTS

CHAPTER 1 - INTRODUCTION..... 1-1

1.1 Background..... 1-1

1.2 Project Objectives 1-1

1.3 Report Organization..... 1-2

1.4 Acronyms and Abbreviations 1-2

CHAPTER 2 - EXISTING WASTEWATER SYSTEM..... 2-1

2.1 Existing Service Area 2-1

2.2 Population Served 2-1

2.3 Wastewater Collection System Assets..... 2-1

CHAPTER 3 – SUMMARY OF UPDATED SECAP 3-1

3.1 System Flows..... 3-1

3.1.1 Dry Weather Flows..... 3-1

3.1.2 Wet Weather Flows..... 3-1

3.2 2018-2019 Flow Monitoring Program..... 3-2

3.3 Planning Criteria..... 3-6

3.3.1 Design Storm 3-6

3.3.2 Hydraulic Deficiency Criteria..... 3-7

3.4 Wastewater Collection System Hydraulic Model..... 3-7

3.4.1 Model Components..... 3-7

3.4.2 Wet Weather Flow Generation 3-8

3.5 Capacity Analysis Results..... 3-11

3.5.1 First and Third Street Capacity Improvements..... 3-11

3.5.2 Upper 23rd Street Capacity Improvements..... 3-11

3.5.3 24th Street Capacity Improvements 3-11

3.5.4 South 33rd Street Capacity Improvements 3-13

3.5.5 Cutting Boulevard Capacity Improvements..... 3-13

3.5.6 Pump Station Capacity Needs..... 3-13

3.6 Inflow and Infiltration Reduction 3-14

3.6.1 Introduction & Background 3-14

3.6.2 I&I Reduction Approach and Results..... 3-14



3.6.3 First Street Pipeline Improvements and Relief Sewer Project..... 3-16

3.7 SECAP Capacity Improvement Plan 3-17

CHAPTER 4 SUMMARY OF 2019 RISK ASSESSMENT ANALYSIS 4-1

4.1 Background and Introduction 4-1

4.2 Likelihood and Consequence of Failure 4-2

4.3 Total Risk Score..... 4-2

4.4 2019 RAA Program Summary..... 4-3

4.5 Keller Beach Interceptor 4-5

CHAPTER 5 SUMMARY OF LIFT STATION MASTER PLAN 5-1

5.1 Introduction..... 5-1

5.2 Summary of Available Data..... 5-1

5.3 Lift Station Condition Assessment 5-2

5.4 Lift Station Conceptual Costs 5-2

5.5 Lift Station Capacity Assessment 5-3

5.6 Lift Station Capital Improvement Program 5-4

5.7 Forcemain Condition Assessment Report..... 5-4

CHAPTER 6 CONSOLIDATED CAPITAL IMPROVEMENT PROGRAM 6-1

FIGURES

Figure 2.1 Sewer Collection System Service Area and Assets

Figure 3.1 Rainfall and Measured Flows at Meter 3

Figure 3.2 Meter Connectivity

Figure 3.3 Flowmeter Locations and Associated Pipelines/Catchments

Figure 3.4 Example Flow Record Showing Wet Weather Flow Components

Figure 3.5 NOAA Temporal 24-Hour Rainfall Distribution

Figure 3.6 Modeled Gravity Sewer Pipelines

Figure 3.7 Components of RTK Hydrograph

Figure 3.8 Meter 9 Validation Results

Figure 3.9 Pipeline Capacity Project Locations

Figure 3.10 First Street Rehabilitation and Relief Sewer Project



Figure 4.1 Total Risk Score Calculation
Figure 4.2 January 2019 Process Used to Develop RAA Priorities
Figure 4.3 Keller Beach Interceptor and Contributing Gravity Sewers

TABLES

Table 3.1 Potential to Eliminate SECAP Projects through Mainline Replacements
Table 3.2 SECAP Capacity Improvement Plan
Table 4.1 Data Utilized in the 2019 Risk Model
Table 4.2 Proposed Implementation Schedule for RAA Pipes
Table 4.3 RAA Costs through Fiscal Year 2029
Table 5.1 LSMP Capital Improvement Program
Table 6.1 Consolidated Capital Improvement Program



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CHAPTER 1 - INTRODUCTION

This Chapter provides background information on the scope and objectives of the Richmond Municipal Services District (“RMSD”) 2019 Wastewater Collection System Master Plan (“Updated Master Plan”). This Updated Master Plan, as with the 2011 Master Plan, is a working document, as it summarizes various planning efforts that were completed at separate times. Each of the planning project reports is also a living document that will be updated on its own timeline; any future updates to the referenced planning reports will be made available for review at the City.

1.1 Background

RMSD provides wastewater collection and treatment services to approximately 60 percent of the City of Richmond (“City”). Some areas of the collection system within the City limits are served by West County Wastewater District (“WCWD”) to the north, and Stege Sanitary District (“Stege”) to the east and south. For the purposes of this report, any references to “Richmond”, “RMSD”, or “City” refers to the services provided by RMSD.

In 2018, the City entered into a settlement agreement with San Francisco Baykeeper (“Baykeeper”) that included a number of required actions and submittals to be completed in 2019 and future years. This report was prepared to address Paragraph VIII.19 of the settlement agreement, which requires the City to complete an Updated Master Plan “incorporating the project list and schedule from the Revised SECAP and seek City Council approval of the Updated Master Plan. The project list in the Updated Master Plan shall include capacity-related improvement projects included in the 2011 Master Plan, provided still necessary and appropriate after the Revised SECAP has been performed, and all capacity-related improvement projects identified by the Revised SECAP.”

Also in 2018, the City and Veolia completed a Lift Station Master Plan (“LSMP”) that evaluated lift station safety, reliability, and capacity needs and provided recommendations for improvement. The LSMP is included in Appendix C, and summarized in Chapter 5 of this report.

In 2019, the City submitted two other documents required by the Baykeeper settlement agreement: the Updated System Evaluation and Capacity Assurance Plan (“SECAP”) and the 2019 Risk Assessment Analysis (“RAA”), which are included in Appendices A and B, respectively. This report summarizes these documents in Chapters 3 and 4. Chapter 4 also discusses Keller Beach interceptor needs, which remains separate from other pipeline replacement needs discussed in the 2019 RAA.

1.2 Project Objectives

The primary purpose of the Updated Master Plan is to update information discussed in the 2011 Master Plan, and to integrate new findings and recommendations from the City’s most current planning documents.

1.3 Report Organization

This report is comprised of the following six chapters:

- Chapter 1 – Introduction
- Chapter 2 – Existing Wastewater System
- Chapter 3 – Summary of Updated System Evaluation and Capacity Assurance Plan
- Chapter 4 – Summary of 2019 Risk Assessment Analysis
- Chapter 5 – Summary of 2018 Lift Station Master Plan
- Chapter 6 – Consolidated Capital Improvement Program
- Appendices

1.4 Acronyms and Abbreviations

The following acronyms and abbreviations have been used throughout this Master Plan to improve document clarity and readability.

AACE	Association for the Advancement of Cost Engineering
ADWF	Average Dry Weather Flow
Baykeeper	San Francisco Baykeeper
BWF	Base Wastewater Flows
CCI	Construction Cost Index
CCTV	Closed Circuit Television
CIP	Capital Improvement Program
City	City of Richmond
CIWQS	California Integrated Water Quality System
fps	Feet Per Second
GIS	Geographical Information System
gpd	Gallons Per Day
GWI	Groundwater Infiltration
HGL	Hydraulic Grade Line
I&I	Inflow and Infiltration
Idf	Inch-Diameter-Foot
LSMP	Lift Station Master Plan
mg	Million Gallons



mgd	Million Gallons Per Day
NASSCO	National Association of Sewer Service Companies
NOAA	National Oceanic and Atmospheric Administration
PACP	Pipeline Assessment and Condition Program
PDWF	Peak Dry Weather Flow
PLC	Programmable Logic Controller
PWWF	Peak Wet Weather Flow
RAA	2019 Risk Assessment Analysis
RDII	Rainfall-Dependent Inflow
RMSD	Richmond Municipal Sewer District
RWQCB	Regional Water Quality Control Board
SECAP	System Evaluation and Capacity Assurance Plan
SSMP	Sewer System Management Plan
SSO	Sewer System Overflow
Stege	Stege Sanitary District
SWRCB	State Water Resources Control Board
V&A	V&A Consulting
Veolia	Veolia Water
WCWD	West County Wastewater District
WDR	Waste Discharge Requirements
WWTP	Wastewater Treatment Plant



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CHAPTER 2 - EXISTING WASTEWATER SYSTEM

This chapter describes the RMSD wastewater collection system.

2.1 Existing Service Area

The City's wastewater service area and assets are shown on Figure 2.1 on the following page. The City limits encompass a total area of 52.6 square miles consisting of over 30 square miles of land. Much of this land comprises open space; approximately one quarter of this acreage is included within the City's sewer service area.

The service area is diverse, ranging from hilly, tree-covered residential areas along the eastern boundary to relatively low topography communities from San Pablo Avenue west and south to the Bay. A small community named Point Richmond, located on the far western boundary, is comprised of steep, narrow roadways. Flows from this community are conveyed by gravity to the Keller Beach interceptor, which is a buried pipeline that is located below sea level.

Abutting the sewer collection service area boundary, WCWD provides sewer collection service to a small portion of the City on the northern border of the City, adjacent to the City of San Pablo, and Stege collects wastewater for a portion of the City in the eastern hills, adjacent to the City of El Cerrito. The City, WCWD, and Stege convey flows to three separate wastewater treatment plants.

2.2 Population Served

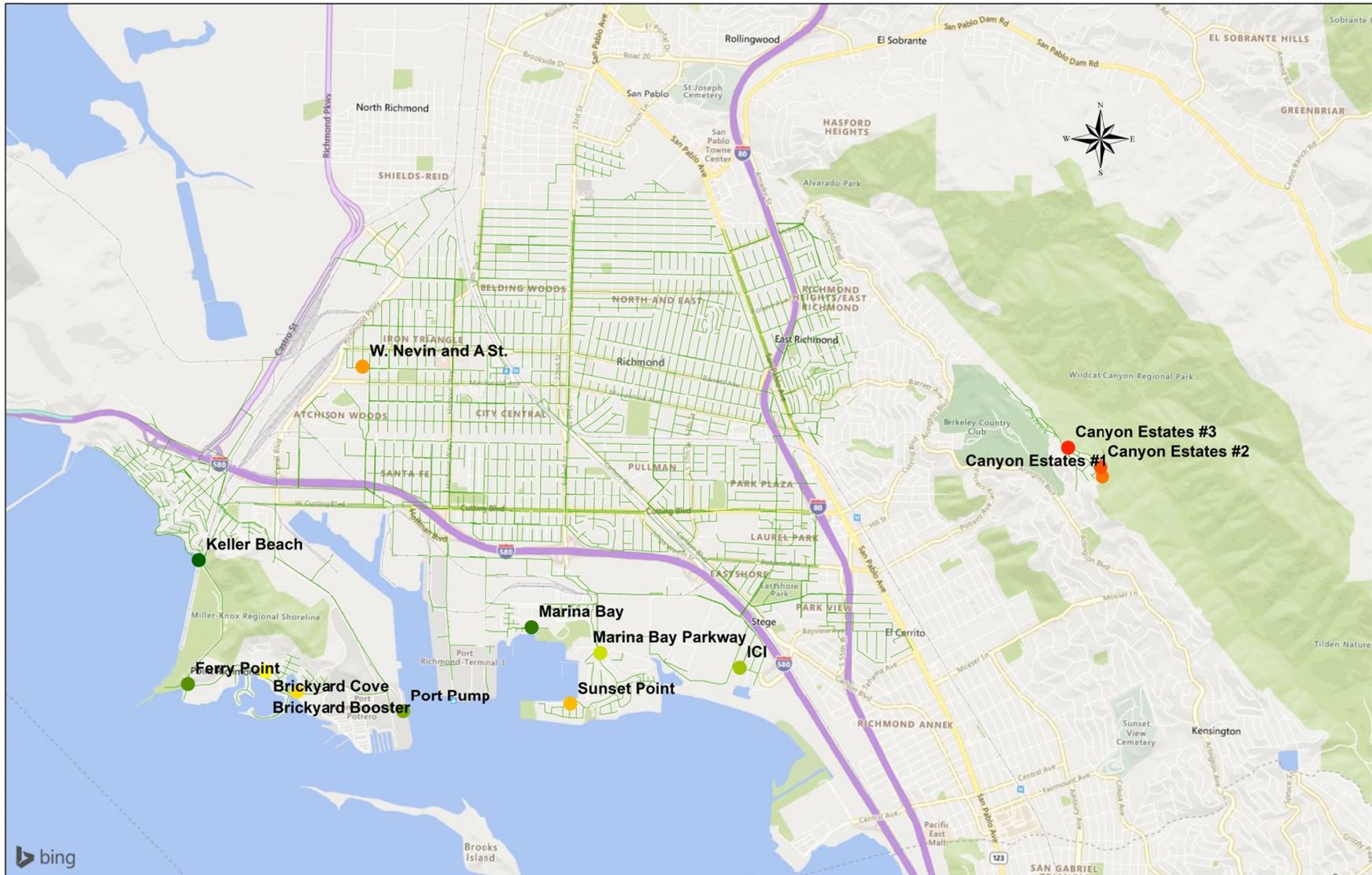
The estimated population for the City of Richmond is 110,746 (in 2018), as reported on the United States Census Bureau website. Approximately 70,000 of these residents are served by RMSD. The RMSD service area includes a wide range of mixed land uses, including various residential classes, industrial/office flex, port functions, commercial/industrial, and neighborhood retail, with Industrial/Office Flex and Residential classes comprising approximately two thirds of the land uses.

