Sewer Master Plan

City of American Canyon

May 2016

CITY OF AMERICAN CANYON
SEWER MASTER PLAN
AMERICAN CANYON, CALIFORNIA

Project No. 02536 - 8411338

Prepared for:

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May, 2016

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The Cost Estimates have been prepared for the purpose of establishing budgets and must not be used for any other purpose.

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1. Executive Summary

This *2016 Sewer Master Plan* (SMP) provides the City with an evaluation of the collection system capacity under existing and buildout conditions, and provides recommendations to address hydraulic deficiencies and to accommodate planned growth. The SMP is based on the latest planning information as of December 2015 for land use and known development projects in the planning and approval stages. The master plan was also prepared in collaboration with the City's *2016 Potable Water Master Plan* (PWMP), with the purpose of correlating indoor potable water demands to sewer flows for future development.

Hydraulic evaluation of the sewer collection system was based on flow metering data recorded in early 2014 within the sewer service area (SSA), which includes the City limits and sphere of influence. Measured flows were prepared for use in a hydraulic model to assess the performance of the collection system under various flow conditions including average dry weather flow (ADWF), peak dry weather flow (PDWF), and peak wet weather flow (PWWF). ADWF is the average flow rate over a 24-hour period during dry weather months, and PDWF is the peak flow rate occurring within that same 24-hour period. The PWWF is the peak dry weather flow plus the peak infiltration and inflow rate resulting from a 24-hour, 10-year return frequency design storm. Table 1 provides a summary of sewer collection system flows for each primary sewer basin in the City's collection system. Figure 1 depicts the sewer basins within the collection system.

Table 1 Existing Condition Sewer Flow Rates [1.]

Sewer Basin	ADWF (mgd)	PDWF (mgd)	Peak I/I (mgd)	PWWF (mgd)	PWWF / ADWF
Main Basin 1	0.030	0.040	0.390	0.430	14.3
Main Basin 2	0.120	0.210	0.260	0.470	3.9
Main Basin 3	0.100	0.160	0.980	1.140	11.4
Main Basin 4	0.410	0.710	2.410	3.120	7.6
Sunset Meadows 1	0.220	0.370	4.270	4.640	21.1
Sunset Meadows 2	0.073	0.121	0.433	0.554	7.6
Industrial	0.197	0.325	1.507	1.832	9.3
Totals	1.150	1.936	10.25	12.19	-

1. Flows recorded by V&A from Jan 15 to Mar 6, 2014. I/I rates normalized to 24-hour, 10-year design storm.

Wet weather has the greatest influence on peak flows within the Main Basins 1 and 3, and in the Sunset Meadows Basin, particularly in the Rio Del Mar area. Pipelines in the Rio Del Mar area are some of the oldest pipelines in the collection system and were installed at a time with lesser performance standards for water tightness compared to today's industry standards. Addressing infiltration and inflow (I/I) in this basin would reduce peak capacity requirements in local sewers, as well as all downstream conveyance infrastructure. Other sewer basins having lower I/I rates do not have the same potential for eliminating capacity upgrades because removal of I/I can be a difficult and expensive undertaking, and there is a point of diminishing returns where capacity upgrades become the more cost-effective option.

The primary goal of having adequate conveyance capacity in the collection system is to minimize the chance of having sanitary sewer overflows (SSO) during peak flow events. This can be achieved using two approaches: 1) minimize I/I entering the collection system; and 2) eliminating flow restrictions by replacing undersized pipes and pumps with larger facilities that can handle the

peak flows. The recommended projects addressing hydraulic deficiencies are a combination of both approaches.

The recommended capital improvements plan (CIP) for the sewer collection system addresses current deficiencies and needed improvements to accommodate planned growth. Table 2 lists the CIP projects recommended for the near term (0 to 10 years). These near-term projects are prioritized based on need and benefits to the City. Projects that will reduce I/I entering the collection system are given top priority. The project drivers, funding sources, and estimated cost are provided for each project.

Table 2 Sewer Collection System Near-Term Capital Improvements (0 – 10 Yrs)

CIP Project	Driver	Funding Source	Estimated Cost
SS1 Rio Del Mar Basin	Reduce I/I and reduce peak flow in local sewers and Main Basin PS	Wastewater Operations	$7,170,000
SS2 Napa Logistics and Green Island Pump Station	Increase capacity of Green Island PS, abandon Tower Road PS, and serve airport area development	Wastewater Operations and Wastewater Capacity	$18,800,000
SS3 Huntington Way	Bypass peak flows away from Sunset Meadows PS to the Main Basin PS, and upgrade capacity of bypass sewer	Wastewater Operations	$4,580,000
SS4 Broadway, north of American Canyon Rd	Reduce I/I and peak flows to Main Basin PS, and serve Watson Ranch	Wastewater Operations and Wastewater Capacity	$2,540,000
SS5 Summerfield Project	Improve collection system hydraulics and access	Wastewater Operations	$370,000
SS6 Theresa Ave and Los Altos Dr	Reduce I/I and peak flows to Main Basin PS, and replace/rehabilitate sewers in poor condition	Wastewater Operations	$2,050,000
		Total Near-Term CIP	**$35,510,000**

Project SS1 includes I/I reduction in the Rio Del Mar basin by rehabilitating existing sewer mains, manholes and laterals to create a more watertight collection system. This project consists of wet weather reconnaissance to identify the pipes contributing the highest levels of I/I, as well as pre- and post-construction flow monitoring to measure effectiveness of peak flow reductions. The project is budgeted to rehabilitate 50 percent of the sewers, manholes and laterals in the basin.

Projects SS3, SS4, SS5, and SS6 are budgeted for capacity upgrades and by replacing sewers that are currently leaking, some level of I/I reduction would occur. However, it is recommended that these basins also be investigated as potential targets for I/I reduction projects at the same time investigations are performed in the Rio Del Mar basin. Based on the findings during this wet weather reconnaissance, the City may determine that more extensive I/I reduction could result in cost savings over the capacity upgrade approach. This could have the added benefit of further reducing peak flows at the Main Basin Pump Station (MBPS). Timing is also a consideration because project SS4 serves the Watson Ranch development.

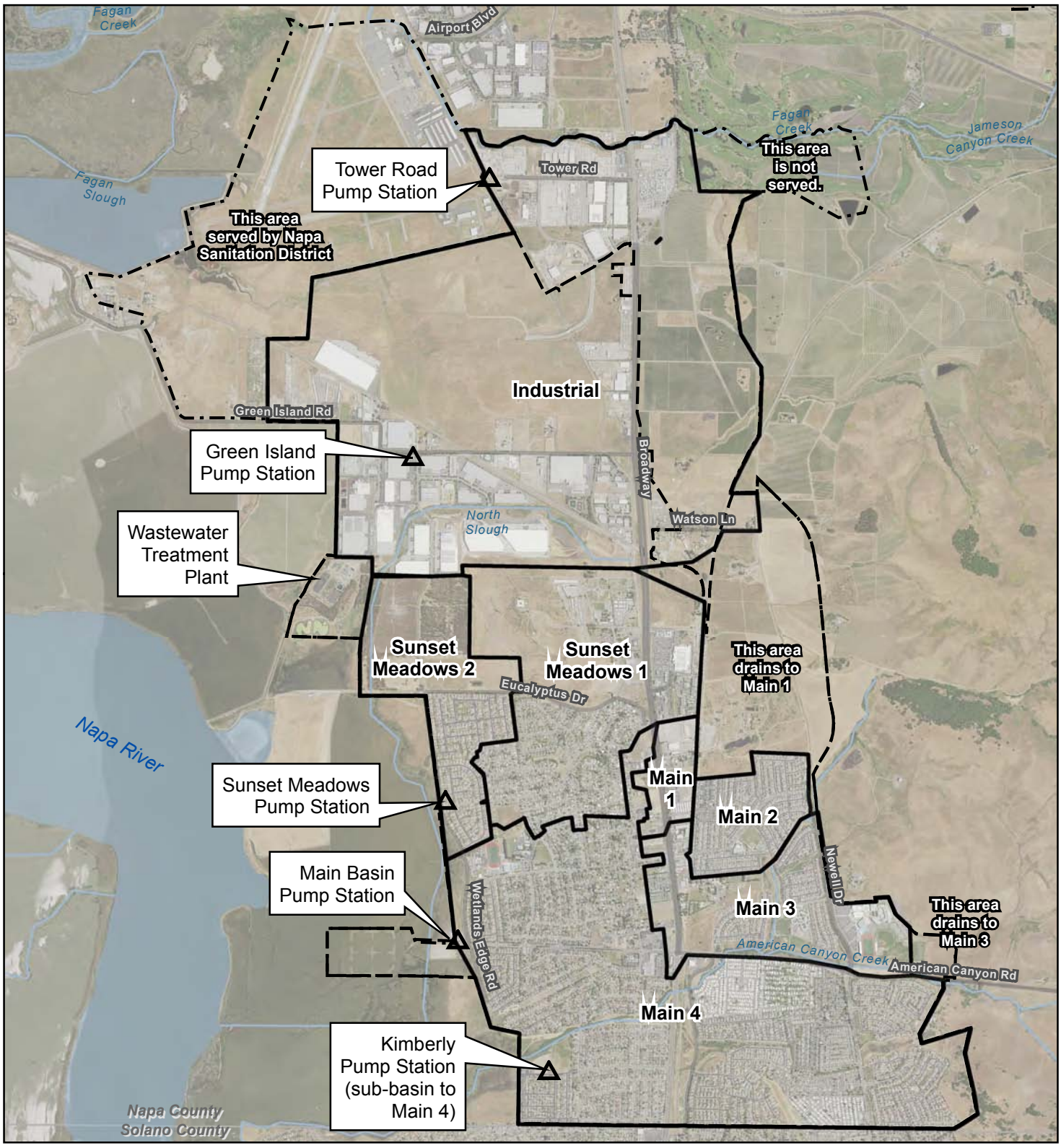
Capital improvement projects that can be implemented over the long-term (11 to 20 years) are also needed to address existing deficiencies and accommodate planned growth, but are not as urgent as the near-term projects. Project SS7, the MBPS, is the highest priority because it serves Watson

Ranch. However, the capacity needed is related to the amount of I/I reduction achieved with the near-term CIP projects. The timing of the Watson Ranch development will impact when project SS7 is completed. Further, an alternative project may be selected for improvements at MBPS, wherein an existing pond could be used to temporarily store peak flow volumes and/or upstream flows could be diverted to the Sunset Meadows Pump Station (which would require upgrade of that pump station). The recommended long-term CIP projects are listed in Table 3, and represent capacity upgrades without factoring for I/I reduction in upstream sewers. The project drivers, funding sources, and estimated cost are provided for each project. The CIP project locations are shown in Figure 2 and detailed summaries are provided in Appendix F.

Table 3 Sewer Collection System Long-Term Capital Improvements (11 – 20 Yrs)

CIP Project	Driver	Funding Source	Estimated Cost
SS7 Main Basin Pump Station	Upgrade capacity to meet peak flows and serve Watson Ranch	Wastewater Operations and Wastewater Capacity	$12,860,000
SS8 Broadway, Cartagena Way to Mobile Home Park Entrance	Address hydraulic deficiency	Wastewater Operations	$680,000
SS9 Elliott Drive south of Northampton	Address hydraulic deficiency	Wastewater Operations	$1,090,000
SS10 Broadway north of Rio Del Mar	Address hydraulic deficiency	Wastewater Operations	$1,030,000
		Total Long-Term CIP	**$15,660,000**

Projects SS8, SS9, and SS10 are all capacity upgrade projects that replace existing sewers with larger diameter pipelines. Although targeted I/I reduction projects could be an option, it is unlikely that the I/I reduction could be done more cost-effectively and there is risk that the I/I reduction would not achieve targeted results. Therefore, it is recommended that the City move forward with capacity upgrades for these three projects.



City Limits

Sanitary Sewer Service Area

Sewer Basins

Pump Station

Paper Size 8.5" x 11" (ANSI A)

0 1,500 3,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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Job Number 8411338
Revision 0
Date 05 May 2016

Sewer Basins

Figure 1

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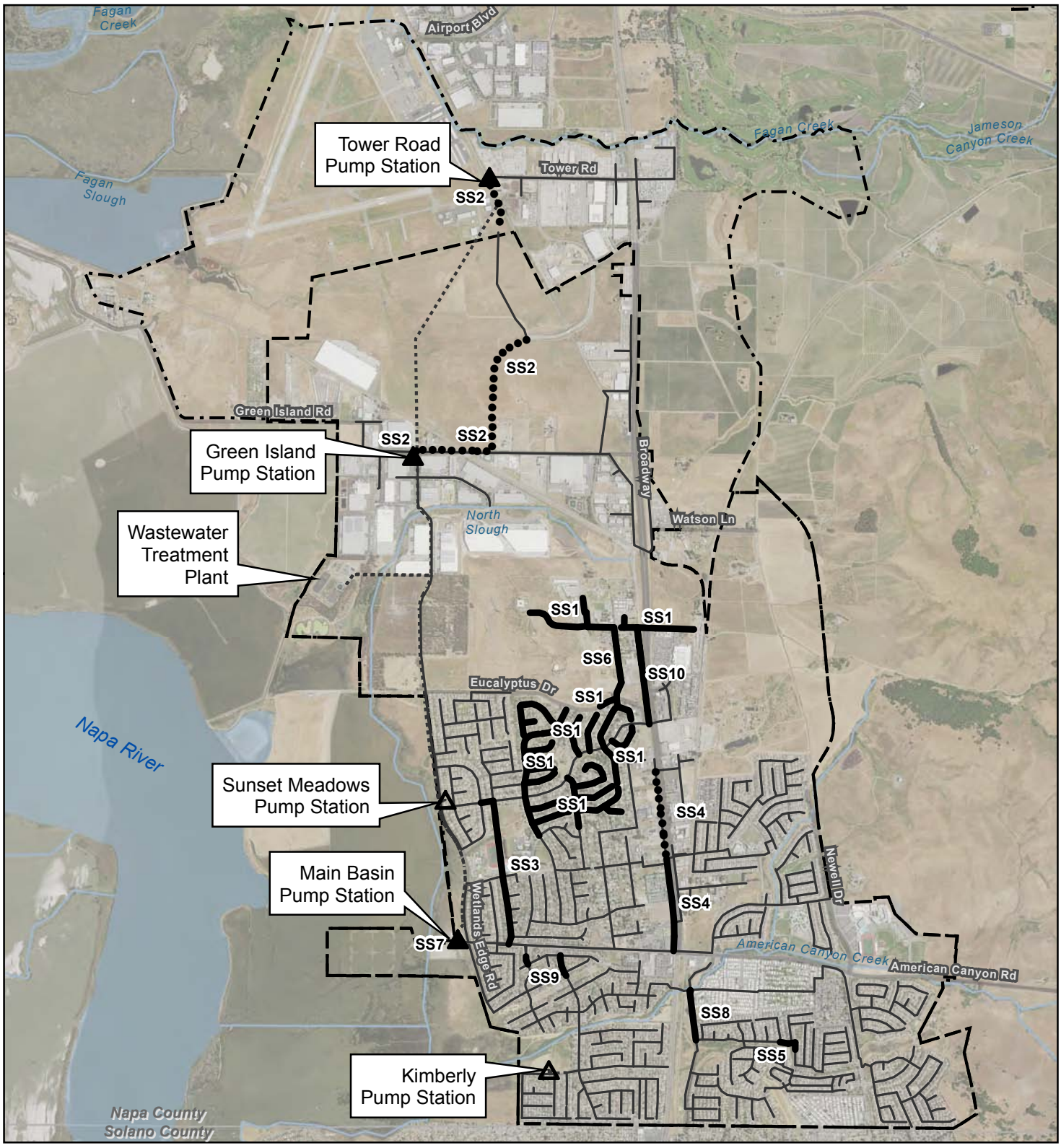
N:\US\Santa Rosa\Projects\02536 - American Canyon\02536-8411338 Master Plan Updates\08-GIS\Maps\Figures\Sewer\Master Plan\Final\Fig 1 - Sewer Basins.mxd

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Sewer System and Customers, 2015. Created by:afisher2



City Limits

Sanitary Sewer Service Area

Existing System:

Gravity Main

Force Main

Pump Station

CIP Projects:

Existing Deficiency

Future Development

Pump Station

Paper Size 8.5" x 11" (ANSI A)

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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Sewer Master Plan

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Date 05 May 2016

Recommended Sewer Capital Improvement Projects

Figure 2

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N:\US\Santa Rosa\Projects\02536 - American Canyon\02536-8411338 Master Plan Updates\08-GIS\Maps\Figures\Sewer\Master Plan\Final\Fig 2 - Recommended Sewer CIPs.mxd

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Sewer System and Customers, 2015; City Limits, American Canyon, 2013; ETSSA, American Canyon, 2016. Created by:afisher2

2. Introduction

2.1 Background

The City of American Canyon (the City) is located in Napa County between the City of Vallejo and City of Napa. Prior to incorporation as a City in 1992, sewer collection and wastewater treatment for the area was provided by the American Canyon County Water District, wherein sewer flows for the area were treated at a facility located at the current Main Basin Pump Station location. In 1975, the City began sending its treated and untreated wastewater to the Napa Sanitation District's wastewater treatment plant. In 2002, the City completed construction of a new water reclamation facility to treat all sewer flows from the City's sewer service area, which is the same basic system layout as today.

