EAST PALO ALTO SANITARY DISTRICT MASTER PLAN UPDATE

FINAL REPORT

March 2015

FREYER & LAURETA INC.

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Executive Summary

In May 2014, East Palo Alto Sanitary District (District) retained Freyer & Laureta, Inc. to update its wastewater collection system master plan. The 2014 Master Plan assesses the conveyance capacity of the District's current sewer collection system pipes and evaluates facilities that may require replacement, develops a prioritized capital improvement plan (CIP), and establishes a connection fee to assist in the funding for the proposed CIP.

ES.1 BACKGROUND AND INTRODUCTION

The main purpose of this update to the sewer collection system master plan (Master Plan) is to evaluate the District's sewer collection system with projected flows under a specific design storm, using a computerized hydraulic model. The purpose of the hydraulic model is to determine whether the system can handle flows without sanitary sewer overflows (SSOs). Where SSOs are predicted by the hydraulic model, this Master Plan provides recommendations to resolve the problem. The Master Plan also recommends a schedule for sewer main replacements.

The District completed a flow monitoring study in 2011/2012. This study provided the flow data that was used as a basis for development and calibration of the District's hydraulic model, which is a component of this Master Plan. The monitoring study performed by V&A Consulting Engineers, was successful in capturing flow data throughout the system during several storm events.

This Master Plan is comprised of the following nine chapters:

- Chapter 1 – Introduction
- Chapter 2 – Existing Wastewater System
- Chapter 3 – System Flows
- Chapter 4 – Inflow & Infiltration Analysis
- Chapter 5 – Hydraulic Model Development
- Chapter 6 – Planning Criteria
- Chapter 7 – Result Summary
- Chapter 8 –Recommendation
- Chapter 9 – Capital Improvement Program

The Master Plan was developed to meet the following objectives:

- Determine system-wide flow characteristics
- Evaluate the existing hydraulic capacity of the collection system
- Determine pipeline potential replacement needs; and
- Develop a prioritized capital improvement program (CIP) and funding approach to provide an affordable and sustainable level of service to the District's ratepayers.

The recommendations that are presented in this Master Plan are considered in conjunction with proposed development of:

1. Ravenswood Villages (University Square)
2. Ravenswood Business Park
3. Four Corners/Bay Road

Future plans of Woodland area and redevelopment are unknown at this time, therefore not included in the scope of this project. As planning in the area progresses, we recommend this Master Plan be updated.

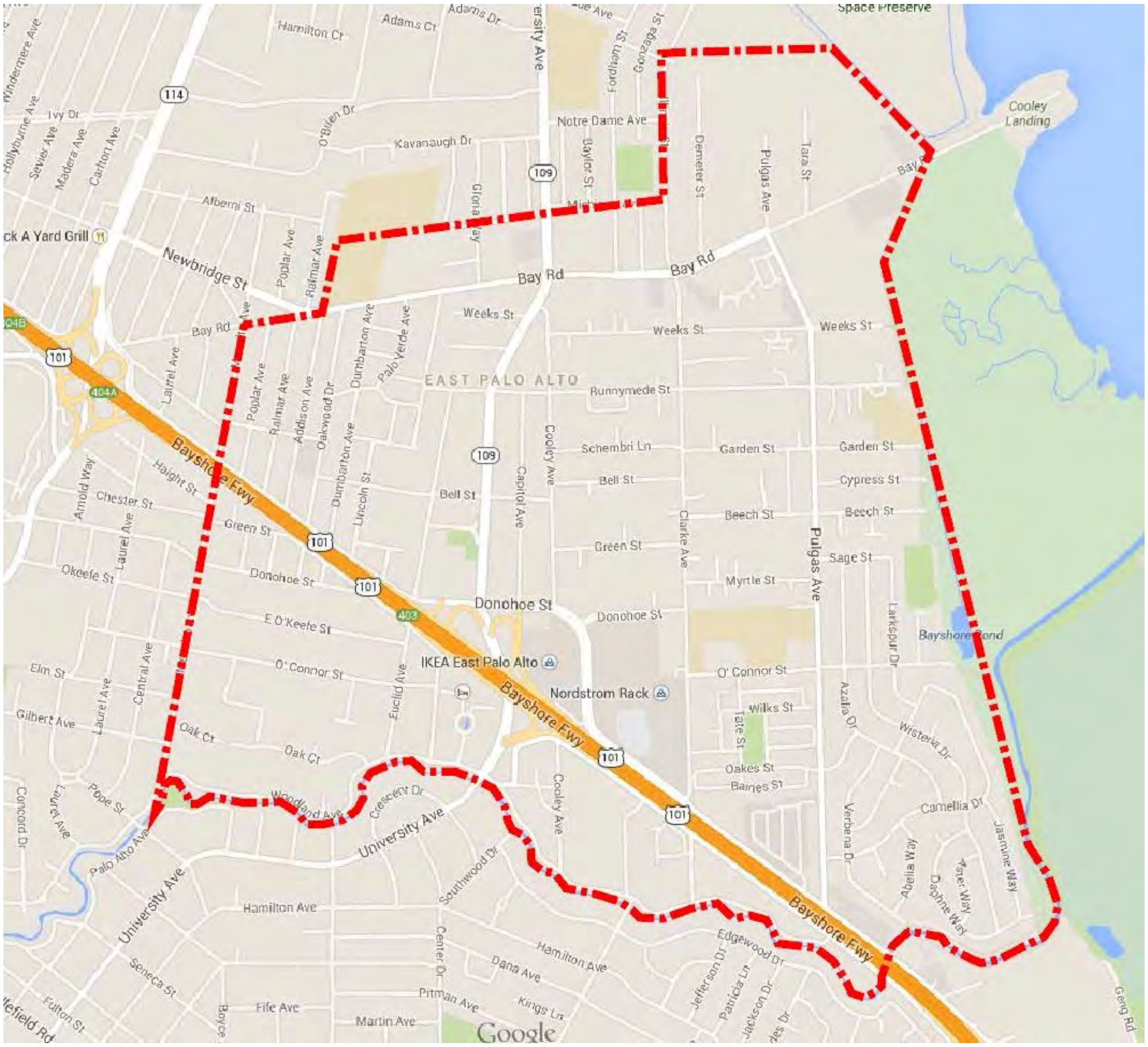
ES.2 EXISTING WASTEWATER SYSTEM

Chapter 2 describes the current system of the District. The District currently provides wastewater collection service to portions of the communities of Menlo Park and East Palo Alto, located in San Mateo County in the San Francisco Bay Area. The District's service area is primarily residential with a few commercial and industrial parcels.

The District's service area, shown on Figure ES-1, encompasses nearly 1,230 acres, or 1.92 square miles. The District's collection system is a gravity system. Approximately 70% of the pipelines are 6" in diameter. The larger collector lines range between 8" and 24" in diameter and contains a siphon beneath the San Francisquito Creek.

The most easterly portion of the system, in East Palo Alto, will experience the greatest change in sewer flows in the future. All pipelines will reach the end of their useful lives and require replacement; however a few sections of mainline will be required to be upsized to handle the future storms and flows.

The District operates and maintains the collection system in accordance with the requirements of the State Water Resources Control Board, as administered through the Statewide SSO Waste Discharge Requirements and RWQCB Sewer System Management Plan guidelines.



ES-1 District's Service Area

ES.3 SYSTEM FLOWS

The methods used to estimate the initial dry weather or base wastewater flow (BWF) component of the collection system hydraulic model is described in Chapter 3. These initial flows were further refined through additional flow meters and information gathered during master planning efforts. The District's BWF, as measured during the 2011/12 flow monitoring program that is discussed below, is 1.53 million gallon per day (mgd). This flow represents an average daily flow for the system.

The initial BWF component was given to us by the V&A study:

- From the data, a model in Hydra 7 was created showing existing conditions

Buildout flows were created by receiving predicted development flows and doing the following:

- Injecting flows into the Hydra model based on the location of predicted development.

ES.4 INFLOW & INFILTRATION ANALYSIS

The V&A Consulting Engineers (V&A) flow monitoring program captured rainfall data useful in our analyses. During their flow monitoring period, the District experienced several relatively short duration storm events, which are ideal for evaluating inflow and infiltration (I&I) and for calibrating the hydraulic model. Using collected data, V&A completed evaluation to quantify the extent of I&I entering the collection system by basin during this period. Chapter 4 further explains the results from the study.

ES.4.1 Data Collection

The flow monitoring program included gravity meters and rain gauges. The eleven meters were located in manholes that delineated the collection system into basins. Table ES-1 presents the flow meter locations and associated flow monitoring basins within the collection system. Depth and velocity readings were collected at each flow meter.

TABLE ES-1. List of Flow Monitoring Sites		
Site	**Location**	**Basin Size (acres)**
A15	Bay Rd, east of Demeter St.	118
B13	Intersection of Bay Rd and Poplar Ave	87
E1	Intersection of Cooley Ave and Green St.	101
E2	Cooley Ave, north of Donohoe St.	149
H3	Intersection of Clarke Ave and Beech St.	74
I3	East end of Beech St.	74
I12	Pulgas Ave, north of Sage St.	135
K4	Intersection O'Connor St and Larkspur Dr	107
K28	Larkspur Dr, south of O'Connor St.	95
T20	75 feet east of end of Cypress St.	171
T13	Along north edge of Palo Alto Municipal Golf Course	-

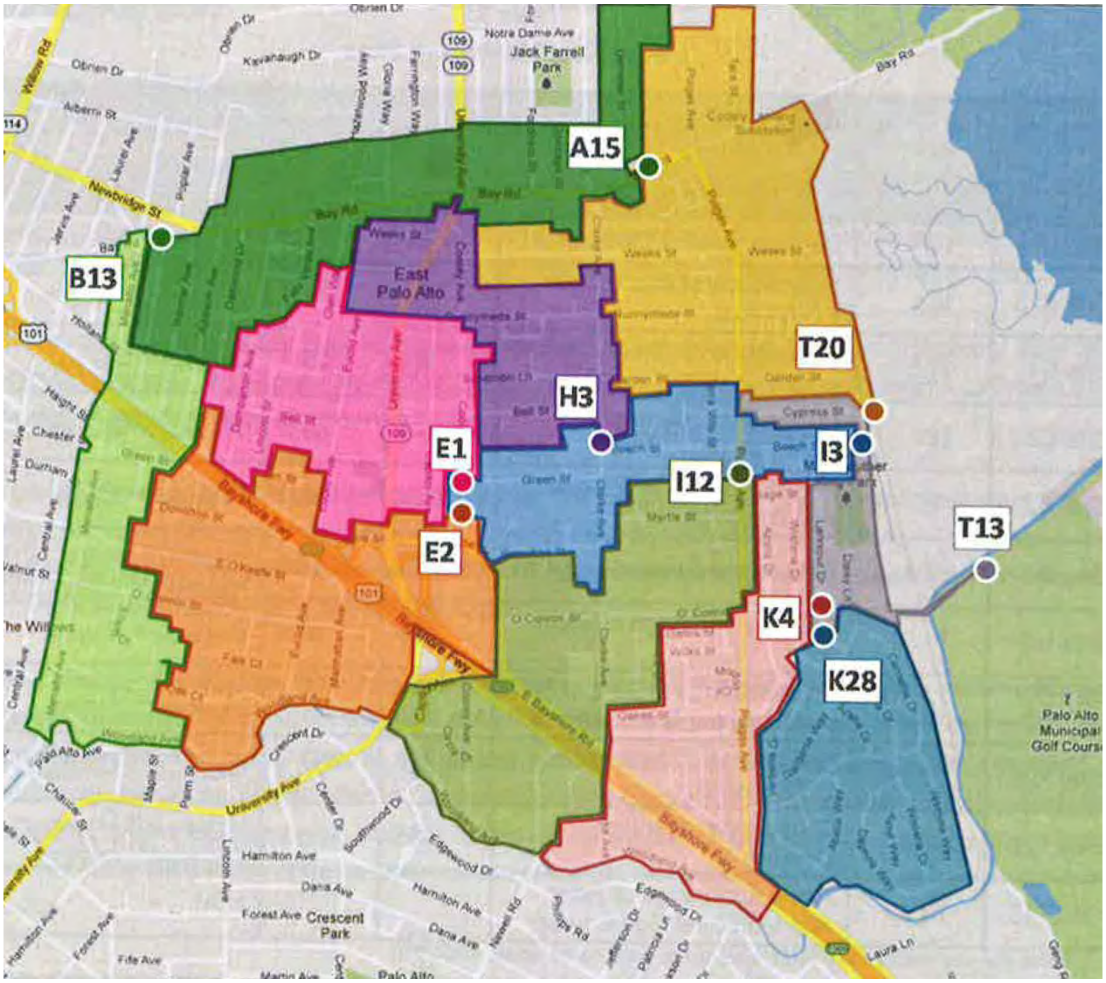


Figure ES-2 Site and Basin Location Map

ES.4.2 Description of Flows

The flow monitoring program measured dry and wet weather flows through the District. The District's BWF, measured across weekday and weekend periods, was 1.53 mgd. BWF includes the wastewater generated from all land uses. The peak wet weather measured flow was 2.80 mgd.

