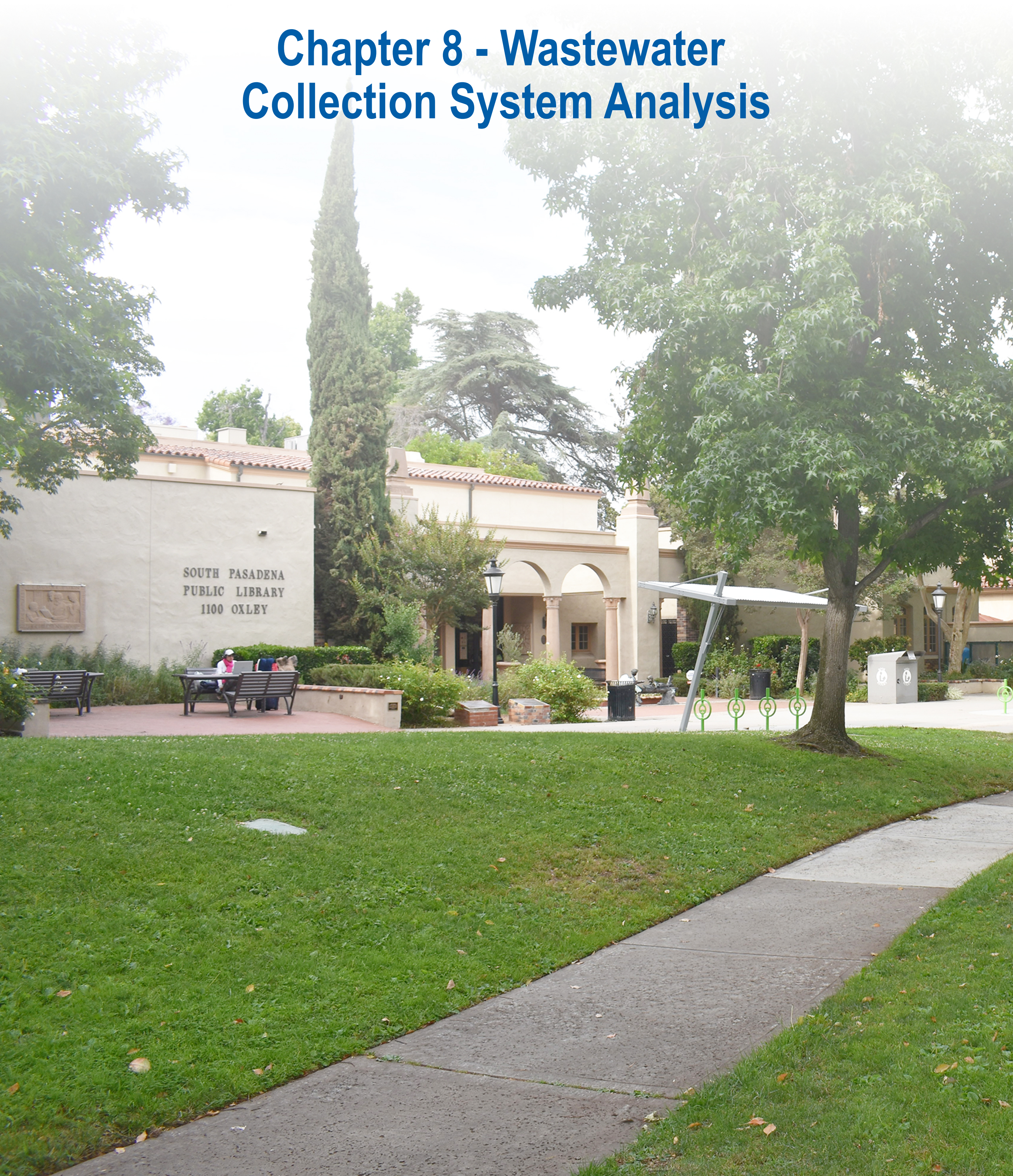
Chapter 8 - Wastewater Collection System Analysis



Chapter 8

WASTEWATER COLLECTION SYSTEM ANALYSIS

This chapter presents an overview of the City of South Pasadena's (City) existing and future wastewater collection system. In this chapter, the existing and future wastewater collection systems are evaluated under various operating conditions utilizing the evaluation criteria described in Chapter 4 and the flow conditions listed in Chapter 3.

This chapter is divided into the following sections:

- **Existing Wastewater Collection System:** This section provides an overview of the City's existing wastewater collection system facilities.
- **Hydraulic Model Development:** This section provides a description of the creation of the Wastewater Collection System Model.
- **Existing Collection System Analysis:** This section presents the findings and improvement recommendations for the wastewater collection system under existing flow conditions. Additionally, this section includes the recommendations from the repair and rehabilitation (R&R) analysis.
- **Future Collection System Analysis:** This section presents the findings and improvement recommendations for the wastewater collection system under future flow conditions with the existing system recommendations in place.
- **Summary of Recommendations:** This section summarizes the recommended improvements, which are prioritized and phased in Capital Improvement Program (CIP) described in Chapter 10 of this One Water 2050 Plan.

8.1 Existing Wastewater Collection System

The City's wastewater collection system consists primarily of gravity sewers with a combined length of 56 miles ranging from 6 to 18 inches in diameter. There is only one sewer lift station located in Arroyo Park with one force main to pump the wastewater back to the gravity main along Arroyo Drive. The City's existing wastewater collection system is shown in Figure 8.1. The City does not own or operate a wastewater treatment plant; instead, all flows are routed into the regional trunk sewer system of LA County Sanitation District (LACSD) for treatment at the Whittier Narrows Water Reclamation Plant (WRP). However, flow can get bypassed at the Whittier Narrows WRP and sent to the Los Coyotes WRP for treatment, which is also owned and operated by LACSD.

In 2009, the City had a large number of sanitary sewer overflows (SSOs), and due to the City's failure to comply with state Water Discharge Requirements (WDR), the Regional Water Quality Control Board (RWQCB) filed a consent decree in 2011 to inspect and repair their sewer system. As a result, between 2014 and 2017, the City performed 33 miles of rehabilitation of sewers with trenchless cured-in-place pipe (CIPP) and 1.1 miles of sewer replacement, totaling approximately 60 percent of the City's collection system. Since this work has been completed, the City has not had any significant SSOs.

8.1.1 Sewer Interceptors

As shown on Figure 8.1, the regional trunk sewer interceptors are located along multiple streets between Arroyo Drive and Marengo Avenue in the center of the City, along Garfield Avenue on the west side of the City, and along Alhambra Road in the south of the City. The sewer interceptors generally flow north to south and west to east. All wastewater flows collected within the City's service area are routed to LACSD's regional trunk sewer interceptor system. Under normal conditions, flows are sent to LACSD's Whittier Narrows WRP but can be bypassed at Whittier Narrows and sent to the Joint Water Pollution Control Plant (JWPCP) or the Los Coyotes WRP. The City of South Pasadena doesn't own or operate a water treatment plant.

8.1.2 Gravity Sewer Distribution by Diameter

The total length of pipeline by diameter of the City's wastewater collection system is summarized in Table 8.1. The table is based on geographic information system (GIS) data provided by the City staff. The table excludes private sewer pipelines within the study area and does not account for regional trunk sewers owned by LACSD. Figure 8.2 illustrates the distribution of pipeline diameters.

Table 8.1 Pipeline Diameter Overview

Diameter (inches)	Length (ft)	Length (mi)	Percent (%)
6	9,700	1.8	3.3%
8	258,620	49.0	87.9%
10	13,150	2.5	4.5%
12	4,470	0.8	1.5%
15	6,200	1.2	2.1%
18	2,110	0.4	0.7%
Total	**294,250**	**55.7**	**100.0%**

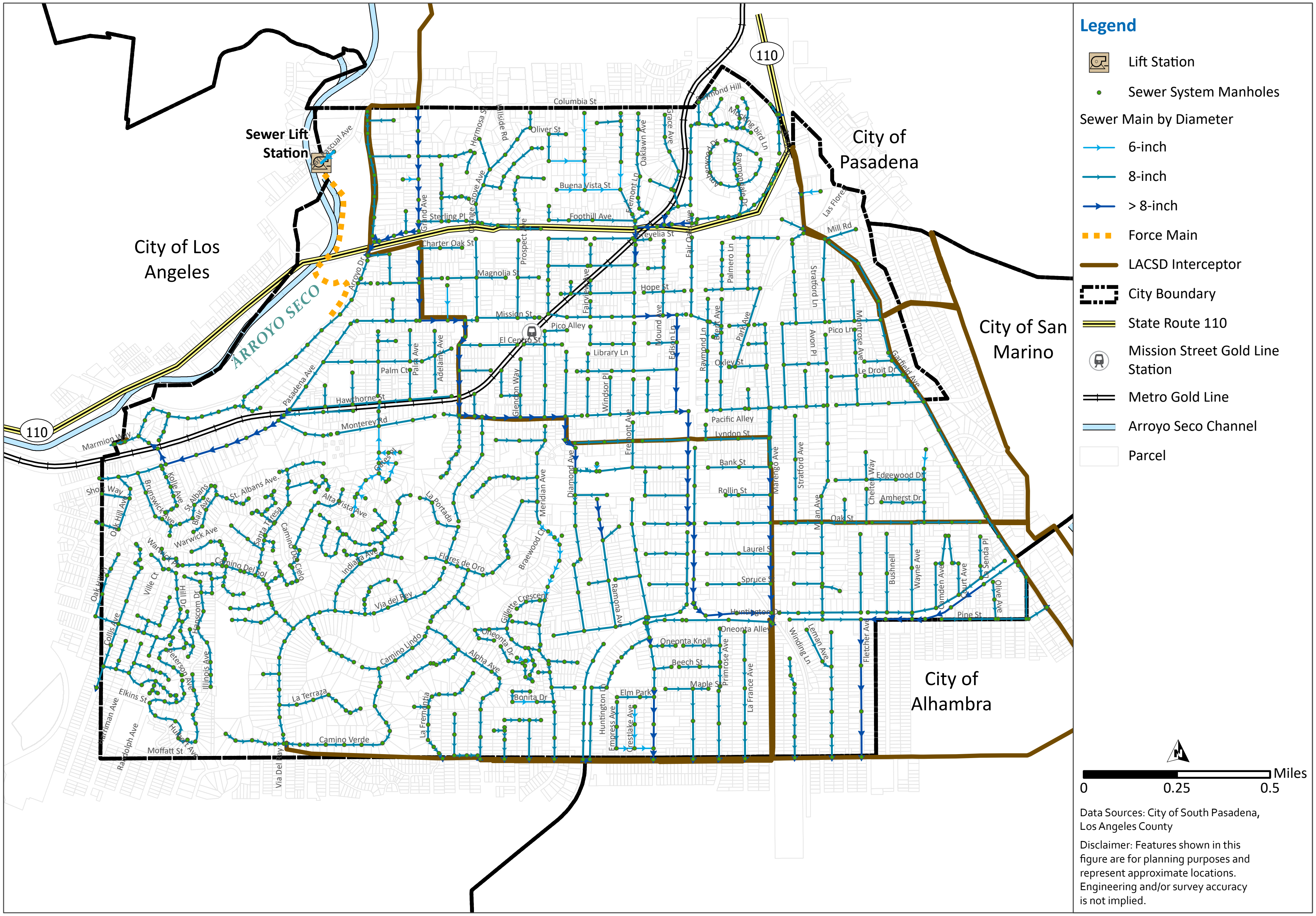


Figure 8.1 Existing Wastewater System as Modeled

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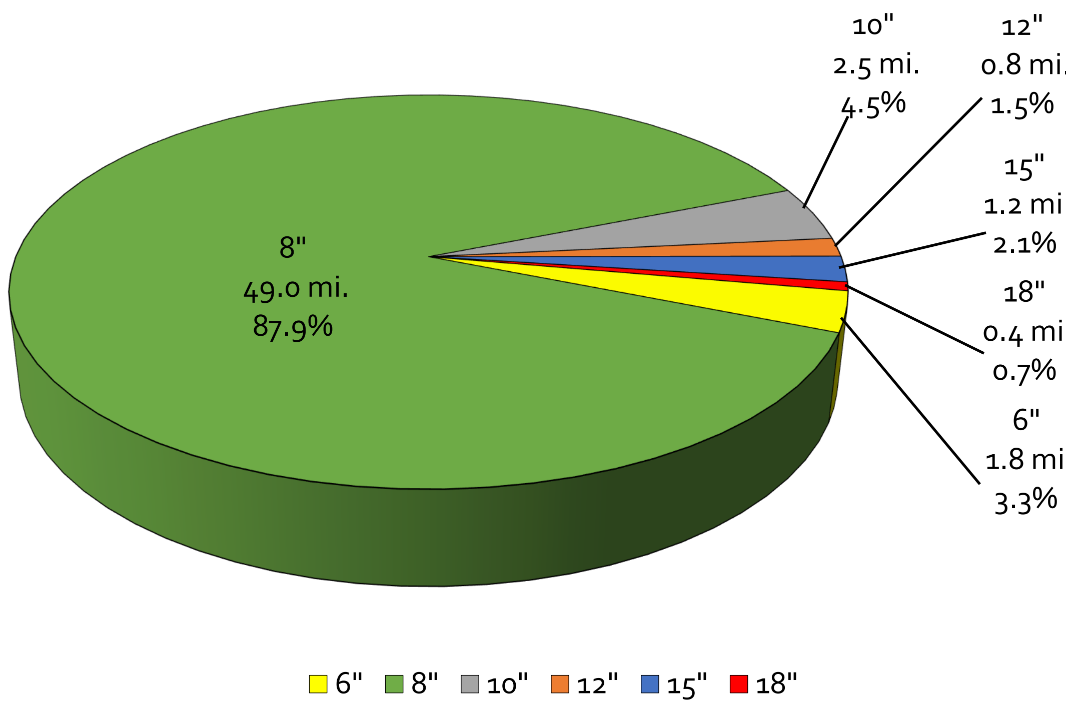

Figure 8.2 Pipelines by Diameter

As listed in Table 8.1, and shown on Figure 8.2, the vast majority, approximately 88 percent of the City's gravity sewers are 8-inches in diameter. Pipelines 10-inch and 12-inch in diameter make up 6.0 percent of the City's gravity sewers, while pipelines smaller than 8-inches in diameter make up 3.3 percent of the City's gravity sewers. The larger sewer mains of 15-inch and 18-inch in diameter make up approximately 2.8 percent of the City's gravity sewers.

8.1.3 Gravity Sewer Distribution by Material

The distribution of pipeline by material is graphically presented on Figure 8.3 and summarized in Table 8.2. The material categories are Cast Iron (CI), High Density Polyethylene (HDPE), polyvinyl chloride (PVC), Vitrified Clay Pipe (VCP), and other. The other category includes Ductile Iron (DI), and Polyethylene. As shown, most of the pipelines (96 percent) are VCP.