The City's sewer collection system serves residential, commercial, and industrial customers and encompasses the City limits and its sphere of influence, which includes a portion of the Airport Industrial Area to the north of the City. The service area also extends east of Highway 29 between Watson Lane to the south and Fagan Creek to the north in unincorporated Napa County.The current area served is approximately 6.3 square miles with an overall potential service area of over 8.5 square miles.

Over time, the sewer collection system has been modified primarily to serve growth. During that time, the collection system has aged and deteriorated, such that peak flows have increased due to the influence of infiltration and inflow (I/I) caused by rainwater and groundwater. Increased flows have caused a reduction in available hydraulic capacity within the collection system, resulting in a higher potential for sanitary sewer overflow (SSO) and reduced capacity to accommodate growth.

The sewer collection system has been studied at various points in time to evaluate system performance, including studies in 1987, 1996, and 2001. These studies are now outdated, as the City's plan for growth has evolved over time. The City is interested in gaining an understanding of system performance that is based on new planning documents, including current growth projections and water demands.

The sewer collection system consists of approximately 53 miles of sewer mains, five pump stations, and 5 miles of sewer force main. The sewer collection system is divided into three primary sewer basins:

- Main Basin: Encompasses the southern portion of the City service area and conveys primarily residential flows to the Main Basin Pump Station (a.k.a., Building E);
- Sunset Meadows: Encompasses the middle portion of the City service area and conveys a combination of residential and commercial flows to the Sunset Meadows Pump Station; and
- Industrial Area: Encompasses the northern portion of the City service area and conveys industrial flows to the Tower Road and Green Island Pump Stations.

The sewer collection system includes gravity pipelines that range in size from 4- to 24-inches in diameter and force mains that range in size from 4- to 18-inches in diameter. Pipelines are constructed primarily of PVC, vitrified clay, and asbestos cement. Flows from the sewer collection system are conveyed to the following pump stations:

- Main Basin Pump Station (MBPS): Located at the western end of American Canyon Road, the MBPS serves approximately 2.4 square miles. Flow is pumped northerly approximately

10,030 feet via an 18-inch force main located at the western edge of the City to the WRF. The capacity of the existing pump station is 3,000 gallons per minute (gpm);

- Sunset Meadows Pump Station (SMPS): Located approximately ½-mile north of the MBPS along Wetlands Edge Road just north of Rio Del Mar. The SMPS serves approximately 1.2 square miles. Flow is pumped approximately 120 feet via an 8-inch force main into the MBPS 18-inch force main. The capacity of the existing pump station is 650 gpm;
- Green Island Pump Station (GIPS): Located at the intersection of Green Island Road and Commerce Boulevard, the GIPS serves approximately 2.3 square miles. Flow is pumped via a 12-inch force main directly into the 18-inch force main located in Commerce Boulevard. The capacity of the existing pump station is 600 gpm;
- Tower Road Pump Station (TRPS): Located at the western end of Tower Road and adjacent to the Napa County Airport, the TRPS serves approximately 0.4 square miles. Flow is pumped directly into the 18-inch force main located adjacent to the railroad. The capacity of the existing pump station is 1,400 gpm; and
- Kimberly Pump Station (KPS): Located in the southwest corner of the City's service area, the KPS serves a small portion of the MBPS (0.06 square miles). Flow is pumped via a 4-inch force main in Kimberly Drive to the gravity sewer system, which flows northerly towards the MBPS. The capacity of the existing pump station is 175 gpm.

Pump stations convey flows to the WRF, which is located at the western edge of the service area adjacent to the Napa River. The WRF treats the wastewater to Title 22 standards and discharges to either the Napa River, via wetlands, or to the City's recycled water distribution system.

2.2 Scope

The purpose of this master plan is to create a new hydraulic model that reflects development that has occurred since the last update in 2001, and identifies system improvements needed to eliminate existing system deficiencies and to enhance the system to accommodate planned growth. Specifically this master plan achieves the following objectives:

- Evaluate hydraulic performance of the existing sewer collection system, including pipelines and pump stations;
- Update existing and projected future sewer flows based on the latest information available from the City; and
- Identify and prioritize capital improvement projects that address current system deficiencies and will meet projected buildout demands.

2.3 References

The following references were provided by the City and used in preparing this master plan:

- Wastewater Collection System Master Plan, West Yost & Associates (December 1996)
- Sanitary Sewer Analysis, Hydroscience Engineers (December 2001)
- Rio Del Mar Sanitary Sewer Project Technical Memorandum, Hydroscience Engineers (October 8, 2004)
- Bay Rock and Newell Scally Sanitary Sewer Impact Analysis Technical Memorandum, Hydroscience Engineers (June 28, 2005)
- Sanitary Sewer Flow Monitoring and Inflow / Infiltration Study, V&A (August 2014)
- Potable Water Master Plan, GHD (May 2016)

3. Utility Land Use Classifications

3.1 Utility Service Area

The City currently provides sewer service to customers located within the City limits, as well as the Airport Industrial Area and a few pockets within the unincorporated County area. Figure 3 shows the boundaries for the American Canyon City Limits and Sphere of Influence as published by LAFCO of Napa County.

The SSA covers the City of American Canyon and its sphere of influence, including the area extending north into the Airport Industrial Area to Fagan Creek. The service area also extends east of Highway 29 between Watson Lane to the south and Fagan Creek to the north in unincorporated Napa County. Figure 4 depicts the SSA as published by LAFCO of Napa County.

3.2 Utility Land Use Classifications

For the purpose of updating the utility master plans, the twenty land use categories listed under the City and County General Plans were consolidated into ten utility land use classifications in order to simplify the process of generating sewer demands. The ten classifications are described in Table 4. Figure 5 depicts the classifications spatially within the City's water and sewer service areas and are based on the City of American Canyon's published Zoning Map (2012) and the County's Land Use Map from the 2009 General Plan (Figure AG/LU-3).

Table 4 Utility Land Use Classifications

Utility Land Use Classifications	Description
Single-family	Single family dwelling units (RE, RR, RS, SP-1SF)
Multi-family	Multi-family dwelling units (RM, RH, PC, SP-1CR)
Commercial	Sale or rental of goods and the provision of services other than classified as public or quasi-public or industrial (CN, CC)
Industrial	Onsite production of goods by methods not agricultural in nature, distribution, warehousing and storage activities, research and development, and vehicle and equipment services other than those classified as commercial (SP-2, L1, G1)
Institutional/Governmental	Public areas, including churches, schools, lodges, and government or public buildings (P)
Landscape	Parks and streetscapes
Open Space	Open space areas, creek areas, water quality basins and detention basins other than landscape (OS)
Watson Ranch	Designated area within the Watson Ranch SPA
Recreation	Areas designated for recreation other than landscape and open space (REC)
Agricultural	Areas used for agricultural production

3.3 Buildout Conditions

Buildout conditions assume that current plans for development projects in the planning and approval stages will be completed and that all other undeveloped land will be developed in accordance with the City Zoning Map and County Land Use Map. Currently identified projects in the planning and approval stages are described below based on information available as of December 2015.

3.3.1 Watson Ranch

This project covers approximately 300 acres in the area shown in Figure 5. The proposed project includes residential neighborhoods with parks and an elementary school, and a mixed use commercial area with a hotel, winery, farmers market and restaurants. Figure 6 shows the Specific Plan Land Use Map from the *Watson Ranch Specific Plan – Administrative Draft* (November 2014) adjusted to the utility land use classifications listed in Table 4. Table 5 provides a breakdown of acres and units by utility land use classification.

Table 5 Proposed Watson Ranch Development Intensity [1.]

Utility Land Use Classification	Acres	Intensity
Single Family	163	1,030 Units
Multi-family	9	223 Units
Commercial	37	200-room Hotel 93.5 ksf Commercial
Landscape	50	Parks
Institutional/Governmental	10	Elementary School 600 Students

1. Acres and intensity from the *Watson Ranch Specific Plan – Administrative Draft* (November 2014).

3.3.2 Highway 29 Priority Development Area (PDA)

The Highway 29 Priority Development Area is about 225 acres along the transportation corridor running north/south through the heart of American Canyon. The City's Zoning Map is consistent with approved PDA land uses and Table 4 depicts the utility land use classifications for estimating future sewer flows, as based on future water demands.

3.3.3 Miscellaneous Projects

Other proposed development projects that were in the planning and approval process as of July 2015 are listed in Table 6 along with estimated sewer flows. These projects will be incorporated into the buildout condition scenarios for the utility master plans.

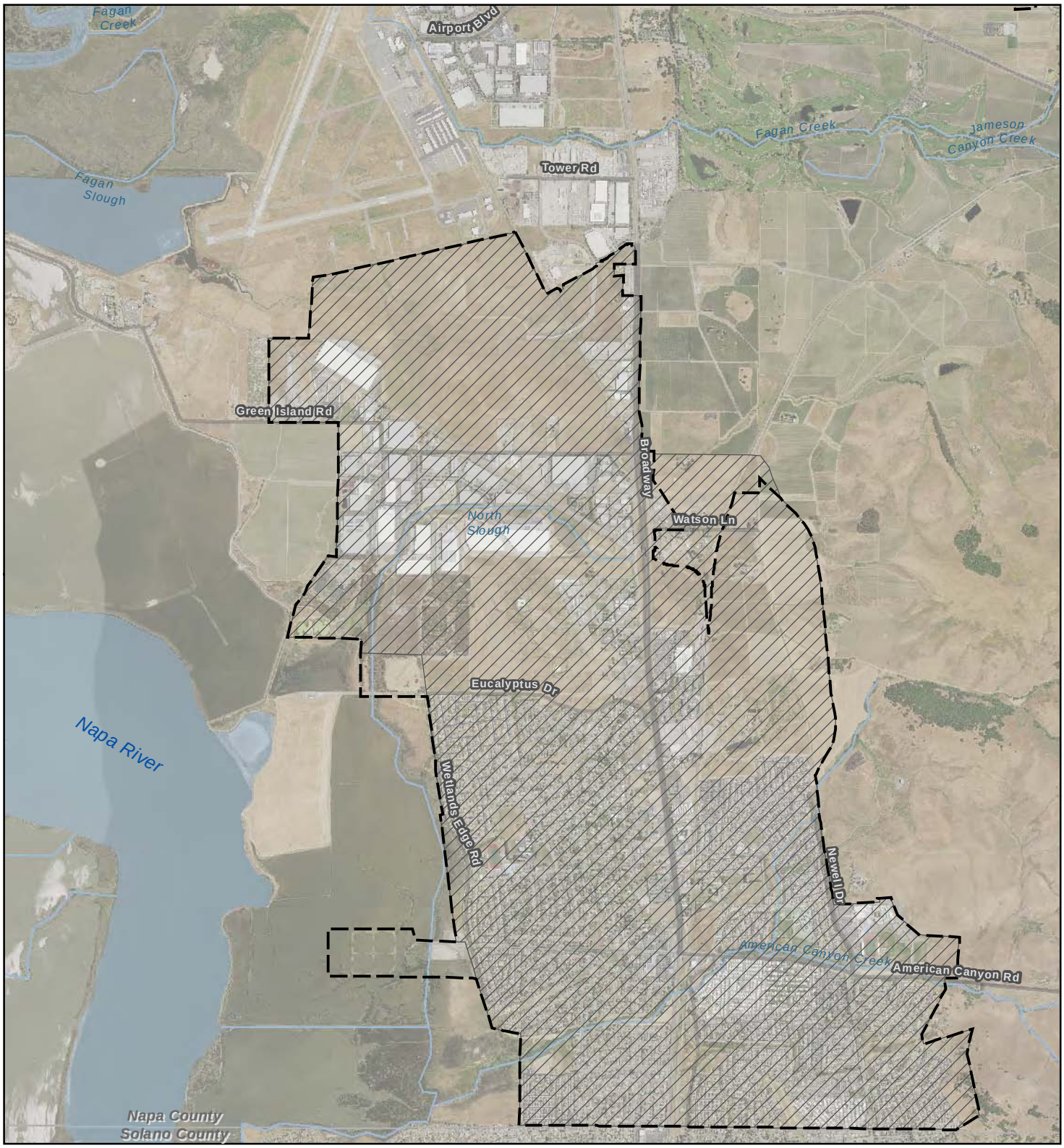
Table 6 Other Proposed Development Projects in Planning and Approval Phase

Project Name	Intensity and Zoning	Estimated Sewer Flow (gpd)
Napa Logistics Park	2,846 ksf Industrial	58,633
Napa Junction III (A-C)	18.5 ksf Commercial 148 Apts. Commercial 100-room Hotel Commercial	2,544 22,923 7,500
Village at Vintage Ranch	158 Apts. Multi-family	30,620
Napa Airport Corporate Center	5 Bldgs. Industrial	4,700
Canyon Estates	38 Homes Single Family	12,000
Valley View	Senior Housing Multi-family	15,300 [1.]
255/256 Lombard Road	Industrial	1,900

1. Estimated.

3.3.4 Other Development

There may be other developments approved between now and General Plan buildout which have not yet been submitted for consideration. For undeveloped property that has the potential for development under the approved General Plans water demands and sewer flows will be estimated using gallons per day per acre based on average demands/flows for developed properties with the same utility land use classification.



City Limits

Sphere of Influence

Source:
Sphere of Influence and City Limits, LAFCO of Napa County, 2013

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Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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City Limits and
Sphere of Influence

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Date 29 Apr 2016

Figure 3

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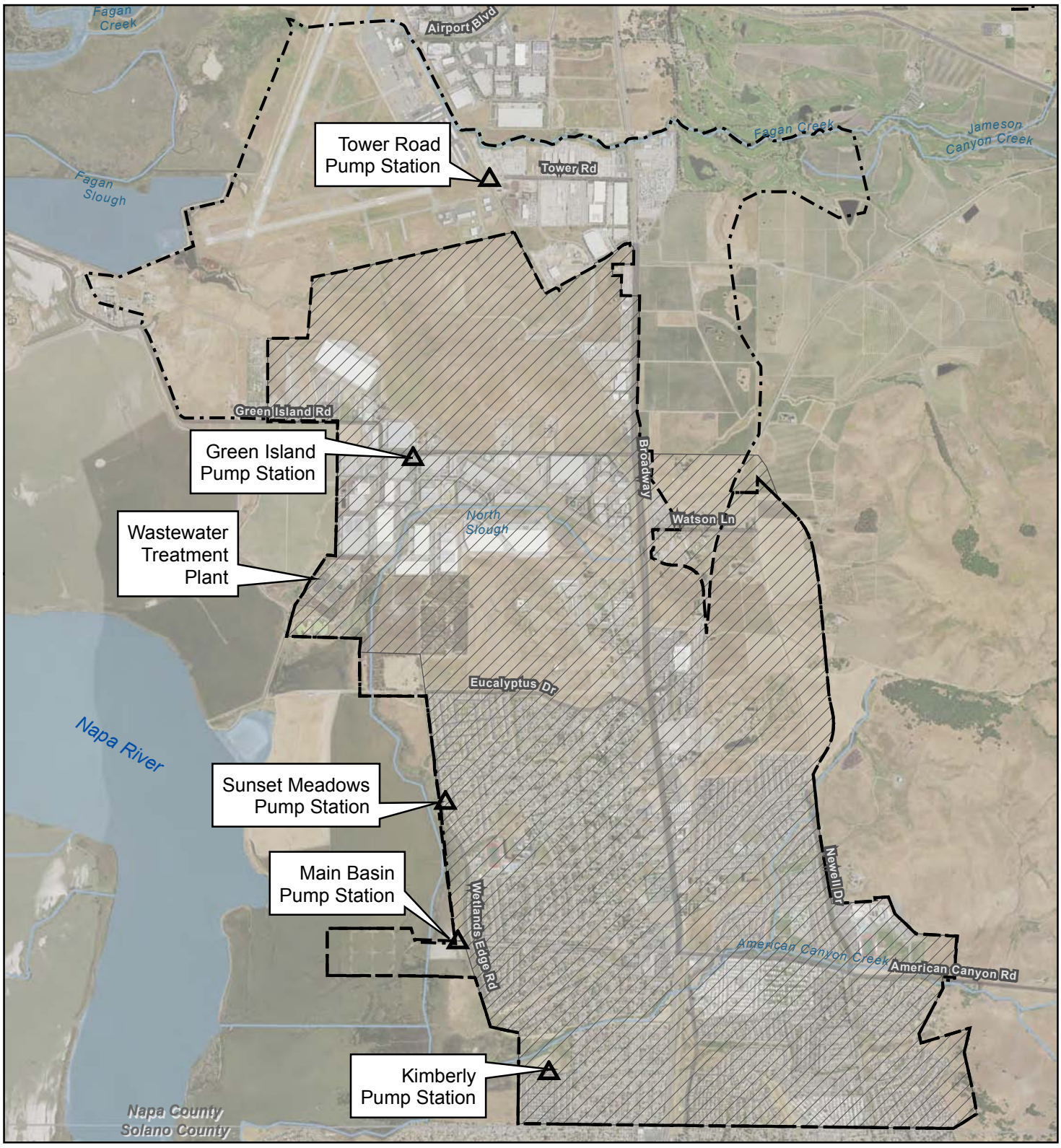
Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; City Limits, American Canyon, 2013. Created by:afisher2