Three main rainfall events occurred during testing which were used in the analysis for the study. The rain events are presented in Table ES-2.

TABLE ES-2 RAINFALL EVENTS	
Rainfall Event	**Event Rainfall (inches)**
Event 1: March 16-17, 2012	0.56
Event 2: March 24-25, 2012	1.14
Event 3: March 27-28, 2012	0.52
Total Over Monitoring Period	**3.30**

ES.4.3 Inflow and Infiltration Analysis

The data collected during the flow monitoring study was plotted against the storm events to compare and analyze the inflow and infiltration. Flows were directly related to the storm events mainly because of specific structures such as downspouts, area drains, and cross connections to catch basins.

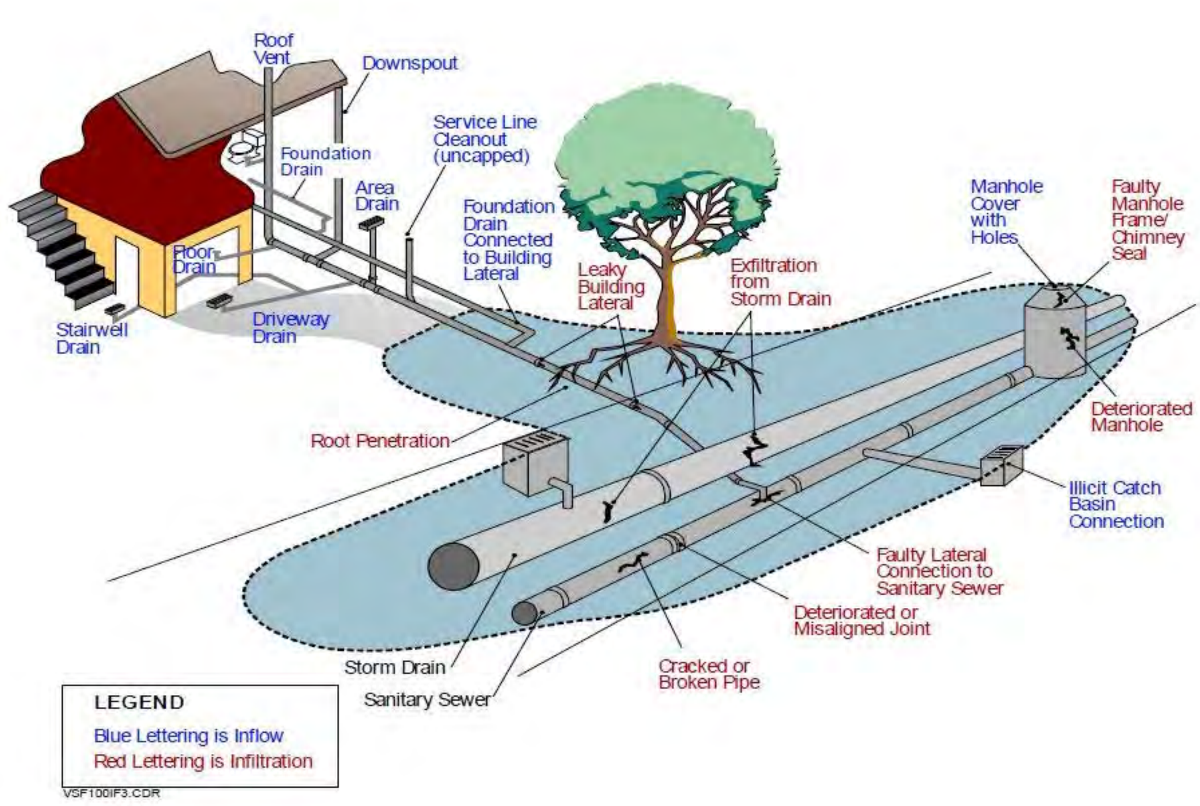


Figure ES-3 – Infiltration and Inflow Diagram

ES.5 HYDRAULIC MODEL DEVELOPMENT

Freyer & Laureta Inc. developed a computer model of the District's system using the program Hydra 7. The pipes were modeled based on the District System Maps, which contained rim & invert elevations and pipe sizes. Once the pipes were modeled with the available information, flows were introduced based on the flow data received. The model was further calibrated using data from flow monitoring performed by District staff using portable meters.

The average dry weather flows were injected into the system. After modeled, a peak wet weather flow scenario was created based on the recorded data. To analyze the system against a predicted storm event, the 10 year 24 hour storm, was modeled. From this model we obtained an understanding of system deficiencies.

Future development will add wastewater flow to the system. These flows were added to the storm event to determine improvement needs of the system.

ES.6 PLANNING CRITERIA

Chapter 6 presents the criteria used to evaluate the system's capacity. The criteria address items such as collection system capacity, pipe slopes, and flow elevation. The District selected a 10 year 24hr storm to be the design storm. Based on V&A's design storm summary, the following flows were used.

Table ES-3 – Design Storm Flows

Site	Peak Dry Weather Flow (mgd)	Peak Wet Weather Flow (mgd)
A15	0.43	1.19
B13	0.11	0.52
E1	0.19	0.59
E2	0.43	1.45
H3	0.23	0.58
I3	1.22	2.76
I12	0.39	0.76
K4	0.35	0.99
K28	0.17	0.68
T20	0.60	1.55
T13	2.31	5.78

ES.7 HYDRAULIC CAPACITY ANALYSIS RESULTS

The Hydra model evaluated the pipe system's ability to convey flows that are expected to occur during the selected 10 year 24 hour design storm. The analysis is further discussed in Chapter 7. The hydraulic model predicted peak hourly flow from the design storm of 5.8 mgd.

Analyses were conducted as follows:

- The system was evaluated for its ability to meet surcharging and flooding criteria. Pipe diameter upsizing that is required to convey peak flows and meet surcharge criteria were determined.

- Proposed improvements were developed and reviewed.

Table ES-4 – Results of Improvements

Monitoring Site	Rim	HGL before improvements	HGL after improvements
T29	4.98	4.82	0.39
B2	16	8.88	4.17
B16	20.39	18.08	14.71
D1	17.33	16.62	9.14
E1	12.09	13.5	4.5
T24	3.66	3.78	0.12
T22	2.81	3.33	-0.08
I11	8.07	7.6	0.84
T18	1.12	2.03	-0.94
T20	2.72	2.68	-0.24
K1	2.02	-0.54	-1.76
K28	3.27	1.23	0
M2	5.62	4.5	1.51
N1	5.32	0.78	-0.44
N8	13.8	4.33	4.33

ES.8 Recommendations

This chapter provides the recommended pipes to be replaced with larger pipes. Recommendations were based on the results from the model and the outcome of the size changes.

ES.9 Capital Improvement Program

This chapter shows a recommended schedule for the recommended improvements. The schedule breaks down the sections of pipe that should be replaced each year for 15 years. This will help set a budget for the District.

Chapter 1 - Introduction

Chapter 1 provides background information on the scope and objectives of the East Palo Alto Sanitary District Wastewater Collection System Master Plan (Master Plan).

1.1 BACKGROUND AND PROJECT OBJECTIVES

The East Palo Alto Sanitary District (District) is responsible for the operation and maintenance of the sanitary sewer collection system that serves most of East Palo Alto and a portion of Menlo Park. The City of East Palo Alto (City) is anticipating redevelopment of portions of the City. Other specific development plans have been submitted to the District for review, and some are currently under construction. The major areas within the District identified for redevelopment include:

- **Ravenswood Villages (University Square)**
- **Ravenswood Business Park**
- **Four Corners/Bay Road**

Future plans of Woodland area and redevelopment are unknown at this time, therefore not included in the scope of this project. As planning in the area progresses, this Master Plan will require updating.

The purpose of this study is to develop a mathematical model of the District's collection system to assess the impact that redevelopment and future projects will have on the District's collection system.

As a first step for this Master Planning effort, V&A created a report for the existing measured flows for the District's system. The report was then analyzed and implemented into a true model to discover problem areas in the network. The objective was to discover and improve capacity issues throughout the District. The plan was broken into tasks for analysis:

Task 1 EPASD Basemap

The existing base drawing of the EPASD collection system in AutoCAD was used with the GIS model provided from the District. These drawings provided the basemap for the system. Included within the drawings was information for pipe sizes, location, inverts and rims of each manhole.

Task 2 – Mathematical Model

A mathematical model of the main lines in the District's system using the computer software program HYDRA 7was developed. The following steps were taken in order to complete the mathematical model:

1) Data Collection

a) Review existing information provided from the District:

i) Physical Data: pipe sizes, pipe materials, pipe ages, manhole rim and inverts.

ii) System Geometry and locations

iii) Influent Flow Data.

iv) Rain Data

v) Troubled Areas.

b) Determine current dry and wet weather flows from the District's collection system.

2) Develop Model

a) Enter existing conditions into the model

Task 3 – Flow Data

Wet and dry weather flow monitoring at eleven manholes in the District was completed. The following steps were taken in order to complete the flow data:

1) Identify manholes monitored – Provided by the District

2) Input given flow data into the model

Task 4 – Mathematical Model Update and Review

The mathematical model was updated to include flow monitoring results and updated redevelopment plans for the City of East Palo Alto. The following steps were taken in order to complete the mathematical model:

1) Data Collection

a) Any additional monitoring information was reviewed and added to the system if necessary.

2) Review Model and Analyze Collection System

a) Utilize the model to evaluate the existing system. Identify capacity deficiencies of the sanitary sewer system for the current condition including both wet and dry weather scenarios.

b) Utilize the model to evaluate the future (with redevelopment) system. Identify capacity deficiencies of the sanitary sewer system for the current condition including both wet and dry weather scenarios.

3) Develop List of Improvements and Recommendations

a) Recommend improvement projects including replacement or parallel pipeline projects for the flooding locations.

1.2 REPORT ORGANIZATION

The Report comprises the following chapters. The sequence of chapters generally conforms to the tasks outlined in the scope of work for the project. This section describes the contents of each of the nine chapters and appendices.

1.2.1 Executive Summary

The Executive Summary provides a comprehensive overview of the Report contents and summarizes key aspects of each chapter.

1.2.2 Chapter 2 – Existing Wastewater System

This chapter describes the District's existing service areas and land uses.

1.2.3 Chapter 3 – System Flows

This chapter presents the methods for determining existing and future dry and wet weather wastewater flows for the purposes of collection system capacity modeling.

1.2.4 Chapter 4 – Flow Monitoring and Inflow/Infiltration Analysis

This chapter summarizes contributions to system-wide inflow and infiltration based on results from V&A Consulting Engineers (V&A).

1.2.5 Chapter 5 – Hydraulic Model Development

This chapter describes the tasks required to build and calibrate the Hydra 7 hydraulic model. The hydraulic model is the primary tool that was used to determine the flows and capacities of the District's major sewers. It was also used for the development of recommendations for the system.

1.2.6 Chapter 6 – Planning Criteria

This chapter documents the planning criteria used to calculate existing and future flows, and to assess whether any hydraulic deficiencies may occur in the collection system. These criteria are based on standard design criteria in use by the District, and modeled criteria that resulted from hydraulic model calibration as discussed in Chapter 4.

1.2.7 Chapter 7 – Capacity Analysis

This chapter presents the results of the existing and future system hydraulic capacity analyses of the District's wastewater collection system. The chapter presents the results of both analyses, identifies existing pipelines that are over capacity, and describes proposed the capital improvement projects.

1.2.8- Chapter 8 – Recommendations

This chapter describes the pipes that should be replaced to reduce surcharging and flooding based on the design scenario.