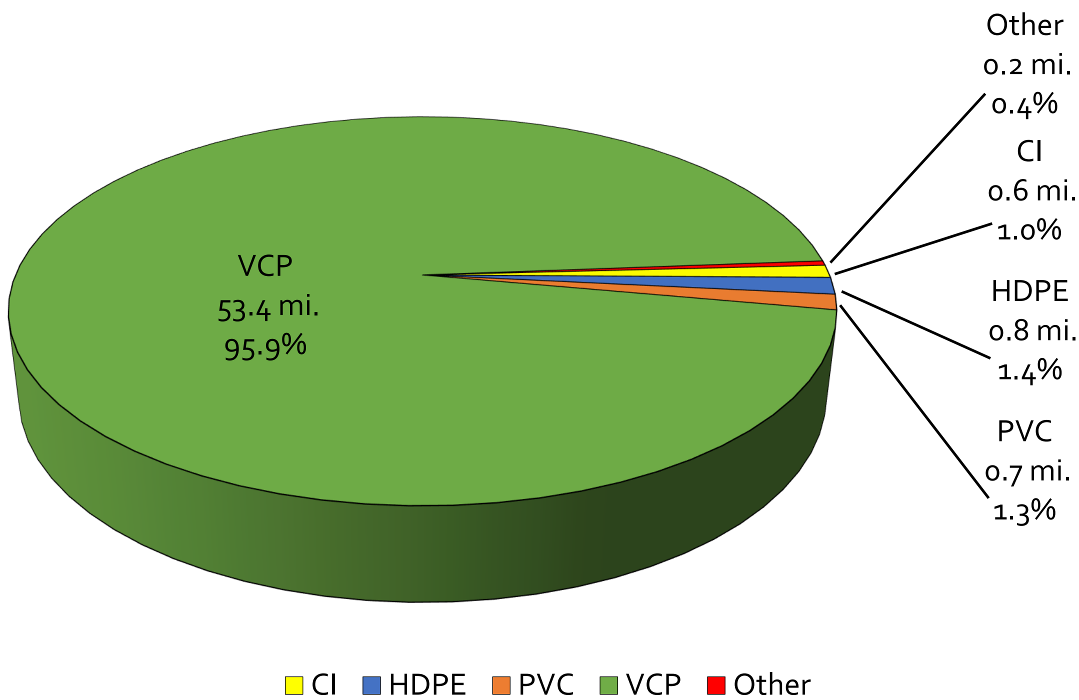

Figure 8.3 Pipelines by Material Type

Table 8.2 Pipeline Material Overview

Diameter	Length (ft)	Length (mi)	Percent (%)
CI	3,040	0.6	1.0%
HDPE	4,130	0.8	1.4%
PVC	3,750	0.7	1.3%
VCP	282,200	53.5	95.5%
Other (1)	1,110	0.2	0.4%
Total	**294,250**	**55.7**	**100.0%**

Notes:
(1) Other pipes included Ductile Iron and Polyethylene as well as segments of sewer that had unknow materials.

8.1.3.1 Gravity Distribution by Age

The distribution of gravity pipeline by age is graphically presented in Figure 8.4 and summarized in Figure 8.4. As shown in Figure 8.4, approximately 74 percent of the collection system was installed prior to 1950. Between 1951 and 1960, only 2.6 miles of new sewer pipes were installed which accounts for 5-percent of the collection system. Another 20 percent or 11.0 miles were installed between 1961 and 1970. Approximately 99-percent of the collection system was installed before 1970. Almost all of the sewers in the City are over 50 years old. Less than one percent or 0.75 miles of sewer have been installed between 1971 and now.

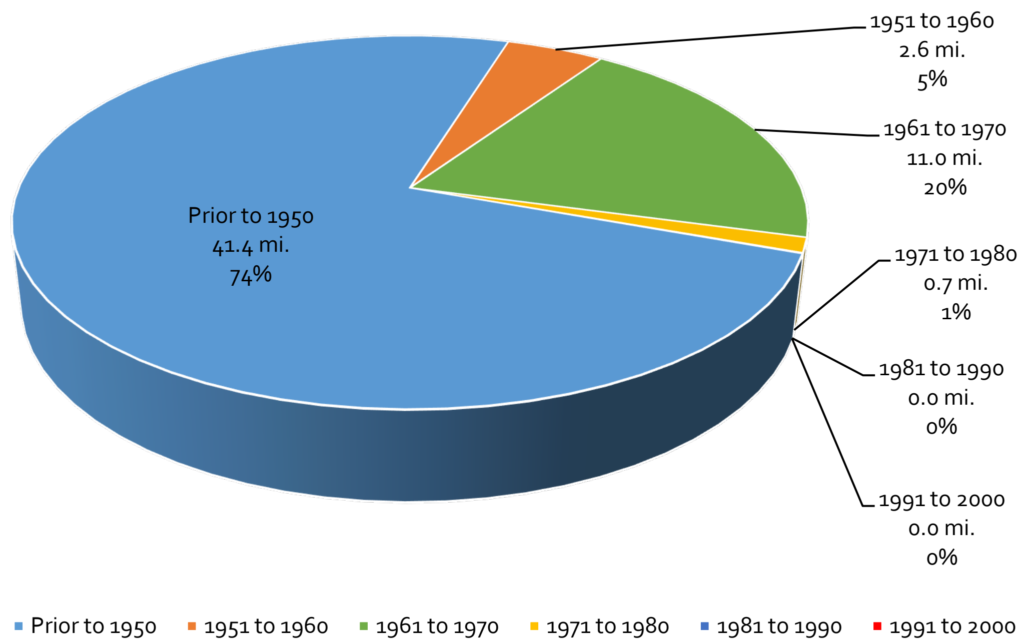

Figure 8.4 Pipelines by Age

Table 8.3 Pipeline Age Overview

Material	Pipeline Length[(1)] (ft) by Installation Year						
	Prior to 1920	1921 to 1930	1931 to 1940	1941 to 1960	1961 to 1980	1981 to 2000	Total (mi)
CI	3,040	0	0	0	0	0	0
HDPE	3,020	1,120	0	0	0	0	0
PVC	3,750	0	0	0	0	0	0
VCP	207,500	12,820	57,950	3,760	0	170	50
Other	1,110	0	0	0	0	0	0
Total (ft)	**218,420**	**13,940**	**57,950**	**3,760**	**0**	**170**	**294,250**
Total (mi)	**41.4**	**2.6**	**11.0**	**0.7**	**0.0**	**< 0.1**	**55.7**

Note:
(1) Pipeline data retrieved from City's GIS data (rounded to nearest 10 feet). For pipes without an install date, the approved date was used.

As mentioned earlier, the City rehabilitation and replaced a majority of their sewer lines from 2014 to 2017. Table 8.3 was updated with the revised repair years included and is presented on Table 8.4.

Table 8.4 Revised Pipeline Age or Most Recent Rehabilitation Overview

Material	Pipeline Length[1] (ft) by Installation and Rehabilitation Year								
	Prior to 1950	1951 to 1960	1961 to 1970	1971 to 1980	1981 to 1990	1991 to 2000	2001 to 2010	2011 to 2020	Total (mi)
CI	2,670	0	0	0	0	0	0	370	0
HDPE	2,680	1,120	0	0	0	0	0	340	0
PVC	690	0	0	0	0	0	1,270	1,790	0
VCP	50,600	2,670	31,640	1,530	0	170	2,470	193,130	50
Other	440	0	0	0	0	0	0	670	0
Total (ft)	**57,080**	**3,790**	**31,640**	**1,530**	**0**	**170**	**3,740**	**196,310**	**294,250**
Total (mi)	**10.8**	**0.7**	**6.0**	**0.3**	**0.0**	**< 0.1**	**0.7**	**37.2**	**55.7**

Notes:
(1) Pipeline data retrieved from City's GIS data (rounded to nearest 10 feet). For pipes without an install date, the approved date was used.
(2) Pipelines installed 2011 to 2020 were repaired or replaced by the City in 2017.

As shown in Table 8.3., and on Figure 8.5, approximately 37 miles or 67 percent of the City's sewers were replaced/or relined between 2011 to 2020. Although this is a significant improvement in a short period of time, there are still a total of 18 miles or 37 percent of pipelines that were not repaired or replaced. Some of the pipelines that were not repaired were installed prior to 1950 and may be nearing the end of their useful life. The City should maintain their efforts to perform a CCTV inspection of their sewer collection system every 10 years in order to catch ageing before they fail.

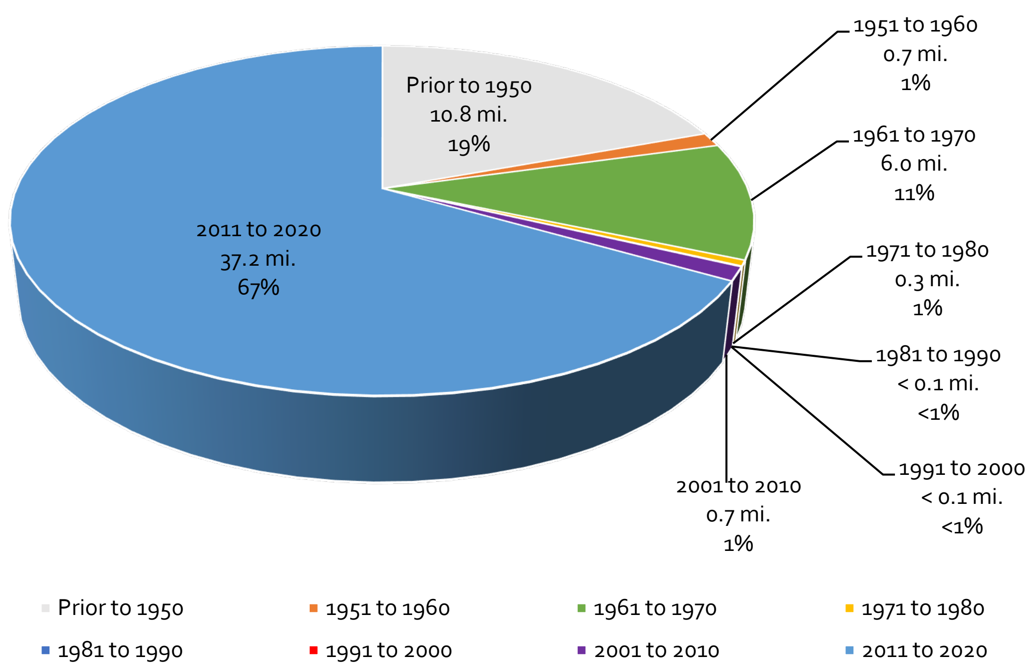

Figure 8.5 Pipelines by Age or Most Recent Rehabilitation

8.1.3.2 CCTV Program

Asset management of buried infrastructure consists of two primary areas: 1) operation and maintenance activities, and 2) rehabilitation and replacement activities. Inspections, repairs, and preventative maintenance efforts aim to optimize the useful life of pipelines and appurtenances.

As described above, the City performed a partial CCTV inspection and made substantial and critical repairs to its sewer collection system. In 2020, the City hired Empire to perform a CCTV of their entire sewer collection system. Empire provided the city with CCTV, summary tables, scores for each pipe segment based on the Pipeline Assessment and Certification Program (PACP) rating system, which was developed by the National Association of Sewer Service Companies (NASSCO). The sewer collection pipes were scored for both structural condition as well as maintenance condition. The results of the Empire CCTV scoring are analyzed in Section 8.3.2.

8.1.4 Lift Station

The City owns and operates one (1) lift station that is located at Arroyo Park on Stoney Drive. The lift station collects wastewater from San Pascual Stables. The wastewater is pumped from Arroyo Park on Stoney Drive up to Arroyo Drive. The sewer lift station consists of two submersible pumps in a wet well.

8.2 Hydraulic Model Development

A sewer system model is a simplified representation of the real sewer collection system. Sewer system models can assess the conveyance capacity for a collection system and can also be used to perform "what if" scenarios to assess the impacts of increased flows due to future developments and land use changes, system upgrades or modifications, and operational changes. The City's sewer system hydraulic model was constructed in InfoSWMM modeling software using a multi-step process utilizing data from varying sources. This section summarizes the hydraulic model development process, a description of the modeled collection system, the hydraulic elements and the model review and update process.

The hydraulic model was not calibrated as part of this project, so it is recommended that the City plan for conducting flow monitoring and calibrating the hydraulic model within the next few years.

8.2.1 Hydraulic Model Development

A new hydraulic model was developed for the City using Innovyze's InfoSWMM Version 14.7, Update No. 1. The hydraulic model development consisted of the following steps:

- **Step 1:** GIS data from the 2017 Dudek work as well as the 2020 Empire CCTV work were imported into the model using the InfoSWMM's Import Manager Function. The locations of both manholes and conduits were imported. The Import Manager was also used to add associated hydraulic information (inverts, diameters, elevations, etc.). Due to the limited flow routed through the City's single lift station, it was decided to not include the lift station or force main in the model.
- **Step 2:** Manholes with missing elevations were assigned elevations based on a USGS DEM with 10-foot contour intervals. The depth to manhole measurements were then used to calculate the invert elevations.

- **Step 3:** InfoSWMM's network connectivity tools were used to verify the connections between the manholes and conduits as well as identify high points in the gravity system. High points are where the invert elevation at one manhole in between two other manholes is not between the invert elevations of the two other manholes. The high points were usually due to situations where the resolution of the elevation data was not good enough which caused the manhole inverts to be higher than they should. In these cases, the elevations of the manholes were adjusted. The direction of flow of the conduits between manholes was mapped and adjusted as needed.
- **Step 4:** Outlets were manually added to the model at locations where the City's gravity sewer system connects to LACSD's sewer interceptors.
- **Step 5:** Wastewater flows (loads) were allocated to the appropriate model junctions. More detail regarding the wastewater load allocation is provided in Section 8.2.2. The wastewater load from the San Pascal Stables were allocated on the manhole on Arroyo Drive where the force main connects with the gravity system.
- **Step 6:** The hydraulic model contains calculation options that need to be set by the user at the beginning of the project. These include run dates, time steps, reporting parameters, and flow routing method. Once the run parameters were established, the model was debugged to ensure that it ran without errors or warnings.
- **Step 7:** Existing and Future Scenarios for both average dry weather flow (ADWF) and peak dry weather flow (PWWF) were added to the model. The scenarios are described in Section 8.2.4.

8.2.2 Wastewater Load Allocation

Determining the quantity of dry weather wastewater flows generated by a municipality and how they are distributed throughout the collection system is an important component of the hydraulic modeling process. Various techniques can be used to assign wastewater flows to individual model junctions, depending on the type of data that is available. Adequate estimates of the volume of wastewater are important in maintaining and sizing wastewater collection system facilities, both for existing and future conditions. Baseline wastewater loads were geospatially allocated (assigned to specific nodes) in the hydraulic model based on the indoor water use portion of the potable water billing data provided by the City. The ADWF that will enter the collection system was determined and allocated in the model as described below:

- **Step 1:** The City's service area was broken up into individual loading polygons. Each loading polygon represents the geographic area that contributes flows into a single model node (i.e., manhole). Loading polygons were evenly distributed between each manhole junction also known as a "Thiessen Polygon".
- **Step 2:** The loads were calculated for loading polygons using GIS "spatial join" tool by combining the water billing data points that reside within each polygon. This allocates a single combined load for each loading polygon.
- **Step 3:** The allocated loads, which were based on the water billing data, were scaled down by the sewer return flow factor to only account for indoor water demand that gets routed into the sewer system. For residential accounts the sewer return flow factor was calculated to be 60% based indoor/outdoor demand ratio calculated in Chapter 3. For commercial and government accounts 80% of the potable demand was calculated to return to the sewer, as described in Section 3.3.1.1 or this One Water 2050 Plan.