2.3 Wastewater Collection System Assets

The wastewater collection system is comprised of approximately 179 miles of active gravity sewer pipelines with sizes ranging from 4 to 66 inches in diameter, 4 miles of pressure pipelines, also referenced herein as forcemains, and 13 pumping stations. All of the pumping stations lift sewage from a local sewershed to a nearby collector sewer or trunk sewer. Throughout this report, the terms, "pump station" and "lift station" are used interchangeably. Three lift stations located near Arlington Avenue in the Richmond hills are owned and operated by the City but convey flow to Stege.

The City conveys all flows, with the exception of the Stege flows discussed above, to the City's wastewater treatment plant ("WWTP") located on Canal Boulevard, south of I-580. The maximum

Figure 2.1 Sewer Collection System Service Area and Assets





hourly flow rate that can be processed by the WWTP during wet weather operations is 42 million gallons per day (mgd). When peak hourly collection system flows are expected to exceed 42 mgd, the City uses a 28 mgd bypass pumping station to divert raw wastewater to a 5 million gallon storage tank. This flow is released back to the plant after the wet weather event concludes.



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CHAPTER 3 – SUMMARY OF UPDATED SECAP

This chapter summarizes information presented in the City’s System Evaluation and Capacity Assurance Plan (“SECAP”). The SECAP is included in Appendix A. The SECAP includes the following nine chapters:

- Chapter 1 – Introduction
- Chapter 2 – Existing Wastewater System
- Chapter 3 – System Flows
- Chapter 4 – Flow Monitoring Program
- Chapter 5 – Planning Criteria
- Chapter 6 – Hydraulic Model Development
- Chapter 7 – Capacity Analysis Results
- Chapter 8 – Inflow and Infiltration Reduction
- Chapter 9 – Capacity Improvement Program, Results, and Timeline

3.1 System Flows

The City’s updated hydraulic model was developed using General Plan land use descriptions, aerial photography, GIS map data, City industrial wastewater discharge data, as-built information, and flow monitoring data to estimate dry weather sanitary sewer flows. Flows were assigned per subcatchment, and these flows aggregated by metered sewer basin.

3.1.1 Dry Weather Flows

The City’s dry weather flow components, which include average dry weather flow (“ADWF”) and dry weather groundwater infiltration (“GWI”), were calibrated to measured flows that were collected during the City’s 2018-2019 flow monitoring program, which is discussed further below.

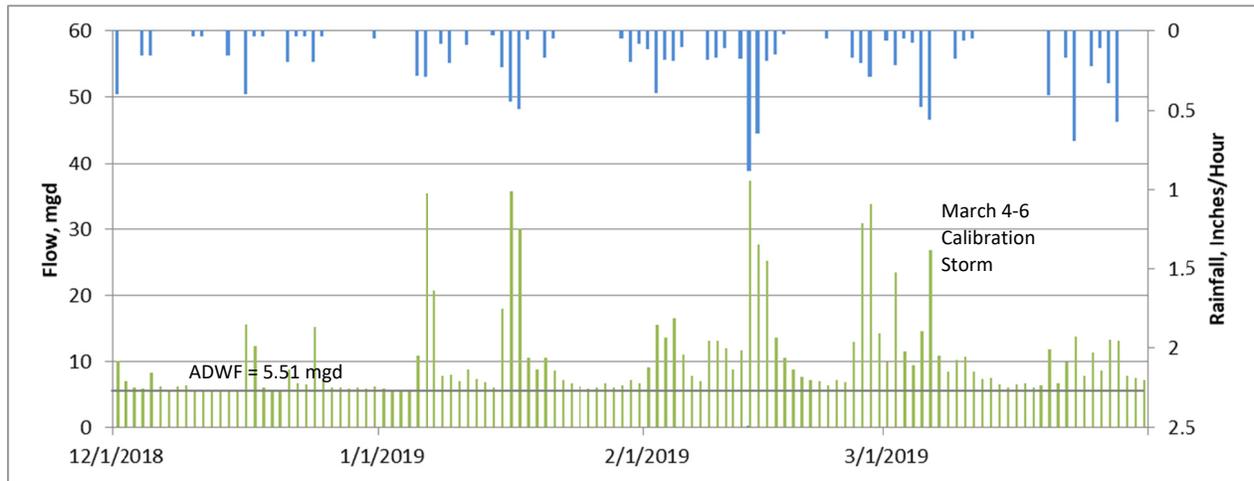
The most representative average dry weather flow rate during the flow monitoring period was 5.51 mgd, as measured on December 13, 2018. Dry weather flows for each basin follow a 24-hour diurnal pattern that matches the measured diurnal pattern for the respective sewer basin.

3.1.2 Wet Weather Flows

Figure 3.1 provides an example of how rainfall and flows varied from December 2018 through March 2019. Flow is shown in green across the bottom of the chart and rainfall is shown in blue. The representative meter, Meter 3, is located in Cutting Boulevard east of Canal Blvd and north of the wastewater treatment plant. This meter measures over three quarters of system flows.

Wet weather system components included ADWF plus dry weather GWI as the foundation. Wet weather GWI augmented this baseline, and rainfall dependent inflow and infiltration (“RDII” or “I&I”) completed the calculation.

Figure 3.1 Rainfall and Measured Flows at Meter 3



3.2 2018-2019 Flow Monitoring Program

From December 1, 2018 through March 31, 2019, the City and Veolia completed a system-wide flow monitoring program. The program, which was conducted by V&A Consulting (“V&A”), included 17 flowmeters and two rain gauges. V&A supplemented the collected data with additional rainfall data gathered at two publicly accessible, permanent rainfall gauges located in the northern portion of the service area. Raw field data (flow and rainfall) provided by V&A after the conclusion of the flow monitoring period were utilized for the development of the SECAP.

Meters were given names ranging from Meter 1 to Meter 14, with some meter names having an alphanumeric component. Many meters contributed flow to downstream meters, as shown in Figure 3.2.

Figure 3.2 Meter Connectivity

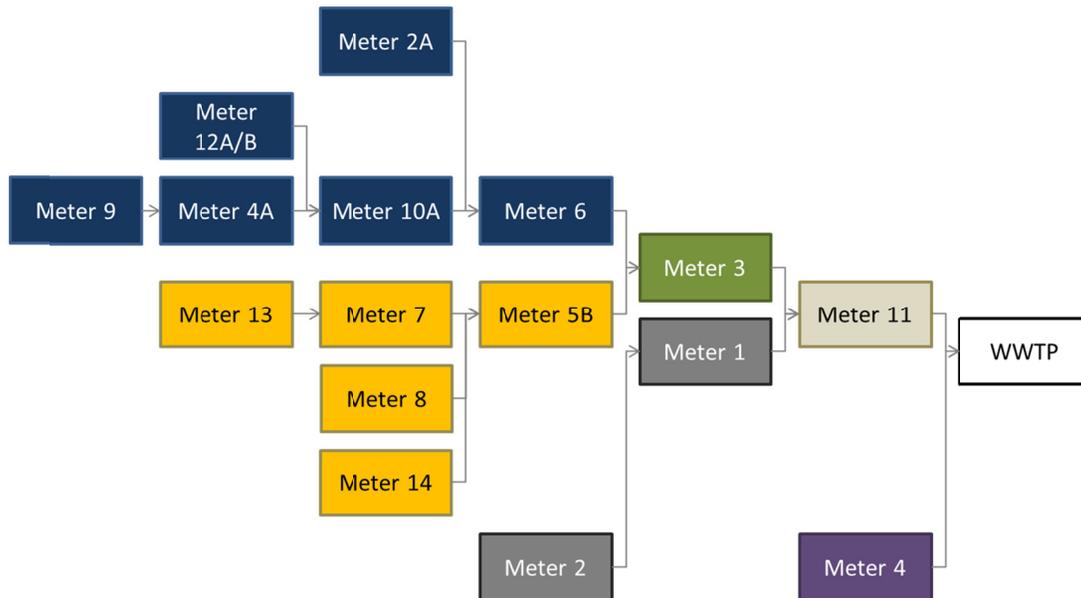


Figure 3.3 on the following page shows the flow meter locations and the collection system gravity pipelines that contribute flow to each meter.

The 2018-19 flow monitoring program documented rain and sewer flows during four significant rainfall periods. The largest single rainfall event occurred between February 12 and February 15, 2019, with the bulk of rainfall falling on February 13, 2019 (“Valentine’s Day Storm”). During this period, approximately 5.7 inches of rain was measured, with 3.6 inches of this volume occurring on February 13, 2019.

Figure 3.4 presents the various wet weather flow components. From left to right:

- The Valentine’s Day storm began on February 13, 2019.
- Wet weather GWI is defined by the flow characteristics on February 24, 2019, when flows stabilized after the Valentine’s Day flow. The difference between these flows and ADWF is attributed to wet weather GWI.
- The calibration storm began on March 4. On this day, I&I from the prior storm was still being released. For the purposes of calibration, this residual I&I was not considered part of the March 4 calibration event.
- I&I from the calibration storm remained in the system through the next, smaller event, and on March 12, system flows returned to the saturated baseline state.