City Limits

Sanitary Sewer Service Area

Sphere of Influence

Pump Station

Source:
Sanitary Sewer Service Area,
LAFCO of Napa County,September, 2014

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Sewer
Service Area

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Figure 4

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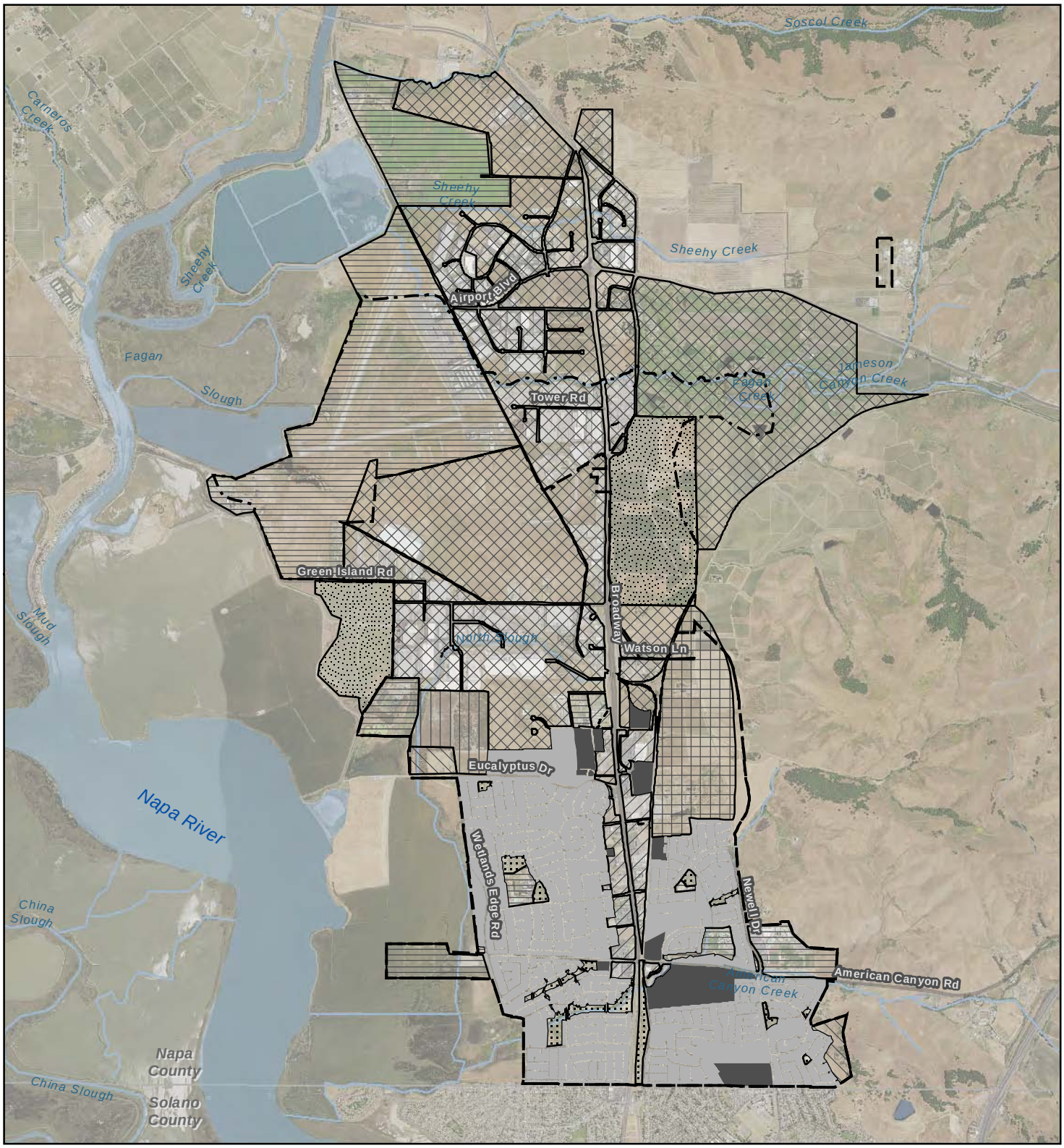

- City Limits
- Sanitary Sewer Service Area
- Agriculture
- Commercial
- Industrial
- Institutional/Governmental
- Landscape
- Multi-Family
- Open Space
- Recreation
- Single-Family
- Watson Ranch

Source:
City Zoning Map, 2012
County Land Use Map, 2009
American Canyon Comments, 2016

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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Utility Land Use Classifications

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Figure 5

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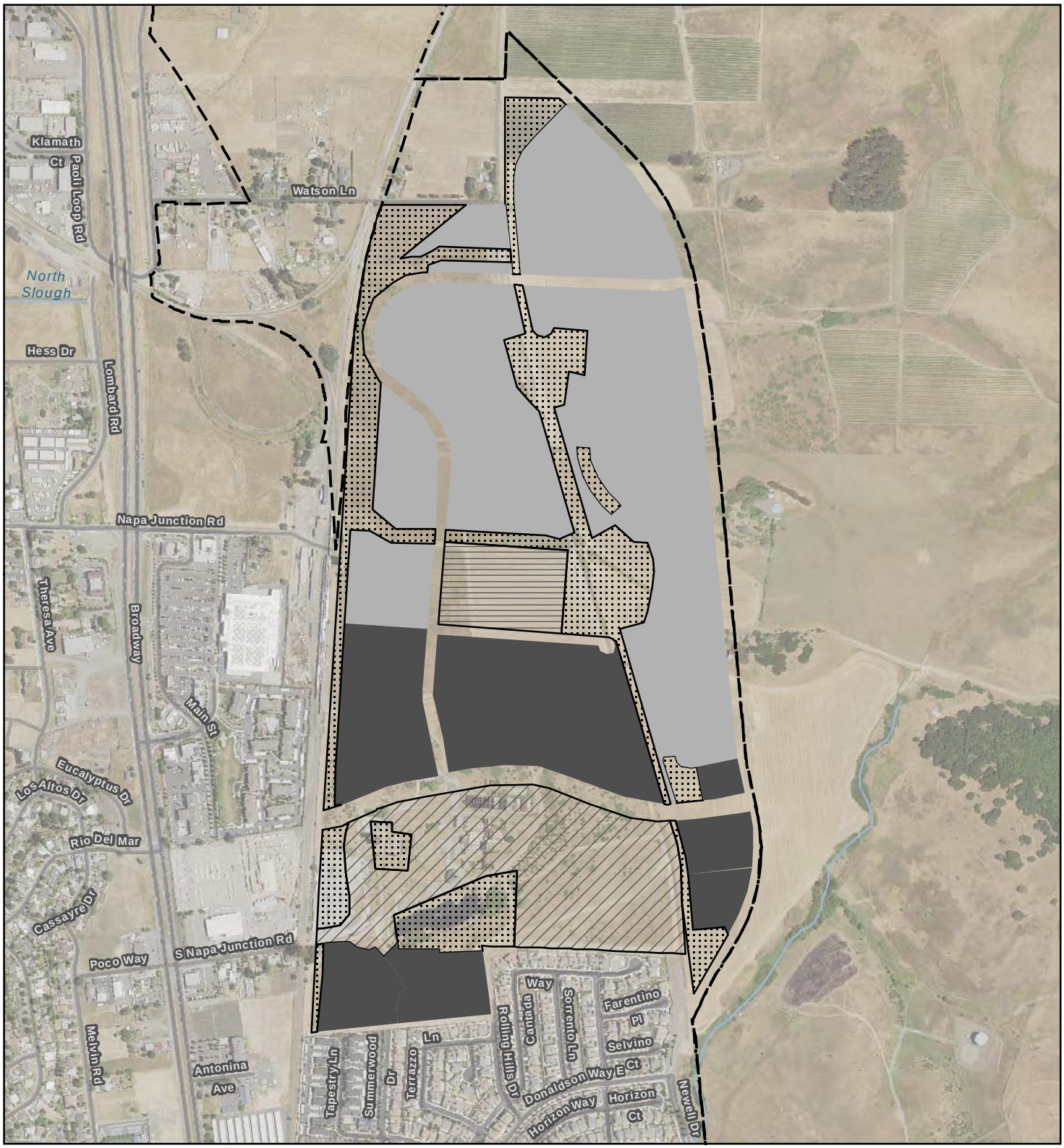
N:\US\Santa Rosa\Projects\02536 - American Canyon\02536-8411338 Master Plan Updates\08-GIS\Maps\Figures\Sewer\Master Plan\Final\Fig 5 - Utility Land Use Classifications.mxd

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Sewer System and Customers, 2015. Created by:afisher2



City Boundary
Sanitary Sewer Service Area
Commercial
Institutional/Governmental
Landscape
Multi-Family
Single-Family

Source:
Watson Ranch Specific Plan - Administrative Draft, Nov 2014

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Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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City of American Canyon
Sewer Master Plan

Watson Ranch
Utility Land Use Classifications

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Figure 6

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N:\US\Santa Rosa\Projects\02536 - American Canyon\02536-8411338 Master Plan Updates\08-GIS\Maps\Figures\Sewer\Master Plan\Final\Fig 6 - Watson Ranch Utility Land Use Classifications.mxd

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Sewer System and Customers, 2015. Created by:afisher2

4. Planning and Evaluation Criteria

4.1 Background

The City has conducted planning and evaluation of the sewer collection system since its incorporation in 1992. In 1996, the City completed the *Wastewater Collection System Master Plan* (West Yost & Associates), for the purpose of establishing capital improvement projects that would eliminate existing system deficiencies and accommodate the growth projected in the City's General Plan. In 2001, the City completed the *Sanitary Sewer System Analysis* (HydroScience Engineers), which focused primarily on evaluating the system's ability to accommodate a 20-year, 24 hour design storm event as requested in the City's 2000 National Pollutant Discharge Elimination System (NPDES) permit for the WRF. Guidelines used in the planning and design of the sewer collection system were developed in these previous studies and updated as necessary for alignment with current industry norms.

The City's *Public Works Department Engineering Standard Plans and Specifications for Public Improvements (Standards)*, dated May 2005, includes minimum design standards for sewer facilities, particularly sewer mains and their appurtenances, primarily for new development. While the Standards adequately delineate guidelines for construction, they do not specifically address overall evaluation and performance of the collection system.

In addition, existing flow rates for the sewer collection system were documented in the *Sanitary Sewer Flow Monitoring and Inflow / Infiltration Study* (V&A, August 2014) and subsequent analysis. V&A's 2014 study focused on system hydraulics downstream of the proposed Watson Ranch development project and included flow monitoring and analysis for the Main Basin. Subsequent analysis included flow calculations for the City's other sewer collection system basins (i.e., Sunset Meadows and Industrial Area).

In order to perform the required hydraulic evaluation of existing and buildout sewer flow scenarios for the collection system and develop the Capital Improvement Plan (CIP), it is necessary to identify planning and evaluation criteria. Development of these criteria enables identification of deficiencies and to judge the effectiveness of alternative improvements. Planning and evaluation criteria include:

- Sewer flow peaking;
- Pipe flow depth to diameter ratio (d/D);
- Pipe material coefficient;
- Minimum and maximum pipe slope and flow velocity;
- Design rainfall event; and
- System reliability goals.

4.2 Planning Criteria

Planning criteria establish the minimum design standards for infrastructure improvements in the sewer collection system. Table 7 lists the planning criteria established for the City's sewer collection system.

Table 7 Sewer Collection System Planning Criteria

Item	Criteria
Flow Scenarios	• Average Dry Weather Flow (ADWF) – the average dry weather wastewater flows (base flow) • Peak Dry Weather Flow (PDWF) – the highest diurnal base flow • Peak Wet Weather Flow (PWWF) – the highest rainfall induced wet weather flow
Wastewater Flow Peaking Factors	• Dry weather peaking factor = PDWF/ADWF • Wet weather peaking factor = PWWF/ADWF; also expressed as the infiltration and inflow (I/I) component of wet weather flow
Pipe Material Coefficient (Manning's "n" Value)	• n = 0.013 for new and existing pipes
Design Rainfall Event	• 10-year, 24 hour recurrence event

4.2.1 Flow Scenarios and Sewer Flow Peaking Factors

Sewer flows were developed by V&A in its August 2014 report and subsequent analysis for the collection system. This included the development of ADWF, PDWF, and PWWF, which were used to develop flow rates for the hydraulic model. Peaking factors were then determined as the ratio between the ADWF, PDWF, and PWWF prepared in V&A's work. These peaking factors were used in lieu of reference standards as they are based on actual City sewer collection system performance as measured between January and March 2014.

Hydraulic modeling for existing conditions used the flows and corresponding peaking factors determined by V&A. The peaking factors were then used to determine PDWF and PWWF for modeling of future conditions, wherein ADWF was determined through analysis of land use water demand converted to sewer flow and that base flow was adjusted using the peaking factors.

A description of each flow rate presented in V&A's analysis and that was used in hydraulic modeling for this master plan is provided below.

Average Dry Weather Flow (ADWF)

ADWF is the normal anticipated dry weather sewer flow. ADWF was determined for each sewer basin by V&A through its flow monitoring analysis of the sewer system.

Peak Dry Weather Flow (PDWF)

PDWF is the peak base flow that occurs during a typical diurnal variation. PDWF was determined by V&A through its flow monitoring analysis of the sewer collection system. The range of dry weather peaking factors for the City that resulted from V&A's flow analysis was 1.33 to 1.75.

Peak Wet Weather Flow (PWWF)

PWWF is the sum of the PDWF and peak I/I flow. PWWF was determined by V&A through its flow monitoring analysis of the sewer collection system.

Per City Standards, I/I is assumed at a rate of 4,000 gallons per day per inch-diameter-mile (GPDIDM) for sewer mains and laterals, which converts to approximately 2.8 gallons per minute per inch-diameter mile (GPMIDM). V&A's analysis estimated I/I distribution at 6 to 55 GPMIDM. The

large range can be attributed to differences between portions of the sewer collection system, including factors such as system age and pipe material.

The 1996 master plan used historical I/I rates to estimate an I/I rate of 600 gallons per day per acre (GPDA). For comparison of this I/I rate to GPMIDM, the I/I rate for the 1,534-acre Main Basin would be 2.0 GPMIDM. Based on flow monitoring, V&A estimated I/I distribution in the Main Basin at 13.9 GPMIDM, which is substantially higher than the 1996 estimate.

4.2.2 Pipe Material Coefficient (Manning's "n" Value)

Pipe capacity depends on many factors, including slope, pipe roughness, and the pipe shape. The Continuity Equation and the Manning Equation for steady-state flow are used to calculate flow in a sewer pipe. The Manning coefficient "n" is a friction coefficient and varies with respect to pipe material, size of pipe, depth of flow, smoothness of pipe and joints, and extent of root intrusion. For sewer pipes, the Manning coefficient "n" typically ranges between 0.011 and 0.017.

City Standards specify a Manning's "n" value of 0.015 for existing sewer mains and 0.013 for new mains. The 1996 master plan used a 0.013 "n" value.

The typical Manning's "n" factor found during research was n=0.013. This factor is relatively conservative for new sewers and accepted by general engineering practice for evaluation of existing sewers. The following sewer agencies use a Manning's "n" of 0.013 for existing and new mains: Napa Sanitation District, Dublin San Ramon Services District, Union Sanitary District, City of Vacaville, City of Santa Rosa, City of Rohnert Park, City of Healdsburg, and Town of Windsor.

Use of the City's Standard of 0.015 for existing sewer mains, together with the d/D standard presented in Section 4.3 may present overly conservative estimates of hydraulic deficiency in the sewer collection system.

Manning's "n" value of 0.013 is used in this master plan for evaluation existing and new sewer mains.

4.2.3 Design Rainfall Event

Modeling analyses are based on a design rainfall event, defined as the rainfall associated with a specific return frequency rain event. Design rainfall events typically are 10-year events (a storm event likely to occur once in ten years), although some sewer agencies consider a 20-year event for large trunk sewers. The duration of the event used for modeling purposes can vary from 4 to 24 hours, or longer, as based on review of the contribution of I/I to the collection system. For example, a collection system with a high contribution of infiltration is best represented by a longer duration, typically 24 hours.

The 1996 master plan (West Yost) used a 5-year, 4 hour design storm event, as that was the design storm used by the City for prior master planning analyses (CH_2Mhill 1996 I/I Reduction Analysis). That storm event was selected based on correlation with the peak I/I rate for the Main Basin between the 1996 I/I Reduction Analysis and estimated peak I/I rates prepared by West Yost using circular chart records from the Parshall Flume at the Main Basin Pump Station.

V&A's synthetic hydrograph analysis, which was based on flow monitoring data collected in 2014, produced a good correlation with a 10-year, 24 hour design storm event per the NOAA Precipitation-Frequency Atlas of the Western United States (NOAA Atlas). V&A's report also notes a good fit for the 10-year, 24 hour design storm event with NOAA Atlas 2-hour and 6-hour durations.