1.2.9 Chapter 9 – Capital Improvement Program

This chapter provides recommendations for the schedule of the Capital Improvement Plan. The replacements are spread over 15 years as well as the budget.

1.2.10 Appendices

The following appendices to this Wastewater Collection System Master Plan contain additional technical information and assumptions:

- Appendix A – EPASD map
- Appendix B – Flow Monitoring Station Map and Table
- Appendix C – Ravenswood Map
- Appendix D – Ravenswood Existing Land Use
- Appendix E – Ravenswood Plan Concept
- Appendix F – Pipe Recommendations
- Appendix G – CIP Timeline Map
- Appendix H – Flow Results at Downstream Basins
- Appendix I – Basin Map
- Appendix J – Recommended pipes to be upside with costs
- Appendix K – System Improvement Results

1.3 ACRONYMS AND ABBREVIATIONS

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

ADWF	Average Dry Weather Flow
BWF	Base Wastewater Flow
CCTV	Closed Circuit Television
CIP	Capital Improvement Program
CIPP	Cured in Place Pipe
CIWQS	California Integrated Water Quality System
CMP	Corrugated Metal Pipe
County	County of San Mateo
District	East Palo Alto Sanitary District
DU	Dwelling Unit
DWF	Dry Weather Flow
EPASD	East Palo Alto Sanitary District
F&L	Freyer & Laureta, Inc.
fps	Feet Per Second
GPAD	Gallons Per Acre Per Day
gpcpd	Gallons Per Capita Per Day
gpd	Gallons Per Day
gpd-idm	Gallons Per Day Per Inch-Diameter-Mile
gpm	Gallons Per Minute
GWI	Groundwater Infiltration
HDD	Horizontal Direction Drilling
HDPE	High Density Polyethelyne
HGL	Hydraulic Grade Line
I&I	Inflow and Infiltration
ID	Identification Numbers

Master Plan	East Palo Alto Sanitary District Master Plan
Menlo Park	City of Menlo Park
mgd	Million Gallons Per Day
NASSCO	National Association of Sewer Service Companies
NOAA	National Oceanic and Atmospheric Administration
PVC	Polyvinyl Chloride
Q_A	Average Daily Dry Weather Flow
Q_{PDWF}	Peak Hourly Dry Weather Flow
Q_{PWWF}	Peak Wet Weather Flow
R&R	Rehabilitation and Replacement
Report	Collection System Master Plan Report
RDII	Rainfall-Dependent Inflow and Infiltration
SCS	Soil Conservation Service (now Natural Resource Conservation Service)
SSO	Sanitary Sewer Overflow
SUH	Synthetic Unit Hydrograph
SWRCB	State Water Resources Control Board
TCE	Temporary Construction Easement
V&A	V&A Consulting Engineers
VA	Veteran's Affairs
VCP	Vitrified Clay Pipe
WWF	Wet Weather Flow

CHAPTER 2 – EXISTING WASTEWATER SYSTEM

Chapter 2 describes the District's existing wastewater collection system. System information was obtained through the review of previous reports, documents from V&A, and miscellaneous documents from the District. The following sections of this chapter describe the components of the District's existing wastewater collection system:

- Existing Service Area
- Population Served and Land Use Characteristics
- Existing Collection System Facilities

2.1 EXISTING SERVICE AREA

The District currently provides wastewater collection service to all or portions of the communities of Menlo Park and East Palo Alto. The District's service area is primarily residential with a few commercial and industrial parcels.

As shown on Figure 2-1, the District service area encompasses nearly 1,230 acres, or 1.92 square miles.

The most Easterly portion of the system, in East Palo Alto, will experience the greatest change in sewer flows in the future.

Figure 2-1 District's Service Area

2.2 POPULATION SERVED & LAND USE CHARACTERISTICS

Land use information was derived from several sources collected for the communities served by the District, including:

- Land Use Database – Existing land use data in Geographical Information System (GIS)
- General Plan Information – Additional land use data from East Palo Alto
- Aerial Photographs – Aerial photographs of the service area were reviewed to identify parcels and properties

2.2.2 Build-out and Land Use

The City of East Palo Alto (City) is anticipating redevelopment of portions of the City. Specific development plans have been submitted to the District for review, and some are currently under construction. The major areas within the District identified for redevelopment include:

- **Ravenswood Villages (University Square) –** Residential development on approximately 10 acres of land between Clarke and Pulgas Streets, just south of O'Connor Ave. The development plans include single family residences and apartments. Construction is nearing completion.
- **Ravenswood Business Park –** Approximately 130 acres located along Bay Road in the northeast corner of the District. Proposed development includes industrial, commercial, office and some residential as described in the August 2000 Preliminary Draft of the East Palo Alto Revitalization Plan.
- **Four Corners/Bay Road –** Creation of a new downtown center at the intersection of University Avenue and Bay Road. Proposed mixed-use development including government, community, office, and commercial spaces as described in the August 2000 Preliminary Draft of the East Palo Alto Revitalization Plan.

As previously stated, these locations were the focus of redevelopment for this model and analysis. All other developments were not included in the Master Plan.

2.3 EXISTING COLLECTION SYSTEM FACILITIES

The District is responsible for the operation and maintenance of the sanitary sewer collection system shown in Figure 2-1. The collection system serves most of East Palo Alto and a portion of Menlo Park. The collection system drains to the Palo Alto Regional Water Quality Control Plant (RWQCP) where the District's flows are treated and discharged to the San Francisco Bay by the RWQCP. The District's collection system is a gravity system consisting of sewer pipelines and manholes. Approximately 70% of the pipelines are 6" in diameter. The larger collector lines range between 8" and 24". The trunk line contains a siphon beneath San Francisquito Creek between manholes T15 and T14. The collection system is composed of 15 drainage basins. A letter, A-O, is used to designate each basin. The boundaries of the drainage basins are shown in Appendix I. Table 2-1 shows the characteristics of each basin. Sections of the system have been replaced; however most of the original pipelines and manholes remain in service. The new manholes are precast, while the original manholes were mostly constructed of brick and mortar. The pipelines were constructed with vitrified clay pipe (VCP), but newer pipelines are being constructed with heavy wall plastic pipe such as PVC or HDPE.

Table 2-1 Basin Information

Basin	Area (acres)	Land Use	Total Length of Sewers	Pipe Diameter (inches)	Approximate Age of Pipes and Manholes
A	106	Industrial	7,888	6-8	20-60 years
B	93	Low Density Residential / Commercial / Medium-High Density Residential	15,080	6-12	55 years <10 years along Menalto <2 years along Bay
C	73	Low Density Residential	12,852	6-8	40-55 years < 10 years along Menalto
D	128	Residential / Commercial	18,756	6-10	40-55 years <2 years on Euclid West Bayshore, and Oakwood.
E	122	Residential / Commercial	18,072	6-12	55 years < 2 years on Bell and Cooley
F	64	Industrial / Residential	4,235	6	55 years
G	30	Low Density Residential	3,715	6	55 years

Basin	Area (acres)	Land Use	Total Length of Sewers	Pipe Diameter (inches)	Approximate Age of Pipes and Manholes
H	124	Residential / Commercial	13,949	6-15	15-55 years
I	78	Low Density Residential	7,143	6-15	10-55 years <5 years on Pulgas
J	36	Low Density Residential	3,824	6-8	55 years <2 years on Cypress
K	66	Low Density Residential	9,046	6-14	15-55 years <2years on Gardenia, Camellia, and Larkspur
L	99	Low Density Residential	15,171	6-10	30-40 years
M	61	Residential / Commercial	5,434	6-10	15-55 years <5 years on O'Connor
N	38	Medium-High Density Residential	2,385	10	15 years
O	102	-	11,094	6-8	30-55 years
Trunk Line	-	-	11,281	18-24	4 years
Total	1,220	-	159,925	6-24	

Chapter 3 – System Flows

Chapter 3 presents the background and methodology used to determine existing and future dry weather wastewater flows for input to the District's collection system hydraulic model. This chapter is organized as follows:

- Sources of System Data
- Estimated Flows

3.1 SOURCES OF SYSTEM DATA

The main sources of data used to estimate wastewater flows for the District's hydraulic model include land use information, aerial photography, and District unit flow factors. All calculations and data were provided by V&A.

The Palo Alto Regional Water Quality Control Plant (RWQCP) records total wastewater flow for the District. These flows are measured from the District's meters. Typically, maximum daily flows in the District occur during the winter months between December and March. Daily flows are lowest during the months of September through November. The dry weather flow capacity of the RWQCP is 38 MGD. The District has an agreement with the RWQCP, which entitles the District to 7.63% of the dry weather capacity of the RWQCP, 2.9 MGD.

Wastewater in the District is composed of sanitary flows and inflow/infiltration (I/I). Sanitary flows are derived from three main sources in the District: commercial, residential, and industrial. I/I is composed mainly of storm water inflow, rain-dependent groundwater infiltration, and groundwater infiltration that enter the collection system through roof drain connections, storm drain cross connections, and manhole covers. Due to the proximity to the San Francisco Bay, the groundwater table within the eastern portion of the District is relatively high, and year-round groundwater infiltration is relatively high. The relative contribution from sanitary and I/I flows varies seasonally. Generally, the wastewater is composed primarily of sanitary flows and some groundwater infiltration during the drier months of summer and fall. I/I flows usually peak during the heavy rain events between January and March and can account for over 50% of the daily flows in the collection system.

3.2 – ESTIMATION OF FLOWS

The initial BWF (average dry weather flow) component was calculated using the following steps:

- Based on the monitoring system put in place by the District, flows were recorded. From those recordings, the flows were averaged to create the BWF. Not all sections were monitored; therefore flows were back calculated to properly distribute flow.
- Once the model was created, additional manholes were monitored and the model adjusted to conservatively show the actual flows.

TABLE 3-1. List of Flow Monitoring Sites

Site	Location	Basin Size (acres)
A15	Bay Rd, East of Demeter St.	118
B13	Intersection of Bay Rd and Poplar Ave	87
E1	Intersection of Cooley Ave and Green St.	101
E2	Cooley Ave, North of Donohoe St.	149
H3	Intersection of Clarke Ave and Beech St.	74
I3	East end of Beech St.	74
I12	Pulgas Ave, North of Sage St.	135
K4	Intersection O’Connor St and Larkspur Dr	107
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T13	Along North edge of Palo Alto Municipal Golf Course	-

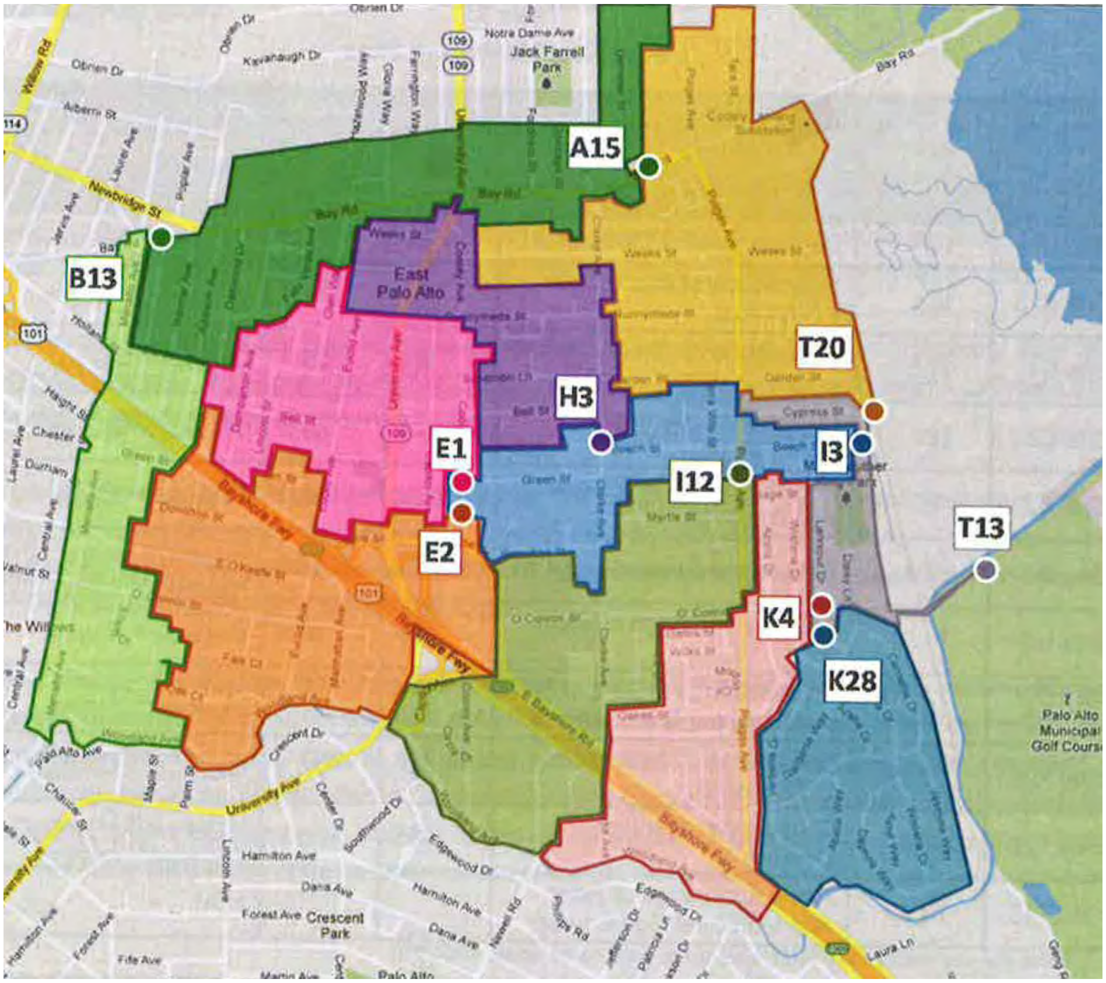


Figure 3-1 Monitoring Station Map

Buildout flows were created by injecting predicted development flows (0.91MGD for ADWF) as follows:

- Locating the development and probably sewer connection points
- Flows were inserted into the sewer model.
- Hydra calculated the flows and the effect on the system downstream and upstream.

3.3 Infiltration and Inflow

3.3.1 Dry Weather Infiltration

A portion of the metered average dry weather flow is due to sanitary flows and the remainder is due to dry weather infiltration. Groundwater infiltration flows studies were developed by taking the difference between the sanitary flows estimated from water use records and the dry weather flows that were measured during the flow metering performed as part of the study.

3.3.2 Wet Weather Infiltration and Inflow

Wet weather inflow and infiltration is directly related to rainfall amounts, groundwater levels, and soil saturation. Wet weather inflow and infiltration flow can vary dramatically from day to day and over the years. For the purpose of the model, a representative inflow and infiltration flow was developed by V&A.

Chapter 4 Inflow Analysis

4.1 FINDINGS AND RECOMMENDATIONS

The following findings were developed to address potential problems within the system that are the most significant contributors to I&I. Through the control of I&I, the District will also likely reduce the potential for wet weather related sewer system overflows (SSOs).

4.1.1 General Sources of Inflow and Infiltration

I&I are extra flows that enter the sanitary sewer system. I&I can negatively impact the capacity of wastewater collection systems by increasing both peak flows and total flow volume. Rainfall-dependent inflow and infiltration (RDII), groundwater infiltration (GWI), and inflow from illegal connections can all be contributors of I&I.

I&I can enter the collection system through different facilities. Inflow is water that enters the collection system through a direct improper connection. Inflow enters the sewer pipe independent of groundwater level and can be seen in the collection system immediately following a storm. Infiltration is water that enters the collection system by percolating through the ground and then into the collection system through defects in pipelines, manholes, and joints. Infiltration will occur over a longer period of time, and depending on conditions, can occur for days, weeks, or seasonally.

Figure 4-1 provides examples of common I&I sources.

RDII generally occurs after a rainfall event, and can enter the collection system on the same day that the rainfall event begins, and may continue to last for days after the rain event has ended. GWI patterns may reflect movement of the groundwater table, which generally rises gradually during the wet weather season and falls as the dry weather season takes place. GWI may occur rather steadily each day.

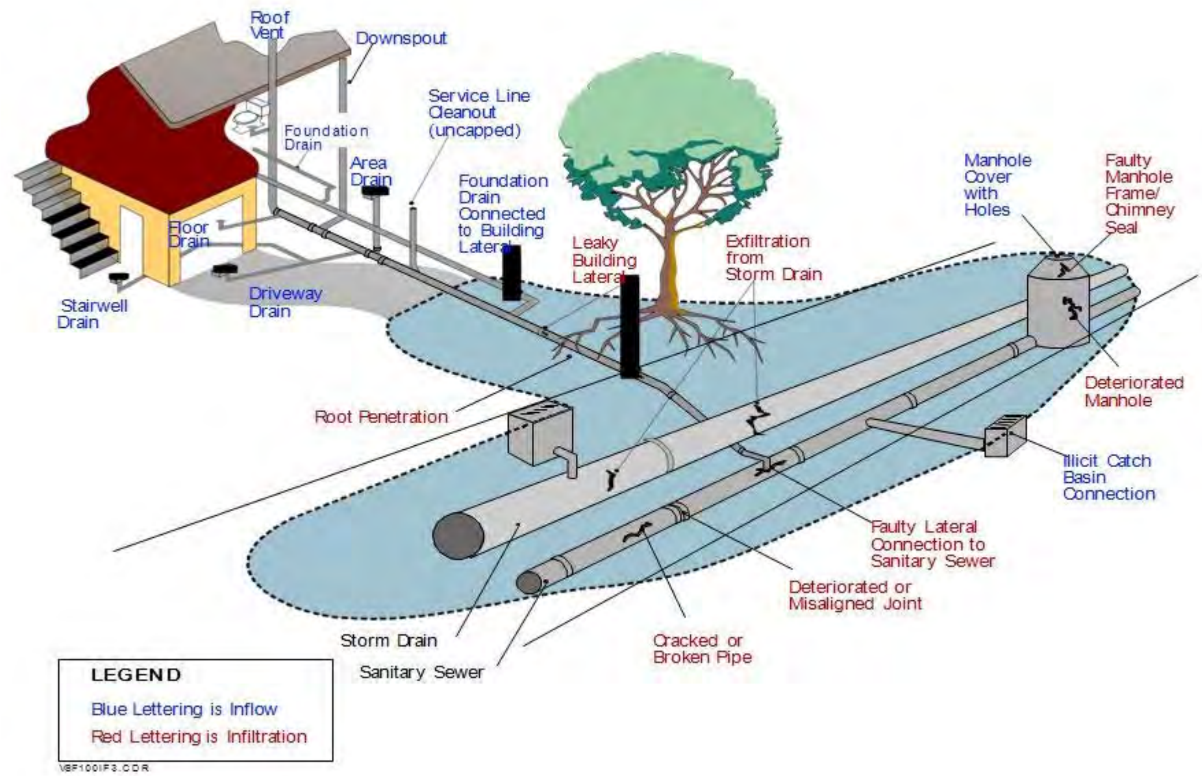


Figure 4-1 Inflow and Infiltration Map

Chapter 5 –Hydraulic Model Development

The computer-based hydraulic sewer model of the District's wastewater collection system, developed using Hydra 7 software, by Pizer Incorporated, is a tool to investigate the flows and to help identify problem areas to create a solution. The hydraulic model is also a tool for performing different scenarios to assess the impacts of future developments, land use changes, and system changes.

5.1 MODEL DEVELOPMENT

The District's hydraulic model creates a mathematical model from the physical and operational information of the system. Hydra simulates flow for the system by taking the given inputed data and running multiple calculations based on parameters set. The modeling results provide information on flow depth, velocity, surcharging, flows and flooding conditions that are used to identify possible system deficiencies. The model is also used to verify the capacity of the proposed system improvements.

The hydraulic model composed of a network of nodes and links. Several types of nodes and links are used for defining the physical entities within the District's system. The following descriptions provide information on elements used in the development of the District's model.

Node: Nodes can represent manholes, split manholes, storage facilities, and outfalls in a collection system. Nodes were also used to create simulated siphons by setting inverts midway through the siphon. All flows loaded into the model are attached to a node structure. The data required for node structures to include elevation data (pipe invert and manhole rim) and manhole diameter.

Links: Links represent pipes that convey wastewater from one point in the system to another. The physical data for the pipe mains include invert elevation, size, length, and friction factor.

5.1.1 Model Description

The hydraulic model configuration was developed using the District's AutoCAD and GIS pipe, manhole information obtained from the District, such as pipeline invert and manhole rim elevations, pipeline diameter and pipeline length data. The GIS model was inserted into the program Hydra. From there the pipe sizes, inverts, and rims were entered to match the provided information.

5.2 DATA VALIDATION

After the model network was constructed, the model was further checked and calibrated.

- Labeled manholes based on the District's label system
- Check the pipe connectivity
- Check for missing or inconsistent data such as missing manhole rim or pipe invert elevations, negative pipe slopes, or abrupt elevation changes
- Identify split manholes and flow distribution
- Field checks and descriptions based on past projects and recordings.

5.3 Model Scenarios

The model was run for both the existing and future flow scenarios. The following is a summary of the input flow files used in each scenario that analyzed:

1. **Average Flow**: The average sanitary flow based on the collected data.
2. **Peak Flows**: The peak sanitary flow files based on the collected data.
3. **10 year 24 hour storm**: The flows given based on a 10 year 24 hour storm estimated response summary from V&A.
4. **Future Flows:** The given predicted flows from future developments.

The scenarios were combined to create the design storm flows, which in this case is the 10 year storm with peak flows including future development. The pipes will be able to handle this situation without flooding.

Chapter 6 - Planning Criteria

Chapter 6 presents planning criteria that can be used to analyze system capacity and size any proposed new pipe recommendations. Planning criteria address items such as collection system capacity, pipe slopes, and maximum depth of flow. The major elements of this chapter include:

- Design Storm
- Hydraulic Deficiency Criteria, and
- New Pipeline Design Criteria

6.1 DESIGN STORM CRITERIA

Design storms are simulated rainfall events used to evaluate collection system capacity under wet weather flow conditions. A design storm has specific recurrence interval and rainfall duration. District's goal is to eliminate all sewer overflows for the 10-year, 24 hour storm event.

The master plan evaluates the ability of the system to convey flows with surcharging under the selected design storm scenario. The District has selected as its design storm a rainfall event of 10-year recurrence intervals and 24-hour duration (10-year, 24-hour storm), as defined by the NOAA rainfall atlas[1].

Table 6-1 shows recorded rainfall data from the V&A report. This information of rainfall was used to create a peak flow scenario combined with a predicted 10 year storm.

TABLE 6-1 RAINFALL EVENTS

Rainfall Event	Event Rainfall (inches)
Event 1: March 16-17, 2012	0.56
Event 2: March 24-25, 2012	1.14
Event 3: March 27-28, 2012	0.52
Total Over Monitoring Period	**3.30**

6.2 EXISTING PIPELINE HYDRAULIC CAPACITY CRITERIA

Hydraulic capacity or deficiency criteria are presented for gravity mains. The criteria sets the standards for determining if a pipe is exceeding allowable surcharging. Under these criteria, a facility may exceed surcharge capacity, yet not overflow. For existing pipelines, the pipe is considered to have a capacity deficiency (surcharge) when, under peak wet weather flow conditions for the design storm, the water level or hydraulic grade line (HGL) is located above the top of pipe. Exceptions to these criteria may be made because of siphons in the system. All capacity deficient pipelines should be considered for replacement over time, as discussed in Chapter 9, Capital Improvement Program.

Chapter 7 Result Summary

Chapter 7.1 - Observations

The following is a summary of general observations about the results of the model:

1. Under the present flow scenarios, the capacity of the existing pipelines is adequate to handle current peak wet weather flows.

2. A large portion of the collection system, including sections of the main trunkline to the RWQCP, is at capacity now, and future buildout flows will overwhelm many of the mains in the existing system. Several sections of pipelines in the model were listed as overcapacity during peak wet weather flow scenarios. The dry weather flow capacity of the RWQCP is 38 MGD. The District has an agreement with the RWQCP, which entitles the District to 7.63% of the dry weather capacity of the RWQCP, approximately 2.9 MGD. The predicted average dry weather flow for both future buildout scenarios exceeds the capacity allotment from the RWQCP.