The existing ADWF was allocated in the model as described above. In addition, three other demand conditions were created in the model. These are:

- **Existing ADWF:** The existing average dry weather flows consist of a total city flow of 1.87 mgd and use the General Sewer diurnal pattern shown in Figure 8.6. Model simulations using the existing ADWF should be run as extended period simulations to account for the hourly variation shown it the diurnal pattern.
- **Future ADWF:** The future average dry weather flows consist of a total city flow of 2.04 mgd and use the General Sewer diurnal pattern shown in Figure 8.6. Model simulations using the existing ADWF should be run as extended period simulations to account for the hourly variation shown it the diurnal pattern
- **Existing PWWF**: The existing peak weather flow represents an instantaneous flow of 4.66 mgd. The existing PWWF is equal to the existing ADWF x 2.5. Model simulations using this pattern should be ran at steady state as the peak flows do not occur across multiple hours throughout the day.
- **Future PWWF:** The future peak weather flow represents an instantaneous flow of 5.11 mgd. The future PWWF is equal to the future ADWF x 2.5. Model simulations using this pattern should be ran at steady state as the peak flows do not occur across multiple hours throughout the day.

The future wastewater flows input into the hydraulic model are based on the more conservative projections from the Regional Housing Needs Assessment (RHNA) Growth Scenario described in Chapter 3 Section 3.3.2.

A single, general, wastewater flow diurnal pattern was derived from the potable water diurnal pattern for Pasadena and Magnolia Zone. This potable water diurnal pattern most closely represents a typical water system diurnal pattern. As described in Chapter 3 Section 3.3.1.1, the wastewater flows are 40 percent of the total potable flows. It was assumed that irrigation would occur during nighttime hours between 10 pm and 6 am. During irrigation hours the potable diurnal pattern was reduced by 40 percent to create the general diurnal pattern for wastewater.

The Pasadena and Magnolia Zone diurnal pattern for potable water are compared to the general wastewater diurnal pattern in Figure 8.6. As shown in Figure 8.6 and described in the previous paragraph, the general wastewater diurnal curve is flattened during the irrigation hours between 10 pm and 6 am. As a result, the peaking factors in the non-irrigation hours between 7 am and 9 pm were increased. Ultimately the maximum peaking factor for wastewater was increased and is greater than that of potable water.

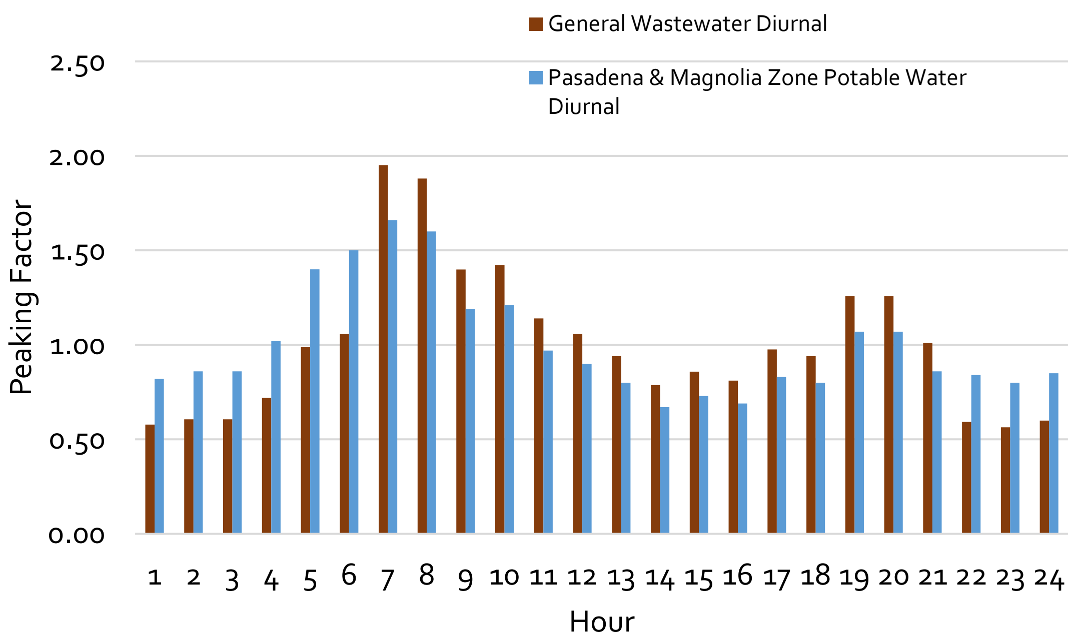

Figure 8.6 Sewer Diurnal Pattern Compared to Potable Water Diurnal Pattern

8.2.3 Elements of the Hydraulic Model

The following provides an overview of the elements in the City's hydraulic wastewater model as well as the required input parameters associated with each and the number of each element in the City's model:

- **Manholes:** Sewer manholes, cleanouts, as well as other locations where pipe sizes change, or where pipelines intersect, are represented by manholes in the hydraulic model. Required inputs for manholes include diameter, sanitary loads, and ground, rim, and invert elevations. Manholes can also be used to represent locations where flows are split or diverted between two or more downstream links. There are 1,165 manholes in the model.
- **Conduits:** Gravity sewers are represented as conduits in the hydraulic model. Input parameters for conduits include length, diameter, material, friction factor (Manning's n), and invert elevations. The are 1,168 conduits in the model.
- **Outfalls:** Outfalls represent areas where flow leaves the system. For the City's model, an outfall represents the connection from the City's collection system to the regional trunk sewer collection system of LACSD. Required input parameters include ground elevation and invert elevation. There are 23 outfalls in the model.
- **Patterns:** Diurnal patterns are represented as trade waste profiles in the hydraulic model. Diurnal patterns are used to simulate the variation in flow throughout the day. Patterns can be established for weekday or weekend, or by land use type, and typically span a 24-hour period. There is one diurnal pattern in the City's wastewater system model.

8.2.4 Hydraulic Model Scenarios

Hydraulic model scenarios are used to save alternative hydraulic model analysis parameters and results of hydraulic model runs in the model. Scenarios allows the user to quickly change between alternatives, rather than modifying them each time. All scenarios started out with the base data sets for the following categories: Junction Set, Outfall Set, Pipe Set, DWF Set, and Curve Set. Note that not all data categories or data sets were used in the hydraulic model as they were not applicable to South Pasadena. The DWF Set was varied for each scenario in the model and all other data sets for each scenario remained the Base Set. Four scenarios were created for the City's hydraulic model:

1. **2020_ADF:** Average dry weather flow scenario. DWF Set = 2020_ADWF. This scenario was used for the existing system sewer analysis. The total existing ADWF is 1.87 mgd, with a peak instantaneous flowrate that varies depending on diurnal pattern.
2. **2020_PWWF**: Peak wet weather flow scenario. DWF Set = 2020_PWWF. This scenario was used for the existing system sewer analysis. The total existing PWWF is 4.66 mgd, with a peak instantaneous flowrate of 7.21 cfs.
3. **2050_ADF:** Future average dry weather flow scenario. DWF Set = 2050_ADWF. This scenario was used for the future system sewer analysis. The total future ADWF is 2.04 mgd, with a peak instantaneous flowrate that varies depending on diurnal pattern
4. **2050_PWWF:** Future peak wet weather flow scenario. DWF Set = 2050_PWWF. This scenario was used for the future system sewer analysis. The total future PWWF is 5.11 mgd, with a peak instantaneous flowrate of 7.91 cfs.

8.3 Existing Sewer System Analysis

The goal of the existing sewer system analysis is to evaluate the system under various operating conditions utilizing the evaluation criteria described in Chapter 4 and the existing flows listed in Section 8.2.2. The evaluation identified areas in the sewer system where pipeline capacity was inadequate to convey design flows. Sewers that lack sufficient capacity create bottlenecks in the sewer and potentially contribute to sanitary sewer overflows (SSOs).

The City's sewer system was evaluated with a hydraulic computer model, which provides a platform for effectively managing and identifying capacity deficiencies within the sewer system. Using the model, an analysis was performed on all 56 miles of pipeline.

The following analyses are described in this section:

1. Gravity System Evaluation.
2. Rehabilitation and Replacement Improvements.
3. Stoney Lift Station Condition Assessment.
4. Existing Sewer System Maintenance.

8.3.1 Gravity System Evaluation

For the existing sewer collection system, the peak wet weather flow (PWWF) was routed through the hydraulic model. In accordance with the established flow depth criteria for existing sewers discussed in Chapter 4, pipelines with a maximum flow depth to pipe diameter (d/D) ratio greater than 0.75 for 8-inch diameter and smaller were identified as capacity deficient. Existing sewer pipelines with a d/D greater than 0.85 for 12-inch diameter and larger were identified as capacity deficient.

There were no capacity deficient sewers identified in the existing gravity system hydraulic analysis. It can therefore be concluded that the existing system configuration and diameters of the collection system are sufficient to carry the existing wastewater flows without exceeding the d/D criteria.

8.3.2 Rehabilitation and Replacement Improvements

In 2020 and 2021, the City had CCTV performed for their entire sanitary sewer system. The CCTV program had structural rating score assigned to each pipe based on the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). In the NASSCO PACP system, there are 5 levels of deficiencies, with Level 5 being the worst condition. The structural sewer pipe ratings were broken into 5 categories:

- **Very Poor:** Very poor pipes had two level 5 deficiencies or 20 level 4 deficiencies.
- **Poor:** Poor pipes had six level 4 deficiencies.
- **Mediocre:** Mediocre pipes had a rating of two level 4 deficiencies or 20 level 3 deficiencies.
- **Average:** Average pipes had two level 3 deficiencies or 20 level 2 deficiencies.
- **Good:** Good pipes had a one level 3 deficiency or less than 20 level 2 deficiencies.

The CCTV structural score ratings are summarized in Table 8.5. The structural ratings for each pipe segment are presented on Figure 8.7. The location of the previously repaired pipe segments from the City's 2017 work were also shown on Figure 8.7.

Table 8.5 CCTV Structural Scores

Structural Rating	6-inch	8-inch	10-inch	12-inch	15-inch	18-inch	Total
Very Poor	-	0.2	-	-	-	-	**0.2**
Poor	-	0.6	0.1	-	-	-	**0.7**
Mediocre	-	14.6	1.1	0.5	0.8	0.1	**17.0**
Average	0.1	17.9	0.6	0.2	0.2	0.1	**19.1**
Good	0.9	14.8	0.2	0.0	0.1	0.2	**16.4**

As show on Table 8.5 there are approximately one mile of pipeline that have a rating of poor or very poor. Each of these pipelines were reviewed and confirmed that they should be prioritized for repair/replacement. The repair/replacement methods that were considered for these pipelines were: replacement, pipe lining, and point repair. The replacement method consists of digging out the entire length of pipe between manholes and installing a new pipe. The lining method consists of installing a synthetic lining on the inner diameter of the pipe, between manholes. The point repair method consists of digging up a small section of pipe and removing and replacing and only that section. Based on the review of the CCTV footage replacement methods for poor and very poor pipes were determined and are summarized in Table 8.6.

Table 8.6 Poor and Very Poor Pipe Repair Summary

Replacement Method	Length of Pipe to Repair (ft)	Percentage of Repair Method
Replace	2,310	45%
Line	2,300	45%
Point Repair	450 ≈ 2 point repairs	10%
Total	**5,060**	**100%**

As shown on Table 8.6, 45 percent of the poor and very poor pipes are to be replaced or lined whereas only 10 percent of them are to be point repaired.

Many of the mediocre pipes replaced or re-lined by the City in 2017, thus it was unexpected that they did not receive an average or good rating. The CCTV recordings of a sample set of 20 mediocre pipes were reviewed, half of them being random pipes that were already lined and the other half of them being random pipes that were not lined. As a result of the review of the sample set of data two determinations were made:

1. Most pipes were in average to good condition. The structural scores included poor structural scores for the taps that the CCTV equipment passed in addition to the actual sewer pipes. The Poor scores from the taps were falsely inflating the severity of the pipe's condition and thus its rating. Figure 8.8 illustrates some example locations where the taps were defective but wouldn't case a need to replace the sewer. In the figure the camera is point up the 4-inch diameter tap coming the customers property.
2. Only 10 percent of the sample set required repair/replacement, as only 2 of the 20 pipes in the sample set of CCTV data analyzed required repair/replacement. One of the two pipes were previously lined, and the lining was buckled; see Figure 8.9 for examples of the structural defects in lined pipes

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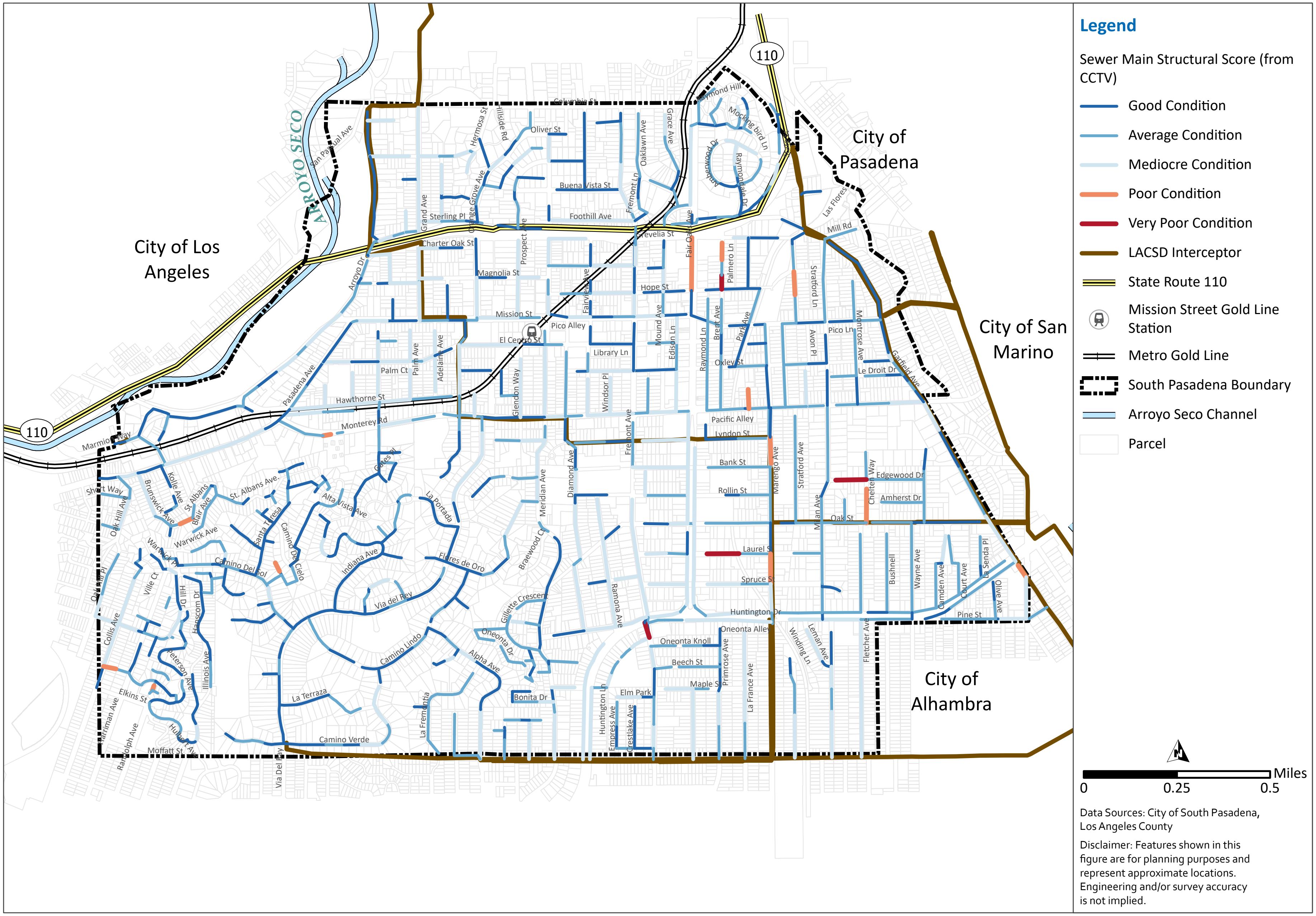