4.2.4 Pump Stations and Force Mains

The following criterion applies to the City's sewer pump stations and force mains:

- Firm Capacity: PWWF served with largest pump out of service and primary power down
- No. of pumps: duty pumps as needed for range of flows, two minimum; one standby
- Force Main Flow Velocity: Maximum velocity at 7 fps

4.3 Evaluation Criteria

Evaluation criteria set the minimum conditions that must be met for the sewer collection system include pipe capacity and flow velocity. Table 8 lists the evaluation criteria established for the City's sewer collection system.

Table 8 Sewer Collection System Evaluation Criteria

Item	Criteria
Pipe Capacity (d/D Ratio)	• Capacity of gravity sewers calculated by the Manning Equation • d/D = 0.75 for sewer mains 10-inch diameter and smaller • d/D = 0.5 for sewer mains 12-inch diameter and greater
Minimum and Maximum Pipe Slopes and Flow Velocities	• Minimum velocity = 2.5 feet per second (fps) for gravity mains flowing full • Minimum slope = 0.5% for 8" gravity mains • Maximum slope = 15% for gravity mains • Maximum velocity = 7 fps for force mains

4.3.1 Pipe Capacity (d/D Ratio)

- The design capacity of a pipeline is often determined by a set ratio of the design flow depth "d" to the pipeline diameter "D", or "d/D". When designing gravity sewer pipelines, it is common practice to set flow depth criteria by the size of the pipeline. Design d/D ratios typically range from 0.5 to 0.9. The maximum capacity of gravity sewers occurs at a d/D ratio of about 0.9, but using something less provides a safety factor for the potential build-up of solids before scheduled maintenance can occur, regardless of the pipe diameter.
- City Standards conform to this typical range and are used in this master plan. Standards include a d/D ratio of 0.75 for new sewer mains 10-inch diameter and smaller and 0.5 for sewer mains 12-inch diameter and greater.

4.3.2 Minimum and Maximum Pipe Slopes and Flow Velocities

Per City Standards, and as used for this master plan, the minimum slope for 8-inch sewers is 0.5%, or 0.5 feet per 100 feet. The minimum design slope for larger diameter sewers is based on achieving a minimum flow velocity of 2 fps when the pipe is flowing full. Hydraulic evaluation of the existing sewer collection system uses PDWF velocity to identify areas with low velocity which require additional cleaning or maintenance. The maximum slope for gravity sewers is 15%, or 15 feet per 100 feet. The minimum slope for sewer laterals is 2.0%, or 0.25 feet per foot.

City Standards do not specifically address maximum velocity in sewer pipelines. Maximum velocity is typically not recommended to exceed 7 fps for gravity and force mains due to the potential for liquids and solids to separate in the flow.

5. Sewer Flows

5.1 Methodology

Estimated flows for the City's sewer collection system are based on various data including water billing records, flow monitoring data collected by V&A Consulting Engineers (V&A) in 2014, WRF flow data, and land use information for planned developments provide by the City.

For hydraulic evaluation of the wastewater collection system, PDWF and PWWF are loaded into model scenarios for existing and future conditions. The PDWF and PWWF for existing conditions are based on the flow monitoring work performed by V&A with the PWWF normalized to the design storm. The PDWF for each basin is then distributed throughout each basin based on the distribution of indoor potable water demand established from water billing records. Estimated I/I is distributed by inch-diameter-mile of pipe in each basin. Having the base and peak flows established for existing conditions, estimated base flows for future development are then added to simulate the buildout conditions.

The sewer collection system is split into three primary sewer basins shown in Figure 7. Sewer flow patterns vary in each sewer basin, with the base and peak flows varying depending on several factors including land use type (i.e., industrial vs. residential customers) for base flows and the condition of the existing sewer mains for peak flows. Therefore each basin has its own unique base flows and peaking factors that are established from measured flows.

5.1.1 Flow Meter Data

Flow meter data provides the basis for the cumulative base and peak flows in each collection system sewer basin. V&A prepared estimates for base flow (ADWF), PDWF, and PWWF for the Main Basin and Sunset Meadows Basin following the flow monitoring effort that was conducted between January 15 and March 6, 2014. The flow meter data recorded by V&A correlates to the City's WRF influent meter data for the same time period. For the Industrial sewer basin V&A used the City's flow meter at the WRF to determine ADWF, PDWF and PWWF in that basin. V&A's *Sanitary Sewer Flow Monitoring and Inflow / Infiltration Study* (2014) and subsequent analysis for the Industrial Basin are provided in Appendix A.

The V&A flow meter data captures one major storm event that occurred from February 6 to 9, 2014 that generated significant I/I flows. With the diurnal base flows already established, the I/I component could be isolated for each basin. I/I flow is based on a synthetic hydrograph analysis for a 10-year return frequency, 24-hour duration design storm event, with NOAA data providing the basis for the 10-year, 24-hour rainfall total. Having established the normal dry weather diurnal flow patterns in each basin the peak wet weather I/I component for the design storm is added to the PDWF to establish the PWWF.

5.1.2 Water Billing Records

Water billing records provide the basis for distributing ADWF within each sewer basin. Records for the period August 2013 through July 2014 are used to establish recent water demand patterns and additional analysis is performed to differentiate between winter demands (December through February) and summer demands (July through September). From this analysis and discussions with City staff to identify process water demands for industrial customers, estimated indoor water demands are estimated for each account. Estimated indoor water demands for each customer are used as the basis for distributing ADWF sewer flows within each basin.

Commercial and industrial customers utilizing process water are generally located in the northern portion of the City's sewer service area, within the Industrial sewer basin. Process water accounts for approximate forty-five percent of the water demand in this basin. Process water was subtracted from potable water demands when determining indoor water use and sewer flows.

5.1.3 Hydraulic Model Flow Distribution

Distribution of flows within the collection system for hydraulic modeling is based on two factors:

1. Measured base flows for each sewer basin were distributed based on indoor water use determined from evaluation of water billing data.
2. I/I flows are distributed within each sewer basin based on inch-diameter-mile of pipe. This methodology is modified in some locations where specific information was provided by the City that would scale I/I flows up or down (i.e., areas of known high wet weather flow).

Base flows are aggregated into model nodes by associating nodes (i.e., manholes) with contributing parcels. The PDWF is calculated by using the peaking factors measured by V&A in each basin and applied to ADWF for the node. The I/I component is added to the pipelines.

5.1.4 Future Conditions

For the General Plan buildout scenario the existing wastewater flows are updated to account for planned development projects and buildout of undeveloped parcels in accordance with the City's zoning map. Development projects in the planning and approval phase as of December 2015 were identified by the City including estimated wastewater flows for each project. Wastewater flows for undeveloped parcels are projected based on unit demand factors estimated from indoor water demands by utility land use category. In aggregate, these modified demands represent the buildout scenario.

Peaking factors for dry weather flow are based on existing conditions peaking factors. I/I flows are assumed to remain constant within each sewer basin, even though the number of pipelines and potential sources for I/I increases with development. This assumption is based on increases in I/I from new development and elsewhere in the collection system being countered by decrease in I/I from repair and rehabilitation of the wastewater collection system. It is assumed that over time the City will manage the system such that I/I does not increase.

5.2 Existing Sewer Flows

The following section provides a summary of existing sewer flows for each sewer basin. Flows are presented in ADWF, PDWF, and PWWF. Various factors are also provided to give context to these base and peak flows, including the estimated quantity of wet weather flow contribution (Peak I/I) and the ratio between PWWF and ADWF. Sewer flow unit demands are also provided for each utility land use classification to provide a basis for determining future condition flows.

5.2.1 Summary of Existing Sewer Flows

Sewer flow rates for each sewer basin are presented in Table 9. An estimation of I/I flow was determined by V&A through the evaluation of metered flows and the preparation of 10-year, 24-hour design storm synthetic hydrograph for each basin. The ratio between PWWF and ADWF provides insight regarding general collection system capacity within a sewer basin, wherein the higher the ratio, the higher the likelihood for capacity deficiencies.

Table 9 Existing Condition Sewer Flow Rates [1.]

Sewer Basin	ADWF (mgd)	PDWF (mgd)	Peak I/I (mgd)	PWWF (mgd)	PWWF / ADWF
Main Basin 1	0.030	0.040	0.390	0.430	14.3
Main Basin 2	0.120	0.210	0.260	0.470	3.9
Main Basin 3	0.100	0.160	0.980	1.140	11.4
Main Basin 4	0.410	0.710	2.410	3.120	7.6
Sunset Meadows 1	0.220	0.370	4.270	4.640	21.1
Sunset Meadows 2	0.073	0.121	0.433	0.554	7.6
Industrial	0.197	0.325	1.507	1.832	9.3
Totals	1.150	1.936	10.25	12.19	-

1. Flows recorded by V&A from Jan 15 to Mar 6, 2014. I/I rates normalized to 24-hour, 10-year design storm.

Approximately 40 percent of the total sewer collection system I/I is found in the Main Basin, or 80 percent when including wet weather overflow into the Main Basin from Sunset Meadows 1 Basin. The ratio of PWWF to ADWF, or wet weather peaking factor, is highest in Sunset Meadows 1 Basin, which makes that basin a high priority for identifying potential capacity deficiencies and I/I rehabilitation projects.

5.2.2 Evaluation of Sewer Flows

Existing base sewer flow rates (ADWF) by utility land use category are provided in Table 10 on a "per acre" basis. They represent the average of the ADWF per acre for each parcel served within the utility land use category.

Table 10 Existing ADWF by Utility Land Use Classification

Utility Land Use Classification	Total Parcels Served (acres)	ADWF (gpd/acre)
Single-family	834	1,008
Multi-family	89	657
Commercial	132	1,283
Industrial	566	247
Institutional/Governmental	100	179
Landscape	0	0
Open Space	0	0
Watson Ranch [1.]	11	50
Commercial	0	0
Agricultural [2.]	241	<1

1. Includes existing residence on two of the Watson Ranch parcels.
2. Includes existing residence on the Green Island Vineyard parcel.

5.3 Future Sewer Flows

Future flows are based on planned development projects and buildout of undeveloped parcels in accordance with the City's zoning map. Anticipated development includes completion of the Watson Ranch and Napa Valley Ruins & Gardens project, buildout of the Highway 29 Priority Development Area, completion of known development projects currently in the planning and approval process, and buildout of undeveloped parcels. Future ADWF for known projects utilized estimated flows provided by the City. For all other undeveloped parcels where future flows are unknown, future

ADWF is estimated by using projected potable water indoor use by utility land use classification from the PWMP. Figures 8 through 10 show the locations of the projects and parcels contributing to future sewer flows. ADWF unit flows are converted to PDWF based on peaking factors determined by V&A for existing conditions.

Peak I/I flows for the design storm are assumed to remain constant within each sewer basin, where potential increases are offset by system rehabilitation projects completed by the City to remove I/I. The City may even reduce I/I in Sunset Meadows 1 Basin or Main Basin 4 over time, but since development could occur faster than I/I reduction it is assumed that it will remain unchanged for modeling hydraulic conditions.

5.3.1 ADWF Unit Flows by Utility Land Use Classification

- ADWF unit flows for future development are presented in Table 12. These unit flows are applied in all cases of new development except for development projects in the planning and approval stages, where projected flows have already been established with the City. They are equivalent to the potable water indoor use factors stated in the City's PWMP.

Table 11 ADWF Unit Flow Factors for Future Development

Utility Land Use Classification	ADWF [1.] (gpd/acre)
Single-Family	1,415
Multi-Family	2,800
Commercial	900
Industrial	370
Institutional/Governmental	170
Watson Ranch	-

1. ADWF unit flow factors are based on indoor potable water use as presented in the City's PWMP, Table 12.

- Unit flows are typically applied on a per acre basis to undeveloped parcels based on utility land use classifications. Unit flows are not established for landscape, open space, recreation, and agricultural land use classifications.

5.3.2 Watson Ranch

Watson Ranch is a mixed-use project which consists of approximately 300 acres east of the railroad tracks, north of Vintage Ranch and south of Watson Lane, as shown in Figure 8. Future sewer flows for Watson Ranch were estimated using information provided by the City for the *Watson Ranch Specific Plan – Administrative Draft, Table 2-3* (November 2014) as a guideline. Table 13 provides a summary of the estimated sewer ADWF by utility land use classification. Estimated ADWF was assigned to parcels based on percent of total area for the project.

Table 12 Estimated Sewer ADWF for Watson Ranch

Utility Land Use Classification	Units	Acres	ADWF (gpd)	ADWF (gpd/acre)
Single-Family	1,030	163	273,980	1,680
Multi-Family	223	9	35,680	3,965
Commercial	-	37	22,821	617
Institutional/Governmental	-	10	3,600	360
Total			**336,081**	

5.3.3 Highway 29 Priority Development Area (PDA)

The Highway 29 Priority Development Area (PDA) consists of development along the Highway 29 Commercial Corridor, as shown in Figure 8. Future development within the PDA was estimated by identifying undeveloped parcels and then calculating ADWF for those parcels based on utility land use classification and corresponding unit flow factors from Table 12. A summary of existing and buildout flows for the PDA is provided in Table 14.

Table 13 Estimated Sewer Flow ADWF for Highway 29 PDA

Utility Land Use Classification	Existing Conditions		Buildout Conditions	
	Acres	ADWF (gpd)	Acres	ADWF (gpd)
Multi-Family	8	3,306	18	29,810
Commercial	104	66,654	143	101,205
Industrial	14	51	144	4,097
Institutional/Governmental	7	264	8	1,739
Total	**133**	**70,275**	**313**	**136,851**

5.3.4 Other Known Development Projects

The City provided estimated future flows for several known development projects currently in the planning and approval stage. These projects are shown in Figure 9 and the estimated ADWF as of December 2014 is presented in Table 15.

Table 14 Estimated Sewer Flow ADWF for Other Known Projects

Other Known Development Projects	Acres	ADWF (gpd)
Napa Logistics I & II	218	35,178
Napa Junction III (A-C)	17	32,967
Village at Vintage Ranch	8	30,620
Napa Airport Corporate Center	37	4,700
Canyon Estates	70	12,000
Valley View Senior Housing [1.]	3	8,400
255 Lombard	3	275
265 Lombard	3	305
Total	**359**	**124,445**

1. Estimated based on 3 acres of Multi-Family demand.

The City is considering building a winery waste receiving station at the location of the Tower Road Lift Station. The waste would be hauled from interested wineries to the City's facility in tanker trucks, and then pumped into the collection system for conveyance to the WRF for treatment. The City would control the number of vehicles received on any given day, and the timing of when they would be received. The hydraulic model assumes a 250 gpm future loading rate for the facility.

5.3.5 Undeveloped Parcels

Undeveloped parcels as of July 2014 that are not otherwise included in another development project were assumed to be developed for the buildout scenario. For these parcels, the acreage was multiplied by the unit demand factor for the appropriate utility land use classification in order to estimate the ADWF. Table 16 presents the estimated ADWF for undeveloped parcels by utility land use classification.

Table 15 Estimated Sewer Flow ADWF for Undeveloped Parcels

Undeveloped Parcels	Acres	ADWF (gpd)
Single Family	54	76,679
Industrial	393	141,608
Watson Lane Annexation [1.]	11	12,427
Total	**458**	**239,114**

1. Two parcels at north end of Watson Ranch are not included in the Specific Plan.

5.4 Summary of Sewer Flows

A summary of the existing and buildout sewer flows is presented in Table 17. According to the *Final Urban Water Management Plan, 2010* the population of the City under buildout conditions will be 30,426. This equates to a per capita ADWF of 62 gpd. Table 18 provides flow rates for buildout conditions by sewer basin.