3. Some pipes may be relatively flat due to settlement

4. The slopes of the District's pipelines are relatively flat. As a result, calculated velocities at average dry weather flow for both the present and future scenarios were often low. The ideal minimum velocity of sewage flows in a gravity pipeline is 2.0 fps to prevent settling of the solids out of the flow. The calculated velocities indicate that the District may have a problem with blockages in the collection system due to the settling out of solids in the flow. In fact, EPASD maintenance crews are required to frequently clean sewer pipelines throughout the District to prevent blockages.

5. The siphon under San Francisquito Creek causes surcharging during both present and future peak flows. EPASD maintenance crews have verified the occurrence of surcharging in this pipeline. Additionally, grease gets trapped in the pipelines just upstream of the siphon requiring frequent routine maintenance.

7.1.1 Surcharged Pipes

The following pipes are surcharged during peak flow, but not including siphons. (Flows based on reported/recorded data)

Table 7-1 Surcharged Pipes			
Street	**Between MH's**	**Size**	**Length**
Woodland Ave	D56-D35	6	287
Woodland Ave	D35-D34	6	178
Oak Court	D36-D35	6	251
Menalto Ave	C3-C2	6	398
Menalto Ave	C2-C1	6	204
Bay Rd	B7-B6	12	380
Donohoe Street	D4-D3	8	297
Green Street	H74-H8	12	113
Green Street	H8-H7	12	234
Verbina Drive	L14-L13	6	302
Verbina Drive	L13-L9	6	311
Gaillardia Way	L11-L10	6	360
Azalia Drive	L10-L9	6	275
Azalia Drive	L9-L4	6	163
Gardenia Way	L8-L7	6	73
Gardenia Way	L7-L6	6	261
Gardenia Way	L6-L5	6	215
Gardenia Court	L61-L5	6	153
Gardenia Way	L5-L47	6	277
Abelia Way	L58-L57	6	296

Street	Between MH's	Size	Length
Abelia Way	L57-L53	6	203
Camellia Court	L56-L54	6	327
Camellia Dr	L55-L54	6	149
Camellia Dr	L54-L53	6	370
Camellia Dr	L53-L52	6	219
Camellia Dr	L52-L50	6	224
Camellia Dr	L51-L50	6	80
Azalia Dr	L50-L49	8	224
Azalia Dr	L49-L48	8	234
Azalia Dr	L48-L47	8	229
Azalia Dr	L47-L4	8	88
Gardenia Way	L4-L3	10	248
Wisteria Dr	L22-L3	6	366
Daphine Ct	L62-L34	6	147
Daphine Way	L34-L26	6	288
Aster Way	L30-L27	6	236
Wisteria Drive	L28-L27	6	363
Wisteria Drive	L27-L26	8	261
Wisteria Drive	L26-L25	8	216
Jasmine Way	L43-L44	8	335
Jasmine Way	L44-L45	8	239
Camellia Drive	L46-L45	6	136
Camellia Drive	L45-L25	8	202

Street	Between MH’s	Size	Length
Wisteria Drive	L25-L24	8	342
Wisteria Drive	L24-L23	8	387
Wisteria Drive	L23-L3	8	352
Gardenia Way	L3-L2	10	84
Gardenia Way	L2-L1	10	179
Camellia Drive	K35-K34	6	280
Camellia Drive	K34-K33	6	279
Camellia Drive	K33-K32	6	131
Camellia Drive	K37-K32	6	351
Camellia Drive	K32-K30	8	227
Gardenia Way	K30-K31	8	109
Gardenia Way	K31-L1	8	148
Larkspur Dr	L1-L21	10	224
Larkspur Dr	L21-L28	10	69
Larkspur Dr	L28-K4	10	242
O’Connor Street	K5-K4	12	249
O’Connor Street	K4-K3	12	239
O’Connor Street	K3-K2	12	190
O’Connor Street	K2-K1	14	452
O’Connor Street	K1-T15	14	21
N/A	T14-T13	24	479
N/A	T8-T7	24	502
N/A	T3-T2	24	500

7.1.2 Flooding Conditions

The existing pipe system does not have the capacity to support the flows from a 10 year storm with peak flow. Each of the following manholes shows flooding during this condition.

Table 7-2 Manholes with Flooding Condition

D37	D19	C4	E1	H17	A20	T19		
D36	D5	C3	H9	H14	A19	T18		
D24	D4	C2	H73	H12	A18	L43		
D26	D21	C19	H74	I14	F7	L45		
D25	D10	E44	H8	I9	T25	L24		
D22	D20	E7	H7	A14	T24			
D47	C6	E46	H75	A13	T22			
D21	C5	E6	H34	A12	T20			

Table 7-3 Design Storm Flows

Site	Peak Dry Weather Flow (mgd)	Peak Flow (mgd)
A15	0.43	1.19
B13	0.11	0.52
E1	0.19	0.59
E2	0.43	1.45
H3	0.23	0.58
I3	1.22	2.76
I12	0.39	0.76
K4	0.35	0.99
K28	0.17	0.68
T20	0.60	1.55
T13	2.31	5.78

Chapter 8 – Recommendations

8.1 – Pipes to Be Upsized

Based on the model produced, the following pipes did not meet the standard criteria for an acceptable pipe. By upsizing the listed pipes, the capacity of the system increases and will handle future flows.

TABLE 8.1 Upsize Recommendations			
Section	**Current Size**	**Recommended Size**	**Approx Length**
C5-C4	6”	8”	328’
C4-C3	6”	8”	436’
C3-C2	6”	8”	398’
C2-C1	6”	8”	205’
D24-D23	8”	12”	350’
D23-D22	8”	12”	74’
D22-D21	8”	12”	149’
D21-D19	8”	12”	391’
D19-D10	10”	12”	49’
D10-D3	10”	12”	490
A14-A13	6”	8”	289’
A13-A12	6”	8”	412’
A12-A11	6”	8”	486’
A11-A10	6”	8”	418’
A20-A19	6”	8”	340’
A19-A18	6”	8”	214’
A18-A16	6”	8”	442’
M4-M3	8”	12”	358
M3-M2	8”	12”	380
M2-M43	8”	12”	48’
E1-H9	12”	18”	270’
H9-H73	12”	18”	247’
H73-H74	12”	18”	101’
H74-H8	12”	18”	113’
H8-H7	12”	18”	234’
H7-H75	12”	18”	90’
H75-H6	12”	18”	260’
H6-H5	12”	18”	9’
H5-H4	15”	18”	260’

Section	Current Size	Recommended Size	Approx Length
H4-H3	15”	18”	8’
H14-H13	8”	12”	447’
H13-H12	8”	12”	108’
H12-H11	8”	12”	334’
H11-H64	8”	12”	199’
H64-H71	8”	12”	161’
H71-H3	8”	12”	35’
H3-H2	15”	24”	31’
H2-I11	15”	24”	37’
I11-I10	15”	24”	380’
I10-I9	15”	24”	222’
I9-I8	15”	24”	155’
I8-I7	15”	24”	239’
I7-I6	15”	24”	259’
I6-I5	18”	24”	411’
I5-I31	18”	24”	135’
I31-I4	18”	24”	322’
I4-I3	18”	24”	243’
I3-T19	18”	24”	189’
A29-T29	18”	24”	346’
T29-T28	18”	24”	234’
T28-T27	18”	24”	163’
T27-T26	18”	24”	356’
T26-T25	18”	24”	306’
T25-T24	18”	24”	283’
T24-T23	18”	24”	317’
T23-T22	18”	24”	447’
T22-T21	18”	24”	198’
T21-T20	18”	24”	339’
T20-T19	18”	24”	332’
T19-T18	21”	24”	500’
T18-T17	21”	24”	541’
T17-T16	21”	24”	482’
T16-T15	24”	30”	35’
T15-T14	24”	30”	279’
T14-T13	24”	30”	479’
A23-A24	6"	8"	251'
A24-A25	6"	8"	254'
A25-A26	6"	8"	235'
A26-A27	6"	8"	311'

Table 8-2 shows the effects of the recommended pipe replacement. The HGL changes dramatically to relieve possible flooding in the system.

Table 8-2 Results of Improvements			
Monitoring Site	**Rim**	**HGL before improvements**	**HGL after improvements**
T29	4.98	4.82	0.39
B2	16	8.88	4.17
B16	20.39	18.08	14.71
D1	17.33	16.62	9.14
E1	12.09	13.5	4.5
T24	3.66	3.78	0.12
T22	2.81	3.33	-0.08
I11	8.07	7.6	0.84
T18	1.12	2.03	-0.94
T20	2.72	2.68	-0.24
K1	2.02	-0.54	-1.76
K28	3.27	1.23	0
M2	5.62	4.5	1.51
N1	5.32	0.78	-0.44
N8	13.8	4.33	4.33

Chapter 9 Capital Improvement Project

9.1 Phasing of the Improvements

A 15-year Capital Improvement Program is recommended to address capacity deficiencies in the system. The following phasing is recommended (Appendix G for addition information):

2015-2016 – replacing the siphon and downstream with 30” pipe (795LF)

2016-2017 – replacing part of Beech Street with 24” pipe (1300LF)

2017-2018 – replacing part of Beech Street with 24” pipe (1285LF)

2018-2019 – replacing part of Clarke Ave with 12” pipe (1600LF)

2019-2020 – replacing part of Green Street with 18” pipe (1325LF)

2020-2021 – replacing part of the 18” trunkline with 24” pipe (1025LF)

2021-2022 – replacing part of the 18” trunkline with 24” pipe (835LF)

2022-2023 – replacing part of the 18” trunkline with 24” pipe (985LF)

2023-2024 – replacing part of the 18” trunkline with 24” pipe (905LF)

2024-2025 – replacing part of the 18” trunkline with 24” pipe (1100LF)

2025-2026 – replace freeway crossing at Manhattan Avenue with a new 12” pipe (490LF)

2026-2027 – replacing pipe at two locations. One at O’Connor Street, and the other along Euclid and Bayshore Rd. (1025LF)

2027-2028 – replacing pipe on Pulgas Ave and Tara Street with new 8” pipe (2045LF)

2028-2029 – replacing pipe on Demeter Street with new 8” pipe (1605LF)

2029-2030 – replacing pipe on Menalto Ave with new 8” pipe (1370LF)

9.2 – Project Costs

The estimated cost of the project would be 12 million dollars, which is based on the number of manholes, length of pipe and includes engineering costs. This spread over a time period of 15 years would result in an average of $800,000.00/yr for 15 years. This does not include the cost for new laterals. In some cases, additional costs are included in the estimate to cover site-specific requirements such as work in high-traffic areas, contaminated soils, and environmentally sensitive areas. The price breakdown can be found on Appendix J.

In addition to these improvements, the District is continuing the televising of main lines, which will further determine pipe sections in need of replacement. Results from the televising may call for changes to scheduling and budget and should also be taken under consideration.