Figure 8.7 CCTV Structural Rating of Sewer Pipes

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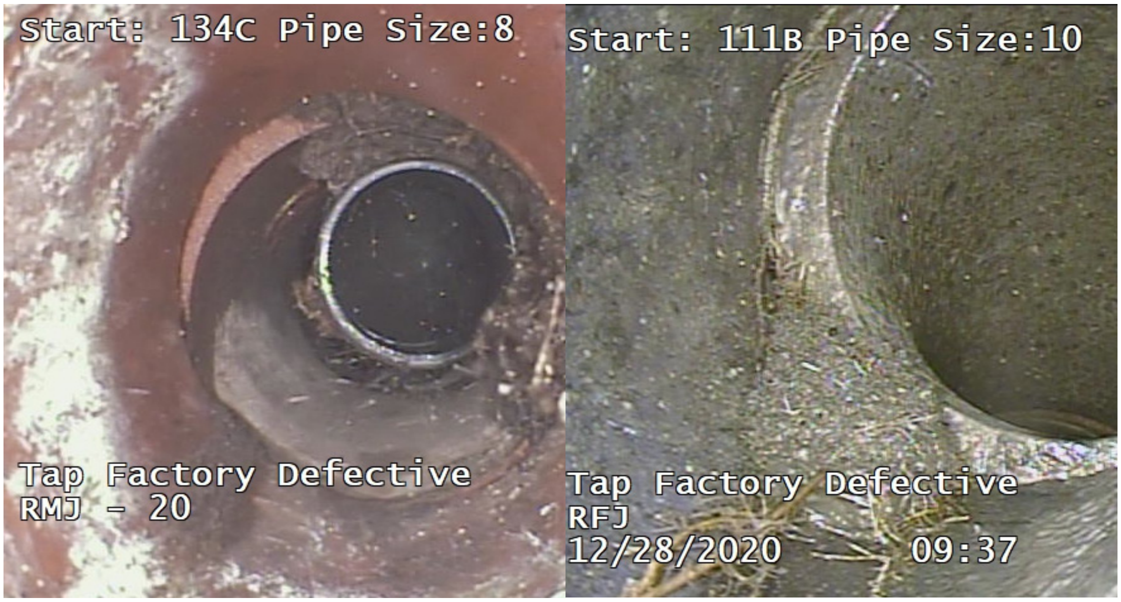

Figure 8.8 Examples of Taps With Poor CCTV Scores

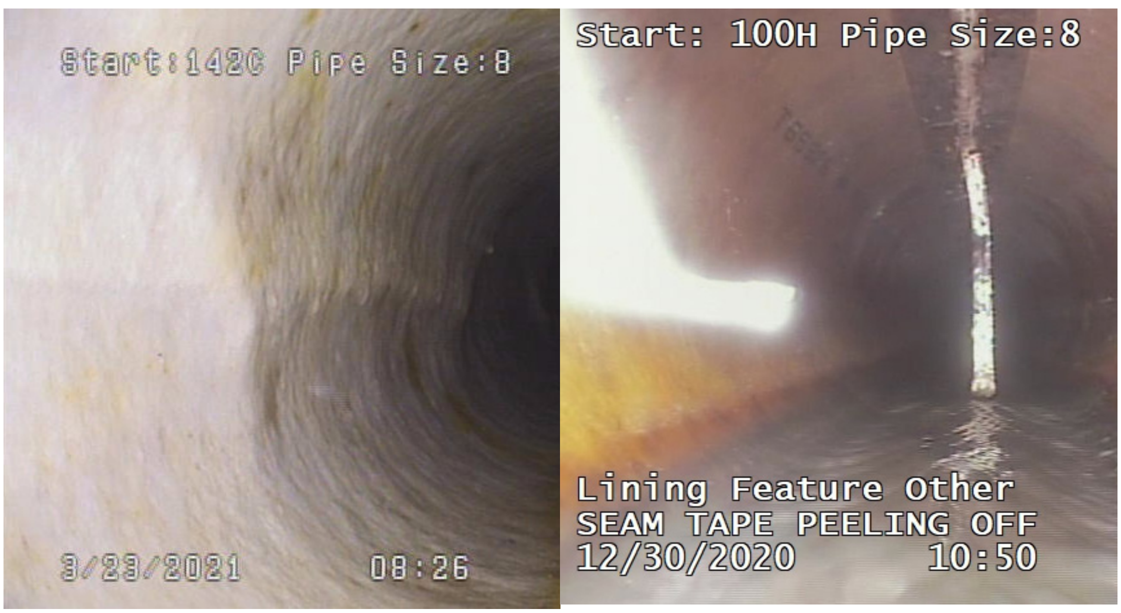

Figure 8.9 Examples of Structural Defects in Lined Pipes

Of the 17 miles of pipe with a mediocre rating, it is estimated that only 1.7 miles or 10 percent are to be prioritized for replacement. The breakdown of the replacement methods assumes that repairs for the 1.7 miles of mediocre pipe have the same breakdown of replacements determined in Table 8.6. Although the CCTV data for each mediocre pipe segment was not individually reviewed the estimated replacement method and lengths are presented in Table 8.7.

Table 8.7 Mediocre Pipe Repair Summary

Replacement Method	Length of Pipe to Repair (ft)	Percentage of Repair Method
Replace	4,000	45%
Line	4,000	45%
Point Repair	900 ≈ 4 point repairs	10%
Total	**8,900**	**100%**

The good and average pipes do not need replacing or rehabilitation at this time but monitoring of these pipelines should continue.

The locations and replacement methods of each individual pipe segments are summarized in Table 8.8 and presented on Figure 8.10. It is recommended that the city prioritize the repair/replacement of these pipes. A Capital Improvement Project ID (CIP ID) was assigned to each of the pipe segments presented in Table 8.8 which corresponds to the CIP ID shown on Figure 8.10.

8.3.3 Existing Lift Station Condition Assessment

A condition assessment was completed for the Stoney Drive Lift Station. The condition assessment was conducted on June 7, 2020. The assessment consisted of visual inspection of mechanical, structural, and electrical equipment. Stoney Lift Station was assessed to be in average to poor condition, however since the station serves less than five customers, it is recommended to keep operating the lift station as-is. There are two pumps at the lift station, so if one pump fails the district can repair the broken pump while keeping the lift station in service.

8.3.4 Existing Sewer System Maintenance

In addition to structural scores, the CCTV resulted in each pipe receiving a maintenance score. Like the structural scores, the maintenance scores were grouped into very poor, poor, mediocre, average, and good ratings. The resulting maintenance rating for the sewer pipes are presented on Figure 8.11. The city should prioritize the cleaning of poor and very poor pipes in their annual pipeline cleaning program. An example of South Pasadena's annual cleaning map is provided in Appendix J.

Table 8.8 Poor and Very Poor Pipe Rehabilitation and Repair Projects

CIP ID	Replacement Type	Diameter (in)	Length[(1)] (ft)	Location Description
SR-1	Replace	8	440	Edgewood Drive between manhole 17E and manhole 16C
SR-2	Replace	8	200	Brent Ave between manhole 52C and manhole 55B
SR-3	Replace	8	220	Fremont Ave between manhole 95E and manhole 39B
SR-4	Replace	8	200	Garfield Ave manhole 117K and manhole 117L
SR-5	Replace	8	340	Fair Oaks Ave between manhole 48B and manhole 48C
SR-6	Replace	8	380	Marengo Avenue between manhole 33E and manhole 33B
SR-7	Replace	8	200	Saint Albans Avenue between manhole 119A and manhole 119K
SR-8	Replace	8	140	In easement east of Camino Del Sol between manhole 178E and manhole 178F
SR-9	Replace	8	190	In easement between Collis Ave and Harriman Ave. Between manhole 142E and manhole 189E
SL-1	Line	8	500	Laurel street between manhole 49A and manhole 49B
SL-2	Line	8	330	Stratford Avenue between manhole 6D and manhole 6E
SL-3	Line	8	240	Brent Avenue between manhole 52A and manhole 52B
SL-4	Line	8	410	Fair Oaks Avenue between manhole 48D and manhole 48C
SL-5	Line	8	280	Donald Court between manhole 134F and manhole 13C
SL-6	Line	10	430	Marengo Avenue between manhole 32A and manhole 32B
SL-7	Line	8	110	Monterey Road between manhole 105E and manhole 105D
SPR-1	Point Repair	8	100	Repair 100 feet of pipe on Chelten Way between manhole 19E and manhole 16D
SPR-2	Point Repair	8	100	Repair 100 feet of pipe in easement south of Peterson Ave between manhole 194C and manhole 194B

Note:
(1) Length of replacement. The point repairs were assumed to be 100 feet, not the entire pipe segment length.

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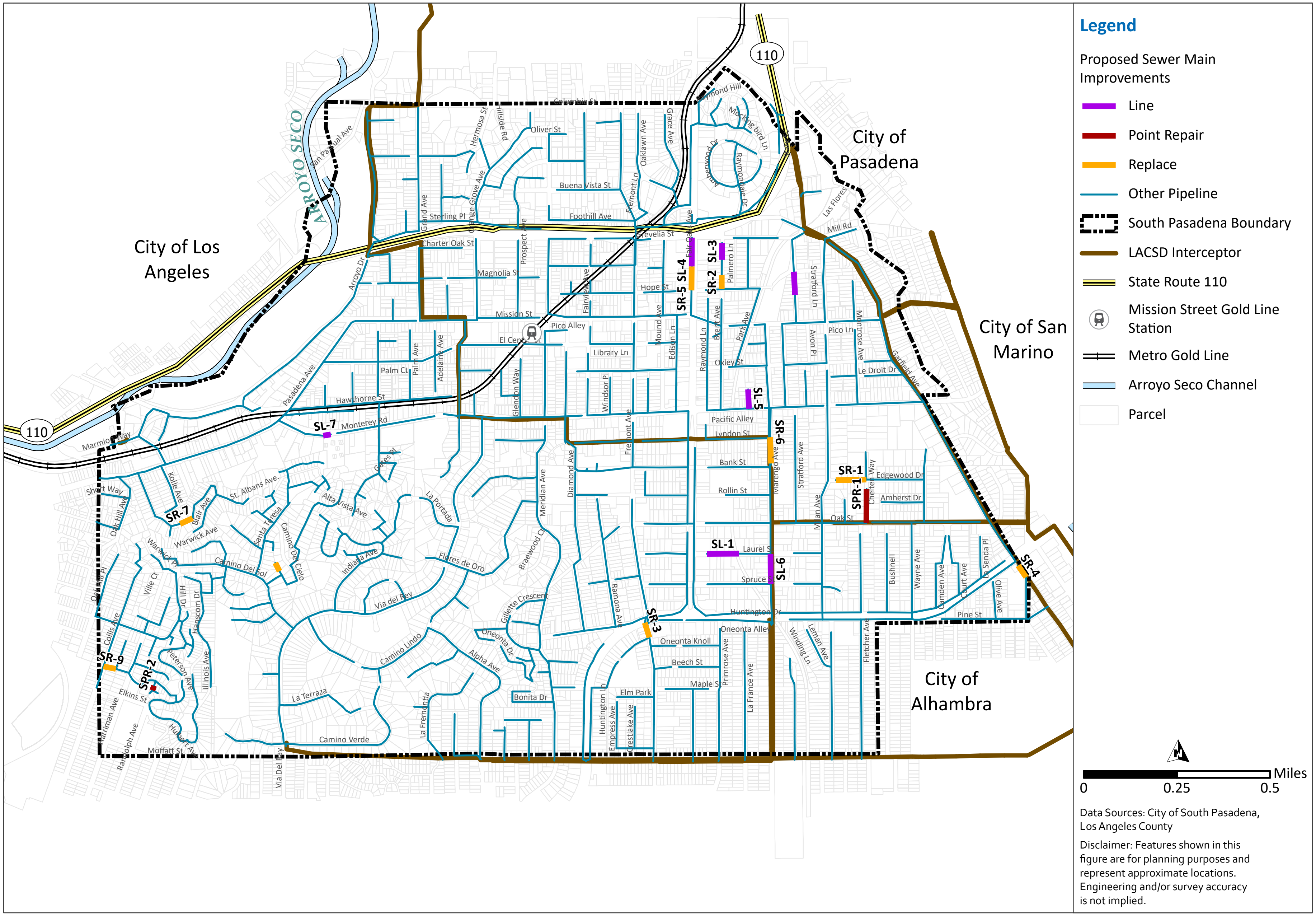

Figure 8.10 Sewer Pipe Rehabilitation and Repair Projects

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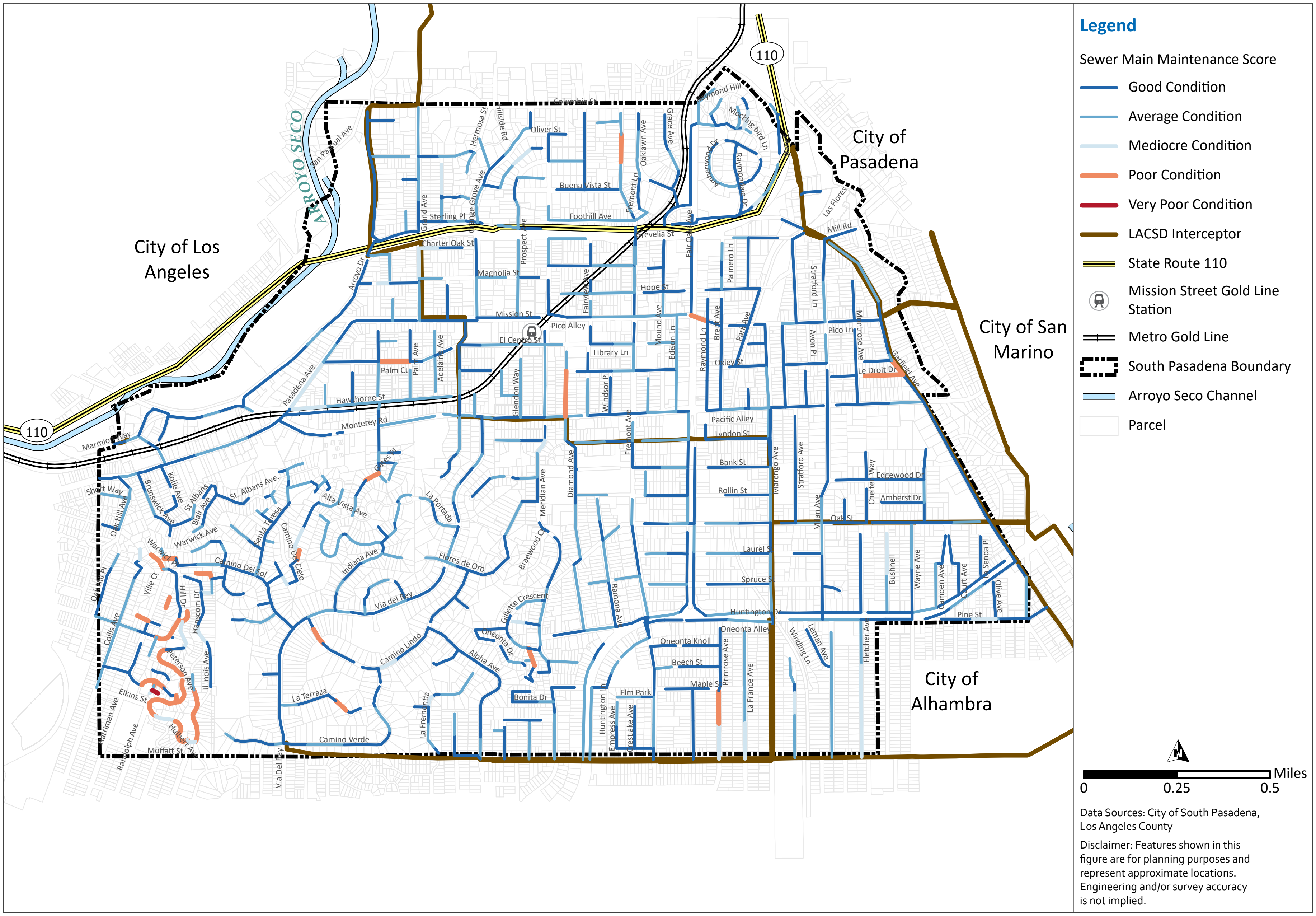