Figure 3.3 Flowmeter Locations and Associated Pipelines / Catchments

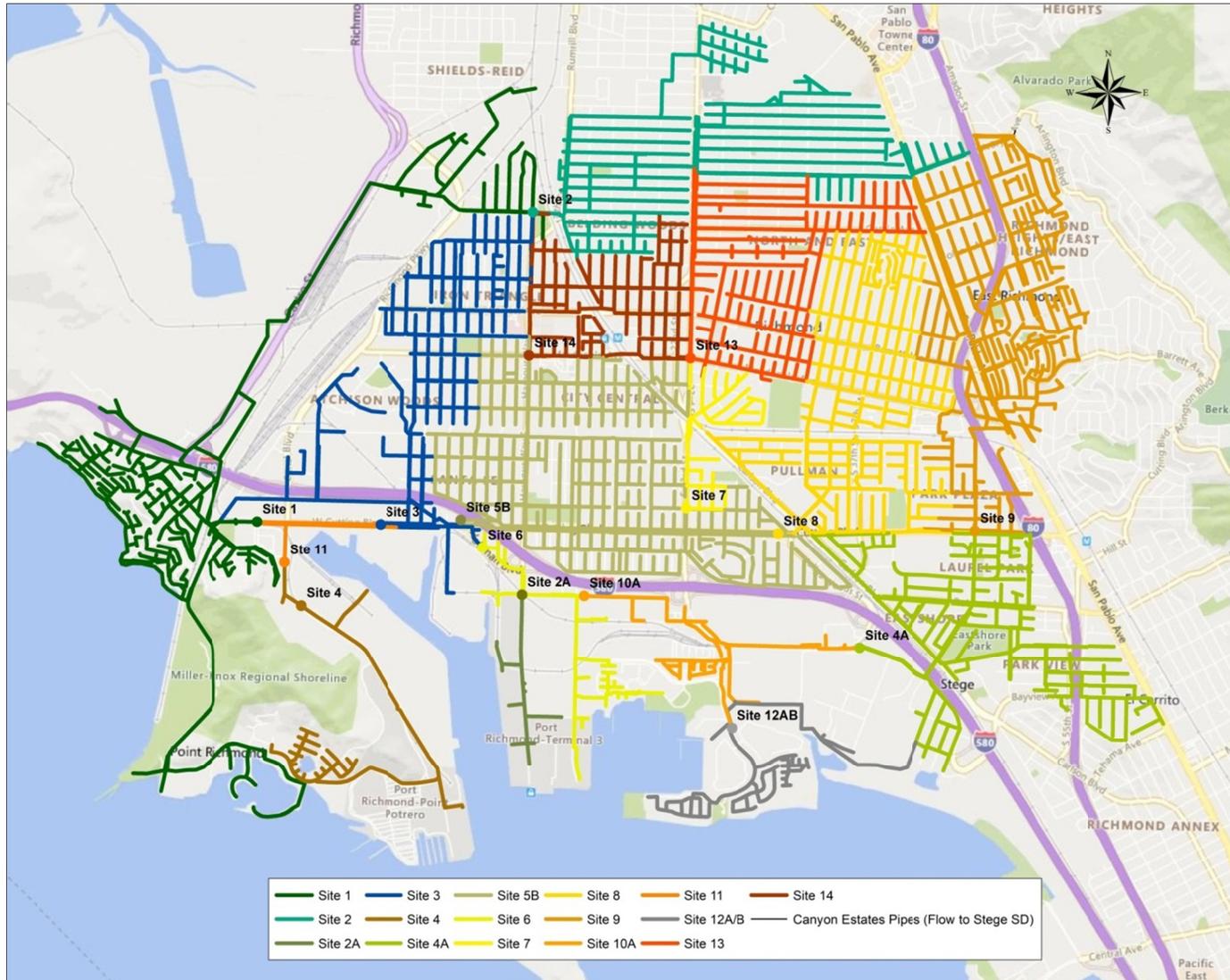
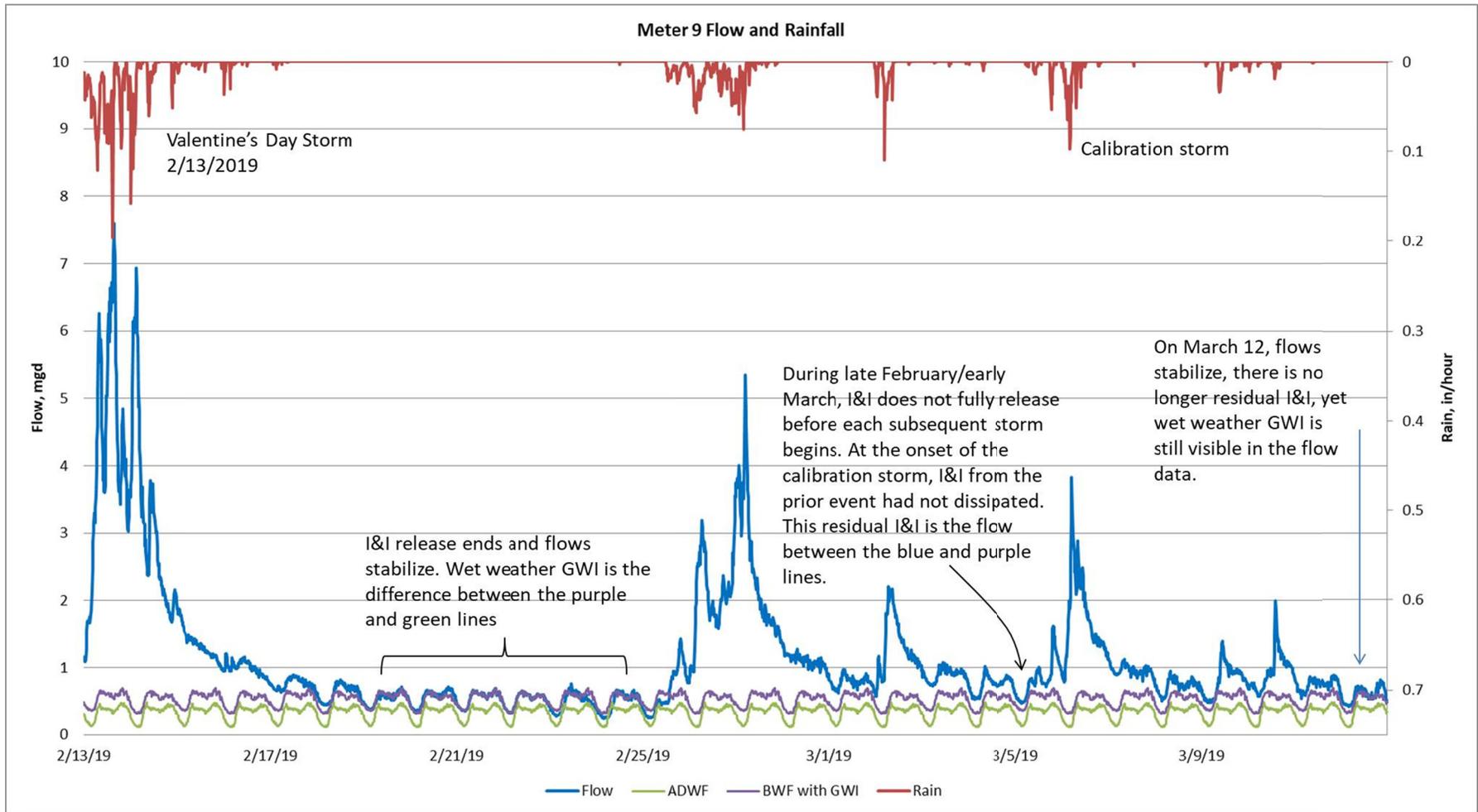


Figure 3.4 Example Flow Record Showing Wet Weather Flow Components



3.3 Planning Criteria

This section summarizes the planning criteria that were utilized in developing the hydraulic model, analyzing results, and developing capacity relief solutions.

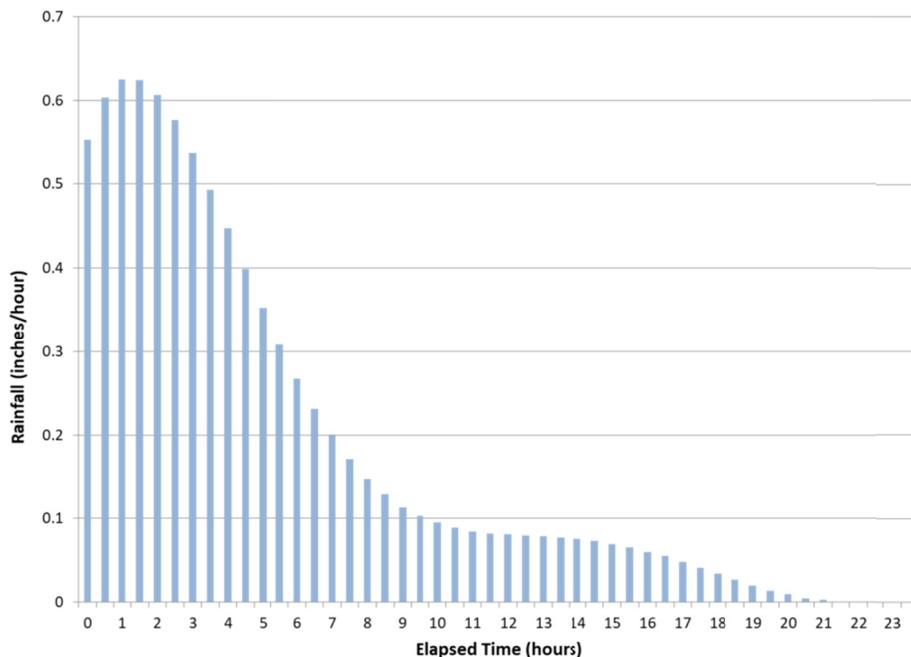
3.3.1 Design Storm

The City evaluated the wastewater collection system under dry weather conditions and also a 10-year, 24-hour design storm. Flow characteristics for the 10-year, 24-hour design storm were derived from data that is maintained by the National Oceanographic and Atmospheric Administration (NOAA). Using the NOAA precipitation frequency table, the 10-year, 24-design storm has a predicted rainfall depth of 3.81 inches, with a possible upper bound of 4.37 inches, and a caveat that this value may exceed valid probable maximum precipitation values.

Based on this information, a rainfall value of 4.37 inches was selected to represent the 10-year 24-hour storm. By comparison, the design storm selected for the 2011 Master Plan utilized a Contra Costa County rainfall event with a depth of 4.2 inches. Both of these values are consistent with the possible upper bound of the NOAA range.

NOAA publishes rainfall distribution tables for use in distributing the design storm rainfall depth across a 24-hour period. NOAA provided 36 temporal distribution options for the City’s rainfall; the temporal distribution that resulted in the highest hourly peak flow was selected for the hydraulic model analysis. This distribution has a 10 percent chance of occurring during the first quartile, and is shown in Figure 3.5.

**Figure 3.5 NOAA Temporal 24-Hour Rainfall Distribution for the City of Richmond
(10% Probability of Occurring in the First Quartile)**





3.3.2 Hydraulic Deficiency Criteria

Pipelines are considered to have a capacity deficiency when an SSO is predicted during the design storm scenario. A lift station is considered capacity deficient if the station does not have sufficient firm capacity, i.e., capacity with the largest pump out of service, to convey peak hourly flows during the design storm.

New or replacement pipelines are designed to most closely meet the following criteria:

- Under peak dry weather flow (PDWF) conditions, velocity shall remain above 2 fps to facilitate self-cleaning
- Under peak wet weather flow (PWWF) conditions during the City's 10-year, 24-hour design storm, maximum depth of flow divided by diameter (d/D) shall be equal to or less than 0.95, with exceptions allowed if, during occasional surcharge conditions, freeboard is equal to or greater to five feet
- Under all conditions, maximum allowable velocity is 10 feet per second

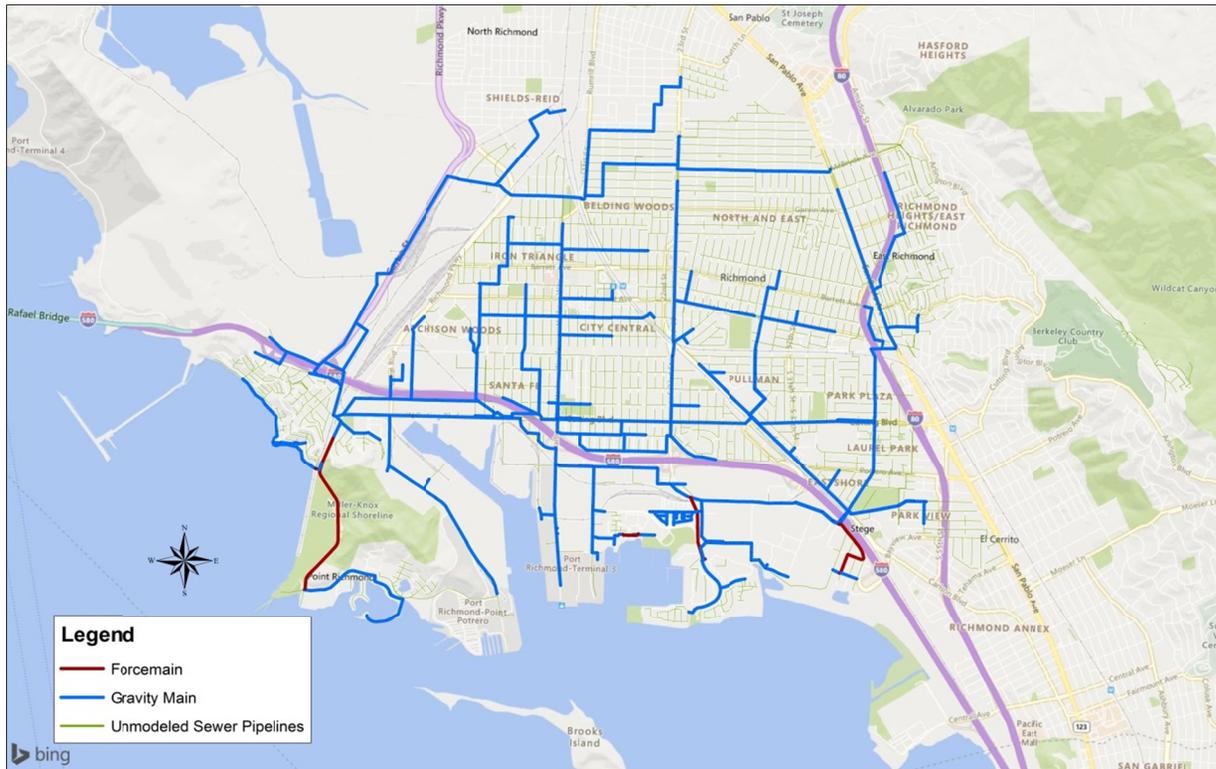
3.4 Wastewater Collection System Hydraulic Model

This section describes the City's wastewater collection system hydraulic model, summarizes the capacity analysis results, discusses I&I reduction, and presents recommendations for capacity relief.