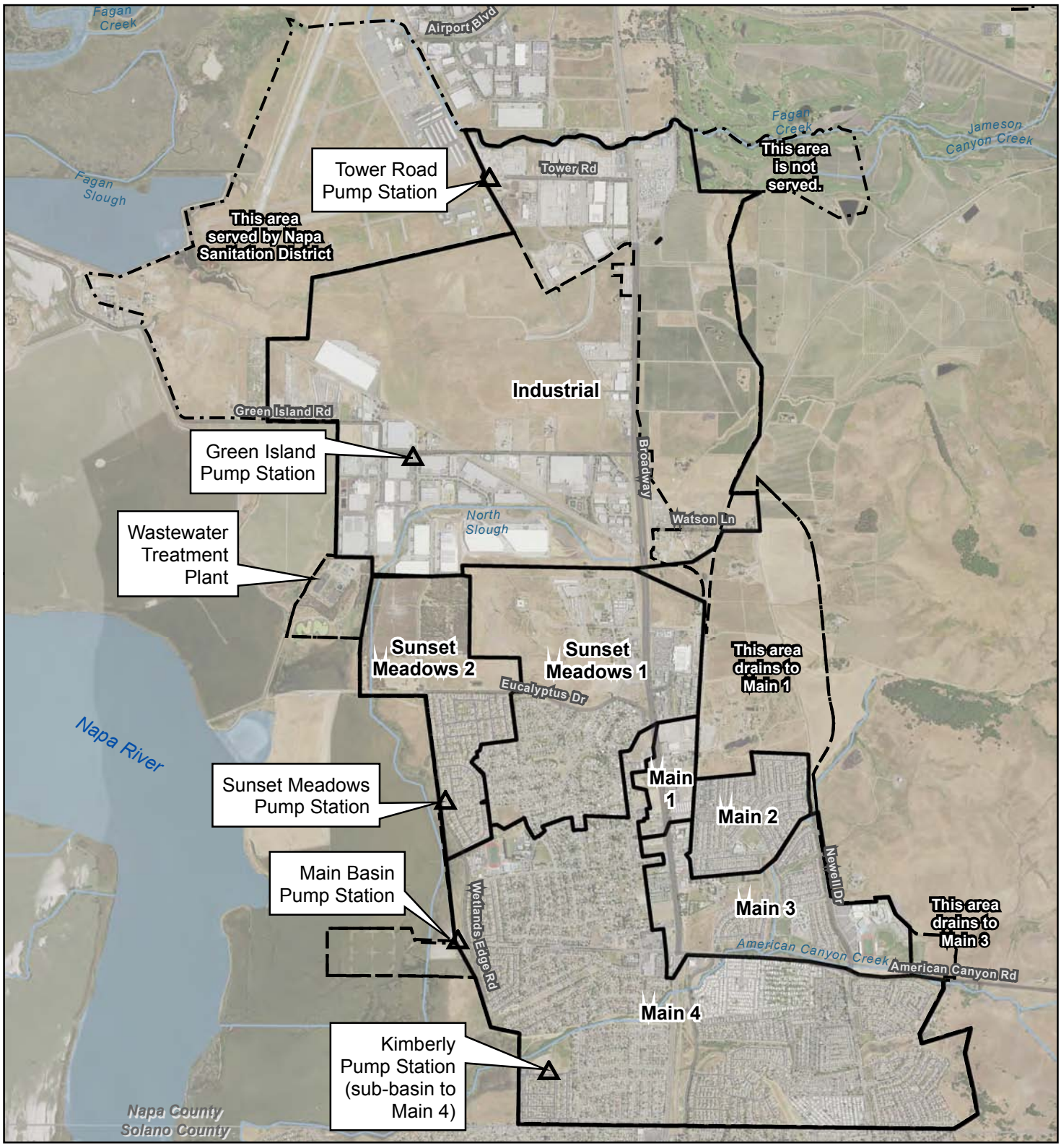
Table 16 Summary of Sewer Flows

Utility Land Use Classification	Existing Conditions		Buildout Conditions	
	Acres Served	ADWF (gpd)	Acres Served	ADWF (gpd)
Single-Family	827	750,130	951	838,809
Multi-Family	96	73,221	132	171,711
Commercial	132	116,134	171	150,685
Industrial	566	191,540	1,243	381,215
Institutional/Governmental	100	12,585	109	14,061
Landscape	0	0	0	0
Open Space	0	0	0	0
Watson Ranch	11	267	302	336,114
Recreation	0	0	0	0
Agricultural	241	62	241	62
Total	**1,973**	**1,143,939**	**3,149**	**1,892,658**

Table 17 Buildout Conditions Sewer Flow Rates

Sewer Basin	ADWF (mgd)	PDWF (mgd)	Peak I/I (mgd)	PWWF (mgd)	PWWF / ADWF
Main Basin 1	0.378	0.504	0.390	0.894	2.4
Main Basin 2	0.132	0.231	0.260	0.491	3.7
Main Basin 3	0.140	0.225	0.212	0.437	3.1
Main Basin 4	0.414	0.717	2.410	3.127	7.6
Sunset Meadows 1	0.372	0.626	4.270	4.896	13.2
Sunset Meadows 2	0.102	0.169	0.433	0.602	5.9
Industrial	0.575	0.948	1.507	2.455	4.3
Totals	2.113	3.420	9.48	12.90	-

With I/I assumed to remain constant from existing to buildout conditions, the wet weather peaking factor (PWWF/ADWF) is lower for each basin (i.e., Main Basin 1 reduced from 14.3 to 2.4). Maintaining I/I levels within the sewer collection system allows for growth (increase in ADWF). I/I contribution for the hydraulic model remains the highest in the Sunset Meadows 1 Basin (Rio Del Mar area).



City Limits

Sanitary Sewer Service Area

Sewer Basins

Pump Station

Paper Size 8.5" x 11" (ANSI A)

0 1,500 3,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

City of American Canyon
Sewer Master Plan

Job Number 8411338
Revision 2
Date 05 May 2016

Sewer Basins

Figure 7

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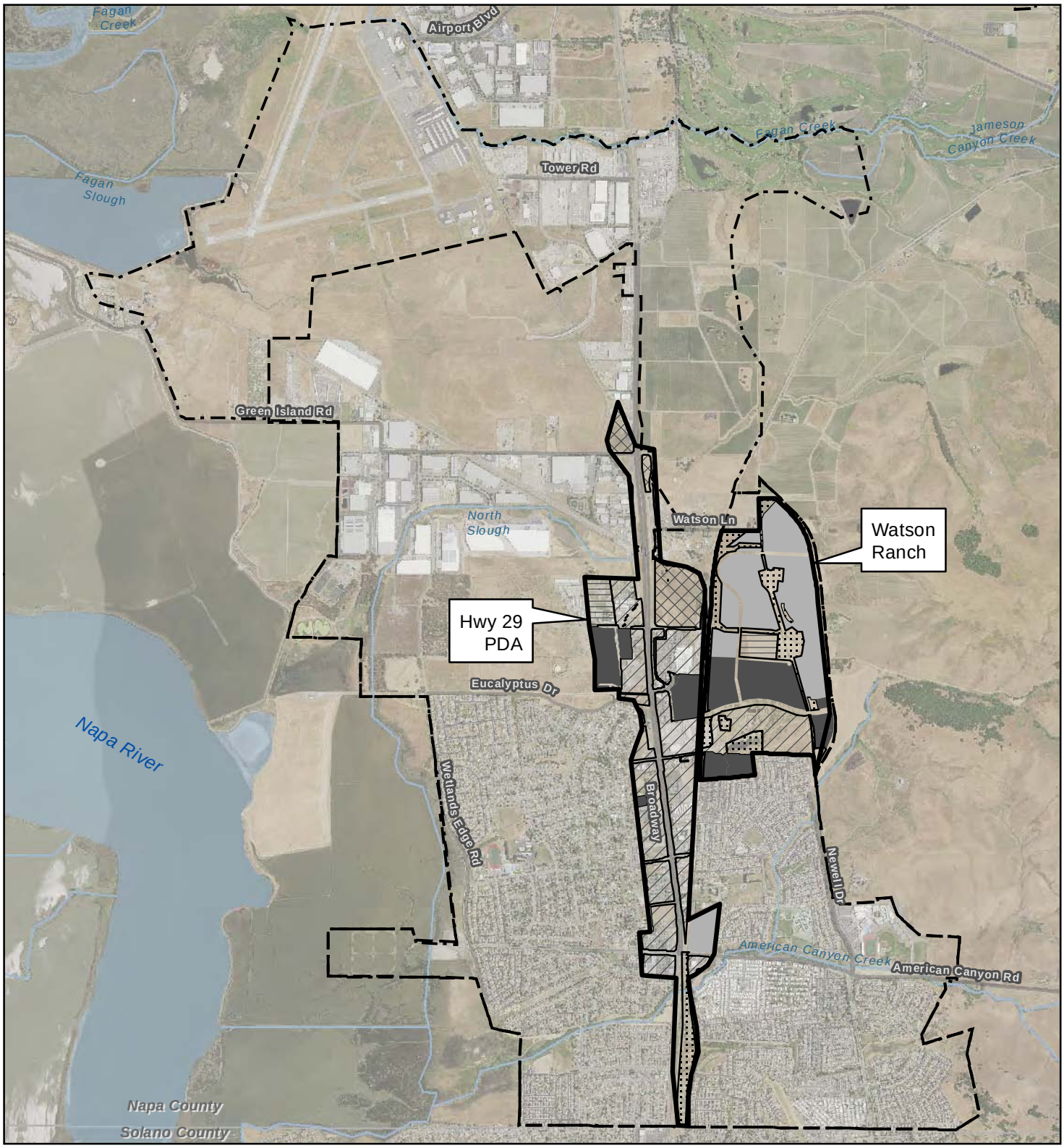
Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Sewer System and Customers, 2015. Created by:afisher2



City Limits
Sanitary Sewer Service Area
Commercial
Industrial
Institutional/Governmental
Landscape
Multi-Family
Single-Family

Paper Size 8.5" x 11" (ANSI A)
0 1,500 3,000
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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City of American Canyon
Sewer Master Plan

Watson Ranch and
PDA Developments

Job Number 8411338
Revision 2
Date 29 Apr 2016

Figure 8

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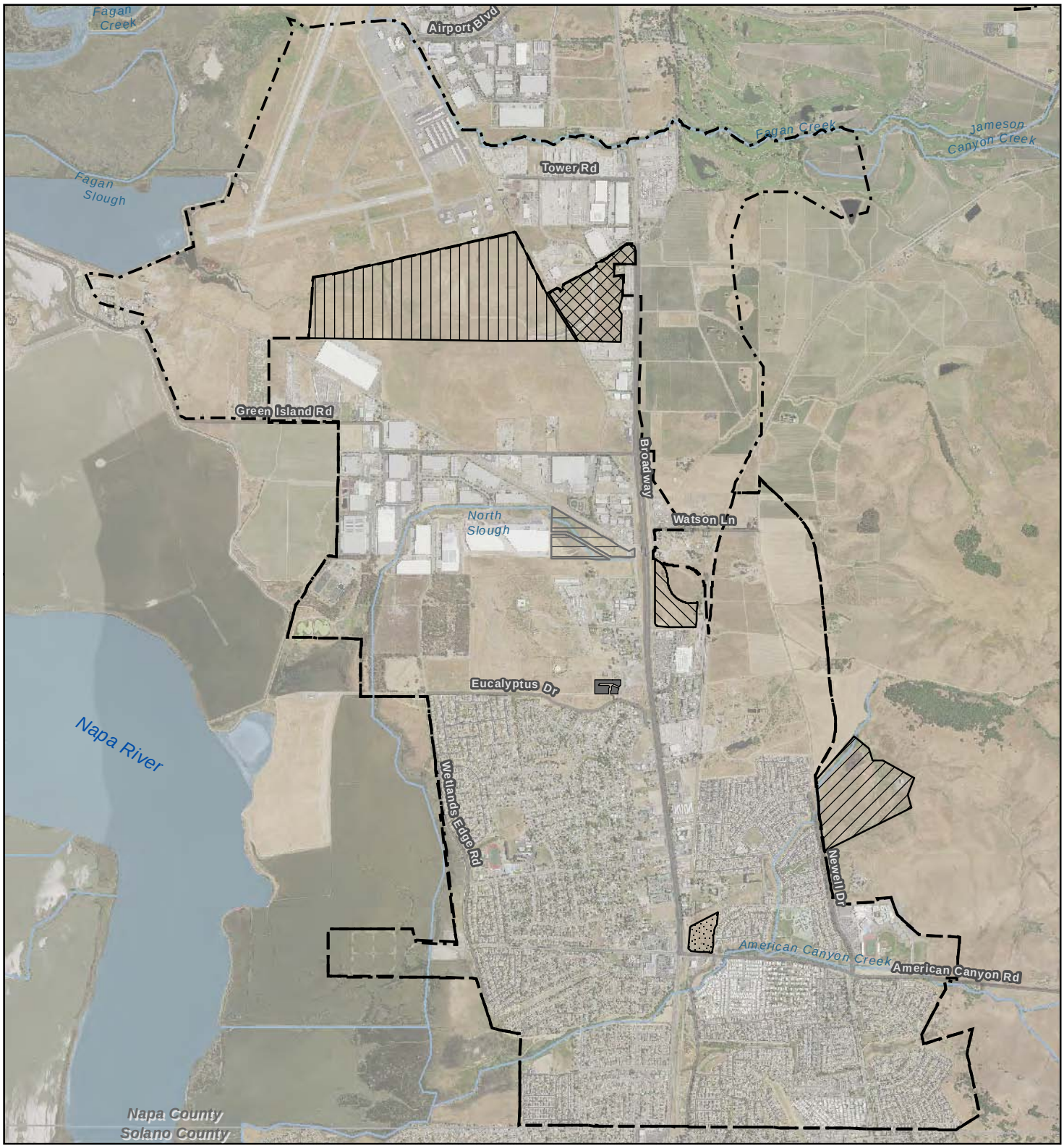
N:\US\Santa Rosa\Projects\02536 - American Canyon\02536-8411338 Master Plan Updates\08-GIS\Maps\Figures\Sewer\Master Plan\Final\Fig 8 - Watson Ranch and PDA.mxd

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, PW System and Customers, 2015. Created by:afisher2



- City Limits
- Sanitary Sewer Service Area
- 255/256 Lombard
- Canyon Estates
- Napa Airport Corporate Center
- Napa Junction III
- Napa Logistics I & II
- Valley View
- Village at Vintage Ranch

Paper Size 8.5" x 11" (ANSI A)
0 1,500 3,000
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

City of American Canyon
Sewer Master Plan

Other Known
Development Projects

Job Number 8411338
Revision 2
Date 29 Apr 2016

Figure 9

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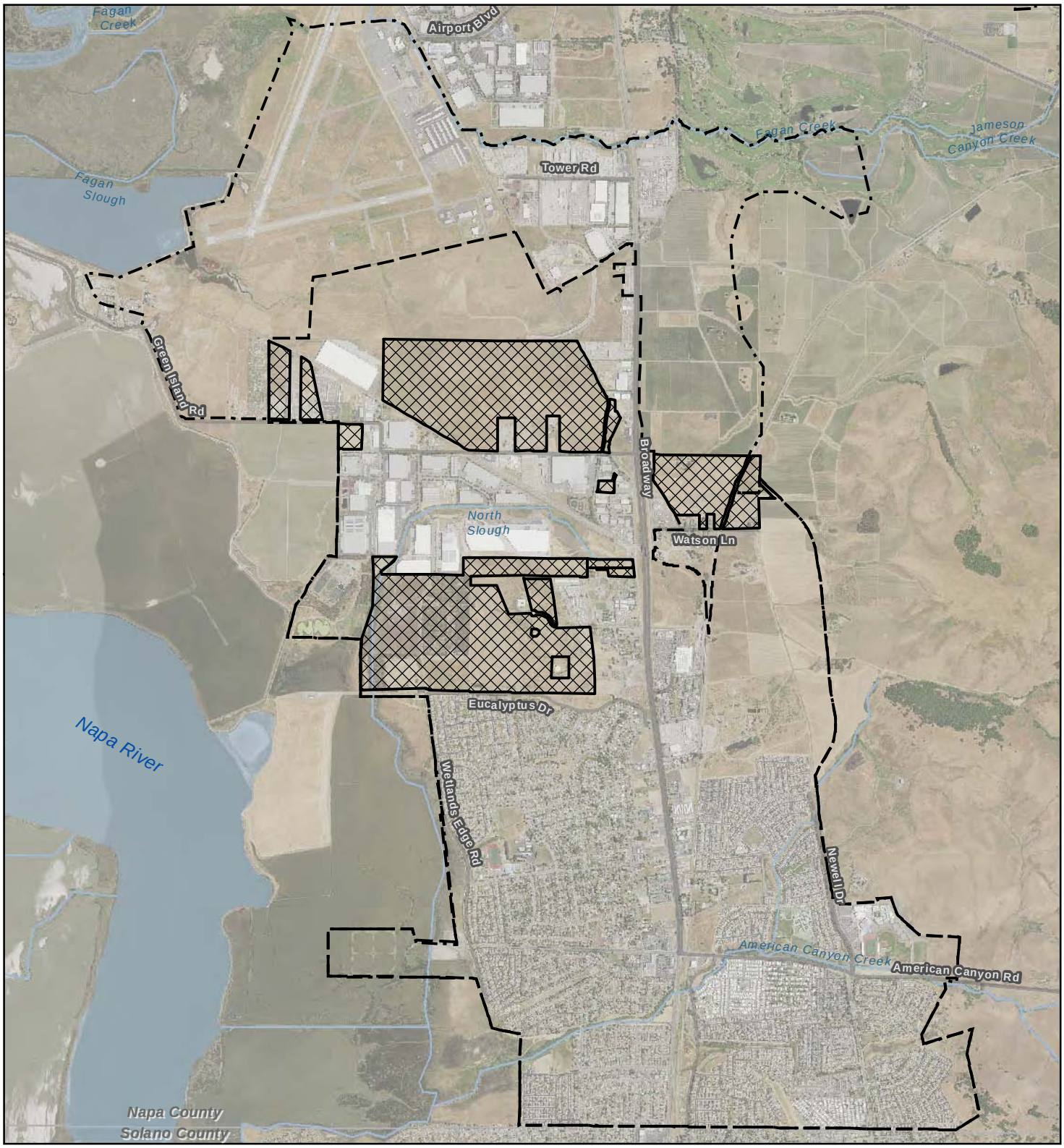
N:\US\Santa Rosa\Projects\02536 - American Canyon\02536-8411338 Master Plan Updates\08-GIS\Maps\Figures\Sewer\Master Plan\Final\Fig 9 - Other Known Development Projects.mxd

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, PW System and Customers, 2015. Created by:afisher2



City Limits

Sanitary Sewer Service Area

Undeveloped Parcels

Paper Size 8.5" x 11" (ANSI A)

0 1,500 3,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

City of American Canyon
Potable Water Master Plan

Job Number 8411338
Revision 2
Date 29 Apr 2016

Undeveloped Parcels

Figure 10

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Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Undeveloped Parcels, 2015. Created by:afisher2

6. Hydraulic Evaluation

A hydraulic model of the City's sewer collection system was utilized for this master plan to evaluate the existing and proposed buildout conditions. The hydraulic evaluation identifies issues that must be resolved to alleviate existing hydraulic deficiencies and for the preparation of future system expansions.