Figure 8.11 CCTV Maintenance Rating of Sewer Pipes

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8.4 Future Sewer System Analysis

The goal of the future system analysis is to evaluate the collection system under various operating conditions utilizing the evaluation criteria summarized in Chapter 5 and the future flow projections presented in Chapter 3. As part of the future system analysis, the planning year 2050 or build-out was evaluated. There were no capacity deficiencies resulting from the existing system analysis; thus, no new sewer pipes were added to the hydraulic model for the future system analysis. The only change between the existing system and future system analysis was the higher ADWF due to growth of 1.87 mgd (2050) compared to 2.04 mgd (2020). It is expected that many R&R pipelines will be replaced by 2050, however for conservative planning purposes they were unchanged between the existing and future model scenarios.

The future sewer system analysis consists of a gravity system evaluation as well as an R&R analysis and did not include a lift station analysis as Stoney Lift Station was already analyzed in the existing system analysis.

8.4.1 Gravity System Evaluation

The future system analysis of the gravity system was performed in a manner similar to the existing system evaluation using the ADWF conditions and PWWF conditions. In accordance with the established flow depth criteria for existing sewers, pipelines with a maximum flow depth to pipe diameter (d/D) ratio greater than 0.75 for pipelines greater or equal to 8-inch diameter and 0.85 for pipelines greater than or equal to 12-inch diameter or greater, were identified.

Like the existing gravity system evaluation, the future gravity system evaluation did not result in any capacity-deficient sewers. It can therefore be concluded that the existing system configuration and diameters of the collection system are sufficient to carry both existing and 2050 wastewater flows without exceeding the d/D criteria. The sewer system CIP is therefore limited to R&R improvements to address the identified condition issues.

8.4.2 Future Rehabilitation and Replacement Improvements

The location and conditions of future pipes needing rehabilitation and replacement is currently unknown, however the sewer pipes will degrade over time and will require rehabilitation and/or replacement. The existing costs of rehabilitation and replacement should be considered and carried into the future to budget for remediation of aging pipelines.

Additionally, the City should perform CCTV inspections and PACP scoring of the sewer pipes every 10 years (2030, 2040, and 2050). The CCTV data will guide the City on which pipelines need rehabilitation and/or replacement.

8.4.3 Other Future Recommendations

The requirements of the Sewer System Management Plans (SSMP) are that the be updated every 5 years. Therefore, between now and 2050, the City should plan on updating their SSMP about five more times.

8.5 Summary of Recommendations

The recommendations identified in this chapter are summarized in this section. Detailed cost estimates for each of these recommendations are included in the CIP chapter (see Chapter 10) of this One Water 2050 Plan. The recommendations are conceptual and should be refined during the design phase.

- **Gravity System Improvements**
  - No projects were recommended for the Existing or Future System.
- **Lift Station and Force Main Improvements**
  - No projects were recommended for the Existing or Future System.
- **Rehabilitation and Replacement Improvements**
  - Existing System:
    - There were 18 projects recommended for sewer pipes with Poor and Very Poor pipeline PACP structural scores.
    - 8,900 feet of pipeline with mediocre PACP scores are estimated to need replacement or rehabilitation.
  - Future System:
    - Consider existing costs of rehabilitation and replacement carry into the future to budget for remediation of aging pipelines
  - CCTV inspections and PACP scoring of pipes every 10 years (2030, 2040, and 2050)
- **Maintenance**
  - Prioritize the cleaning of the poor and very poor pipes in annual cleaning program.
- **Other Improvements**
  - Conduct a flow monitoring and calibration of the sewer hydraulic model in the near-term.
  - Updated the SSMP every 5 years.

Chapter 9 - Stormwater Management

Chapter 9

STORMWATER MANAGEMENT

9.1 Introduction

Stormwater and urban runoff is rain or melting snow that flows over the ground. In urban or developed areas, stormwater runs over pavement and parking lots, picking up oil and other pollutants before flowing into a nearby storm drain, combined collection system, stream, river, or ocean. In more natural areas including forests and wetlands, stormwater can recharge into the ground, filtered through SAT and be stored in underlying aquifers.

Due to the high amount of impervious surfaces in urban areas, rainfall cannot soak into the ground through these surfaces and thus does not replenish groundwater supplies. Impervious surfaces also increase the amount and speed of water entering storm drains or natural waterways. The result is an increase in the severity and frequency of floods and a decrease in base flows in our streams and water in our groundwater aquifers.

Stormwater management is moving towards a multi-benefit approach throughout Southern California that maximizes the retention and use of urban runoff as a resource for groundwater recharge and irrigation, while also creating additional benefits for communities in the watershed and addressing applicable stormwater quality regulations. These opportunities follow best management practices (BMPs), including:

- **Institutional control measures:** control measures that prevent the transport of pollutants in the watershed without the need of physical structures.
- **Low impact development (LID):** control measures on parcels that retain stormwater runoff during rain events. These include LID ordinances and residential LID programs that incentivize the adoption of rain cisterns and other methods that reduce runoff from residential properties. LID ordinances also facilitate community engagement and awareness.
- **Regional projects**: control measures that capture runoff from large upstream areas; these measures typically retain the 85^{th} percentile, 24-hour storm event.
- **Green streets:** the right-of-way along streets offers a significant opportunity to implement control measures on city-owned land.

This chapter briefly describes current stormwater regulations, the City existing storm drain systems, existing stormwater management programs, and potential future stormwater management opportunities for the City.

9.2 Stormwater Regulations

This section briefly describes the federal, state, and local regulations that impacts the City's stormwater management practices and compliance needs.

9.2.1 Federal Regulations

The Clean Water Act prohibits anybody from discharging "pollutants" through a "point source" into a "water of the United States" unless under a National Pollutant Discharge Elimination System (NPDES) permit. Created in 1972 by the Clean Water Act, the NPDES permit program is authorized to state governments by the US EPA to perform permitting, administrative, and enforcement aspects of the program. NPDES permits contain discharge limits, monitoring and reporting requirements, and other provisions to protect human health and the environment. The permit translates general requirements of the Clean Water Act into specific provisions tailored to the operations of each permittee discharging pollutants.

Section 303(d) of the Clean Water Act requires states to prepare a list of water bodies that do not meet water quality standards and establish for each of these water bodies load and waste load allocations (load refers to pollutants), that is, a total maximum daily load (TMDL) that will likely achieve attainment of water quality standards. A TMDL represents an amount of pollution that can be released by anthropogenic and natural sources of a watershed into a specific water body without causing a decline in water quality and beneficial uses.

Stormwater and non-stormwater are conveyed through the Municipal Separate Storm Sewer Systems (MS4s) and ultimately discharged into receiving waters of the Los Angeles Region.

9.2.2 Existing Regional Stormwater Regulations

The Los Angeles Regional Water Quality Control Board (LARWQCB), under the jurisdiction of the State Water Resources Control Board (SWRCB), issues permits under the NPDES Program. The NPDES program requires municipalities and counties of medium and larger population sizes to obtain MS4 Permits for discharges of stormwater runoff. The City is a co-permittee, along with Los Angeles County, the LACFCD, and 84 incorporated cities within Los Angeles County, for an NPDES Permit issued by the LARWQCB (Order No. R4-2012-0175; NPDES Permit No. CAS004001) on November 8, 2012 and as amended in 2016.

The MS4 Permit contains effluent limitations, receiving water limitations, minimum control measures requirements, and TMDL provisions. California State law requires Regional Boards to include an implementation plan for TMDLs and these plans generally include compliance schedules. The MS4 Permit outlines the process for developing watershed management programs, including the EWMP as part of the implementation plan for applicable TMDLs. The MS4 Permit incorporates TMDL waste load allocations applicable to dry- and wet- weather as water quality-based effluent limits, and/or receiving water limitations. Section V.A of the Permit requires compliance with these limits as outlined by the respective TMDLs.

TMDLs applicable to the City are summarized in Table 9.1 and include when the LARWQCB applied them to the MS4 (i.e., resolution number) and applicable effective dates.

TMDLs established by the EPA, to which Permittees are subject, do not contain an implementation plan adopted pursuant to California Water Code section 13242. However, EPA has included implementation recommendations as part of these TMDLs. In lieu of inclusion of numeric water quality-based effluent limitations at this time, this Order No. R4-2012-0175requires Permittees subject to waste load allocations in EPA established TMDLs to propose and implement BMPs that will be effective in achieving compliance with EPA established numeric waste load allocations.

Table 9.1 TMDLs Applicable to the City

Total Maximum Daily Load (TMDL) Regulation	LAWRQCB Resolution Number	Effective Date and/or EPA Approval Date
LA River Nitrogen Compounds and Related Effects(1)	2003-009 2012-010 (amended)	03/23/2004 08/07/2014
LA River Trash	2007-012	09/23/2008
LA River Metals TMDL(2)	2007-014 2010-003 (amended)	11/03/2011
LA River Bacteria TMDL(3)	2010-007	03/23/2012

Notes:
(1) Includes Ammonia - N, Nitrate - N, Nitrite - N, and Nitrate as N + Nitrite as N. Effluent limit established based on TMDL.
(2) Includes Copper and Lead (dry and wet weather), Zinc (dry weather applies only to Rio Hondo Reach 1: wet weather), Cadmium (wet weather). Effluent limit established based on TMDL.
(3) Effluent limit and receiving water limit established based on TMDL.

9.2.3 Upper LA River Enhanced Watershed Management Plan

The City took part in the developed the Enhanced Watershed Management Plan (EWMP) for the Upper Los Angeles River (ULAR) Watershed Management Area as part of the collaborative ULAR EWMP Group, to address TMDLs. The ULAR EWMP Group is comprised of the cities of Los Angeles, Alhambra, Burbank, Calabasas, Glendale, Hidden Hills, La Cañada Flintridge, Montebello, Monterey Park, Pasadena, Rosemead, San Fernando, San Gabriel, San Marino, South El Monte, South Pasadena, and Temple City, along with the County of Los Angeles (Unincorporated County) and the LACFCD. The EWMP provides a compliance pathway for attaining the limitations set forth in the MS4 permit. The revised final ULAR EWMP was submitted in January 2016 as approved by LARWQCB.

9.2.4 Anticipated Future Stormwater Regulations

The LARWQCB updates the MS4 permitting system periodically. Updates to the 2012 permit that are currently underway to incorporate Ventura County and the City of Long Beach MS4 Permits into a regional Phase 1 Permit. Proposed requirements in the regional permit include new/revised TMDLs since the issuance of the previous permits, the statewide trash amendment provisions and will provide Ventura County MS4 permittees the option to develop a watershed management program. Additionally, the regional permit will include monitoring data and reporting requirements; additional direction on cost tracking and reporting; and will include the annual report form template as an attachment.

No new TMDL provisions or requirements that would affect the City are anticipated at this time. Future potential TMDLs or provisions may include the addition of plastics, algae and additional metals, such as mercury.

9.3 Existing Stormwater Drainage System and Ongoing Projects

The City's stormwater is collected and conveyed through City-owned storm drains, the LACFCD storm drainage system, and an open channel - the Arroyo Seco. This section describes the drainage basins and the existing stormwater infrastructure systems within the City's boundary. These stormwater infrastructure components are depicted on Figure 9.1.

9.3.1 Local Stormwater Drainage Basins

Stormwater drains to one of three basins, the Arroyo Seco watershed, and Chavez Ravine Los Angeles Watershed, and Rio Hondo Watershed.

The Arroyo Seco watershed stretches from the San Gabriel Mountains to downtown Los Angeles and passes along the City along the northwestern boundary. The basin sits between the San Gabriel Valley to the east and the San Fernando Valley to the west and drains into the LA River at the confluence in Lincoln Heights. As shown on Figure 9.1, stormwater in the northwest portion of the City drains to the Arroyo Seco.

Chavez Ravine is a shallow canyon area of Los Angeles that drains into the LA River just north of downtown. As shown on Figure 9.1, stormwater runoff from the southern portion of the City drains to Chavez Ravine.

Similar to the Arroyo Seco, the Rio Hondo begins along the San Gabriel Mountains near Irwindale and flows southwest to the confluence of the LA River in South Gate, passing through the Whittier Narrows. As shown on Figure 9.1, stormwater runoff from the eastern portion of the City drains into the Rio Hondo watershed through the Alhambra Wash.

Of the approximately 2,608 acres for the City, approximately 25 percent of stormwater runoff flows within the ULAR Watershed via the Arroyo Seco, approximately 40 percent flows to the Lower Los Angeles River Watershed via the Chavez Ravine, and approximately 35 percent drains to the Rio Hondo.

9.3.2 City-Owned Stormwater Infrastructure

Most of the storm drains for the City are either partly or completely under the jurisdiction of the LACFCD with few drains owned solely by the City. The City's existing storm drainage system network, including catch basins, is shown on Figure 9.1.

A catch basin is an engineered drainage structure with the sole function of collecting rainwater from streets and parking area and transporting it to local waterways, such as the storm drain network. Approximately 14 percent of the total miles of storm drains and 26 percent of the catch basins are of the City's jurisdiction, ranging in approximate size from 18 inches to 76 inches in diameter. All City owned facilities connect directly to the LACFCD system.

The storm drain facilities owned by the City and LACFCD located within the City limits are summarized in Table 9.2.