APPENDIX

EAST PALO ALTO SANITARY DISTRICT

Appendix A

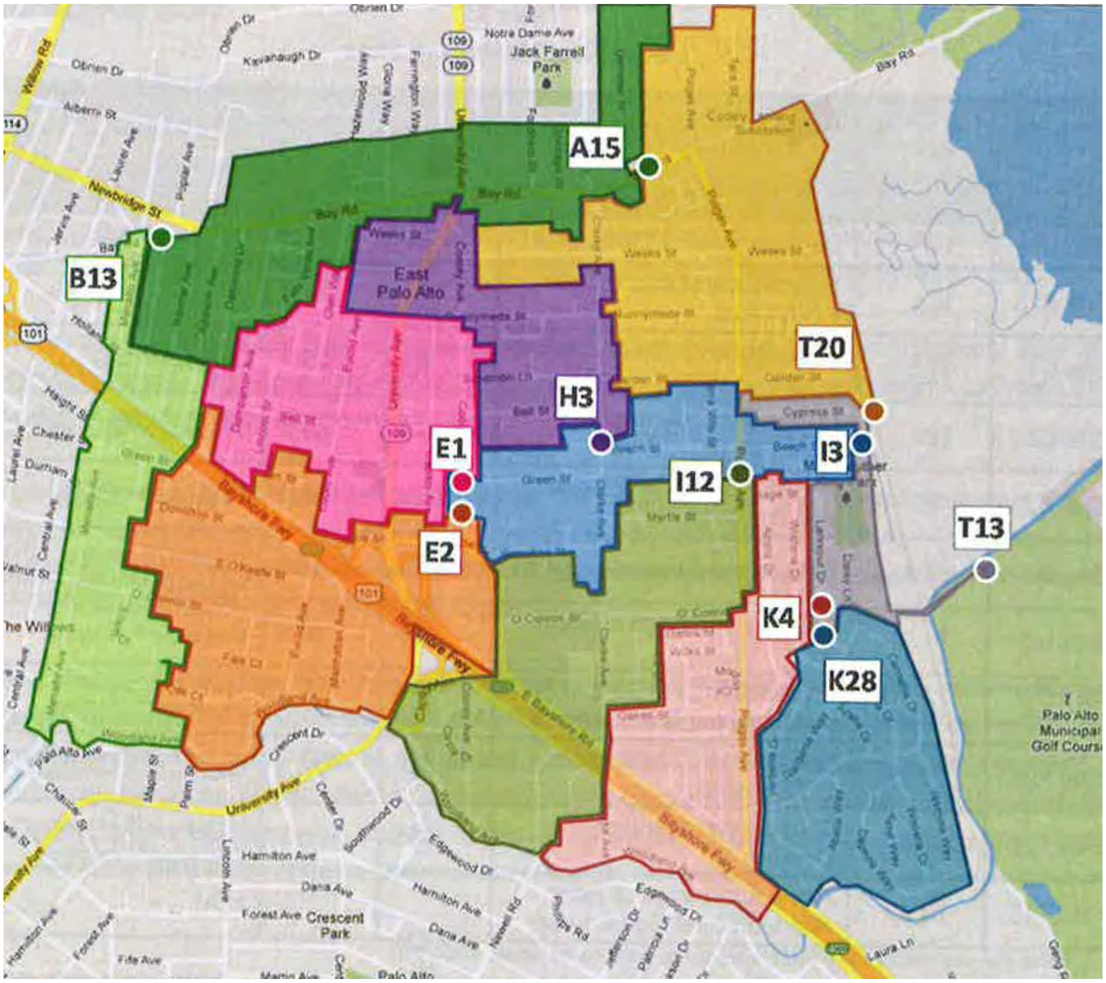
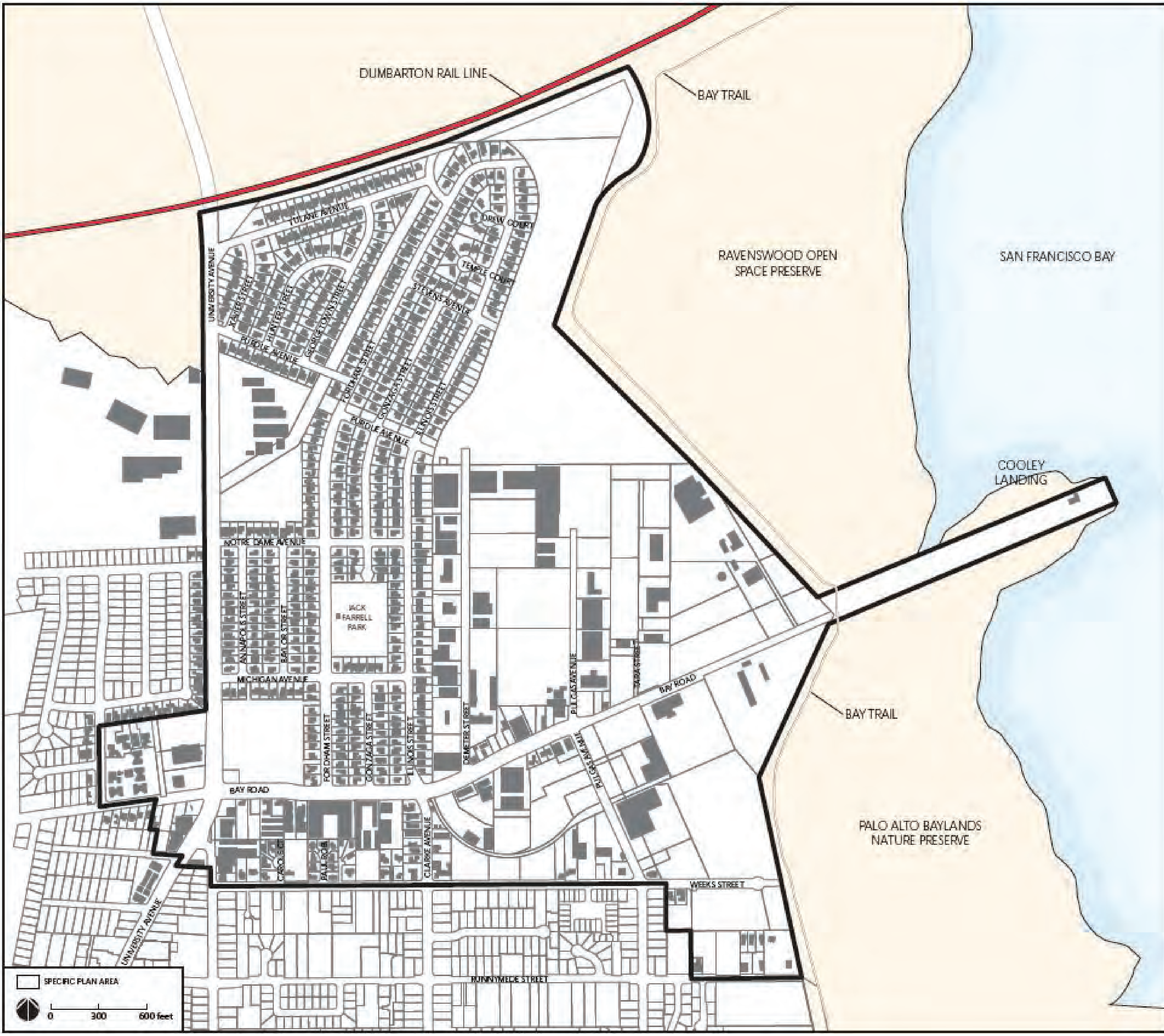


TABLE ES-1. List of Flow Monitoring Sites		
Site	**Location**	**Basin Size (acres)**
A15	Bay Rd, East of Demeter St.	118
B13	Intersection of Bay Rd and Poplar Ave	87
E1	Intersection of Cooley Ave and Green St.	101
E2	Cooley Ave, North of Donohoe St.	149
H3	Intersection of Clarke Ave and Beech St.	74
I3	East end of Beech St.	74
I12	Pulgas Ave, North of Sage St.	135
K4	Intersection O'Connor St and Larkspur Dr	107
K28	Larkspur Dr, South of O'Connor St.	95
T20	75 feet East of end of Cypress St.	171
T13	Along North edge of Palo Alto Municipal Golf Course	-



DUMBARTON RAIL LINE
BAY TRAIL
RAVENSWOOD OPEN SPACE PRESERVE
SAN FRANCISCO BAY
COOLEY LANDING
BAY TRAIL
PALO ALTO BAYLANDS NATURE PRESERVE
JACK FARRELL PARK
TULANE AVENUE
DREW COURT
TEMPLE COURT
STEVENS AVENUE
UNIVERSITY AVENUE
PURDUE AVENUE
NOTRE DAME AVENUE
MICHIGAN AVENUE
BAY ROAD
WEEKS STREET
RUNNYMEDE STREET
FORDHAM STREET
GONZAGA STREET
ILLINOIS STREET
DEMETER STREET
PULGAS AVENUE
CLARKE AVENUE
SPECIFIC PLAN AREA
0
300
600 feet

Appendix C

Figure 3-1: Existing Land Use

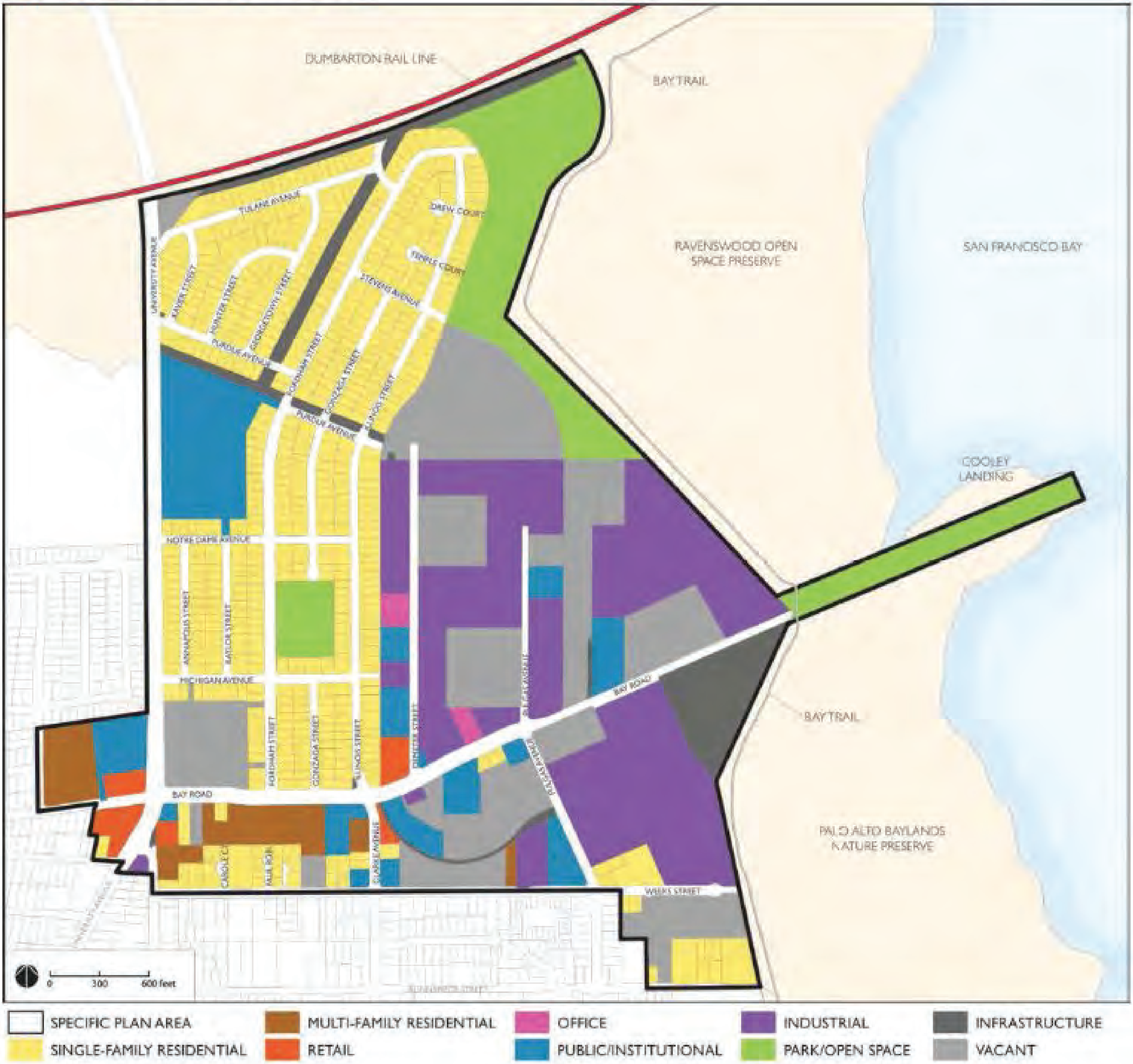
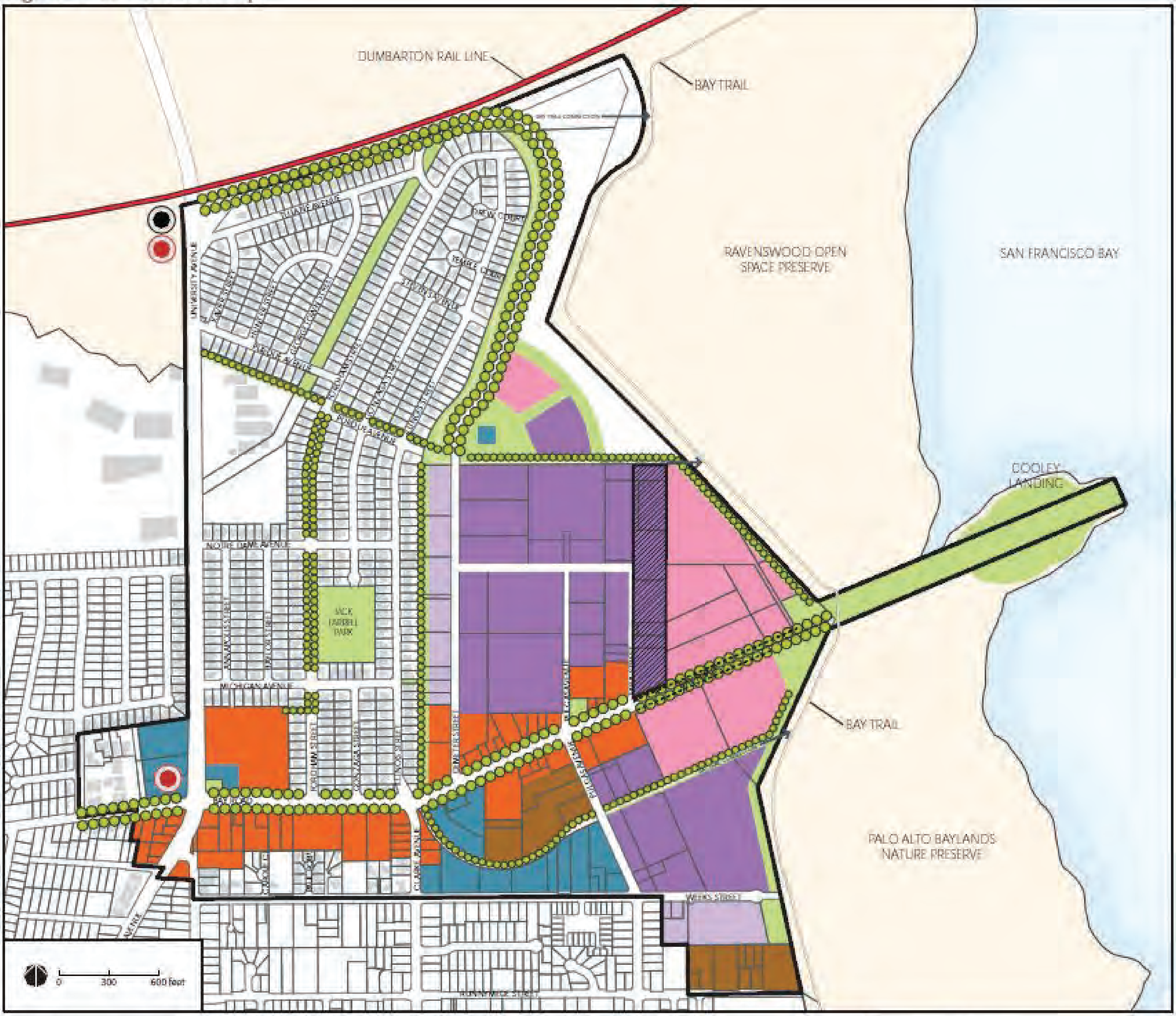