3.4.1 Model Components

The hydraulic model is a skeletonized representation of the City's wastewater collection system. The modeled network is comprised of approximately 44 miles of pipe ranging in diameter from 4-inches to 66-inches. The network represents approximately 25 percent of the City's gravity collection system. The modeled collection system pipelines are shown in Figure 3.6.

Figure 3.6 Modeled Gravity Sewer Pipelines



Eight of the City’s pump stations are included in the hydraulic model: Marina Bay Parkway, ICI, Ferry Point, Marina Bay Cove, Brickyard Cove, Sunset Point, Nevin & A, and Keller Beach. Pump information was adjusted to be consistent with data provided for the LSMP.

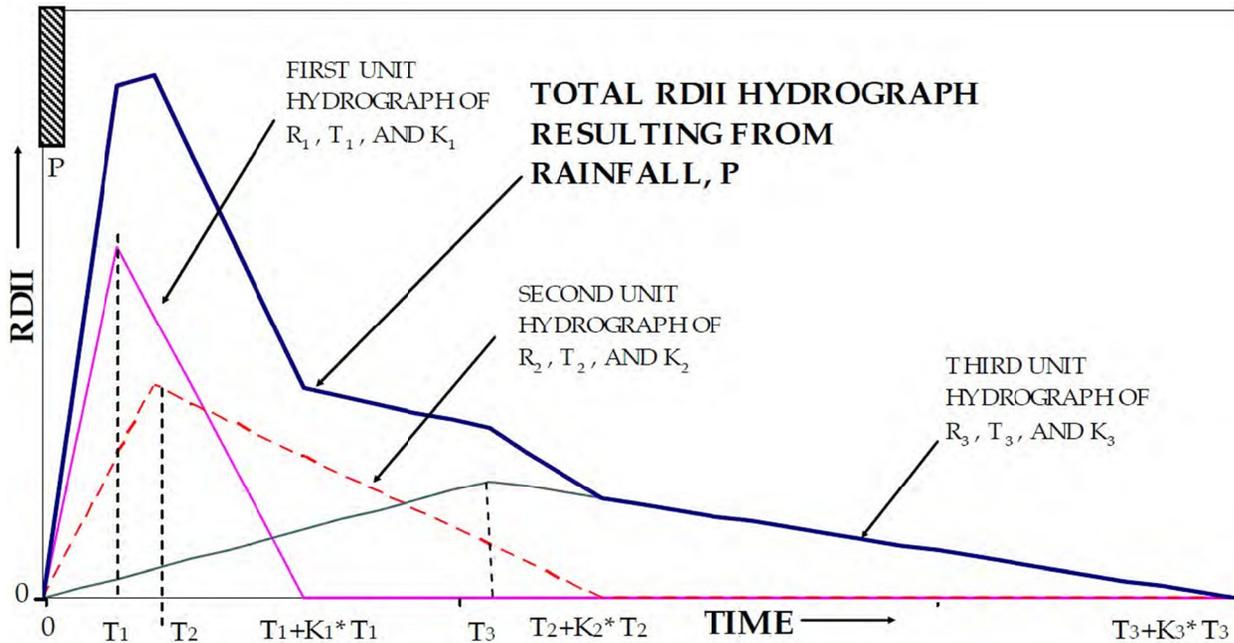
3.4.2 Wet Weather Flow Generation

The “RTK” method was used to model RDII. The RTK method generates a hydrograph for each subcatchment that estimates the percent of rainfall that enters the pipelines within the subcatchment, and the rate of infiltration. The RTK method generates three triangular hydrographs that represent short-term, medium-term, and long-term response. The RTK parameters include:

- R = the area of the graph representing the portion of rainfall falling on a subcatchment that enters the sewer collection system.
- T = the time from the onset of rainfall to the peak of the triangle.
- K = the ratio of the “time to recession” to the “time to peak” of the hydrograph.

Components of the RTK hydrograph are provided courtesy of the United States Environmental Protection Agency (EPA) Office of Research and Development, and are presented in Figure 3.7.

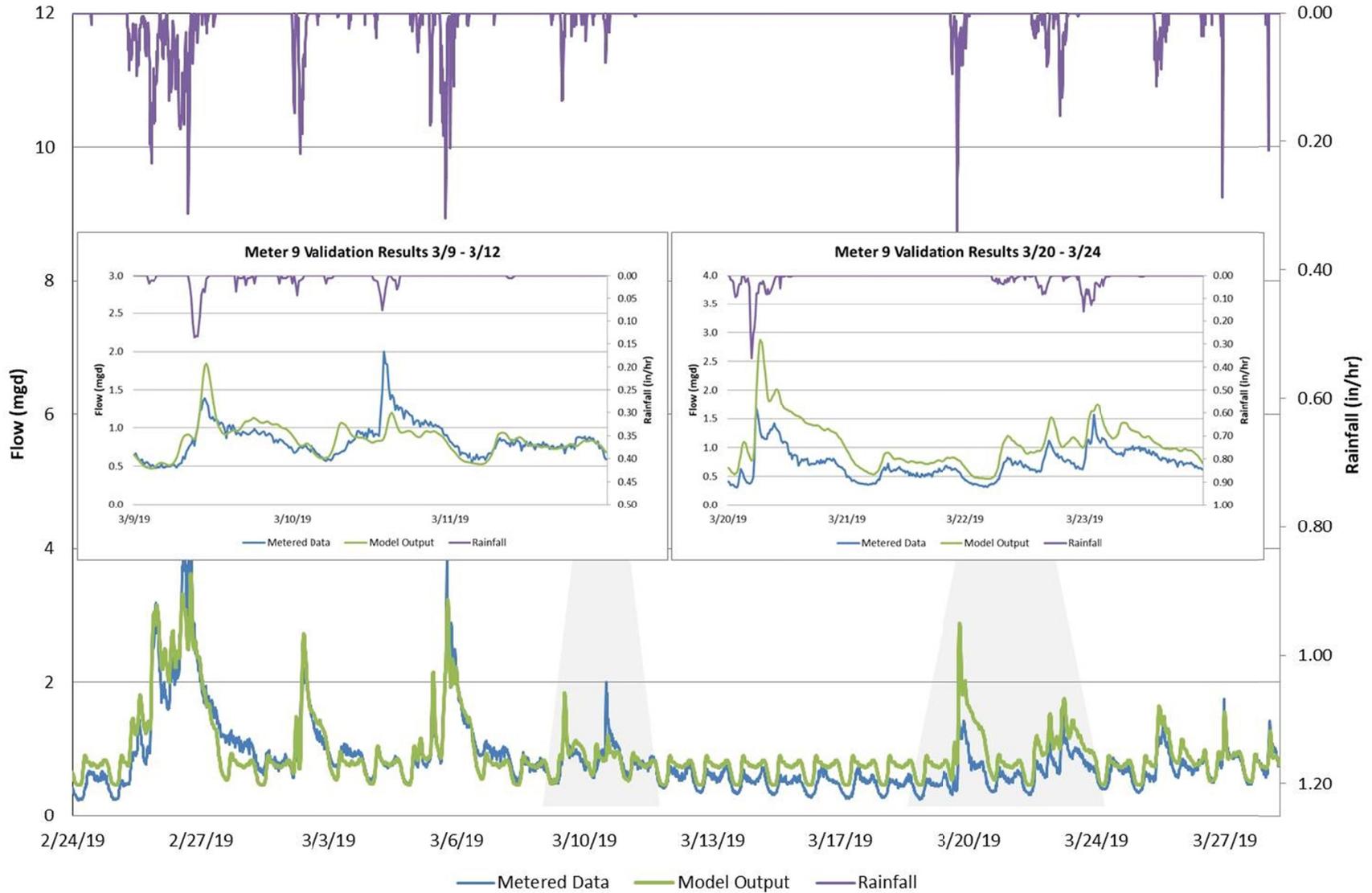
Figure 3.7 Components of RTK Hydrograph



Hourly peak wet weather flows were generated in the model using these wet weather factors. Wet weather flows were calibrated by assigning a calibration rainfall profile to the model and comparing model outputs to measured flows during the same storm.

After the model was calibrated for the selected storm, these results were validated by comparing model outputs and measured data for other wet weather events. Figure 3.8 shows a representative long-term simulation for Meter 9. Figure 3.8 demonstrates that in different storms, model-generated flows were consistent with or exceeded measured flow. This result confirms that the calibrated model will provide accurate or slightly conservative flow results when tested with a given rainfall profile.

Figure 3.8 Meter 9 Validation Results



3.5 Capacity Analysis Results

The hydraulic model identified five areas with predicted SSOs during the design storm. Capacity relief projects were developed to address these areas, as described below and shown in Figure 3.9 on the following page. The predicted flow at the wastewater treatment from the City's design storm, after all proposed capacity improvements are constructed, is 50.8 mgd.

3.5.1 First and Third Street Capacity Improvements

The City has identified opportunities for I&I reduction in this basin through pipeline replacements as discussed further in Section 3.6. However, if the pipeline replacements do not occur, the City would need to upsize 3,800 linear feet of 12- and 18-inch diameter pipe on First Street, W. Nevin Ave., and Third Street between Pennsylvania and Bissell Avenue. The new pipes would be 15 and 20 inches in diameter. Alternatively, a 12-inch relief sewer could be constructed to bypass flows during wet weather events.

If the City pursues a hybrid Pipeline Rehabilitation and Relief Sewer project, the hybrid project would install 878 lineal feet of 15-inch relief sewer on First Street between Florida Avenue and Maine Avenue, and would also replace approximately 6,900 lineal feet of collector sewers, plus conduct point repairs on approximately 9,700 lineal feet of additional pipe. The estimated cost of this hybrid project, which is listed as the recommended project in Chapter 7 of this report, is \$4.5 million. Adding 40% to account for engineering, administration, and construction management, the total estimated project cost is \$6.3 million.