Table 9.2 Storm Drainage Facilities Within City Limits

Facility	City	LACFCD	Total
Storm drains (miles)	1.8	10.7	12.5
Catch Basins (number)	118	335	453

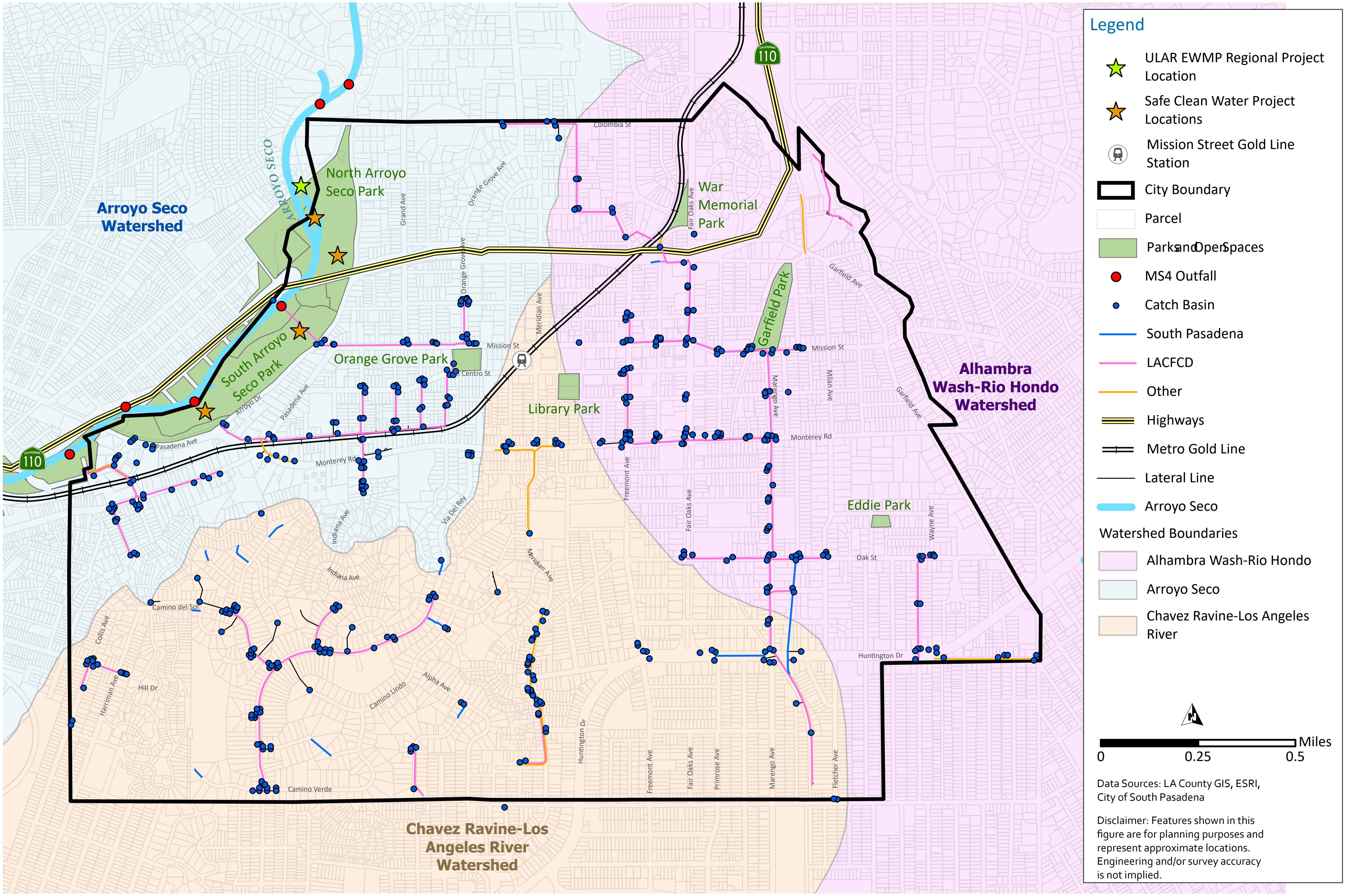

Figure 9.1 Existing Stormwater Infrastructure

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9.3.3 Los Angeles County Flood Control District

In 1915, the Los Angeles County Flood Control Act established LACFCD and empowered it to manage flood risk and conserve stormwater for groundwater recharge. In coordination with the United States Army Corps of Engineers the LACFCD developed and constructed a comprehensive system that provides for the regulation and control of flood waters through the use of reservoirs and flood channels. The system also controls debris, collects surface storm water from streets, and replenishes groundwater with storm water and imported and recycled waters. LACFCD is a special district governed by the County of Los Angeles Board of Supervisors, and its functions are carried out by the LACDPW.

The LACFCD's system includes the majority of drainage infrastructure within incorporated and unincorporated areas in every watershed, including approximately 500 miles of open channel, 3,500 miles of underground drains, and an estimated 88,000 catch basins, and several dams. Unlike cities and counties, the LACFCD does not own or operate any municipal sanitary sewer systems, public streets, roads, or highways. The LACFCD operates and maintains storm drains and other appurtenant drainage infrastructure within its service area. The LACFCD has no planning, zoning, development permitting, or other land use authority within its service area.

Los Angeles County Flood Control facilities make up much of the storm drain network across the City with 86 percent of storm drains and 74 percent catch basins under the jurisdiction of LACFCD. LACFCD storm drains range in approximate size from 24 inches to 90 inches in diameter

9.3.4 Existing Stormwater Management Programs

Stormwater management throughout the City is implemented through programs required by the MS4 Permit that include non-structural and structural BMPs.

Non-structural BMPs are policies and procedures that manage land use in order to lessen the impacts of resource development and redevelopment on storm impacts on stormwater quality and quantity and are often referred to as institutional control measures or minimum control measures. Structural BMPs are facilities designed and constructed for the treatment of stormwater with respect to quality and quantity.

The City continues to implement MS4 Permit requirements for minimum control measures by to protect water quality of receiving waters, including institutional BMPs. The MS4 Permit classifies institutional BMPs, or non-structural BMPs and minimum control measures into six program categories:

- Development Construction Programs.
- Industrial/Commercial Facilities Programs.
- Illicit Connection and Illicit Discharge Detection and Elimination Programs.
- Public Agency Activities Programs.
- Public Information and Participation Programs.
- Planning and Land Development Programs.

The minimum control measures as currently implemented by the City as required by the MS4 permit are summarized in Table 9.3.

Table 9.3 Summary of the Minimum Control Measures

Measure	Requirements
Progressive Enforcement	Developed and maintains a Progressive Enforcement Policy to track compliance, including: 1) follow-up inspection, 2) enforcement action, 3) records retention, 4) referral of violations, 5) investigation of complaints, 6) assistance with Regional Board enforcement actions.
Public Information and Participation Program	Implemented a robust public participation program that measurably increases knowledge and changes behavior and involves a diversity of socio-economic and ethnic communities.
Industrial/Commercial Facilities Program	Added education component to notify of BMP requirements applicable to the site. Expanded inspection to all commercial and industrial facilities that may contribute substantial pollutants.
Planning and Land Development Program	Updated ordinance/design standards to conform with new requirements (LID and hydromodification). Increased performance measure to require onsite retention or bioretention/biofiltration. Provision for alternative compliance measures due to technical infeasibility of onsite retention, or opportunity for groundwater replenishment at offsite location. Updated ordinance/design standards to conform with new requirements
Development Construction Program	For sites disturbing less than an acre, added requirement to inspect construction sites based upon water quality threat The use of BMPs are tailored to the risks posed by the project, ranked from Low Risk (Risk 1) to High Risk (Risk 3). Increased frequency of inspections, at least once every 2 weeks for high threat sites, at least monthly for lower threat sites, and during all phases of construction (at least three times).
Public Agency Activities Program	Added requirement to maintain an updated inventory of all public facilities that are potential sources of stormwater pollution and inventory of existing development for retrofitting opportunities.
Illicit Connections and Illicit Discharges Elimination Program	Implemented a spill response plan for all sewage and other spills that may discharge into its MS4.

In addition to the minimum control measures implemented, the City has implemented structural BMPs during the construction of the Garfield Reservoir Replacement Project, shown in Figure 9.2. This included distributed LID components, such as Filterra bioretention systems as part of the development construction program. The Filterra system includes custom – designed filter media that captures pollutants in stormwater runoff, followed by the discharge of treated water.

Figure 9.2 Garfield Reservoir BMP

9.3.5 Ongoing City Projects

Watershed Control Measures include BMPs implemented individually or collectively, at watershed-scale to address water quality, and includes the total network of LID, green streets and regional BMPs as part of the EWMP implementation strategy. In addition to LID projects, the City continues to implement structural projects throughout the City in its effort to meet water quality standards. The ongoing projects implemented by the City are:

- Trash Capture Devices.
- Low Flow Diversions.

9.3.5.1 Trash Capture Devices

As trash and debris can carry pollutants into waterways, the City has installed approximately 50 trash capture devices in City – owned catch basins in order to reduce associated pollutants reaching receiving waters and comply with Trash TMDL requirements and will continue to implement such devices across the City as necessary. It is recommended that the City complete a field survey of trash capture devices to document the exact number of devices and their locations.

9.3.5.2 Low Flow Diversions

Dry-weather urban runoff from over irrigation, broken/misadjusted sprinklers, and other sources is some of the most potentially problematic water that enters storm drains, and can include motor oil, fertilizer, pet waste, and trash. A Low Flow Diversion (LFD) is a structural system that that diverts water from storm drains into the sanitary sewer or another treatment system to eliminate the discharge of potentially polluted dry-weather runoff into receiving waters.

The City, in collaboration with the cities of Alhambra, Pasadena, and San Marino, is currently in the design phase of implementing a LFD system for areas draining to the Rio Hondo subwatershed that diverts dry weather flows to the sanitary sewer. Implementing LFD systems could also help maximize water recycling in Los Angeles County.

9.3.6 Ongoing Regional Projects and the Safe, Clean Water Program

In response to water quality limitations, and to increase water supplies, voters passed a parcel tax in Los Angeles County in 2018 (Measure W) to implement the SCWP. The measure will raise an estimated $285 million annually for projects and programs throughout Los Angeles County, allocating funds to support municipal, regional, and district programs. Estimated annual revenue under the municipal program for the City is approximately $250,000 for project and programs at the local level.

The SCW Regional Program provides funding for stormwater projects at the watershed level and is distributed among nine watershed areas. The objective of this program is to plan, build, and maintain watershed-based projects that incorporates multi-benefit components to its communities.

These projects address stormwater runoff for consideration under the Technical Resources Program of the SCW Regional Program, which provides technical assistance and resources to develop BMPs through the County's SCW Program funding sources. The City or its project partners have received SCW funds for the following projections:

- Arroyo Seco San Rafael & San Pascual Treatment/Infiltration Projects.
- Arroyo Seco Lower Arroyo Park Infiltration Basin Facility.
- Arroyo Seco Golf Course Wetland Facility.
- Arroyo Seco Golf Course Driving Range Wetland/Infiltration Facility.
- Huntington Drive Regional Green Street.
- Rio Hondo Load Reduction Strategy – Alhambra Wash Dry-Weather Diversion Project.

In addition to the above projects, the City has applied for SCW funds for the Camino Verde Stormwater/Infiltration Project and funding for this project is currently under consideration.

Each regional project intends to achieve multiple benefits, including increasing water supply, groundwater recharge, flood control, recreation and/or enhancement of habitat. Regional projects emphasize subsurface retention and infiltration and/or use as a primary function. A brief summary for each project is provided below, while the detailed SCW Program application submittals of each project are included in Appendix I of this One Water 2050 Plan. Regional project locations are shown on Figure 9.3.

9.3.6.1 Arroyo Seco San Rafael and San Pascual Treatment/Infiltration Project

The ULAR EWMP identified a two-part project to divert a portion of the runoff from the Arroyo Seco to be passively treated, stored, and reused through the use of man-made wetlands and related infrastructure. The San Rafael Treatment Wetlands portion of the project is located in the City of Pasadena, who is partnering with the City on the implementation of this project.

The San Pascual Wetland will replace the existing park area with a new constructed wetland, native trees and vegetation, and a bicycle and pedestrian trail. The wetland has a BMP capacity of 8 acre-feet. This project will receive wet-weather flow from the Arroyo Seco channel at a diversion site approximately 0.4 miles north of the wetland and dry-weather flow from the channel using an existing berm that will be modified for this project. Treated water from the wetland will be used for both irrigation via a disinfection unit and diversion to other downstream projects. The San Pascual Wetland portion of the project is part of the Safe Clean Water program. The concept plan for the San Pascual Wetland is shown on Figure 9.4.

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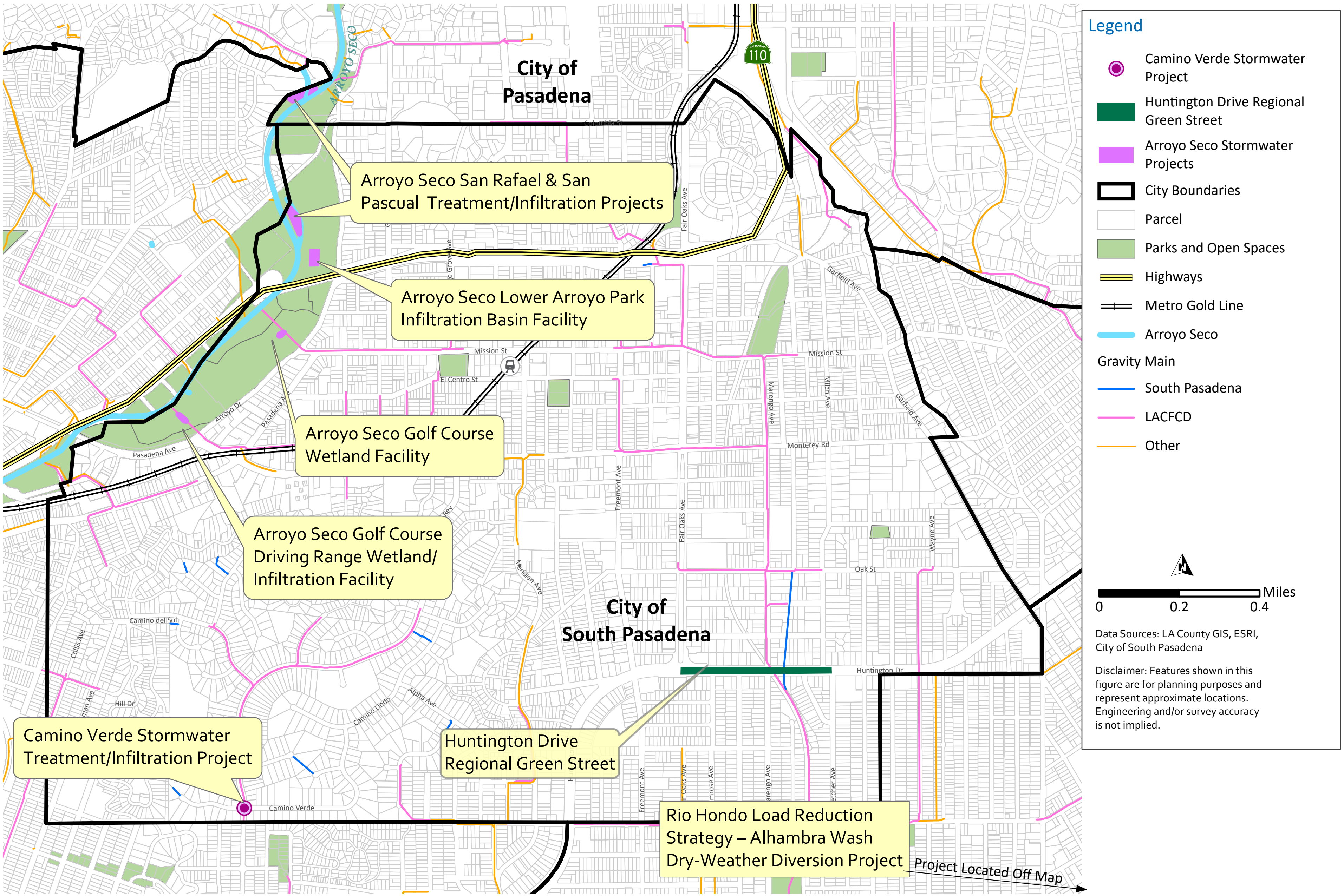

Figure 9.3 Regional Stormwater Project Locations

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Source: *Arroyo Seco Projects Feasibility Study*

Figure 9.4 San Pascual Treatment Wetland Concept

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9.3.6.2 Arroyo Seco Lower Arroyo Park Infiltration Basin Facility

The Lower Arroyo Park Infiltration Basin will improve the existing sports field and park by implementing an underground stormwater capture facility and infiltration basin enlargement south of the park. This stormwater capture facility has a BMP capacity of 6 acre-feet and will receive water from the upstream facility (Arroyo Seco San Rafael and San Pascual Treatment and Infiltration Project) and divert overflow to downstream facilities. The concept plan for the Lower Arroyo Park Infiltration Basin is shown on Figure 9.5.