6.1 System Description

The City's sewer collection system is divided into three primary sewer basins and consists of approximately 53 miles of sewer mains, five pump stations, and 5 miles of sewer force main, which is described in the next subsections. Collection system pipelines and pump stations are shown in figures included in Appendices B through E and a schematic of the sewer collection system is shown in Figure 11.

6.1.1 Sewer Basins

The sewer collection system is divided into three primary sewer basins:

- Main Basin: Encompasses the southern portion of the City service area and conveys primarily residential flows to the Main Basin Pump Station (a.k.a., Building E). The Main Basin was further divided into four subbasins based on flow monitoring locations prepared by V&A;
- Sunset Meadows: Encompasses the middle portion of the City service area and conveys a combination of residential and commercial flows to the Sunset Meadows Pump Station. The Sunset Meadows Basin was further divided into two subbasings based on flow monitoring locations prepared by V&A; and
- Industrial Area: Encompasses the northern portion of the City service area and conveys industrial flows to the Tower Road and Green Island Pump Stations.

6.1.2 Pipelines and Pump Stations

The sewer collection system includes gravity pipelines that range in size from 4- to 24-inches in diameter and force mains that range in size from 4- to 18-inches in diameter. Pipelines are constructed primarily of PVC, vitrified clay, and asbestos cement. Flows from the sewer collection system are conveyed to the following pump stations, which are described in Section 2:

- Main Basin Pump Station (MBPS)
- Sunset Meadows Pump Station (SMPS)
- Green Island Pump Station (GIPS)
- Tower Road Pump Station (TRPS)
- Kimberly Pump Station (KPS)

Pump stations convey flows to the City WRF, which is located at the western edge of the service area adjacent to the Napa River. The WRF treats the wastewater to Title 22 standards and discharges to either the Napa River or to the City's recycled water distribution system.

The modeled sewer collection system totals over 20 miles of pipelines. Pump stations and associated force mains were not included in the hydraulic model, though the sewer collection

system flows conveyed to each pump station were compared to each pump station's firm capacity and the maximum flow velocity criterion established in Section 4.3.

A summary of the modeled sewer collection system pipelines is shown in Table 19. Pipe material information by pipe diameter was not available for the preparation of this master plan document.

Table 18 Gravity Pipeline Lengths by Diameter

Diameter	Length (LF)
4-inch	278
6-inch	57,323
8-inch	158,359
10-inch	23,646
12-inch	29,862
14-inch	1,103
15-inch	11,316
21-inch	1,078
24-inch	925
Total	**283,891**

6.2 Hydraulic Model

Hydraulic models have previously been prepared for the 1996 and 2001 Sewer Master Plans. Previous models were prepared using Hydra developed by Pizer. The hydraulic methods used in the Hydra program were determined to be too simplistic for use in the current master plan and the software does not have the capability to account for complex hydraulics. SewerCAD by Bentley was initially selected due to its ease of use; ability to use the product as a stand-alone application or work within AutoCAD or MircoStation; and the built-in conversion utilities from CAD, GIS and database files. During model development, GHD needed to utilize a different modeling platform in order to accurately convey flows through the flow split located in Rio Del Mar at its intersection with Rio Grande. H2O Map Sewer (10.5, SP1, Update #7) developed by Innovyze was selected to meet project hydraulic modeling needs.

6.2.1 Model Inputs

Pipelines to be included in the model were exported from the prior Hydra model; however, model flows were not exported due to the availability of metered sewer flows and water billing records for the collection system. The following general modeling input data was utilized in the creation of the hydraulic model:

- Manning's "n" value: 0.013 for all pipes.
- Ground elevations were extracted from a topographic GIS shapefile based on information from Napa County. The elevation for each manhole was assigned by linearly interpolating between the 5 foot contours in the GIS shapefile.
- Junctions were placed at all manholes.
- Pipe lengths were based on GIS mapping or as-built mapping (record drawings).

- Static model runs were made under the PDWF and PWWF flow scenarios described in Section 4 for current flows and under the PWWF scenario for future buildout flows.
- Pipe diameters included in the model ranged from 6- to 24-inches.
- Pipe diameters are of nominal size.
- Sewer flows are expressed in gallons per minute (gpm) or million gallons per day (mgd) and were assigned to manholes based on the analysis presented in Section 5.

6.3 System Performance

The performance of the City's sewer collection system was analyzed using static flow simulations under PDWF and PWWF scenarios for the existing and buildout conditions. The goal of the hydraulic analysis is to identify system improvements that would be required to address current and future system flows.

6.3.1 Existing Conditions

The existing sewer collection system was analyzed using two flow scenarios (PDWF and PWWF) with the current flows, as discussed in Section 5. The existing modeled pipes and junctions were evaluated using the pipe capacity (d/D) ratio and minimum and maximum pipe slope and velocity criteria presented in Section 4. The hydraulic model results for the existing conditions are included in Appendix B.

In general, the velocities in a majority of the existing pipelines were below the recommended minimum of 2 fps for the PDWF scenario, which is primarily the result of minimal pipe slopes throughout the system. This may contribute to additional City effort for cleaning pipelines to clear blockages and reduce odors. Velocities are improved for the PWWF scenario, with I/I contributing additional flow in the collection system.

Collection system hydraulic capacity was assessed using the PWWF scenario. Pipelines that exceeded hydraulic evaluation criteria were primarily located in the Sunset Meadows 1 Basin and Main Basin 4, in the vicinity and downstream of Rio Del Mar. The model also identified hydraulic deficiencies in the eastern (upstream) portion of Main Basin 4 and in Broadway within Main Basin 3.

Peak flows within the model also exceeded the capacity of the Main Basin, Sunset Meadows, and Green Island Pump Stations. CIPs SS2, SS3, and SS7 address the capacity at each pump station.

The City also indicated concern for collection system hydraulics between Cartagena Way and Westpark located in Main Basin 4. Relocation of the sewer at the area of concern was addressed in the hydraulic model. CIP SS5, also known as the Summerfield project, addresses City concerns at this location in the collection system.

The peak flow velocity for existing pump stations is less than the maximum velocity criterion of 7 fps.

6.3.2 Existing Conditions with CIP Fixes

The PWWF existing conditions model scenario was updated to incorporate the CIP projects identified to alleviate existing hydraulic conditions. The hydraulic model results for the existing conditions scenario with CIP fixes in place are included in Appendix C.

A few areas of minor hydraulic deficiencies remained after implementation of the CIP projects in the model, including pipe capacity exceeding the 0.75 d/D limit for the pipeline in American Canyon

Road immediately upstream of the Main Basin Pump Station and minimal freeboard remaining in four manholes located in the upper reaches of Main Basin 4.

The peak flow velocity for the MBPS force main would increase to approximately 9 fps with the increase in pumping capacity provided in the existing conditions model with CIP fixes implemented. This flow velocity exceeds the design maximum of 7 fps, and should be accounted for during design. Detailed design should include smoothing out of pumping rates by using variable frequency drives (VFDs), consideration for number of pumps to handle the range of anticipated flows (ADWF to PWWF), and the effect of peak flows and associated flow velocities attributed to I/I reduction in the Main Basin.

6.3.3 Buildout Conditions

The existing sewer collection system with the implementation of CIP projects was analyzed using two flow scenarios (PDWF and PWWF) with the future flows, as discussed in Section 5. The existing modeled pipes and junctions were evaluated using the pipe capacity (d/D) ratio and minimum and maximum pipe slope and velocity criteria presented in Section 4. The hydraulic model results for the existing conditions are included in Appendix D.

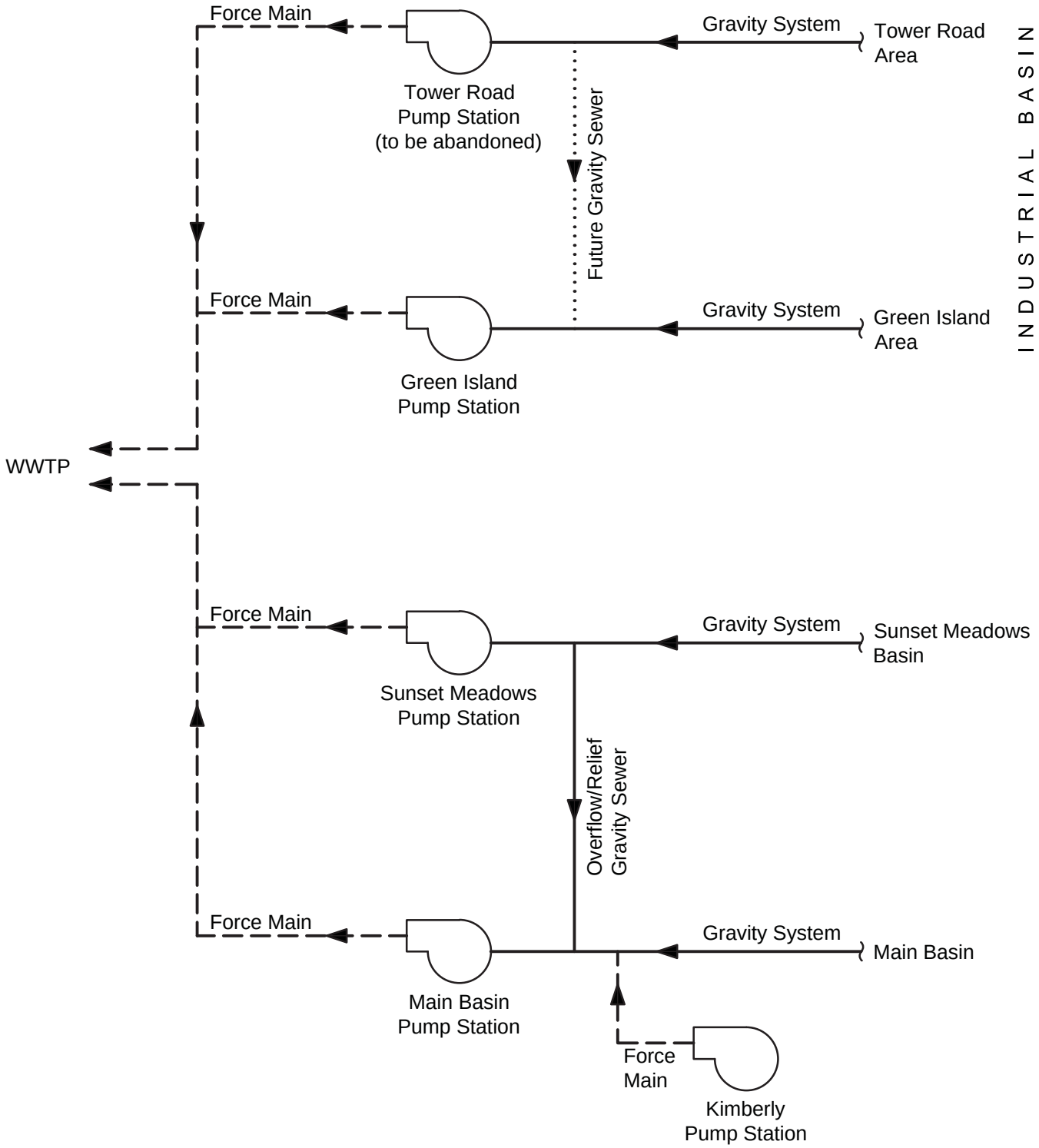
Two locations within the sewer collection system exceeded the pipe capacity limit of 0.75 d/D, including approximately 2,004 linear feet (LF) of the existing 6- and 10-inch gravity sewer in Broadway between Donaldson Way East and American Canyon Road and 2,110 LF of the existing 8-inch gravity sewer in Broadway north of Rio Del Mar.

6.3.4 Buildout Conditions with CIP Fixes

The PWWF future conditions model scenario was updated to incorporate the CIP projects identified to alleviate future hydraulic conditions. The hydraulic model results for the future conditions scenario with CIP fixes in place are included in Appendix E.

The same areas of minor hydraulic deficiencies as in the Existing Conditions with CIP Fixes model remained after implementation of the CIP projects in the model. As discussed in Section 7, reduction of I/I in the sewer collection system will improve the general hydraulic performance of the system and likely alleviate areas shown in the model with minor hydraulic deficiencies.

Peak flow velocity for the MBPS force main should be evaluated during detailed design, as noted under the prior section.



City of American Canyon
Sewer Master Plan

Sewer System Schematic

Job Number 8411338
Revision
Date 18 Mar 2016

Figure 11

2235 Mercury Way Suite 150 Santa Rosa California 95407 USA **T** 1 707 523 1010 **F** 1 707 527 8679 **E** santarosa@ghd.com **W** www.ghd.com

Plot Date: 18 March 2016 - 9:31 AM Cad File No: N:\US\Santa Rosa\Projects\02536 - American Canyon\02536-8411338 Master Plan Updates\06-CAD\Figures\848411138 Figure 10 Sewer System Schematic.dwg

7. Recommended Improvement Projects

Recommended improvement projects are primarily focused on upsizing existing pipelines to increase hydraulic capacity, increase the firm capacity at pump stations to handle anticipated peak flows, and reduce the contribution of I/I within the collection system where cost effective. Most of these improvements address existing deficiencies while also accommodating future growth in the Airport area and Watson Ranch. Improvements are focused on reducing the potential for sanitary sewer overflow (SSO) and associated environmental and cost impacts, with designs conforming to established design criteria (see Section 4).

7.1 Improvements to Address Current Deficiencies

The hydraulic evaluation identified a number of deficiencies with the current sewer collection system including pipelines and pump stations with insufficient hydraulic capacity to convey peak flows for existing and/or future conditions. Improvement projects will enable the City to resolve the current hydraulic deficiencies within the sewer collection system and support the buildout condition of existing communities. In addition, the City identified certain pipes with known structural deficiencies that are also addressed with the CIP projects.

All of the existing capacity deficiencies are related to I/I entering the system in that pipes have adequate capacity to handle peak dry weather flows, but not peak wet weather flows. Improvements that address I/I typically include lining sewer mains and laterals and rehabilitating manholes to minimize leaking (infiltration) into the collection system. Improvements also address known illicit connections from the storm drain system, roof leaders, yard drains and basement pumps (inflow). I/I programs typically require flow monitoring in sub-basins with high I/I flows, nighttime reconnaissance during wet weather, CCTV inspections and smoke testing to identify target neighborhoods for rehabilitation.

Results from I/I reduction projects vary from neighborhood to neighborhood, and they are dependent on several factors including extent of rehabilitation of a main and its appurtenances, and the percentage of a basin rehabilitated. For example, lining a sewer main but not rehabilitating the manholes and laterals may have little benefit. Likewise, rehabilitating one block in a neighborhood may not be effective because water flows down the trench to the next block and enters the system at that location.

In general, the wastewater industry does not have clear manual of practice for addressing I/I. Reported results vary and in general one can conclude that at least 40 percent of a sub-basin needs to be fully rehabilitated (mains, manholes and laterals) to get meaningful results. As a percentage of PWWF reduction, results are typically in the 15 to 50 percent range as measured at the sub-basin level. Moving downstream the reduction in peak flow as a percentage is reduced due to attenuation of flow in the collection system and therefore the benefit is not as great for downstream infrastructure.

For these reasons the recommended CIP projects are budgeted around capacity upgrade costs rather than I/I reduction, with the exception of project SS1 in the Rio Del Mar neighborhood. However, it would be worthwhile for the City to investigate potential I/I reduction projects in other neighborhoods to evaluate whether or not the cost and potential benefit would be improved over the recommended capacity upgrade projects. The scope of this master planning effort is not sufficiently detailed to make that determination.