3.5.2 Upper 23rd Street Capacity Improvements

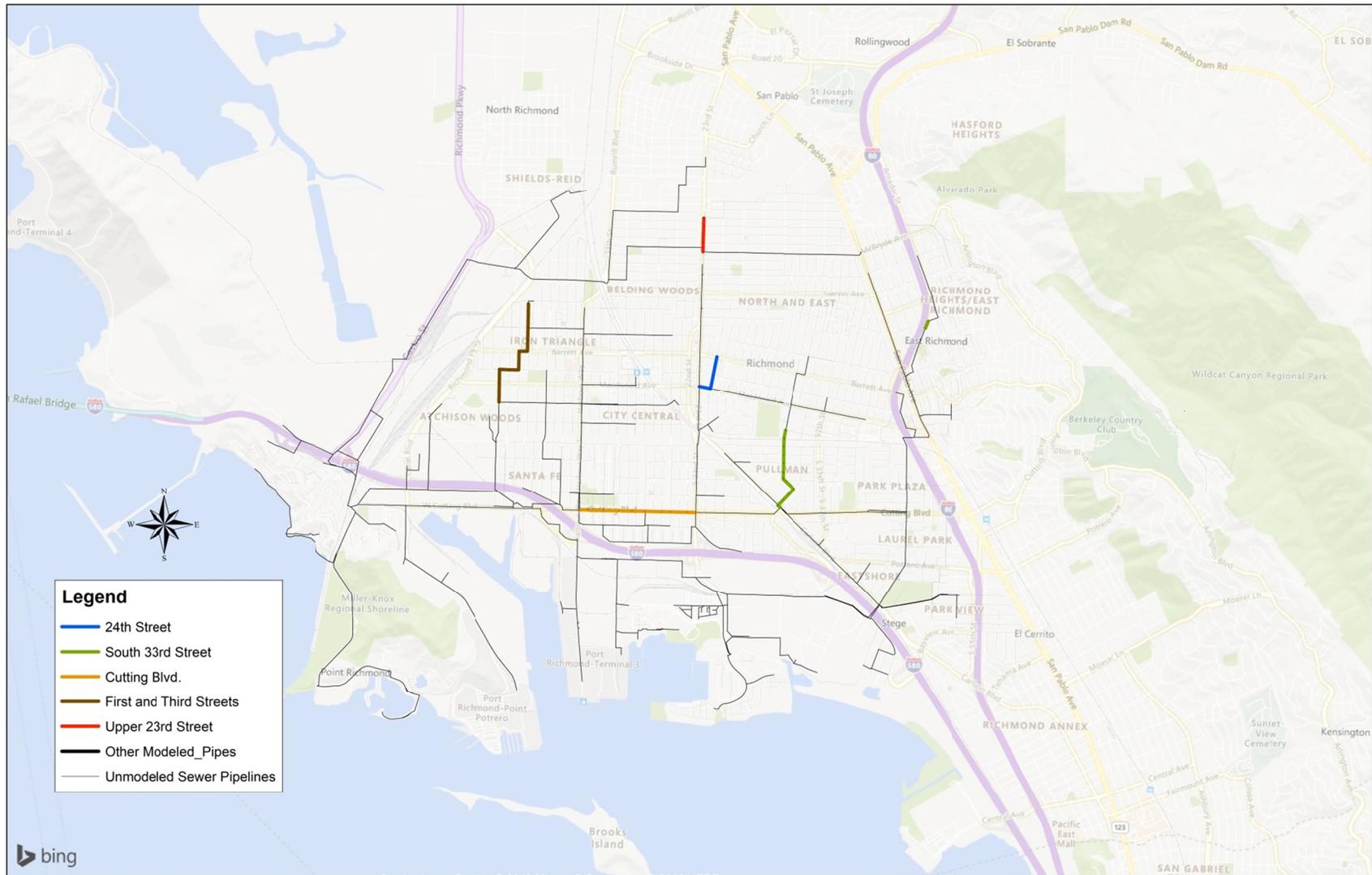
This project replaces 895 linear feet of 10-inch diameter pipe on 23rd Street near Rheem Avenue with 15-inch diameter pipe. Alternatively, a 10-inch relief sewer can be constructed to bypass flows during wet weather events. The estimated construction cost for this project based on the relief sewer alternative is \$652k. Adding 40% to account for engineering, administration, and construction management, the total estimated project cost is \$912k.

3.5.3 24th Street Capacity Improvements

This project upsizes 1,337 linear feet of 10-inch diameter pipe on Macdonald Avenue and 24th Street. If completed, the existing pipe would be replaced by a 15-inch diameter pipe. Alternatively, a 10-inch relief sewer can be constructed to bypass flows during wet weather events. If constructed, the estimated construction cost for this project is \$973k. Adding 40% to account for engineering, administration, construction management, and contingency, the total estimated project cost is \$1.4M.

This project will not be required after completion of the Macdonald and Virginia project, which is beginning construction. The Macdonald Avenue component of the project replaces approximately 4,250 lineal feet of pipeline directly upstream of the 24th Street Capacity Improvement project area. These pipe replacements are expected to remove sufficient I&I from

Figure 3.9 Pipeline Capacity Project Locations



the system at the Macdonald and 24th Street intersection during the design storm to address the predicted capacity constraint, as discussed further in Section 3.6.

3.5.4 South 33rd Street Capacity Improvements

This project upsizes 2,974 linear feet of 15-inch diameter pipe on South 33rd Street, Beale Street, and South Street, north of Carlson Blvd. The existing pipe would be replaced by an 18-inch diameter pipe. Alternatively, a 10-inch relief sewer can be constructed to bypass flows during wet weather events. The estimated construction cost for this project based on the relief sewer alternative is \$2.2M. Adding 40% to account for engineering, administration, and construction management, the total estimated project cost is \$3.0M.

3.5.5 Cutting Boulevard Capacity Improvements

This project upsizes 3,660 linear feet of 24-inch diameter pipe on Cutting Blvd. between Harbour Way South and South 23rd Street with 30-inch and 36-inch diameter pipe. Alternatively, a 27-inch relief sewer can be constructed to bypass flows during wet weather events. The estimated construction cost for this project based on the relief sewer alternative is \$7.2M. Adding 40% to account for engineering, administration, and construction management, the total estimated project cost is \$10.1M.

3.5.6 Pump Station Capacity Needs

Pump station capacity results from the LSMP were confirmed in the SECAP. The hydraulic model confirmed that three stations, Ferry Point, Brickyard Booster, and Marina Bay Cove, require additional capacity to convey flows from the design storm event. The LSMP recommends addressing Brickyard Booster and Marina Bay Cove capacity needs through operational adjustments.

Significant pump station upgrades are required to provide sufficient firm capacity at the Ferry Point lift station. As discussed in the LSMP, upgrades for the Ferry Point lift station are planned as part of the Terminal One project, which is currently in the development process.

The 2018 Lift Station Master Plan also discussed potential capacity needs at the Marina Bay Parkway lift station. In order to more accurately evaluate wet weather inflows to this station, flow monitors 12A and 12B were installed during the 2018-19 flow monitoring program. The pump station did not have capacity issues during the Valentine's Day storm, and the hydraulic model does not predict any capacity issues during the design storm¹.

¹ The local gravity collection system downstream of the Marina Bay Parkway lift station experienced SSOs during the Valentine's Day storm. As-built pipe information for downstream pipelines has been added to the hydraulic model, and potential causes and solutions for avoiding future SSOs at this location are under review.

3.6 Inflow and Infiltration Reduction

The results from the 2019 RAA and the City's SECAP were reviewed together to determine if potential I&I reductions that can be achieved through pipeline replacements identified in the 2019 RAA would reduce capacity needs as predicted by the SECAP. This section summarizes the analyses performed and discusses resulting changes to the SECAP projects.

3.6.1 Introduction & Background

The City's 2019 RAA identifies over 42 miles of pipe requiring restoration through point repairs or line replacements, in order to address known structural Grade 5 defects. Approximately 20 percent of these lines require full replacement based on recorded NASSCO PACP Quick Ratings². Replacement pipes will be constructed of plastic materials with sealed joints, which are less likely to admit I&I than the existing vitrified clay pipelines.

If groups of pipes are replaced in locations where excess I&I creates capacity issues, the I&I rate should be lower after the new pipes are installed. The I&I reduction evaluation estimates the amount of I&I that can be removed from the system through such pipeline replacements.

3.6.2 I&I Reduction Approach and Results

Recommended capacity improvement projects are located upstream of Meter 2 (Upper 23rd project), Meter 3 (First and Third project), Meter 5B (Cutting Boulevard project), Meter 8 (South 33rd Street project), and Meter 13 (24th Street project). The I&I flow rate that is expected to be removed from the wastewater collection system through pipe repairs was calculated for each basin as follows:

1. Identify the gravity pipelines that contribute to each flowmeter.
2. Determine the peak I&I rate during the design storm event from each of the five basins with capacity needs.
3. Calculate the I&I rate from any upstream meters that contribute flow to the meter under consideration, at the same timestep. Subtract this value from the peak I&I value.
4. Assume that 50 percent of peak I&I can be removed through pipe replacements, and the other 50 percent of I&I is contributed by private laterals.

² The NASSCO PACP Quick Rating assigns a code that designates the number of the worst and next highest defects on a given pipe. The Quick Rating does not provide information about the defect, or the proximity of defects. This and other information on pipeline condition must be obtained through a more detailed review of CCTV inspection data.

5. Using 50 percent of the calculated basinwide I&I, determine the peak I&I rate that can be attributed to each pipe in the basin, in proportion to the pipe size measured in inch-diameter-feet.

Hydraulic model results were used to determine how much I&I must be removed from design storm peak flow in order to eliminate SSOs at each capacity project location. This calculation was completed as follows:

1. Obtain the peak flow rate during the design storm.
2. Evaluate the existing system scenario without capacity improvements and identify the hydraulic simulation timestep when an SSO occurs.
3. Calculate the I&I that must be removed from the system (Step 1 less Step 2).
4. Divide this I&I by the flow removal rate in Step 5 above to determine the amount of pipe replacement necessary to eliminate the SECAP project.

This analysis determined that two of the five SECAP projects, the Upper 23rd Street and 24th Street projects, can be eliminated through 2019 RAA pipe replacements. However, only the 24th Street project can be addressed in this manner cost effectively.

The Macdonald Avenue component of the City's planned Macdonald and Virginia project will reduce I&I entering the system at the intersection of 24th Street and Macdonald Avenue through a cluster of pipe replacements. As discussed further within the updated SECAP, after the pipelines have been replaced, flows entering the system at this location during the design storm event are no longer predicted to create an SSO condition. Therefore, after completion of the Macdonald and Virginia project, the 24th Street Capacity Improvement project will no longer be required.

Similarly, pipeline replacements in the vicinity of the First and Third Street project will help to reduce this project scope by reducing I&I. The First and Third Street project is discussed further in Section 3.6.3.

Table 3.1 on the following page presents the results from the I&I reduction analysis for the five SECAP projects.

Table 3.1 Potential to Eliminate SECAP Projects through Mainline Replacements

Sewer Basin and Capacity Project	RAA Replacements will Eliminate Capacity Project	Discussion
Basin 3 (First & Third)	No	Although RAA replacements do not eliminate the SECAP project, a hybrid project that combines capacity relief with mainline replacements is recommended, as discussed in Section 3.6.3.
Basin 2 (Upper 23 rd St.)	Yes	Although the RAA replacements can eliminate this project, implementing the SECAP solution is a more cost effective way to address predicted SSOs quickly. The SECAP project continues to be recommended.
Basin 5B (Cutting Blvd)	No	The Cutting Blvd. capacity improvement project cannot be addressed through I&I reduction and continues to be required.
Basin 8 (South 33 rd St.)	No	The South 33 rd Street capacity improvement project cannot be addressed through I&I reduction and continues to be required.
Basin 13 (24 th Street)	Yes	The Macdonald and Virginia project replaces more pipe in idf than required to address the 24 th Street capacity issue. Therefore, construction of the Macdonald and Virginia project eliminates the need for this project.