Figure 4-1: Plan Concept

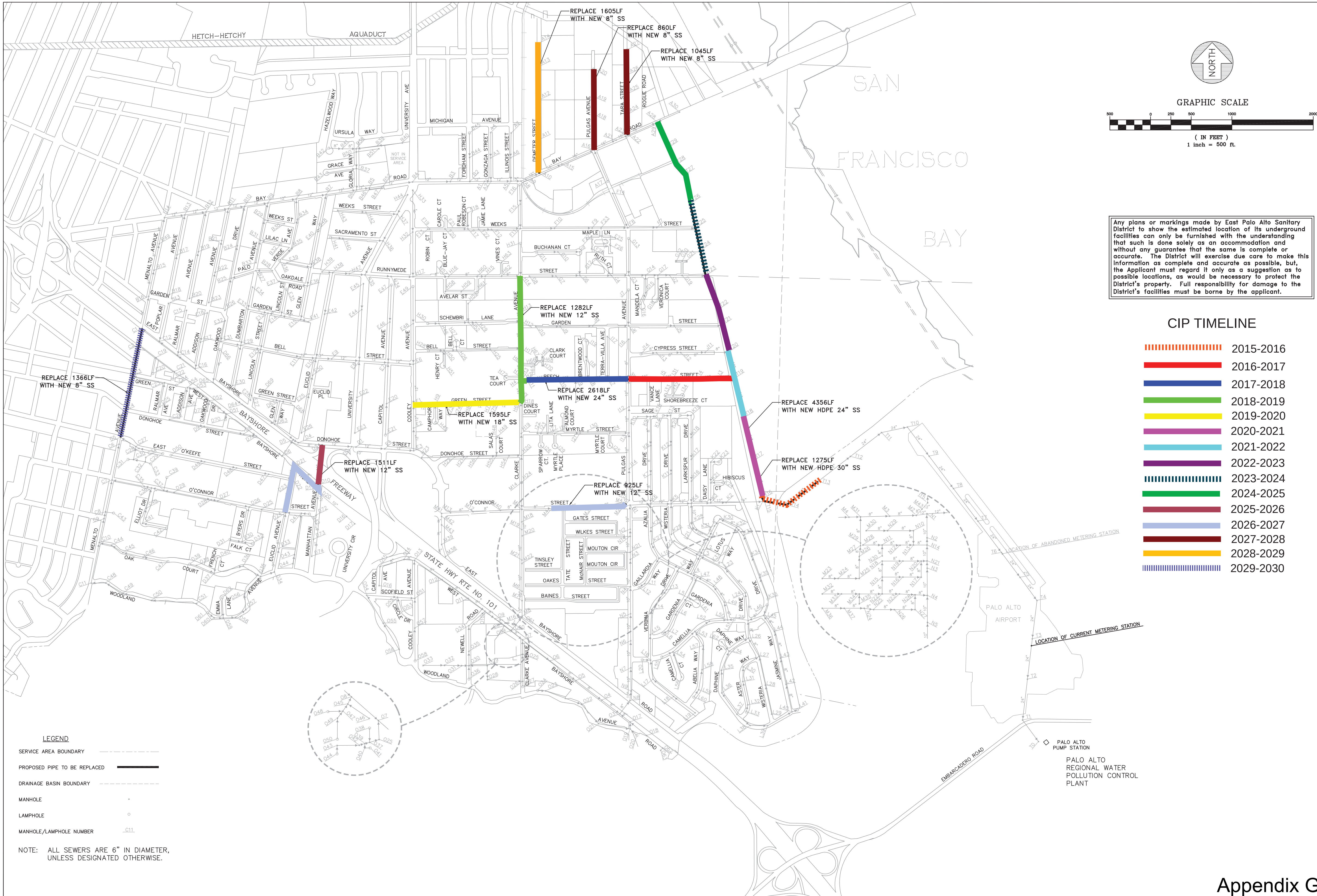


* This Diagram shows a conceptual vision for future land uses in the Specific Plan area. Figure 4-1 does not represent zoning for the Specific Plan Area.

- MIXED USE (OFFICE OR RESIDENTIAL)
- CIVIC / COMMUNITY
- R&D / INDUSTRIAL
- LIGHT INDUSTRIAL
- OFFICE
- OFFICE/R&D/INDUSTRIAL OVERLAY
- RESIDENTIAL
- PARKS / OPEN SPACE
- RAPID BUS / BRT STATION
- DUMBARTON RAIL STATION
- ACTIVE FRONTAGE
- SPECIFIC PLAN AREA

EPASD IMPROVEMENT PLAN
EAST PALO ALTO SANITARY DISTRICT
EAST PALO ALTO, CALIFORNIA
GRAPHIC SCALE
(IN FEET)
1 inch = 500 ft.
NORTH
Any plans or markings made by East Palo Alto Sanitary District to show the estimated location of its underground facilities can only be furnished with the understanding that such is done solely as an accommodation and without any guarantee that the same is complete or accurate. The District will exercise due care to make this information as complete and accurate as possible, but, the Applicant must regard it only as a suggestion as to possible locations, as would be necessary to protect the District's property. Full responsibility for damage to the District's facilities must be borne by the applicant.
UPSIZE TO 8"
UPSIZE TO 12"
UPSIZE TO 18"
UPSIZE TO 24"
UPSIZE TO 30"
REPLACE 1605LF WITH NEW 8" SS
REPLACE 860LF WITH NEW 8" SS
REPLACE 1045LF WITH NEW 8" SS
REPLACE 1366LF WITH NEW 8" SS
REPLACE 1282LF WITH NEW 12" SS
REPLACE 2618LF WITH NEW 24" SS
REPLACE 1595LF WITH NEW 18" SS
REPLACE 1511LF WITH NEW 12" SS
REPLACE 925LF WITH NEW 12" SS
REPLACE 4356LF WITH NEW HDPE 24" SS
REPLACE 1275LF WITH NEW HDPE 30" SS
SAN FRANCISCO BAY
HETCH-HETCHY AQUADUCT
STATE HWY RTE NO. 101
BAYSHORE FREEWAY
PALO ALTO AIRPORT
PALO ALTO PUMP STATION
PALO ALTO REGIONAL WATER POLLUTION CONTROL PLANT
LOCATION OF ABANDONED METERING STATION
LOCATION OF CURRENT METERING STATION
EMBARCADERO ROAD
LEGEND
SERVICE AREA BOUNDARY
PROPOSED PIPE TO BE REPLACED
DRAINAGE BASIN BOUNDARY
MANHOLE
LAMPHOLE
MANHOLE/LAMPHOLE NUMBER
NOTE: ALL SEWERS ARE 6" IN DIAMETER, UNLESS DESIGNATED OTHERWISE.
SUBCONSULTANT:
DATE
DESCRIPTION
FREYER & LAURETA, INC.
CIVIL ENGINEERS • SURVEYORS • CONSTRUCTION MANAGERS
144 North San Mateo Drive • San Mateo, CA 94401
(650)344-9901 • Fax (650)344-9920 • www.freyerlaureta.com
DATE: 03/21/13
SCALE: NTS
DESIGNED: RJL
DRAWN: JL
CHECKED: RJL
PROJ. ENGR: RJL
SHEET 1 OF 4 SHEET
JOB NO. 2002

Appendix F



Appendix G

EPASD IMPROVEMENT PLAN
EAST PALO ALTO SANITARY DISTRICT
EAST PALO ALTO, CALIFORNIA

SUBCONSULTANT:

DATE | DESCRIPTION

FREYER & LAURETA, INC.
CIVIL ENGINEERS • SURVEYORS • CONSTRUCTION MANAGERS
144 North San Mateo Drive • San Mateo, CA 94401
(650)344-9901 • Fax (650)344-9920 • www.freyerlaureta.com