- SS1 consists of I/I rehabilitation within the Rio Del Mar area, including approximately 2.1 miles of 6- and 8-inch gravity sewers, 60 manholes, and 230 sewer laterals. The assumed method for rehabilitation is cured-in-place pipe (CIPP) lining for sewer mains and laterals and epoxy coating or similar for manholes. Reduction of I/I within the Rio Del Mar area is anticipated to have multiple benefits, including: reduced potential for an SSO in the project area and downstream system; and reduction in conveyance needs, including energy costs associated with pumping excess I/I in the downstream system (i.e., at the Main Basin Pump Station);
- SS2 consists of upgrading the firm capacity for the Green Island Road Pump Station (GIPS) to 950 gallons per minute (gpm) to meet current hydraulic conditions. The project involves the construction of a new pump station at the existing pump station site;
- SS3 consists of pipeline upsizing and relaying of sewers to alleviate hydraulic conditions related to the sewers located downstream of the flow split at the intersection of Rio Del Mar and Rio Grande, including the Sunset Meadows Pump Station (SMPS). The project scope consists of pipeline upsizing of approximately 3,134 LF of existing 15-inch gravity sewer with a 24- to 30-inch gravity sewer between Rio Del Mar and American Canyon Road. The project also consists of relaying 268 LF of 10-inch gravity sewer in Rio Del Mar downstream of the flow split to restrict the amount of flow conveyed towards SMPS. Alternatives to be considered for this project during preliminary design include: construction of a parallel sewer in lieu of replacing the existing sewer; and diverting all flows to SMPS and upgrading SMPS capacity, which would reduce the hydraulic demand on MBPS;
- SS4 consists of pipeline upsizing of approximately 2,004 LF of the existing 6- and 10-inch gravity sewer in Broadway between Donaldson Way East and American Canyon Road with a 15-inch gravity sewer to address hydraulic deficiencies and a known pipeline defect (i.e., bottom missing from a portion of the pipeline);
- SS5 consists of relocating approximately 430 LF of existing 8-inch gravity sewer that connects Westpark, Cartagena Way, and Independence Drive to access City concerns for hydraulic performance and access limitations. The relocated pipeline would consist of approximately 485 LF of 8-inch gravity sewer;
- SS6 consists of pipeline upsizing of approximately 3,318 LF of the existing 6-inch gravity sewer in Theresa Avenue and Los Altos Drive with an 8- to 10-inch gravity sewer to address hydraulic deficiencies;
- SS7 consists of upgrading the firm capacity for the Main Basin Pump Station (MBPS) to 6,330 gpm to meet current PWWF hydraulic conditions. The project involves the construction of a new pump station at the existing pump station site. Modifications to the MBPS sewer basin could reduce the pump station's peak flow capacity, including: use of an existing pond at the pump station site to temporarily store peak flows; reduction of I/I from various upstream projects; and redirection of additional flows towards the SMPS;
- SS8 consists of pipeline upsizing of approximately 1,111 LF of the existing 10-inch gravity sewer in Broadway between Cartagena Way and the Mobile Home Park Entrance with a 15-inch gravity sewer to address hydraulic deficiencies;
- SS9 consists of pipeline upsizing of approximately 601 LF of the existing 12- and 15-inch gravity sewers in Elliott Drive and Chaucer Lane with 18- to 24-inch gravity sewers to address hydraulic deficiencies; and
- SS10 consists of pipeline upsizing of approximately 2,110 LF of the existing 8-inch gravity sewer in Broadway north of Rio Del Mar with a 10-inch gravity sewer to address hydraulic deficiencies. The scope of this project could be reduced if I/I reduction from implementing CIP project SS1 is significant.

A summary of the recommended sewer collection system improvement projects is presented in Table 19.

Table 19 Recommended Improvement Projects to Address Current Deficiencies

Project ID	Proposed Pipe Size/ Pump Station Capacity	Targeted Deficiencies
SS1	Rehabilitation [1.]	Reduce I/I in collection system to increase hydraulic capacity
SS2	950 gpm	Increase firm capacity for Green Island Pump Station from 600 gpm [2.]
SS3	24 & 30-inch	Increase hydraulic capacity and restrict flows to SMPS
SS4	15-inch	Increase hydraulic capacity and replace deteriorated pipeline
SS5	8-inch	Improve collection system hydraulics and access
SS6	8 & 10-inch	Increase hydraulic capacity
SS7	6,330 gpm	Increase firm capacity for Main Basin Pump Station from 3,000 gpm [2.]
SS8	15-inch	Increase hydraulic capacity
SS9	18 & 24-inch	Increase hydraulic capacity
SS10	10-inch	Increase hydraulic capacity

1. Trenchless rehabilitation of 6- and 8-inch pipelines, manholes, and sewer laterals.

2. Firm capacity is defined as capacity without primary power and largest pump out of service.

7.2 Improvements for Planned Growth

Improvements to the sewer collection system to accommodate planned growth primarily focus on serving planned development in the Airport area and connecting the Watson Ranch development to the collection system.

CIP projects SS2, SS4, and SS7 need additional capacity to accommodate the future development projects. The following is a description of the additional capacity requirements:

- SS2 consists of various improvements to serve future developments southeast of the Napa County Airport, including Napa Logistics. Improvements include: upgrading the firm capacity for the Green Island Road Pump Station (GIPS) from 950 to 1,455 gpm to meet future hydraulic conditions; construction of approximately 5,832 LF of 10- and 21-inch gravity sewer in between the Tower Road Pump Station (TRPS) and GIPS, including sewer under the railroad west of TRPS and in the airport property, in the future Devlin Road extension, and in Green Island Road; and abandonment of the TRPS and 18-inch force main between TRPS and GIPS;
- SS4 consists of pipeline upsizing of an additional 1,922 LF of the existing 6- and 10-inch gravity sewer in Broadway between Donaldson Way East and American Canyon Road with a 15-inch gravity sewer to address hydraulic deficiencies and serve future customers including Watson Ranch; and
- SS7 consists of upgrading the firm capacity for the MBPS from 6,330 to 6,864 gpm to serve future customers including Watson Ranch.

A summary of the recommended improvement projects for planned growth is presented in Table 20.

Table 20 Recommended Improvement Projects for Planned Growth

Project ID	Proposed Pipe Size/ Pump Station Capacity	Targeted Development
SS2	GIPS from 950 to 1,455 gpm Pipes: 10 & 21-inch	Industrial customers southeast of Napa County Airport
SS4	15-inch	Watson Ranch development
SS7	MBPS from 6,330 to 6,864 gpm	Watson Ranch development

8. Capital Improvements Plan

The CIP is intended to provide a roadmap for the construction or replacement of sewer infrastructure to address the current and future sewer flows within the City. Nine projects are recommended and have been prioritized to meet more critical and time dependent needs first, whether to correct existing system deficiencies or accommodate pending development projects, and then address longer term issues and future planned growth over an extended timeframe. Project assumptions, cost estimations, and project prioritizations for these projects are discussed below. The detailed project descriptions and cost estimates for each CIP project are included in this report as Appendix F and Appendix G, respectively.

8.1 Estimates of Probable Cost

The estimates of probable cost in this CIP should be considered as order-of-magnitude estimates for planning purposes only. The total project cost consists of the construction cost, design and technical effort, construction management effort, and a contingency fund. Land acquisition and/or City degradation fees are not included in the cost estimates.

Construction costs are based on a Class 5 (planning-level) estimate of probable cost as defined by the Association for the Advancement of Cost Engineering, International (AACE). AACE defines the "Class 5" estimate as follows:

> *Generally prepared on very limited information, where little more than proposed plan type, its location, and the capacity are known, and for strategic planning purposes such as but not limited to market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, long-range capital planning, etc. Some examples of estimating methods used would include cost/capacity curves and factors, scale-up factors, and parametric and modeling techniques. Typically, very little time is expended in the development of this estimate. The typical expected accuracy ranges for this class estimate are -20% to -50% on the low side and +30% to +100% on the high side.*

Construction costs are based on the July 2015 Engineering News Record Construction Cost Index (ENR CCI) for San Francisco, CA (11,155).

8.1.1 Construction Cost

Construction costs associated with sewer projects typically include the efforts and materials for the following items:

- Mobilization and demobilization
- Temporary traffic control
- Potholing to identify existing utilities
- Shoring and trench safety
- Trench dewatering
- Handling, treatment and disposal of contaminated soil and groundwater
- Construction or replacement of collection system and supporting infrastructures

A summary of the unit costs associated with each item is presented in Table 21. The unit cost estimates are based on previous project experience and contractor/supplier-provided information.

Adjustments to the cost estimates can be made in the future by applying a ratio of the future ENR CCI to the value used herein.

Estimated unit costs for pipelines includes pipe material, trenching (at minimum cover), installation, backfill, fittings and appurtenances, connections, pavement restoration, testing, and traffic control. Sewer pipelines are assumed to be SDR 26 or AWWA C900 PVC for pipelines 15-inch and smaller, AWWA C905 PVC for pipelines 18-inch and larger. Method of rehabilitation for sewer pipelines, including sewer laterals is cured-in-place pipe (CIPP). Method of rehabilitation for sewer manholes is epoxy coating or similar.

Costs were developed for construction of sewer pump stations ranging in size from 2.1 to 9.9 million gallons per day (mgd). The costs are for a typical wet well / dry well pump station, with associated improvements for valve vault, generator, electrical and instrumentation, and limited grading and access impacts. Costs were based on published cost curves (*Pumping Station Design, Second Edition, Sanks, 2000*), with adjustment for ENR CCI values.

Table 21 Construction Unit Costs

Item	Unit Cost
Mobilization and demobilization	6% of construction costs
Temporary traffic control	5% of construction costs [1.]
Potholing to identify existing utilities	$12/linear foot (LF)
Shoring and trench safety	$20/LF
Trench dewatering	$40/LF [2.]
Temporary bypass pumping	$5 to $30/LF [3.]
Handling, treatment and disposal of contaminated soil and groundwater	$10/LF
Construction or replacement of collection system and supporting infrastructures	
• 8” SDR 26 PVC Sewer Pipe (invert 10’ or less)	$91/LF
• 8” SDR 26 PVC Sewer Pipe (invert over 10’ to 18’)	$108/LF
• 8” SDR 26 PVC Sewer Pipe (invert 18’ or more)	$125/LF
• 10” SDR 26 PVC Sewer Pipe (invert 10’ or less)	$104/LF
• 10” SDR 26 PVC Sewer Pipe (invert over 10’ to 18’)	$123/LF
• 12” SDR 26 PVC Sewer Pipe (invert 10’ or less)	$118/LF
• 12” SDR 26 PVC Sewer Pipe (invert over 10’ to 18’)	$138/LF
• 15” SDR 26 PVC Sewer Pipe (invert 10’ or less)	$138/LF
• 15” SDR 26 PVC Sewer Pipe (invert over 10’ to 18’)	$161/LF
• 18” C905 PVC Pipe (invert over 10’ to 18’)	$183/LF
• 18” C905 PVC Pipe (invert 18’ or more)	$208/LF
• 24” C905 PVC Pipe (invert 10’ or less)	$199/LF
• 24” C905 PVC Pipe (invert over 10’ to 18’)	$228/LF
• 27” C905 PVC Pipe (invert 10’ or less)	$293/LF
• 27” C905 PVC Pipe (invert over 10’ to 18’)	$329/LF

Item	Unit Cost
• 30” C905 PVC Pipe (invert over 10’ to 18’)	$359/LF
• Reconnect Sewer Lateral	$5,000/each (EA)
• 48” Diameter Manhole (invert 10’ or less)	$8,000/EA
• 48” Diameter Manhole (invert over 10’ to 18’)	$10,000/EA
• 48” Diameter Manhole (invert 18’ or more)	$15,000/EA
• 60” Diameter Manhole (invert 10’ or less)	$15,000/EA
• 60” Diameter Manhole (invert over 10’ to 18’)	$20,000/EA
• 60” Diameter Manhole (invert 18’ or more)	$25,000/EA [4.]
• 21” Tunneled Pipeline (CIP-SS2)	$750/LF
• 18” Steel Tunnel Casing	$750/LF [5.]
• 30” Steel Tunnel Casing	$1,000/LF [6.]
• 42” Steel Tunnel Casing	$1,500/LF [7.]
• Tunneling Sending and Receiving Pits	Lump sum [8.]
• 6” Pipe – Cured-in-Place Pipe (CIPP) Rehabilitation	$90/LF
• 8” Pipe – Cured-in-Place Pipe (CIPP) Rehabilitation	$120/LF
• Sewer Lateral Rehabilitation	$8,000/EA
• Sewer Manhole Rehabilitation	$4,000/EA
• Sewer Pipeline Cleaning and CCTV Inspection	$10/LF
• Miscellaneous Utility Relocations	Lump sum [9.]
• Additional Pavement Restoration in Caltrans R/W	Lump sum [10.]

1. Temporary traffic control increased to 10% for anticipated high traffic areas.
2. Trench dewatering was increased to $80/LF for projects with deep utility trenching.
3. Temporary bypass pumping varied depending on anticipated effort.
4. Very deep 60” diameter manholes associated with CIP-SS2 (Napa Logistics and Green Island Road Pump Station) unit cost: $50,000/EA.
5. Tunnel casing under Southern Pacific Railroad west of Tower Road Pump Station for CIP-SS2.
6. Tunnel casing under Southern Pacific Railroad in Green Island Road for CIP-SS2.
7. Tunnel casing under creek located north of American Canyon Middle School for CIP-SS3.
8. Lump sum amounts based on anticipated scope of work, including depth of pits.
9. Lump sum amount based on anticipated scope of work for specific project.
10. Lump sum amount based on anticipated scope of work paving within Caltrans right-of-way in addition to standard trench paving.

8.1.2 Design and Technical Effort

Design and technical efforts include the costs for the following items:

- Completing the pipeline and infrastructure designs
- Land surveys
- Geotechnical surveys
- Environmental review
- Permitting (excluding permits associated with land acquisition)

The costs for the design and technical efforts are estimated to be approximately 25% of the construction cost based on previous project experience.

8.1.3 Construction Management Effort

Construction management efforts include the costs for the following items:

- Site inspections
- Project management
- Engineering services during construction

The costs for the construction management efforts are estimated to be approximately 12% of the construction cost based on previous project experience.

8.1.4 Contingency

The actual project costs can vary greatly due to a number of possible external factors, including but not limited to climate, market conditions, government policy and material pricing. An additional 25 percent of the construction cost is added to the overall cost as a contingency to ensure appropriate levels of financing for the CIP.

8.2 Prioritized Capital Improvements Plan

The CIP will be implemented in stages based on the priority assigned to each project. The projects are prioritized according to the condition of the existing infrastructures, the existing and future sewer flows, the anticipated timing of developments within the City, and the complexity of the project. The CIP projects presented in Table 22 are prioritized using the above criteria, in which Project SS1 has the highest priority and Project SS10 has the lowest priority. The total project cost for the sewer system Capital Improvements Plan is $51,170,000. The estimates for each CIP project are rounded to the nearest $10,000.

I/I rehabilitation for the sewer collection system in the vicinity of Rio Del Mar was given the highest priority, which was based on the cumulative benefit of I/I reduction in the collection system, including the following: reduce the potential for sanitary sewer overflow (SSO) from hydraulically-deficient pipelines within and downstream of the project area; and reduction in conveyance needs, including energy costs associated with pumping excess I/I in the downstream system. Project SS1 is scoped to be an I/I rehabilitation project in lieu of capacity enhancement project, wherein existing pipelines would be lined with cured-in-place pipe (CIPP) or similar in lieu of replaced with larger pipelines.

Modification to the existing sewer collection system between the Green Island Pump Station (GIPS) and Tower Road Pump Station (TRPS) was given the next highest priority, which was based on addressing hydraulic deficiency for the GIPS and to serve planned development in the sewer basin (e.g., Napa Logistics). Project SS2 consists of pump station replacement for GIPS, extension of a new sewer main between GIPS and TRPS, and abandonment of the TRPS and 18-inch force main between the TRPS and GIPS. Other high priority projects address current deficiencies for collection system hydraulics that have the highest potential for SSO, as based on modeling results for surcharging of sewer pipelines, will be implemented first.

The order of the project implementation may change in the future due to changes in sewer demand, infrastructure deterioration, land development, and funding availability. Based on current priorities CIP projects SS1 through SS6 are considered near-term priorities and should be completed over the next 10 years. CIP projects SS7 through SS10 are of a lower priority or need more time for other projects to be completed and could be completed 11 to 20 years from now. For example, Project SS7 has a high priority but would benefit by having projects SS1, SS3, SS4 and SS6

completed before designing the upgrades to the Main Basin Pump Station. The locations of the near-term and long-term CIP projects are shown in Figures 12 and 13.

CIP projects are funded from two sources, wastewater capacity fees and wastewater rates. Wastewater capacity fees are paid by new development to offset their impact on the system. This "Wastewater Capacity" revenue is then used to construct capacity improvements required to meet the needs of new growth. Wastewater rates, the monthly service charges levied by the wastewater utility, pays for all operating expenses as well as debt covenants and replacement and rehabilitation of capital assets. This "Wastewater Operations" revenue is used to cover operating expenses including the cost of treatment, power and chemicals, salaries and benefits for wastewater utility staff, and timely replacement and rehabilitation of wastewater infrastructure. Table 22 lists the near and long-term CIP projects and estimated costs and funding sources.