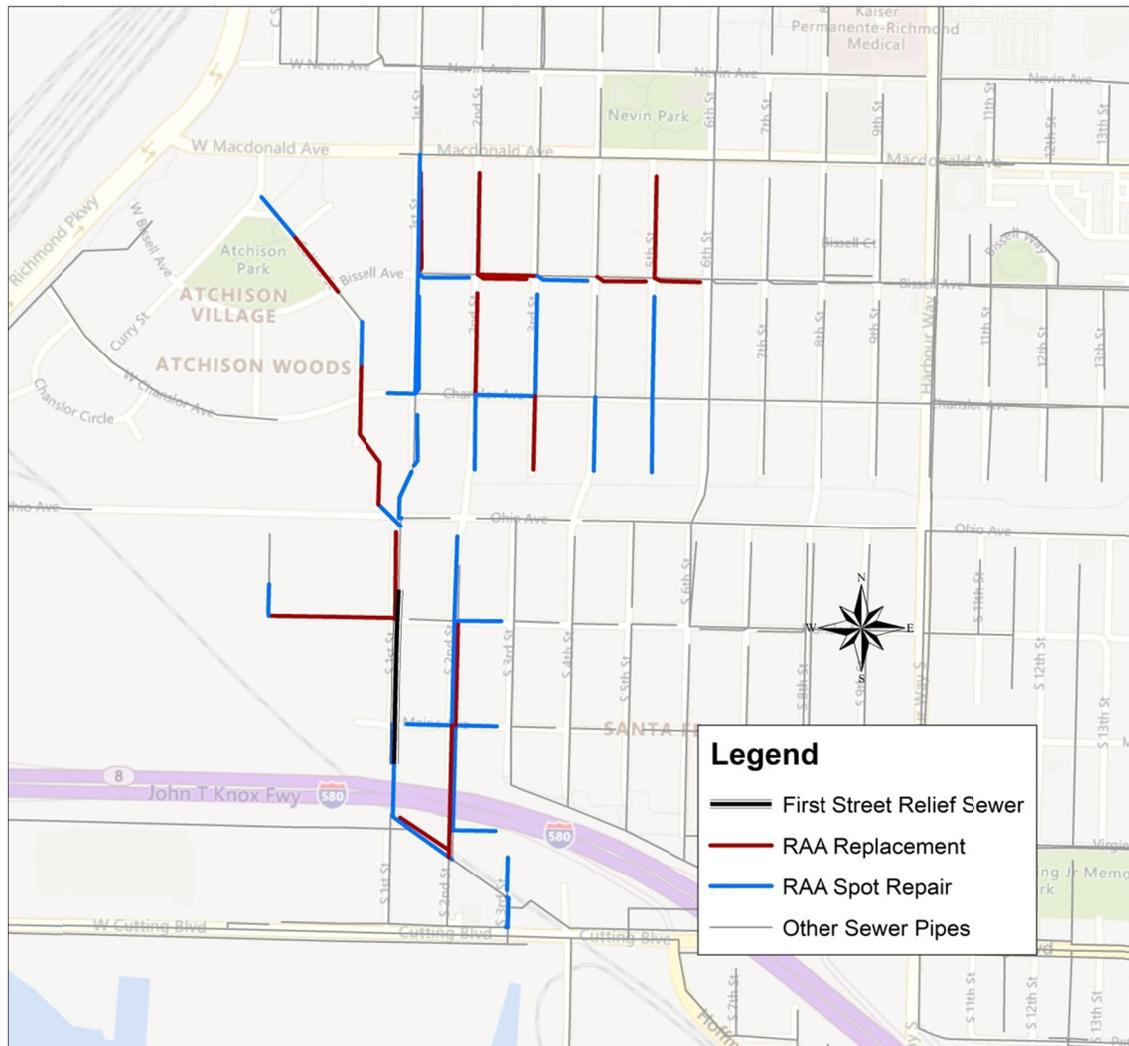
3.6.3 First Street Pipeline Improvements and Relief Sewer Project

The I&I reduction analysis confirmed the feasibility of a hybrid project that is recommended as an alternative to the SECAP First and Third Capacity Improvement project. The hybrid project addresses the First Street basin capacity needs and also replaces and repairs gravity sewer pipelines that are identified in the 2019 RAA.

The analysis shows that if approximately 45 percent of the 2019 RAA pipes slated for replacement in this basin are replaced, then in lieu of the First and Third Street project, an 878-foot relief sewer can be constructed on First Street south of Florida Avenue. In conjunction with construction of the relief sewer, the hybrid project replaces approximately 6,900 lineal feet or 49,000 idf of pipe. In addition, 9,700 lineal feet of pipe in the same area will receive one to three point repairs.

Figure 3.10 shows the scope of the proposed First Street Pipeline Rehabilitation and Relief Sewer project.

Figure 3.10 First Street Rehabilitation and Relief Sewer Project



3.7 SECAP Capacity Improvement Plan

The Baykeeper settlement agreement requires the First Street Projects to be completed by July 15, 2024, and all other capacity projects to be completed by July 15, 2026. The implementation schedule shown in Table 3.2 meets these requirements. The schedule does not show projects that are currently in progress, which include the Cutting, Carlson and Hoffman improvements and Macdonald & Virginia improvements.

Costs are indexed to the Engineering News Record Consumer Cost Index, San Francisco, October 2019 (12524.93).



Table 3.2 SECAP Capacity Improvement Plan

Project	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	Total
First Street Pipeline Rehab and Relief Sewer	\$0.7M	\$2.8M	\$2.8M					\$6.3M
Upper 23 rd Street			\$0.1M	\$0.8M				\$0.9M
So. 33 rd Street			\$0.3M	\$2.7M				\$3.0M
Cutting Boulevard				\$0.9M	\$2.3M	\$4.6M	\$2.3M	\$10.1M
Total	\$0.7M	\$2.8M	\$3.2M	\$4.4M	\$2.3M	\$4.6M	\$2.3M	\$20.3m



CHAPTER 4 SUMMARY OF 2019 RISK ASSESSMENT ANALYSIS

This report summarizes the City’s 2019 Risk Assessment Analysis (“RAA”) dated January 15, 2019 and updated on March 27, 2019. The 2019 RAA evaluates repair and replacement needs for pipes with structural defects, and provides an updated list of priorities for the rehabilitation of pipes with NASSCO PACP Structural Grade 5 defects. The 2019 RAA is included in Appendix B.

4.1 Background and Introduction

The City uses a numerical asset management tool to evaluate the risk of failure of its gravity sewer pipelines. This tool, referenced throughout this report as the 2019 Risk Model, is the basis for assigning repair priorities to pipes with Structural Grade 5 defects. In addition, the 2019 Risk Model identifies other pipes with a maximum structural defect code of Grade 4.

The model assigns a risk score to every gravity pipe segment in the City’s asset database. Risk is the numerical product of Likelihood and Consequence of Failure, using a combination of data provided by the City and also publicly available data from the Contra Costa County GIS database.

Data that was used in development of the 2019 Risk Model is summarized in Table 4.1.

Table 4.1 Data Utilized in the 2019 Risk Model

Data Description	Likelihood of Failure Parameter	Consequence of Failure Parameter
Pipe Asset Data (Pipe IDs, Diameters, Lengths)	X	X
PACP Structural and O&M Quick Ratings	X	
Publicly-Mapped Waterways		X
School, Park, and Firehouse Parcels		X

Preprocessing of the City’s data was required prior to entering the information into the 2019 Risk Model. For example, only the most recent CCTV inspection record is used. Also, pipes that have records for forward and reverse inspections in the same day were assigned a single manually adjusted CCTV inspection rating. Similarly, pipes without complete inspections were flagged for special consideration.

After the 2019 Risk Model results were generated, postprocessing of Risk Model results was required. A list of pipes with a specific defect code of “XP” (i.e., collapsed pipe) was gleaned from the results and provided to Veolia for manual review. Also, pipes with a high number of defects when compared to pipe length were elevated in priority. Finally, pipes that are currently under repair or planned for repair as part of a future project were removed from the 2019 Risk Model results.

4.2 Likelihood and Consequence of Failure

The Likelihood of Failure metrics utilized within the risk model were comprised of the following:

- NASSCO PACP Structural CCTV Inspection Rating
- O&M CCTV Inspection Rating
- Pipe Size, Indicating 4-inch Pipes that are Difficult to Maintain
- SSO Locations

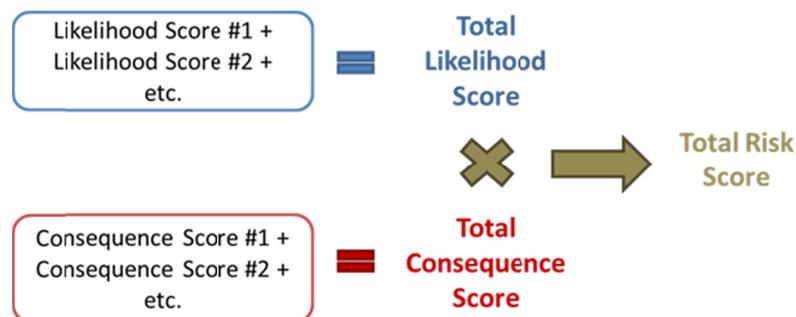
Consequence of Failure metrics provide information on how the failure of an asset will impact the ability of the City to meet its service objectives. Consequence of Failure metrics that were used in the 2019 Risk Model are listed below:

- Proximity to Waterway
- Proximity to Parks, Schools, and Fire Stations
- Area Impacted, as Determined by Pipe Size
- Impact on Arterial Roadways

4.3 Total Risk Score

The 2019 Risk Model uses a series of queries to filter or perform calculations on the City's sewer data. The model overlays Likelihood and Consequence metrics and scores, and develops an associated Total Risk Score. The process used to compile these scores is shown in Figure 4.1.

Figure 4.1 Total Risk Score Calculation

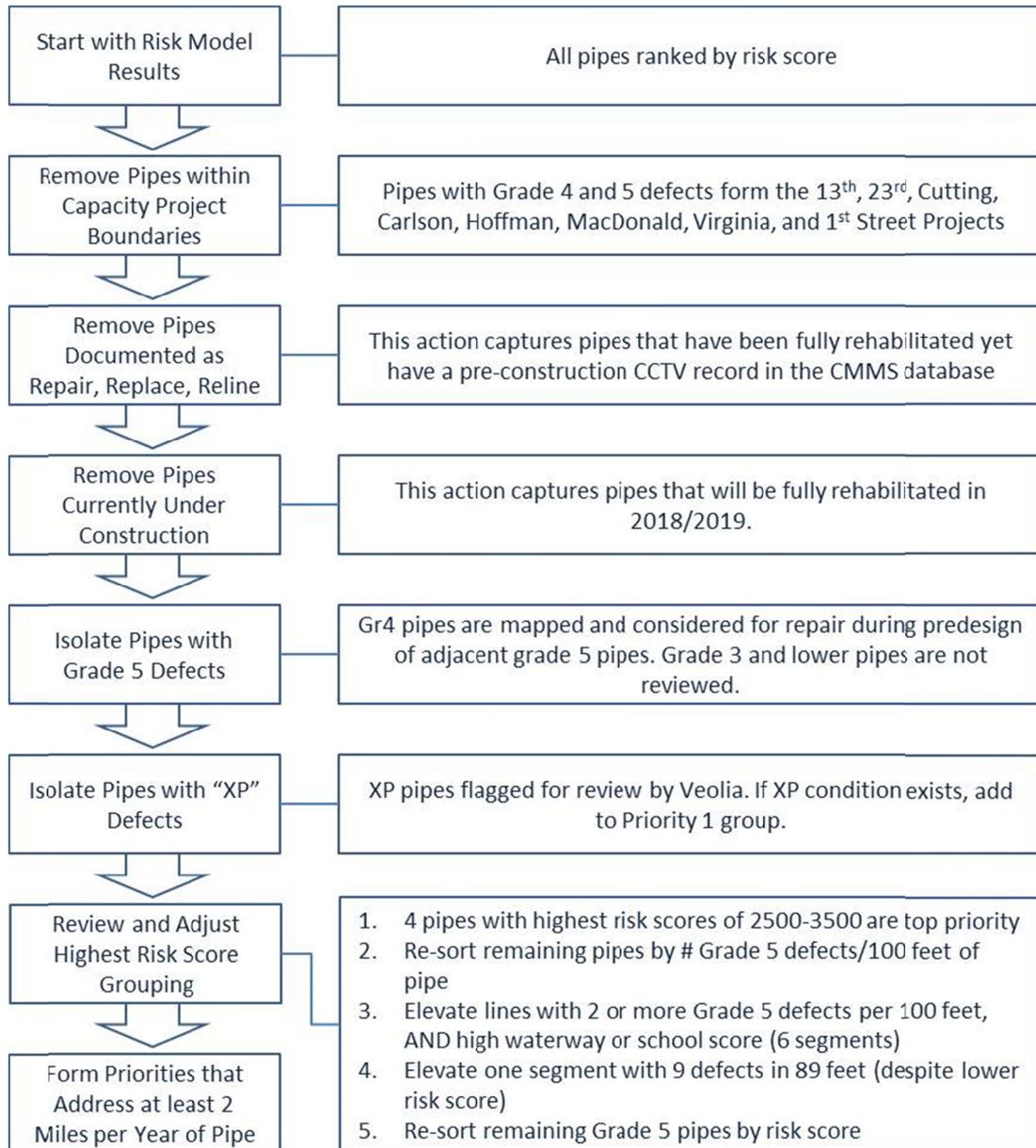


The Risk Score is a relative number, to be compared to similar scores for other pipes in the same model run. The Risk Score, when considered alone, has no numerical significance.