DATE: 03/21/13
SCALE: NTS
DESIGNED: RJL
DRAWN: JL
CHECKED: RJL
PROJ. ENGR.: RJL

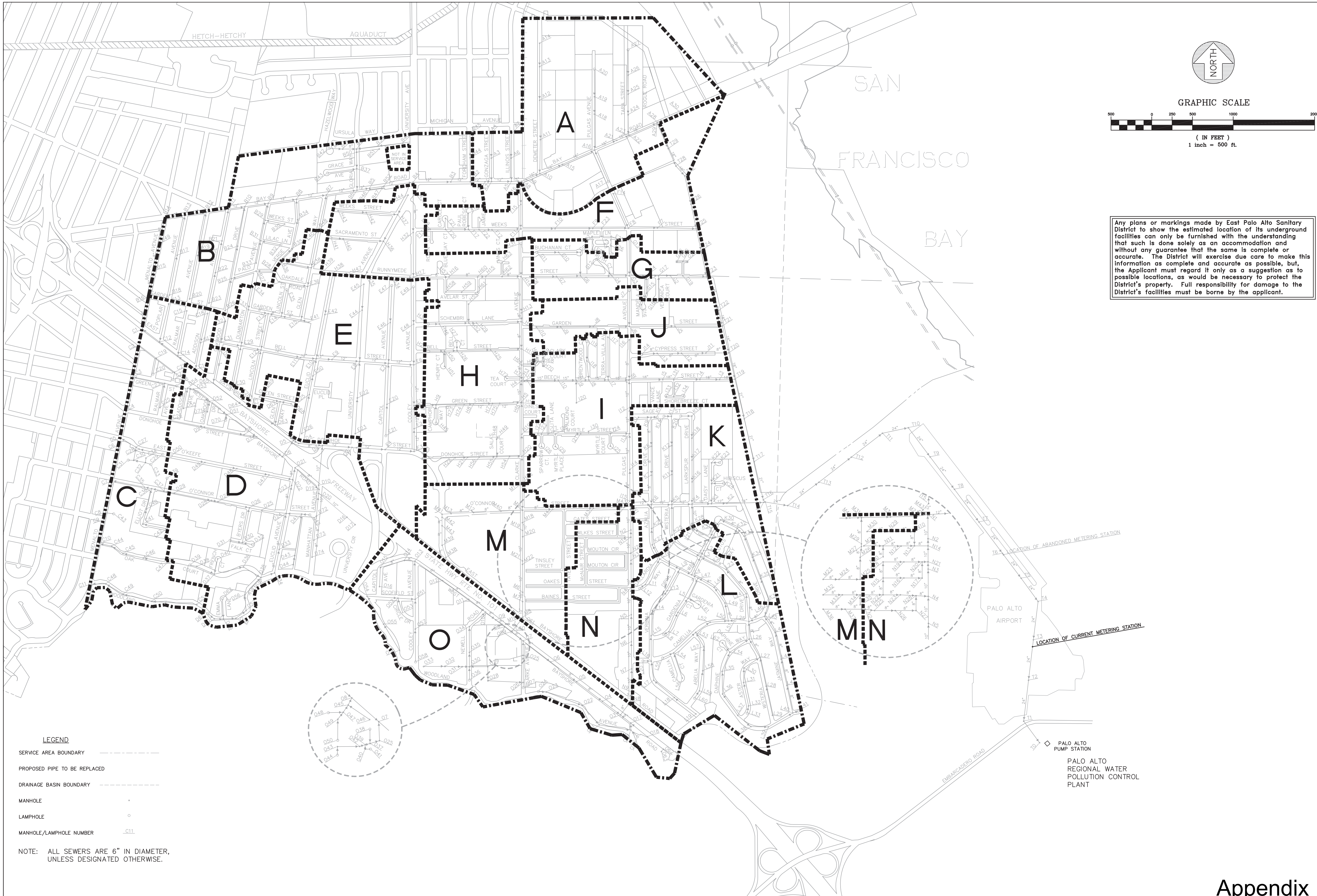
SHEET 1 OF 4 SHEET

JOB NO. 2002

Flow Results at Down stream Basins

Basin	Monitoring Site	Average Flow (cfs)	Peak Flow (cfs)	Storm and Peak Flow (cfs)
A	T29	0.6308	0.9712	3.899
B	B2	0.5438	0.8403	1.57
C	B16	0.171	0.3604	0.7693
D	D1	0.4121	1.2366	2.12
E	E1	0.6185	1.5098	3.026
F	T24	0.6948	1.0058	4.76
G	T22	0.7858	1.0354	4.9
H	I11	0.8969	1.8097	3.938
I	T18	2.1091	3.8491	10.15
J	T20	0.842	1.0574	5.01
K	K1	0.4075	0.98	1.56
L	K28	0.216	0.573	1.0554
M	M2	0.2574	0.8364	0.8976
N	N1	0.156	0.3156	0.4
O	N8	0.1108	0.19	0.2967

Basin	Monitoring Site	Average Flow (mgd)	Peak Flow (mgd)	Wet weather Peak Flow (mgd)
A	T29	0.98	1.50	6.03
B	B2	0.84	1.30	2.43
C	B16	0.26	0.56	1.19
D	D1	0.64	1.91	3.28
E	E1	0.96	2.34	4.68
F	T24	1.08	1.56	7.37
G	T22	1.22	1.60	7.58
H	I11	1.39	2.80	6.09
I	T18	3.26	5.96	15.71
J	T20	1.30	1.64	7.75
K	K1	0.63	1.52	2.41
L	K28	0.33	0.89	1.63
M	M2	0.40	1.29	1.39
N	N1	0.24	0.49	0.62
O	N8	0.17	0.29	0.46



Any plans or markings made by East Palo Alto Sanitary District to show the estimated location of its underground facilities can only be furnished with the understanding that such is done solely as an accommodation and without any guarantee that the same is complete or accurate. The District will exercise due care to make this information as complete and accurate as possible, but, the Applicant must regard it only as a suggestion as to possible locations, as would be necessary to protect the District's property. Full responsibility for damage to the District's facilities must be borne by the applicant.

EPASD BASIN MAP

EAST PALO ALTO SANITARY DISTRICT
EAST PALO ALTO, CALIFORNIA

SUBCONSULTANT:

DATE
DESCRIPTION

FREYER & LAURETA, INC.
CIVIL ENGINEERS • SURVEYORS • CONSTRUCTION MANAGERS
144 North San Mateo Drive • San Mateo, CA 94401
(650)344-9901 • Fax (650)344-9920 • www.freyerlaureta.com

DATE:	03/21/13
SCALE:	NTS
DESIGNED:	RJL
DRAWN:	JL
CHECKED:	RJL
PROJ. ENGR:	RJL

SHEET
1
OF 1 SHEET

JOB NO.
2002

Appendix I

Recommended Pipes to be Upsized

Section		Street	Current Size	Recommended Size	Approx Length	Unit Cost	Pipeline Cost	MH	Total Cost	Project Cost
C5	C4	Menalto Avenue	6″	8″	328	180	59,040	6,000	65,040	
C4	C3	Menalto Avenue	6″	8″	436	180	78,480	6,000	84,480	
C3	C2	Menalto Avenue	6″	8″	398	180	71,640	6,000	77,640	
C2	C1	Highway 101 Crossing	6″	8″	205	1200	246,000	10,000	256,000	
										$483,160
D24	D23	Euclid Avenue	8″	12″	350	200	70,000	6,000	76,000	
D23	D22	Euclid Avenue	8″	12″	74	200	14,800	6,000	20,800	
D22	D21	Euclid Avenue	8″	12″	149	200	29,800	6,000	35,800	
D21	D19	W. Bayshore	8″	12″	391	200	78,200	6,000	84,200	
D19	D10	W. Bayshore	10″	12″	49	200	9,800	6,000	15,800	
D10	D3	Highway 101 Crossing	10″	12″	490	1200	588,000	10,000	598,000	
										$830,600
A14	A13	Demeter Street	6″	8″	289	180	52,020	6,000	58,020	
A13	A12	Demeter Street	6″	8″	412	180	74,160	6,000	80,160	
A12	A11	Demeter Street	6″	8″	486	180	87,480	6,000	93,480	
A11	A10	Demeter Street	6″	8″	418	180	75,240	6,000	81,240	
										$312,900
A20	A19	Pulgas Ave. (north of Bay)	6″	8″	340	180	61,200	6,000	67,200	
A19	A18	Pulgas Ave. (north of Bay)	6″	8″	214	180	38,520	6,000	44,520	
A18	A16	Pulgas Ave. (north of Bay)	6″	8″	442	180	79,560	6,000	85,560	
										$197,280
A27	A26	Tara Street	6″	8″	311	180	55,980	6,000	61,980	
A26	A25	Tara Street	6″	8″	234	180	42,120	6,000	48,120	
A25	A24	Tara Street	6″	8″	253	180	45,540	6,000	51,540	
A24	A23	Tara Street	6″	8″	251	180	45,180	6,000	51,180	
										$212,820
M4	M3	O'Connor Street	8″	12″	358	200	71,600	6,000	77,600	
M3	M2	O'Connor Street	8″	12″	380	200	76,000	6,000	82,000	
M2	M43	O'Connor Street	8″	12″	48	200	9,600	6,000	15,600	
										$175,200
E1	H9	Green Street	12″	18″	270	220	59,400	6,000	65,400	
H9	H73	Green Street	12″	18″	247	220	54,340	6,000	60,340	
H73	H74	Green Street	12″	18″	101	220	22,220	6,000	28,220	
H74	H8	Green Street	12″	18″	113	220	24,860	6,000	30,860	
H8	H7	Green Street	12″	18″	234	220	51,480	6,000	57,480	
H7	H75	Green Street	12″	18″	90	220	19,800	6,000	25,800	
H75	H6	Green Street	12″	18″	260	220	57,200	6,000	63,200	
H6	H5	Clarke Street	12″	18″	9	220	1,980	6,000	7,980	
H5	H4	Clarke Street	15″	18″	260	220	57,200	6,000	63,200	
H4	H3	Clarke Street	15″	18″	8	220	1,760	6,000	7,760	
										$410,240
H14	H13	Clarke Street	8″	12″	447	200	89,400	6,000	95,400	
H13	H12	Clarke Street	8″	12″	108	200	21,600	6,000	27,600	
H12	H11	Clarke Street	8″	12″	334	200	66,800	6,000	72,800	
H11	H64	Clarke Street	8″	12″	199	200	39,800	6,000	45,800	
H64	H71	Clarke Street	8″	12″	161	200	32,200	6,000	38,200	
H71	H3	Clarke Street	8″	12″	35	200	7,000	6,000	13,000	
H3	H2	Beech Street	15″	24″	31	300	9,300	6,000	15,300	
H2	I11	Beech Street	15″	24″	37	300	11,100	6,000	17,100	
I11	I10	Beech Street	15″	24″	380	300	114,000	6,000	120,000	
I10	I9	Beech Street	15″	24″	222	300	66,600	6,000	72,600	
I9	I8	Beech Street	15″	24″	155	300	46,500	6,000	52,500	
I8	I7	Beech Street	15″	24″	239	300	71,700	6,000	77,700	
I7	I6	Beech Street	15″	24″	259	300	77,700	6,000	83,700	
I6	I5	Beech Street	18″	24″	411	300	123,300	6,000	129,300	
I5	I31	Beech Street	18″	24″	135	300	40,500	6,000	46,500	
I31	I4	Beech Street	18″	24″	322	300	96,600	6,000	102,600	
I4	I3	Beech Street	18″	24″	243	300	72,900	6,000	78,900	
I3	T19	Beech Street	18″	24″	189	300	56,700	6,000	62,700	
										$1,151,700
A29	T29	Bay Road	18″	24″	346	1000	346,000	10,000	356,000	
T29	T28	Easement (Levee)	18″	24″	234	1000	234,000	10,000	244,000	
T28	T27	Easement (Levee)	18″	24″	163	1000	163,000	10,000	173,000	
T27	T26	Easement (Levee)	18″	24″	356	1000	356,000	10,000	366,000	
T26	T25	Easement (Levee)	18″	24″	306	1000	306,000	10,000	316,000	
T25	T24	Easement (Levee)	18″	24″	283	1000	283,000	10,000	293,000	
T24	T23	Easement (Levee)	18″	24″	317	1000	317,000	10,000	327,000	
T23	T22	Easement (Levee)	18″	24″	447	1000	447,000	10,000	457,000	
T22	T21	Easement (Levee)	18″	24″	198	1000	198,000	10,000	208,000	
T21	T20	Easement (Levee)	18″	24″	339	1000	339,000	10,000	349,000	
T20	T19	Easement (Levee)	18″	24″	332	1000	332,000	10,000	342,000	
T19	T18	Easement (Levee)	21″	24″	500	1000	500,000	10,000	510,000	
T18	T17	Easement (Levee)	21″	24″	541	1000	541,000	10,000	551,000	
T17	T16	Easement (Levee)	21″	24″	482	1000	482,000	10,000	492,000	
T16	T15	Easement (Levee)	24″	30″	35	1200	42,000	10,000	52,000	
T15	T14	Siphon	24″	30″	279	2500	697,500	10,000	707,500	
T14	T13	Easement (Levee)	24″	30″	479	1200	574,800	10,000	584,800	
										$6,328,300
				Total Linear Feet	**18,442**				**Anticipated Cost**	**$10,102,200**

System Improvement Results

Monitoring Site	Rim	HGL before improvements	HGL after improvements
T29	4.98	4.82	0.39
B2	16	8.88	4.17
B16	20.39	18.08	14.71
D1	17.33	16.62	9.14
E1	12.09	13.5	4.5
T24	3.66	3.78	0.12
T22	2.81	3.33	-0.08
I11	8.07	7.6	0.84
T18	1.12	2.03	-0.94
T20	2.72	2.68	-0.24
K1	2.02	-0.54	-1.76
K28	3.27	1.23	0
M2	5.62	4.5	1.51
N1	5.32	0.78	-0.44
N8	13.8	4.33	4.33