9.3.6.3 Arroyo Seco Golf Course Wetland Facility

The Golf Course Wetland will renovate the existing Arroyo Seco Golf Course by removing an existing storm drainpipe, reconfiguring the 14th tee box, and creating an open channel outlet structure from the wetland into the downstream facility at the Golf Course Driving Range. The Golf Course Wetland has a BMP capacity of 9 AF and will receive water from the upstream facilities. Treated/disinfected water from the wetland will also be used for golf course irrigation. The concept plan for the Gold Course Wetland is shown on Figure 9.6.

9.3.6.4 Arroyo Seco Golf Course Driving Range Wetland/Infiltration Facility

The Golf Course Driving Range Wetland or Infiltration Facility (both options are currently being considered) will be constructed along the Arroyo Seco Golf Course driving range boundary along Arroyo Drive. This facility will receive water from both an existing storm drain line and upstream facilities. If a wetland is constructed, any overflow of treated water will be diverted back to the Arroyo Seco Channel. If an infiltration facility is constructed, treated water will discharge into the groundwater basin. The concept plan for the wetland option of this project is shown on Figure 9.7.

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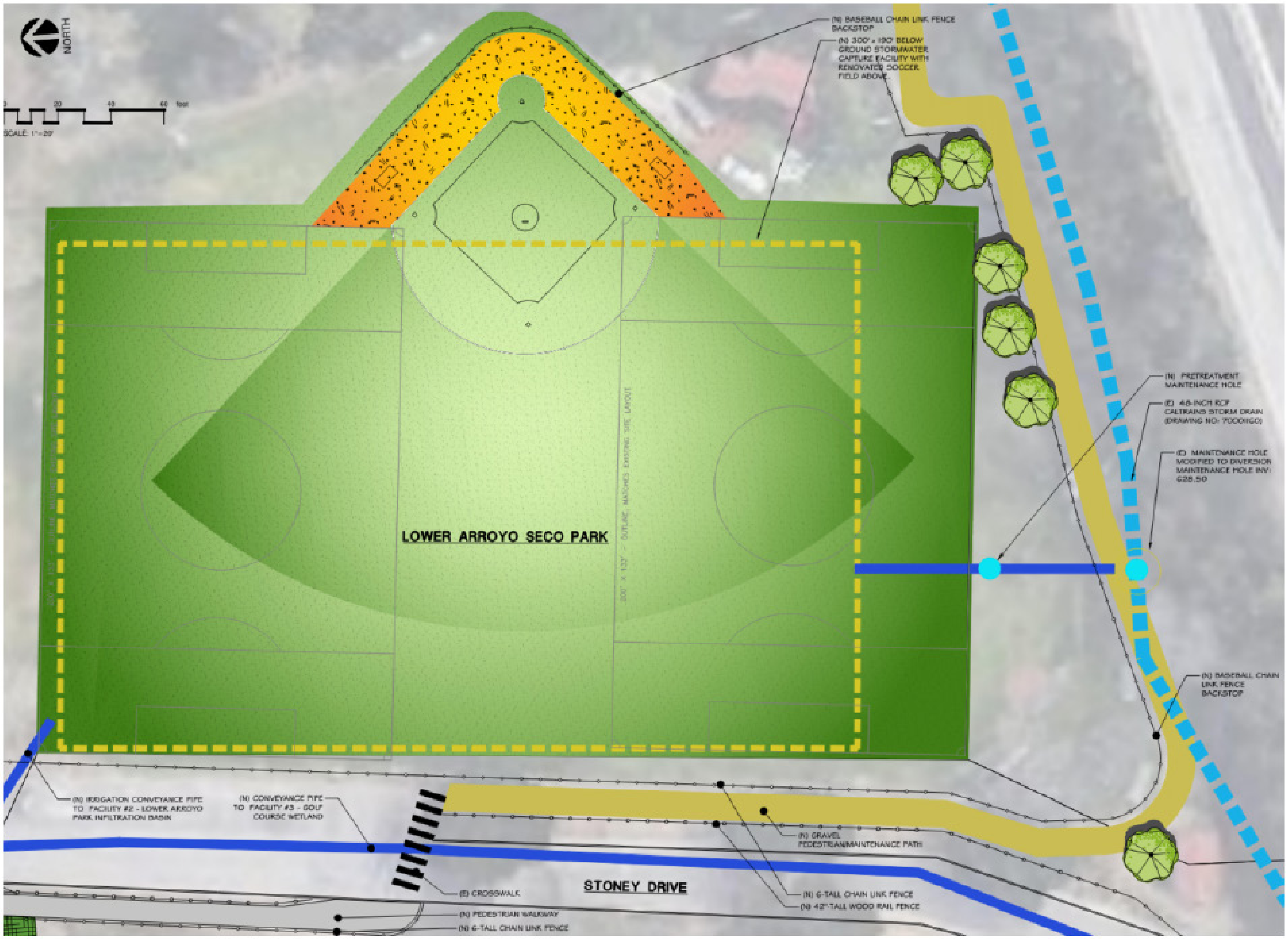

Source: Arroyo Seco Projects Feasibility Study

Figure 9.5 Lower Arroyo Park Infiltration Basin Concept

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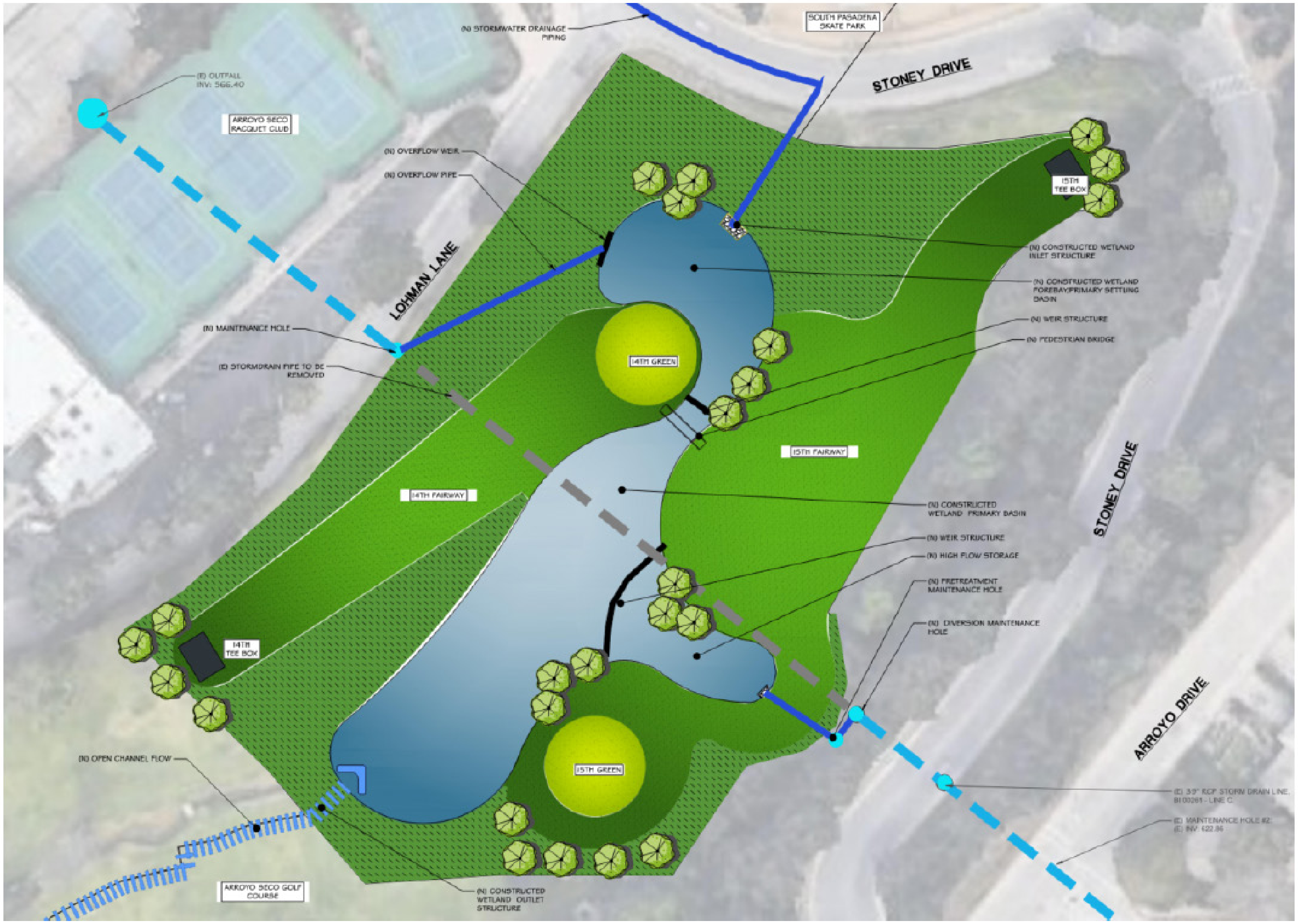

Source: *Arroyo Seco Projects Feasibility Study*

Figure 9.6 Golf Course Wetland Concept

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Source: *Arroyo Seco Projects Feasibility Study*

Figure 9.7 Golf Course Driving Range Wetland Concept

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9.3.6.5 Huntington Drive Regional Green Street

The city street medians surrounding the intersection of Huntington Drive and Marengo Avenue from Fair Oaks Avenue to Fletcher Avenue cover approximately 0.77 acres of open space. These medians could be retrofitted to capture stormwater and urban runoff from the upstream drainage area, as well as from the roadway and surrounding neighborhood. The project aims to improve water quality, add water supply, provide flood management, and enhance green space.

This project begins with a study to evaluate the feasibility of this approach. If feasible, the green street retrofit would consist of installing underground storage chambers or dry wells beneath the medians, as shown on Figure 9.7, and connecting them via diversion pipes to an underground storm drain located just east of the intersection. The underground storage has an estimated capture capacity of 5 AF and captured runoff could be infiltrated to groundwater, used to supplement irrigation, or released to the sanitary sewer. The existing turf would also be replaced with drought-tolerant plants, and stormwater reuse educational signage would be incorporated in the walkways at pedestrian crossings.

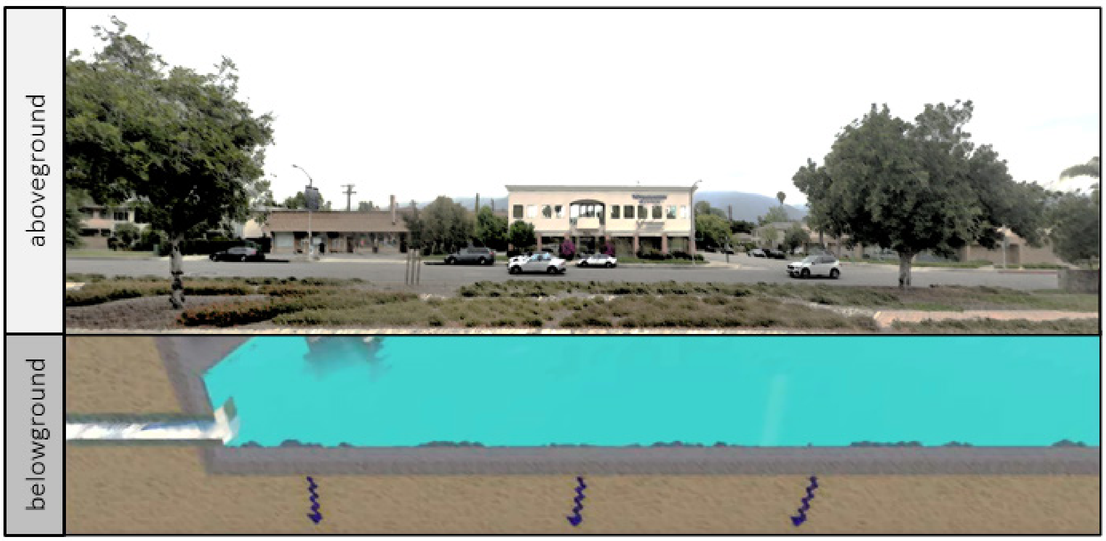


Figure 9.8 Underground Infiltration System Beneath Huntington Drive Green Street

9.3.6.6 Rio Hondo Load Reduction Strategy – Alhambra Wash Dry-Weather Diversion Project

The San Gabriel Valley Council of Governments, on behalf of the County of Los Angeles and the Cities of Alhambra, Monterey Park, Pasadena, Rosemead, San Gabriel, San Marino, South Pasadena, and Temple City is implementing the Load Reduction Strategy (LRS) Projects for the Rio Hondo River and Tributaries. The purpose of the LRS Projects is to help the agencies comply with the final dry-weather Water Quality Based Effluent Limitations (WQBELs), as specified by the Los Angeles River Bacteria TMDL.

The LRS Projects include the Alhambra Wash Dry-Weather Diversion, which will capture and treat runoff from the 11,120-acre drainage area to the Alhambra Wash. Project components include a rubber dam diversion structure, a pump station, a pretreatment system, and a UV treatment system enclosed in a building. The project will capture dry-weather runoff with a peak diversion rate of 1,000 gpm in order to improve water quality in the Rio Hondo and Los Angeles River.

9.3.6.1 Camino Verde Stormwater Treatment/Infiltration Project

The project concept is to divert wet and dry weather flow from an underground 72-inch diameter storm drain pipe to an underground retention system. The storm drain pipe drains a residential area of about 280 acres, and runs beneath a City-owned pocket park known as Camino Verde Pocket Park. The diversion point and retention system will be located within a small footprint at the southern end of the pocket park. The project will include the use of vertical cisterns that store stormwater and are also equipped with infiltration dry wells.