Risk Scores were evaluated in spreadsheet form, and used to develop the list of repair priorities. The process used to assign repair priorities began with the 2019 Risk Model results, and adjusted

through post-processing using additional data and judgment. Figure 4.2 presents the approach that was followed to develop the January 2019 project priorities.

Figure 4.2 January 2019 Process Used to Develop RAA Priorities



4.4 2019 RAA Program Summary

The 2019 RAA identified 42.3 miles of pipe to be replaced or to receive point repairs across the entire system. The City and Baykeeper Settlement Agreement requires the restoration of at least two miles of gravity sewer pipelines annually. Table 4.2 lists the 2019 RAA implementation



schedule as projected over the next ten years. This list does not include additional pipelines that will be replaced or repaired in conjunction with the 2011 SECAP projects.

**Table 4.2 Proposed Implementation Schedule for 2019 RAA Pipes
(excludes pipes in 2011 SECAP project areas)**

Fiscal Year	Replaced		Point Repair		Total
	# Pipes	Miles	# Pipes	Miles	Miles
2018-2019	27	1.45	9	0.57	2.02
2019-2020	21	1.40	22	0.61	2.00
2020-2021	12	0.63	22	1.39	2.02
2021-2022	14	0.71	22	1.30	2.01
2022-2023	11	0.51	22	1.49	2.00
2023-2024	9	0.29	28	1.74	2.02
2024-2025	20	1.10	15	0.92	2.01
2025-2026	5	0.21	31	1.80	2.01
2026-2027	0	0.00	31	2.06	2.06
2027-2028	4	0.10	32	1.94	2.03
2028-2029	5	0.05	43	1.96	2.01
Total	128	6.44	277	15.77	22.21

The estimated cost per year for the 2019 RAA program is shown in Table 4.3. The 2019 RAA utilized unit costs that have been superseded with more recent unit cost information. Table 4.3 applies the most current cost basis, as discussed in Chapter 6, to the proposed implementation schedule. An average annual budget of \$3.3 million is required to implement the 2019 RAA recommendations over the next ten years. After this time, the average annual program cost is expected to decrease as the focus begins to shift from pipe replacements and predominantly point repairs.

The purpose of the 2019 RAA priority list is to group necessary repairs by overall priority based on risk. However, the 2019 RAA priority list does not consider project refinements that would result from further review of detailed CCTV results, the proximity of defects, and the condition of surrounding pipes. During the preliminary design stage for each rehabilitation project, these project adjustments are expected that will require adjustments to the pipe tallies and lengths that are shown in Table 4.3.

Table 4.3 RAA Costs through FY2029

Fiscal Year	Construction Cost Includes 30% Contingency	Admin, Eng'g, CM, CO Allowance	Total Cost
2018-2019	\$4.6	\$1.9	\$6.5
2019-2020	\$4.5	\$1.8	\$6.3
2020-2021	\$2.3	\$0.9	\$3.3
2021-2022	\$2.5	\$1.0	\$3.5
2022-2023	\$2.0	\$0.8	\$2.8
2023-2024	\$1.3	\$0.5	\$1.8
2024-2025	\$3.7	\$1.5	\$5.2
2025-2026	\$1.2	\$0.5	\$1.7
2026-2027	\$0.6	\$0.2	\$0.8
2027-2028	\$0.7	\$0.3	\$0.9
2028-2029	\$0.6	\$0.2	\$0.8
Total	\$23.9	\$9.5	\$33.4

4.5 Keller Beach Interceptor

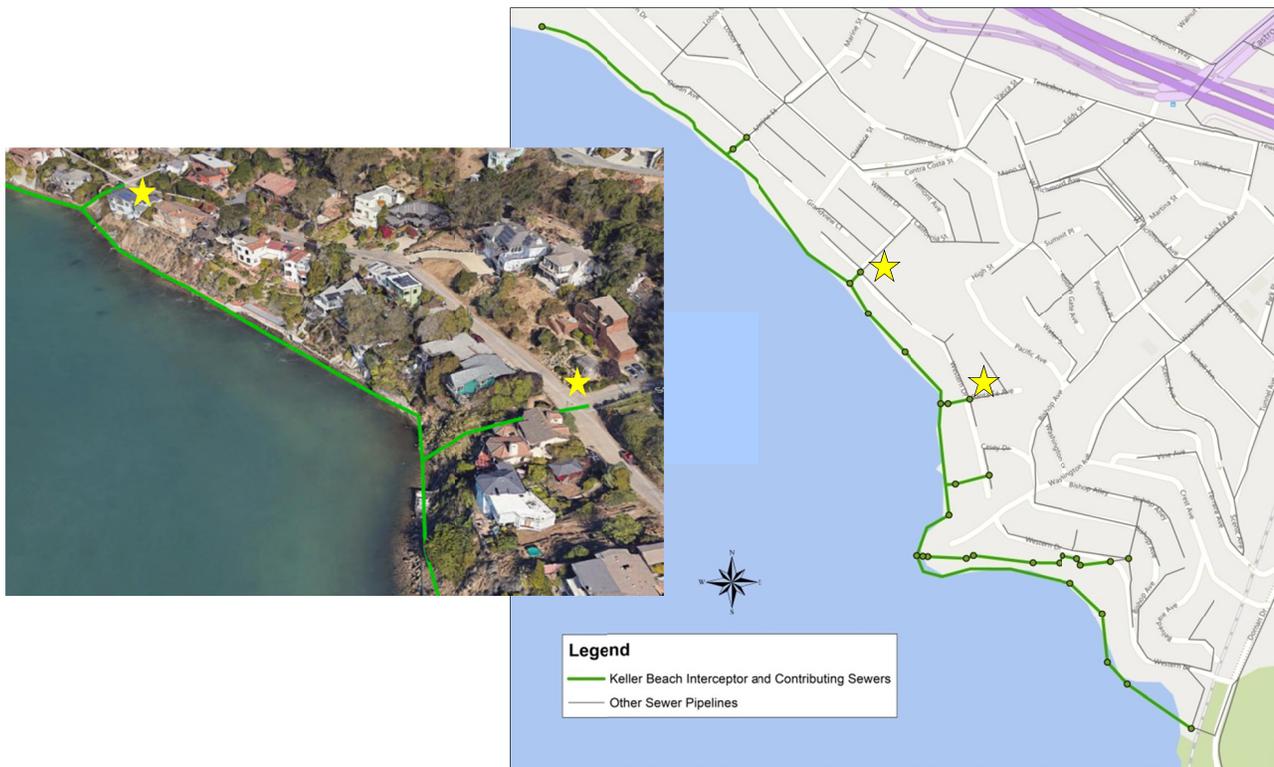
The Keller Beach interceptor is a submerged pipeline that is located several feet off of the coast of Point Richmond. The pipeline is buried within the tidal zone. Some manhole lids have been removed in prior years to facilitate maintenance. However, manhole access is not sufficient to allow CCTV inspection of the pipeline.

The Keller Beach interceptor is comprised of 5,500 lineal feet of pipe ranging in diameter from 6- to 12 inches. Twelve manholes are also identified in GIS for this asset. However, most of these manholes cannot be accessed safely. Five collector sewers ranging from 6- to 12-inches in diameter flow to the Keller Beach interceptor from various locations on Ocean Avenue and Western Drive. The collector sewers begin within easements between houses and proceed down a rocky cliff to a submerged connection to the Keller Beach interceptor. The total length of contributing sewers is 1,528 lineal feet. Figure 4.3 shows the pipeline alignment in GIS. This figure includes a Google Earth inset showing how two of the contributing sewers enter the interceptor.

The condition of the Keller Beach interceptor is unknown. However, flows measured at Meter 1 display a clear diurnal flow pattern and do not show elevated dry weather groundwater levels. Also, measured flows are consistent with expected values based on designated land uses. Therefore, it is unlikely that the Keller Beach Interceptor is currently admitting water from the San Francisco Bay.

The contributing sewers have some recorded defects, including one NASSCO Structural Grade 5 defect on the pipe that begins at Ocean Avenue south of Casey Drive. The contributing sewers are

Figure 4.3 Keller Beach Interceptor and Contributing Gravity Sewers



accessible, and as long as the connection to the Keller Beach interceptor does not need to be accessed, the most severe defects can be repaired in the near-term through point repairs.

A long-term strategy is required to minimize the risk presented by the Keller Beach interceptor and its contributing pipeline. All options, which may include upgrading the existing pipeline to convey current flows, reuse of the existing pipeline for a smaller subset of flows, relocating the asset entirely, or other options should be reviewed for the feasibility, cost, and environmental risk. If the Keller Beach interceptor is impacted, then the contributing sewers, private laterals, and the Keller Beach lift station are also likely to be impacted. The strategy must consider a holistic solution that balances risks to the City, its residents, and the environment.

The estimated cost to replace this pipeline and the associated tributary sewers from Ocean Avenue and Western Drive could range from \$11 to \$15 million or more. The selected solution is likely to include costs associated with environmental protection and permitting, groundwater management, and wastewater pumping, in addition to pipeline construction. A placeholder of \$500,000.00 has been included in the CIP to complete a feasibility study for this project. This cost does not include environmental documentation that is required under CEQA.

CHAPTER 5 SUMMARY OF LIFT STATION MASTER PLAN

The Lift Station Master Plan was completed in 2018 to consolidate and confirm available information, gather new field condition data, and identify system upgrades that are needed to improve overall reliability and wet weather capacity of the City’s wastewater lift stations. Necessary improvements were identified and prioritized to address safety, reliability, capacity, and general maintenance. Conceptual costs were then developed for each of the recommended projects.

5.1 Introduction

The LSMP project included field inspections, document reviews, and hydraulic modeling to evaluate the City’s 13 wastewater lift stations. Work completed, findings, and recommendations are presented in the following six chapters. The LSMP without appendices and accompanying Forcemain Assessment Report are included in Appendix C. The entire LSMP is available from the City.

- Executive Summary
- Chapter 1 – Introduction
- Chapter 2 – Summary of Available Data
- Chapter 3 - Condition Assessment Protocol
- Chapter 4 - Condition Assessment
- Chapter 5 – Hydraulic Model and Capacity Assessment
- Chapter 6 –Capital Improvement Program

5.2 Summary of Available Data

The LSMP describes available background documents and information held by the City and its contract operator, Veolia Water. Available data includes record drawings, reports, system modeling information, Geographic Information System (“GIS”) data, and operational records.

The City’s lift stations are located primarily within neighborhood collection systems. Existing lift stations are submersible wet well type stations, with the exception of two locations. Lift stations utilize programmable logic controllers (“PLCs”) for pump starting and stopping, logging of operational data, and reporting of alarm conditions. The stations all use cellular network communication providing for remote monitoring and limited remote operation. All stations are powered by diesel emergency generators in the event of utility power failure.

The City and Veolia maintain a data library that includes the following resources, most of which were utilized in developing the LSMP:

- Wastewater collection system hydraulic model

- Master plan reports
- Wastewater collection system GIS asset registry
- Force main evaluation and inspection report
- Lift station record drawings
- Routine maintenance and inspection records (including computerized maintenance system data)
- Repair records
- Station-specific pump curves and operational settings information.

5.3 Lift Station Condition Assessment

The City's wastewater lift stations were assessed through a desktop evaluation followed by a field inspection of each station. The primary focus of the assessments was operational reliability. The findings were recorded in detailed inspection checklists, which are included as an appendix to the LSMP. Items that required modification, repair or replacement were identified, prioritized, and assigned conceptual costs.