9.3.7 Other Projects

Stormwater projects included in this section are either currently on hold or projects in which the City is not a partner but may be indirectly impacted.

9.3.7.1 Almansor Park and Vincent Lugo Park Stormwater Capture

In December 2017, the City, in collaboration with the Cities of Alhambra, Pasadena, and San Marino, initiated concept plans for a multi-benefit regional project at the Alhambra Golf Course. This project was identified in the ULAR EWMP and is anticipated to capture an 85th percentile, 24-hour (design) storm event over a total drainage area of 1,145 acres, of which the City drains approximately 159 acres (14 percent).

The Alhambra Golf Course and the adjacent Almansor Park are located in an area that drains to the Alhambra Wash. The proposed BMP is a retention/infiltration basin situated underneath the baseball fields and open space in the southwest portions of the park that will retain/infiltrate dry weather and wet-weather runoff. The BMP is sized to accommodate all inline flows contributed by a maximum drainage volume of approximately 75 acre-feet. The multi benefit component of the project includes groundwater recharge to the Main San Gabriel Groundwater Basin, flood control, enhancement of existing park facilities, trash capture, as well as public outreach and education.

The Almansor Park project is currently on hold but may be implemented in the future. Meanwhile, the Vincent Lugo Park Stormwater Capture Project is moving forward with a feasibility study through the SCW Technical Resources Program and would also capture stormwater runoff from the Alhambra Wash. This project would consist of diversion of stormwater runoff to bioswales, mechanical treatment systems, storage cisterns, and subsurface infiltration galleries in Vincent Lugo Park. The City is not directly involved in this project, but the project is included in this Plan as stormwater from the City feeds Alhambra Wash. The project partners are the City of San Gabriel, LACFCD, the City of Alhambra, and the U.S. Army Corps of Engineers.

9.4 Future Stormwater Management Opportunities

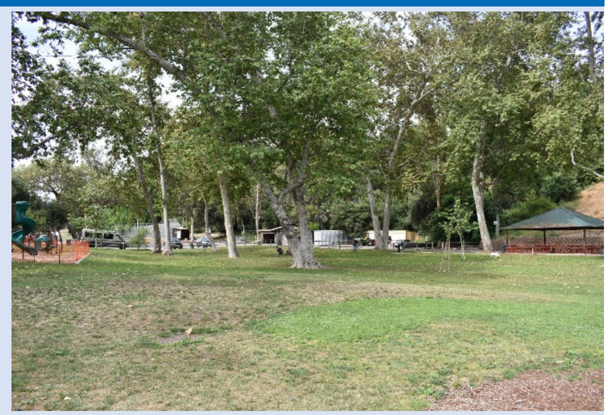
Additional opportunities to capture stormwater runoff by the City will be possible as SCW Program more funding become available. Future opportunities include implementation of stormwater capture projects and green street projects.

9.4.1 Stormwater Infiltration Project Opportunities

City parks provide viable opportunities for larger stormwater capture projects. In areas where groundwater infiltration is limited, stormwater capture and management may be used to offset potable water use, including capture and treatment of stormwater for irrigation of City parks, as well as capture and transfer to the sewer for future recycling at wastewater treatment facilities.

In addition to Arroyo Seco Park discussed above, there are several other parks within the City boundary that may provide additional opportunities for stormwater capture and infiltration projects. Table 9.4 provides a summary for these parks while the locations are depicted on Figure 9.9.

Table 9.4 Summary of City of South Pasadena Parks

Park	Location	Photo
Arroyo Park North	20 acre park located along Stoney Drive, divided into three sections, the upper section (Arroyo Park North), the center (playground and gazebos), and lower section (Arroyo Park South).	
Garfield Park	7 acre park located at Park Avenue and Mission Street.	

Park	Location	Photo
Eddie Park	0.75 acre park located on the southeast corner of Chelten Way and Edgewood Drive.	
Library Park	2 acres surrounding the South Pasadena Public Library and the Senior Center that are bounded by El Centro Street, Diamond Avenue, Fairview Avenue, and Oxley Street.	
Orange Grove Park	2.5 acre park located at Mission Street and Orange Grove Avenue.	
War Memorial Park (Legion Park)	2 acre park located on Fair Oaks Avenue, north of the Arroyo Seco Parkway	

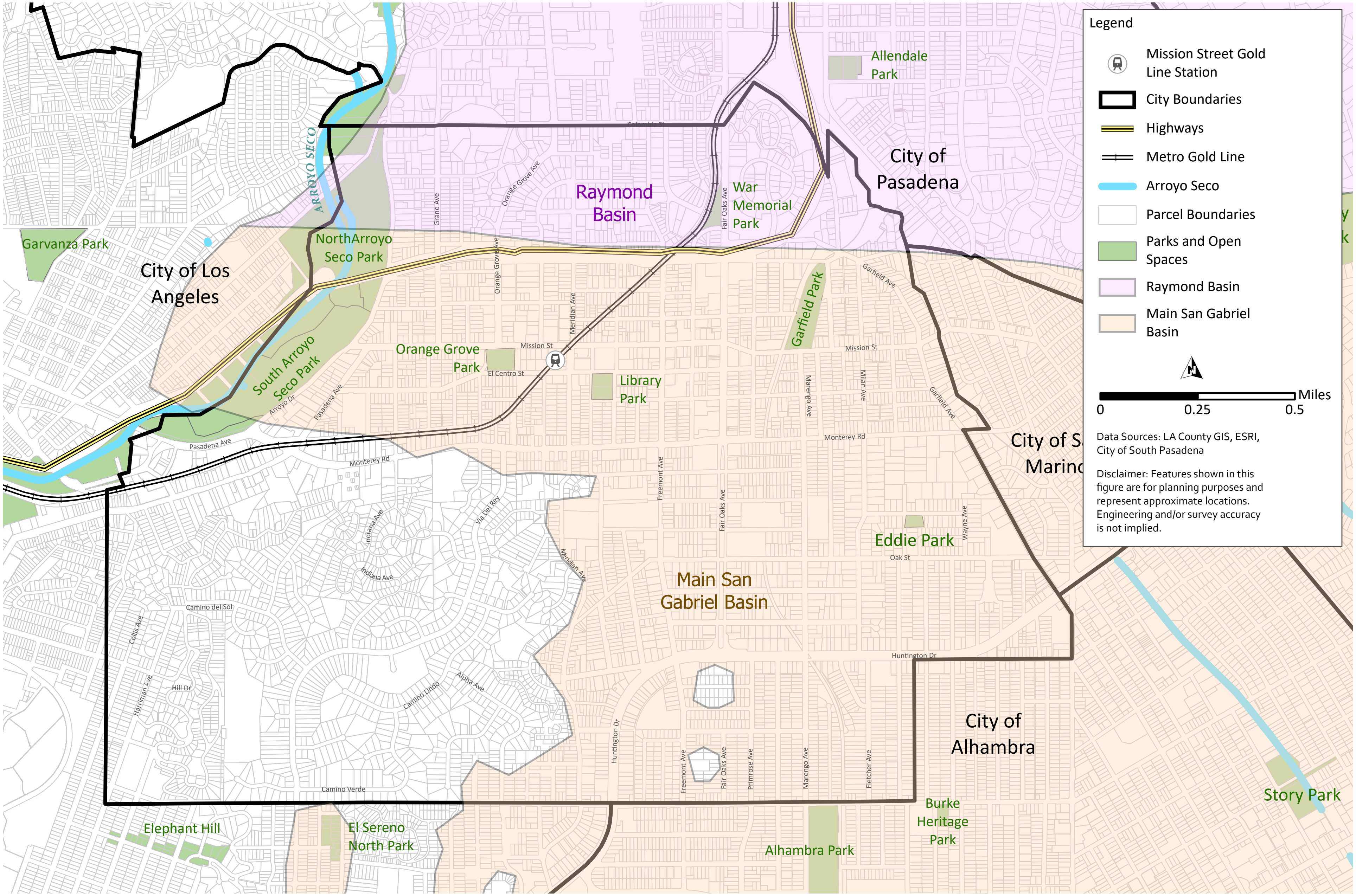


Figure 9.9 Stormwater Infiltration Opportunities

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9.4.1.1 Opportunities in the Main San Gabriel Groundwater Basin

As shown on Figure 9.10, Garfield Park, Eddie Park, Library Park, and Orange Grove Park provide opportunities for stormwater capture for infiltration or reuse within the Main San Gabriel Groundwater Basin. Potential opportunities for each include:

- **Garfield Park** – Stormwater capture for irrigation from nearby storm drains or infiltration; LID components to include bioretention, bioswales and permeable pavement walkways throughout the Park. The natural depression in the center provides storage for stormwater detention with an outlet into the storm drains along Mission Street and Marengo Avenue.
- **Eddie Park** – LID components at the historic Eddie House, group barbecue area, and an open lawn area and small play area to include bioretention, bioswales, and permeable pavement that prevent runoff from leaving a parcel. Rainfall harvest practices such as cisterns can also be used to capture rainwater from the house. There are no existing storm drains along Library Park. Excess stormwater that cannot be captured, would continue to be routed via sheet flow to the storm drain on Oak Street.
- **Library Park** – Stormwater capture for irrigation from nearby storm drains or infiltration; LID components to include bioretention, bioswales, and permeable pavement walkways. Rainfall harvest practices such as cisterns can also be used to capture rainwater from the Library and the South Pasadena Unified School District (SPUSD) building, across the street on the north side of El Centro Avenue. There are no existing storm drains along Library Park. Excess stormwater that cannot be captured, would continue to be routed via sheet flow to the storm drain on Meridian Avenue.
- **Orange Grove Park** -- Stormwater capture for irrigation from nearby storm drains or infiltration; LID components to include bioretention, bioswales, and permeable pavement walkways. Rainfall harvest practices such as cisterns can also be used to capture rainwater from 9,500 square feet recreation building. Excess stormwater flows that cannot be captured, would continue to be routed on the north side of the park to the storm drain on Mission Street, while the south side of the park connects to the storm drain on El Centro Avenue.

9.4.1.2 Opportunities in the Raymond Groundwater Basin

As shown on Figure 9.10, War Memorial Park would provide opportunities for stormwater capture and recharge of the Raymond Groundwater Basin. Potential opportunities at this 2 acre park include LID components on the open lawn area and small play area to include bioretention, bioswales, and permeable pavement in parking areas that prevent runoff from leaving a parcel. Rainfall harvest practices such as cisterns can also be used to capture rainwater from 12,000 square feet War Memorial building. It should be noted that the tributary area of this small park area that overlays the City of South Pasadena is very limited as the boundary with the City of Pasadena is only about 1,000 feet north of this park.

These opportunities may be implemented in conjunction with other infiltration projects such as green street components, which are discussed in the following section.

9.4.2 Green Stormwater Infrastructure Opportunities

Green Streets are distributed structural practices are similar to LID components identified above that are typically implemented as linear bioretention/ biofiltration installed parallel to roadways and shown on Figure 9.10.

These systems receive runoff from the gutter via curb cuts or curb extensions (sometimes called bump outs) and infiltrate it through native or engineered soil media. Permeable pavement can also be implemented in tandem or as a standalone practice, such as in parking lanes of roads.

The ULAR EWMP (see Appendix 6, table 6.C-10) identified approximately 84 linear miles of green street opportunities in South Pasadena that retain runoff from roads and alleys support compliance with the MS4 Permit within the City Limits. In an effort to meet this requirement, the initial focus may be geared towards larger roads to utilize medians and parking lanes for LID improvements.

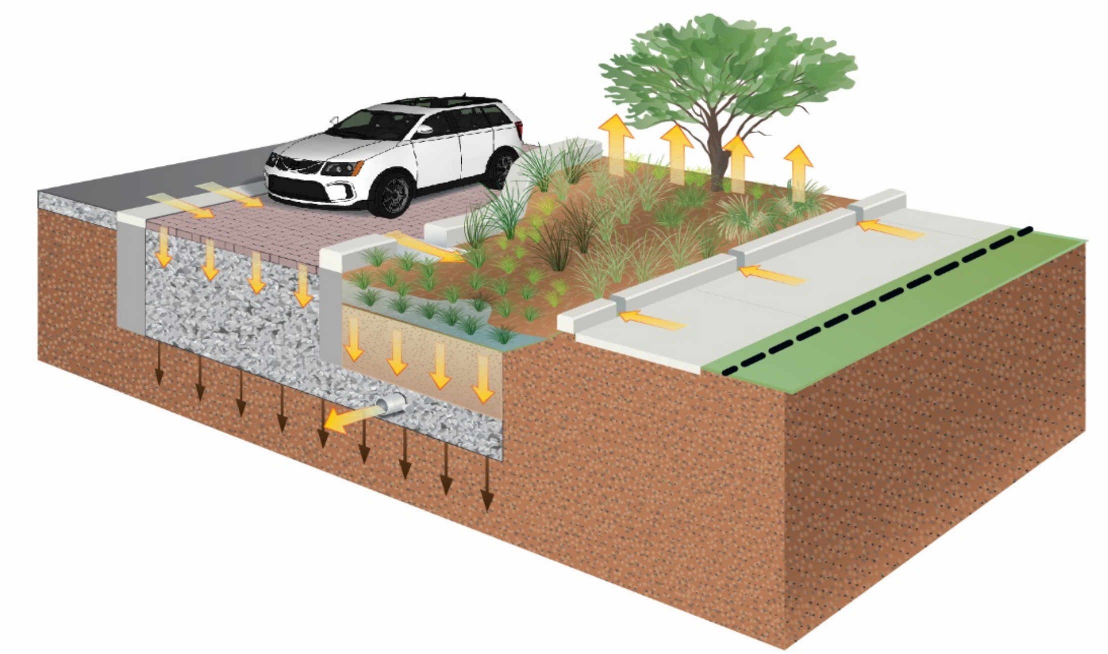

Figure 9.10 Illustration of a Green Street Project

In addition to the Huntington Drive Green Street Project described in Section 9.3.6, stormwater opportunities in the Main San Gabriel Groundwater Basin consist of green street components that include, but are not limited to:

- Develop a green median along approximately 1.0 mile stretch of Fair Oaks Avenue South of the CA-110 interchange.
- Develop a green median along approximately 1.0 mile stretch of Mission Street connecting Fair Oaks Boulevard to Arroyo Seco Park.

Opportunities in the Raymond Groundwater Basin consist of green street components, including, but not limited to:

- Development of a green street and median along the 0.3 mile stretch of Fair Oaks Avenue north of State Route 110 that would enable infiltration to the Raymond

Groundwater Basin. This location is adjacent to Legion Park and could also incorporate green elements and LID components as discussed previously.

9.4.3 Potential Stormwater Management Programs

Green streets are an important strategy that can be used to meet water quality compliance in areas that are fully built out. The City could consider developing a Green Street Master Plan that provides a screening process that identifies areas with the greatest potential via GIS (geographic information system) and quantifies water quality benefits through hydrologic and hydraulic modeling that ranks sites against one another. This plan should be developed in conjunction with roadway improvement plans to allow for cost-effective scheduling of City's capital improvement projects.

9.4.4 Other Opportunities

In addition to the park and green street opportunities detailed above, the City could choose to mandate the use of stormwater BMPs within new development projects to further encourage effective stormwater management within City limits. Internally, the City should continue to implement BMPs similar to those constructed at Garfield Reservoir when undertaking other site improvement projects.

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