The recommended lift station improvement projects were prioritized as follows:

- Priority "A" projects address safety and reliability issues
- Priority "B" projects are recommended to extend remaining useful life of the lift station components
- Priority "C" projects represent long-term improvements that should be considered for implementation as part of a longer-term CIP

5.4 Lift Station Conceptual Costs

Recommended projects were assigned conceptual costs, which were calculated as follows:

- (Unit Costs) x (Installation Costs) x (Contingency) = Construction Cost
- Construction Cost x (Soft Costs) = Conceptual Project Cost

Unit costs were developed using manufacturer's estimates and/or recently acquired bid data for similar Bay Area projects. Pre-established percentages were then applied to the equipment costs to represent "installation" costs. For example, for electrical, control and SCADA systems, 68 percent was added to represent installation costs comprising labor (33 percent), transportation (4.75 percent), tax (9.25 percent), and overhead and profit (21 percent). The percentage used to represent installation costs was reduced to 50 percent for items that do not require electrical and controls.

An estimating contingency of 30 percent was added after applying the installation cost percentage, to address the level of uncertainty of the cost estimate.

Finally, 40 percent was added to the construction cost to represent “soft” costs comprising engineering, technical services and specialty inspections, permitting, construction unknowns, estimating (bidding climate) fluctuations, and database updates.

The level of accuracy in cost estimating followed the Association for the Advancement of Cost Engineering (“AACE”) Class 5, Concept Screening, with an expected accuracy range of -30 to +50 percent. Costs were indexed to the Engineering News Record Construction Cost Index (“ENR CCI”), San Francisco, of May 2018 (12014.72). In Chapter 6 these costs have been adjusted to the ENR CCI for October 2019 (12524.93).

5.5 Lift Station Capacity Assessment

The City’s 2011 wastewater collection system hydraulic model was used to evaluate the “firm” capacity, i.e., the capacity with the largest pump out of service, for each station. A lift station is considered under capacity when the incoming flow is greater than the stated capacity of the operating pump(s). Lift station performance was evaluated in the LSMP using the City’s 2011 design storm, then reevaluated in 2019 using the Updated SECAP design storm.

The LSMP capacity assessment identified four stations that do not have sufficient firm capacity to convey all incoming flows during the design storm. Capacity shortfalls for two of the stations, Brickyard Booster and Marina Bay Cove, should be able to be addressed through minor operational adjustments and/or a closer review of the data used to evaluate flows. The third station, Ferry Point, is scheduled to be relocated and rebuilt as part of the Terminal One development. This station also needs substantial repairs and conversion of the current dry pit / wet pit configuration to a single wet well. During the relocation and upgrade of this lift station, capacity needs should be reviewed to assure that the new station is properly sized to convey design flows.

The remaining station, Marina Bay Parkway, was shown as significantly under capacity in the LSMP analysis. However, operationally, this station had not had sewer system overflows during heavy rainfall events. During the City’s 2018-19 flow monitoring program, the City installed temporary flow meters on the two influent pipelines to this station (Meters 12A and 12B). The metered flow data confirmed that during peak wet weather events, incoming flow remains below the firm pumping capacity of the station. In addition, the City updated and recalibrated the hydraulic model using this flow data, as a component of the Updated SECAP. The updated hydraulic model also confirms that the Marina Bay Parkway lift station has sufficient capacity to convey flows from the design storm. Therefore, the capacity upgrades that are discussed in the 2018 LSMP are no longer required.

5.6 Lift Station Capital Improvement Program

The LSMP CIP presents a consolidated list of projects by priority and implementation timeline. Projects are scheduled in priority order, with Priority “A” projects in the first five years, followed by Priority “B” and then “C” projects. One Priority “C” project, replacement of the Canyon Estates No. 1 lift station, is scheduled outside of the 10-year CIP timeframe.

Table 5.1 on the following page presents the proposed CIP as shown in the LSMP. The Priority A projects have a combined total cost of \$5,029,300 (including the complete replacement of the Ferry Point Lift Station for \$2,966,600). The CIP includes \$1,412,400 in Priority B projects, and \$3,226,800 in Priority C projects. The Priority C estimate includes future replacement of the Canyon Estates No. 1 Lift Station, which would occur beyond the 10-year CIP planning horizon. All costs shown are in May 2018 dollars.

5.7 Forcemain Condition Assessment Report

In January 2016, the City, Veolia, and V&A completed the Forcemain Condition Assessment project. This project documented the condition of five of the City’s forcemain systems: Marina Bay Parkway, Ferry Point and Keller Beach, Canyon Estates, Brickyard Cove and Brickyard Booster, and the Port system. Inspection methods included the following, which were applied on a system by system basis where feasible:

- Visual assessment with digital photo documentation
- Concrete sounding and penetration testing
- In situ concrete pH testing
- Wastewater grab sample test for dissolved and total sulfide
- CCTV inspection
- Ultrasonic Testing (UT) of metallic pipe surfaces
- Pit depth measurement of metallic pipe surfaces
- Broadband Electromagnetic (BEM) testing of metallic pipe surfaces
- In situ soil resistivity testing
- Soil sample analysis
- Pipe-to-soil potential testing

Recommendations were provided in this report. However, estimated costs or a timeline for implementation were not presented. Therefore, the Consolidated CIP that is presented in Chapter 6 references the need for these improvements, but does not include specific forcemain improvement projects in the capital improvement program timeline.



The recommendations included in the Forcemain Condition Assessment Report include the following items:

1. Replace the severely corroded metallic section of the Port forcemain.
2. Address condition needs at the Port forcemain discharge manhole.
3. Improve access to the Ferry Point forcemain to allow additional information gathering for further assessment.
4. Rehabilitate the Ferry Point / Keller Beach forcemain discharge manhole.
5. Monitor the Brickyard Booster forcemain internal surface condition at the discharge manhole and address if condition worsens. Consider rehabilitation of the Brickyard Booster / Port discharge manhole.
6. Repair T-Lock joints in the Brickyard Booster lift station wetwell liner.
7. Monitor the Marina Bay Parkway discharge manhole condition due to turbulent flow.
8. Remove and reapply concrete top coat that is spalling in the Marina Bay Parkway FM discharge manhole.
9. Improve protection and slope stabilization for the Keller Beach forcemain sections located within the hillside (directly outside of the lift station).
10. Consider rehabilitation of the Canyon Estates FM discharge manhole.
11. 13) Consider installing an odor control system at the Keller Beach pump station to control sulfides.
12. Seal open joints and spall cavity with a repair mortar in the Marina Bay Parkway FM discharge manhole chimney.



Table 5.1 Lift Station Master Plan Capital Improvement Program

	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	Future	Total
Brickyard Booster				\$ 165,600			\$ 299,300				\$ 464,900
Brickyard Cove				\$ 121,600			\$ 44,100		\$ 135,100	\$ 135,100	\$ 435,900
Canyon Estates 1					\$ 191,900			\$ 193,000	\$ 193,000	\$ 2,912,900	\$ 3,490,800
Canyon Estates 2					\$ 148,000			\$ 112,100		\$ 9,100	\$ 269,200
Canyon Estates 3					\$ 138,000			\$ 106,700		\$ 9,100	\$ 253,800
Ferry Point ^{See Note 1}	\$ 29,666	\$ 266,994	\$ 2,669,940								\$ 2,966,600
ICI	\$ 427,000						\$ 3,800			\$ 8,200	\$ 439,000
Keller Beach	\$ 187,400					\$ 39,700				\$ 2,700	\$ 229,800
Marina Bay Cove		\$ 115,700				\$ 316,500				\$ 5,500	\$ 437,700
Marina Bay Parkway			\$ 133,700				\$ 17,300				\$ 151,000
Nevin & A	\$ 185,300						\$ 1,500			\$ 900	\$ 187,700
Port				\$ 126,200			\$ 53,900			\$ 8,200	\$ 188,300
Sunset Pointe		\$ 122,300				\$ 31,500					\$ 153,800
	\$ 829,366	\$ 504,994	\$ 2,803,640	\$ 413,400	\$ 477,900	\$ 387,700	\$ 419,900	\$ 411,800	\$ 328,100	\$ 3,091,700	\$ 9,668,500

Note 1. Ferry Point lift station upgrades should be coordinated with Terminal One development project lift station relocation/upgrades.

- Priority A Projects
- Priority B Project
- Priority C Projects



CHAPTER 6 CONSOLIDATED CAPITAL IMPROVEMENT PROGRAM

This chapter consolidates the Capital Improvement Program components of the Updated System Evaluation and Capacity Assurance Plan, Risk Analysis Assessment, and Lift Station Master Plan, and presents the various CIPs in Table 6.1. For more information about each of these planning efforts and about the individual projects listed in this consolidated CIP, please see the individual plans that are included in the Appendices.

Table 6.1 proposes collection system capital improvements that require budget commitments beyond those needed to meet the terms of the Baykeeper settlement agreement. The projects and projected timelines for these additional projects have some flexibility, and the City and Veolia may change the project priorities, schedules, or scopes of work as required to address changing system needs



Table 6.1 Consolidated 10-Year Capital Improvement Program

	Project	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Capacity Improvements	First Street Pipeline Rehab and Relief Sewer	\$ 759,568	\$ 2,785,082	\$ 2,785,082							
	Upper 23 rd Street			\$ 100,000	\$ 812,184						
	So. 33 rd Street			\$ 363,732	\$ 2,667,369						
	Cutting Boulevard				\$ 1,208,608	\$ 2,215,781	\$ 4,431,563	\$ 2,215,781			
RAA	Pipeline Replacements and Repairs (Note 1)	\$ 6,291,600	\$ 3,256,400	\$ 3,490,200	\$ 2,762,200	\$ 4,365,900	\$ 2,585,100	\$ 1,689,800	\$ 785,400	\$ 932,400	\$ 747,600
Lift Station Improvements (Note 2)	Brickyard Booster				\$ 172,632			\$ 312,010			
	Brickyard Cove				\$ 126,764			\$ 45,973		\$ 140,837	\$ 140,837
	Canyon Estates 1					\$ 200,049			\$ 201,196	\$ 201,196	
	Canyon Estates 2					\$ 154,285			\$ 116,860		\$ 9,486
	Canyon Estates 3					\$ 143,860			\$ 111,231		\$ 9,486
	Ferry Point	\$ 30,926	\$ 278,332	\$ 2,783,320							
	ICI	\$ 445,133						\$ 3,961			\$ 8,548
	Keller Beach	\$ 195,358					\$ 41,386				\$ 8,548
	Marina Bay Cove		\$ 120,613				\$ 329,940				\$ 8,548
	Marina Bay Parkway			\$ 139,378				\$ 18,035			
	Nevin & A	\$ 193,169						\$ 1,564			\$ 8,548
	Port				\$ 131,559			\$ 56,189			\$ 8,548
Sunset Pointe		\$ 127,494				\$ 32,838					
KBI	Keller Beach Interceptor (Note 3)	\$ 250,000	\$ 250,000								
Total		\$ 8,165,753	\$ 6,817,920	\$ 9,661,711	\$ 7,881,316	\$ 7,079,876	\$ 7,420,827	\$ 4,343,313	\$ 1,214,687	\$ 1,274,433	\$ 950,151

Note 1. RAA includes 3 miles of restoration in 2023-24 and 1 mile in 2024-25. Three additional years of 2019 RAA point repairs are planned beyond the 10-year window.
 Note 2. Lift Station Costs adjusted to reflect October 2019 ENR CCI, San Francisco. Full replacement of the Canyon Estates 1 Lift Station (\$3.0M) is planned in future years.
 Note 3. The cost to repair, replace, or relocate KBI and its contributing sewers is not included. Cost will be determined through further studies. A placeholder of \$11M to \$15M is recommended.
 Note 4. The V&A Forcemain Condition Assessment Report discusses additional projects. The estimated costs for these projects, when developed, will be added to the CIP.
 Note 5. Projects with schedule commitments in the Baykeeper settlement agreement are highlighted in green.



APPENDIX A
Updated System Evaluation and Capacity Assurance Plan



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APPENDIX B
2019 Risk Assessment Analysis



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APPENDIX C
Lift Station Master Plan (without Appendices or
Forcemain Condition Assessment Report for brevity)



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