Table 22 Sewer System Capital Improvements Plan

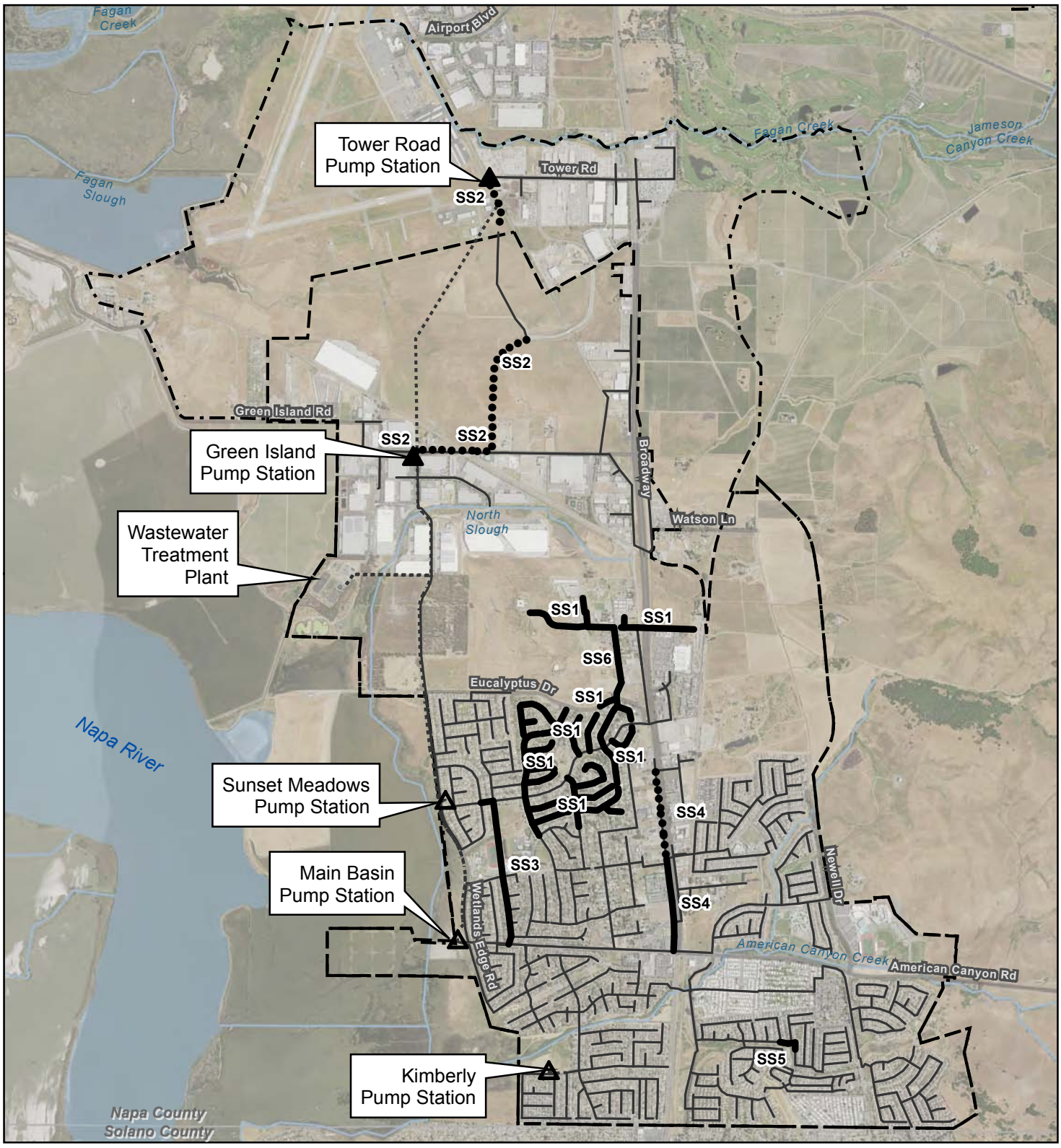
CIP Project	Funding Source	Project Cost
Near-Term CIP Projects (0 – 10 Years)		
SS1 Rio Del Mar Basin	Wastewater Operations	$7,170,000
SS2 Napa Logistics and Green Island Pump Station	Wastewater Operations and Wastewater Capacity	$18,800,000
SS3 Huntington Way	Wastewater Operations	$4,580,000
SS4 Broadway North of American Canyon Road	Wastewater Operations and Wastewater Capacity	$2,540,000
SS5 Summerfield Project	Wastewater Operations	$370,000
SS6 Theresa Avenue and Los Altos Drive	Wastewater Operations	$2,050,000
Long-Term CIP Projects (11 – 20 Years)		
SS7 Main Basin Pump Station	Wastewater Operations and Wastewater Capacity	$12,860,000
SS8 Broadway, Cartagena Way to Mobile Home Park Entrance	Wastewater Operations	$680,000
SS9 Elliott Drive South of Northampton	Wastewater Operations	$1,090,000
SS10 Broadway North of Rio Del Mar	Wastewater Operations	$1,030,000
	Total CIP	**$51,170,000**

Preliminary design for each project should include an evaluation of the feasibility for I/I rehabilitation in lieu of upsizing of existing infrastructure. Reduction of I/I has multiple benefits for the City's sewer system, including:

- Alleviating hydraulic conditions within the collection system;
- Reducing the scope and cost of downstream projects;
- Reducing energy costs associated with pumping excess I/I to the WRF; and
- Reducing energy and other infrastructure costs associated with treating excess I/I at the WRF.

The City may consider a pilot project to test the effectiveness of I/I reduction, wherein pre- and post-construction flow monitoring and assessment would be used to demonstrate I/I reduction for specific collection system improvements. CCTV inspection records should also be used to identify specific collection system defects in order to define the rehabilitation scope of improvements.

The scope of improvements for pump station projects should be based on providing a firm capacity capable of handling anticipated buildout PWWF. Pump design should also consider handling anticipated low flows and maintaining minimum and not exceeding maximum flow velocities, instrumentation and SCADA provisions, and easy site access.



City Limits

Sanitary Sewer Service Area

Existing System:

Gravity Main

Force Main

Pump Station

Near Term CIP Projects:

Existing Deficiency

Future Development

Pump Station

Paper Size 8.5" x 11" (ANSI A)

0 1,500 3,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

City of American Canyon
Sewer Master Plan

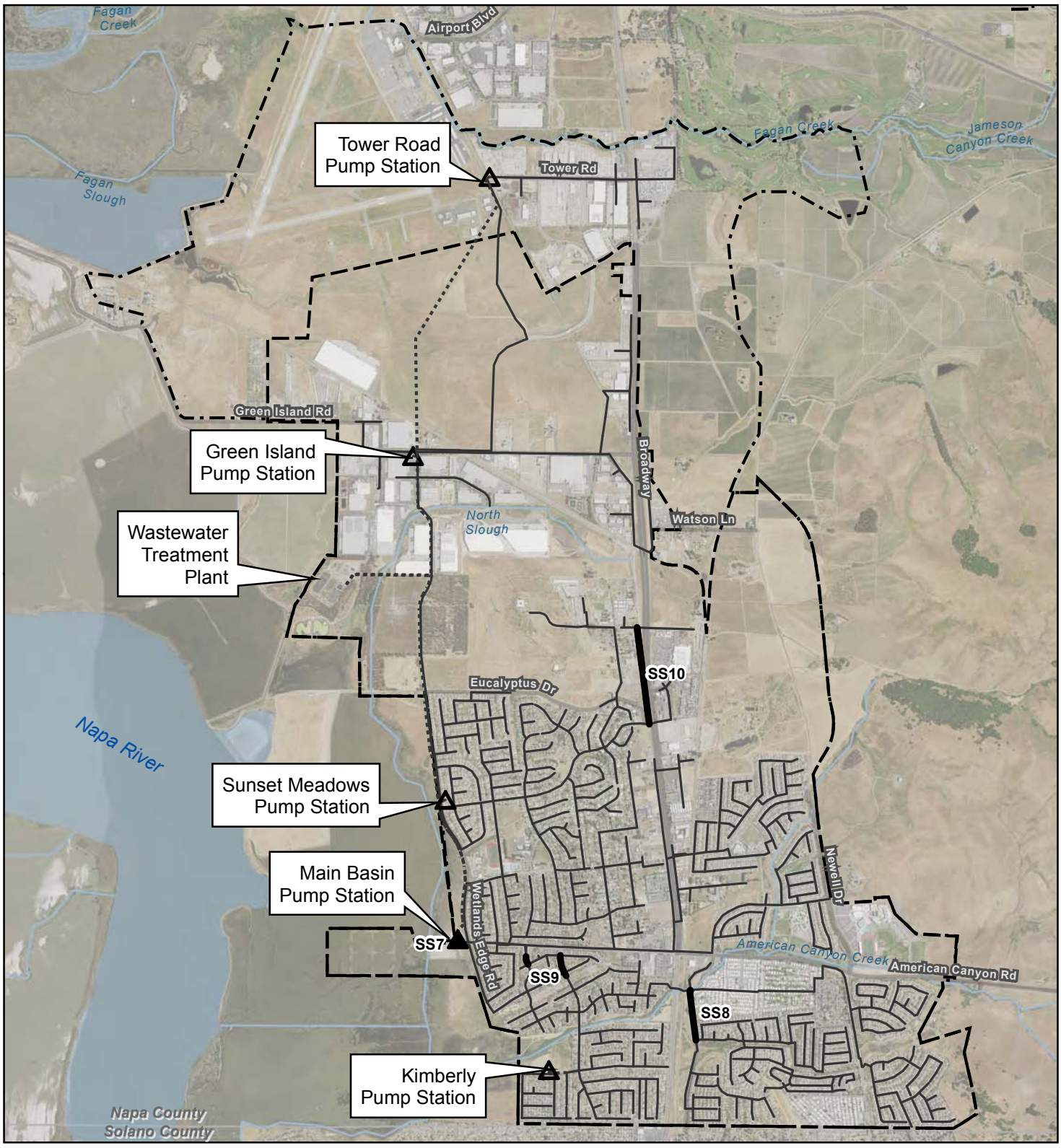
Recommended Near Term CIP Projects

Job Number 8411338
Revision 2
Date 05 May 2016

Figure 12

2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA T 707 523 1010 F 707 527 8679 E santarosa@ghd.com W www.ghd.com

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Sewer System and Customers, 2015; City Limits, American Canyon, 2013; ETSSA, American Canyon, 2016. Created by:afisher2



City Limits

Sanitary Sewer Service Area

Existing System:

Gravity Main

Force Main

Pump Station

Long Term CIP Projects:

Existing Deficiency

Pump Station

Paper Size 8.5" x 11" (ANSI A)

0 1,500 3,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

City of American Canyon
Sewer Master Plan

Job Number 8411338
Revision 2
Date 05 May 2016

Recommended Long Term CIP Projects

Figure 13

2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA T 707 523 1010 F 707 527 8679 E santarosa@ghd.com W www.ghd.com

Data source: USDA, Imagery, 2014; County of Napa, Roads, 2015; GHD, Sewer System and Customers, 2015; City Limits, American Canyon, 2013; ETSSA, American Canyon, 2016. Created by:afisher2

Wastewater Collection System CIP Summary

Table 1: Summary of Recommended Wastewater Collection System CIP Projects

CIP Project	Wastewater Operations	Wastewater Capacity	Total Project
SS1 Rio Del Mar Basin	$7,170,000	$0	$7,170,000
SS2 Napa Logistics and Green Island Pump Station	$2,400,000	$16,400,000	$18,800,000
SS3 Huntington Way	$4,580,000	$0	$4,580,000
SS4 Broadway north of American Canyon Rd	$1,280,000	$1,260,000	$2,540,000
SS5 Summerfield Project	$370,000	$0	$370,000
SS6 Theresa Avenue and Los Altos Drive	$2,050,000	$0	$2,050,000
SS7 Main Basin Pump Station	$11,990,000	$870,000	$12,860,000
SS8 Broadway, Cartagena Way to Mobile Home Park Entrance	$680,000	$0	$680,000
SS9 Elliott Drive south of Northampton	$1,090,000	$0	$1,090,000
SS10 Broadway north of Rio Del Mar	$1,030,000	$0	$1,030,000
Total Budget	**$32,640,000**	**$18,530,000**	**$51,170,000**

CIP – SS1 Rio Del Mar, Los Altos Drive to Rio Grande

Hydraulic evaluation of the existing 12-inch gravity sewer in Rio Del Mar between Los Altos Drive and Rio Grande finds that the pipeline is undersized to convey existing peak wet weather flows. This capacity deficiency results in surcharging of the sewer and potential sanitary sewer overflow.

CIP SS1 includes reduction of infiltration and inflow (I/I) in the sewer basin tributary to this pipeline. The tributary basin includes approximately 4.2 miles of 6- and 8-inch gravity sewer pipelines with associated manholes and approximately 450 sewer laterals that serve residential and commercial properties. Predesign for the project should characterize the distribution of I/I within the sewer basin, including the location and quantity of infiltration and inflow sources. Due to a lack of specific data for the distribution of I/I within the project area, an assumption needed to be made regarding I/I contribution: two-thirds (66.7 percent) of the I/I is assumed to be contributed by 50 percent of the pipelines and associated laterals.

Characterization of I/I within the project area is recommended prior to beginning project design.

Pre- and post-construction flow monitoring is also recommended to quantify the amount of I/I in the project area relative to the scope of improvements and associated cost for the I/I rehabilitation. The project cost for CIP SS1 includes budget for flow monitoring and further study of the sewer basin, with the goal to define the scope of project improvements.

Rehabilitation of the existing sewer system includes lining of sewer mains, lower and upper laterals, and manholes, which constitutes “full” rehabilitation with an approximate I/I reduction rate of 70 percent for the rehabilitation components. Pre- and post-construction flow monitoring will demonstrate the effectiveness for I/I reduction, and inform the City of the need, if applicable, for further I/I reduction or capacity enhancements in the sewer basin.

CIP SS1 includes rehabilitation of approximately 2.1 miles of the existing 6- and 8-inch gravity sewers, 60 manholes, and 230 sewer laterals. The assumed method for rehabilitation is cured-in-place pipe (CIPP) lining for sewer mains and laterals and epoxy coating or similar for manholes. The project scope includes coordination with residents for lateral improvements and bypass pumping during lining work.

Rehabilitation is targeted at restoring approximately 44 percent (1,131 gpm) of the estimated 2,561 gpm I/I for the 10-year design storm in the upstream sewer basin. By removing this I/I in the upstream basin, the amount of flow pumped at the Main Basin PS and treated at the City’s wastewater treatment plant would be reduced; costs associated with pump station improvements and conveying and treating flows would also be reduced. CIP SS1 may also be combined with related CIP projects in the sewer basin tributary to Rio Del Mar for I/I reduction in lieu of capacity enhancement for those projects. This may result in a reduced scope of improvements for CIP SS10 if adequate I/I reduction can be achieved in the pipelines located upstream of that project in Broadway.

Figure 1 provides an illustration of project improvements. The pipelines highlighted for potential I/I reduction are generally consistent with anecdotal information provided by the City in October 2015 for pipelines to be targeted for I/I rehabilitation.

Figure 1

Table 1: CIP – SS1 Summary

CIP Component	Description
Proposed Improvements	• Rehabilitate 11,040 LF (2.1 miles) of 6- and 8-inch gravity sewer by CIPP lining • Rehabilitate 60 manholes by epoxy coating or similar method • Rehabilitate 230 sewer laterals, including lower and upper laterals by CIPP lining or similar method
Additional Project Considerations	• Obtain rights-of-entry from private properties for sewer lateral work • Construction permits
Project Cost Total [(1)]	$7,170,000 – Wastewater Operations

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS2 Napa Logistics and Green Island Road Pump Station

Various sewer system improvements are necessary to accommodate development in the sewer basins tributary to the existing Tower Road Pump Station (TRPS) and Green Island Pump Station (GIPS). Capacity upgrade is also needed for GIPS to pump the estimated future peak wet weather flow rate of 1,455 gallons per minute (gpm), inclusive of the Napa Logistics development. According to pump station data provided by the City, the existing firm capacity for GIPS is approximately 600 gpm; the existing firm capacity for TRPS is approximately 1,400 gpm. Note: firm capacity is defined as one primary pumping unit out of service and the availability of a secondary power source (i.e., standby diesel generator). TRPS does not have a generator, so the statement regarding firm capacity only regards pumping capacity.

The existing peak wet weather flow conveyed to GIPS is estimated at 950 gpm; the peak flow rate increases to 1,455 gpm for future conditions, which includes rerouting of a portion of the basin flows currently tributary to TRPS.

Improvements planned to serve development within the basin include open cut and tunneled construction of 8- to 21-inch diameter gravity pipelines that vary in depth from 8 feet to over 30 feet deep. Pipeline improvements include tunneled construction under the railroad west of TRPS and in the airport property, in the proposed Devlin Road Extension, within Green Island Road, and under the railroad in Green Island Road. Pump station improvements include replacement of the existing GIPS within the pump station site with a new pump station. The new pump station has a firm capacity (i.e., one pump in standby and backup power generation available) of 1,455 gpm. In order to handle the range of dry and wet weather flows conveyed to the new pump station, the new pump station should be equipped with multiple pumps, potentially including small and large capacity pumps.

The existing TRPS is abandoned, with tributary flows now conveyed to GIPS. The TRPS site is anticipated to be converted to a winery truck waste disposal station.

Land acquisition is not included in project planning.

Figure 2 provides an illustration of project improvements.

The cost provided in Table 2 for upgrading GIPS to meet existing flow conditions is $2.4 million. The cost to upgrade the pump station and construct other project components to meet buildout flow is $16.4 million, for a total CIP cost of $18.8 million.

Figure 2

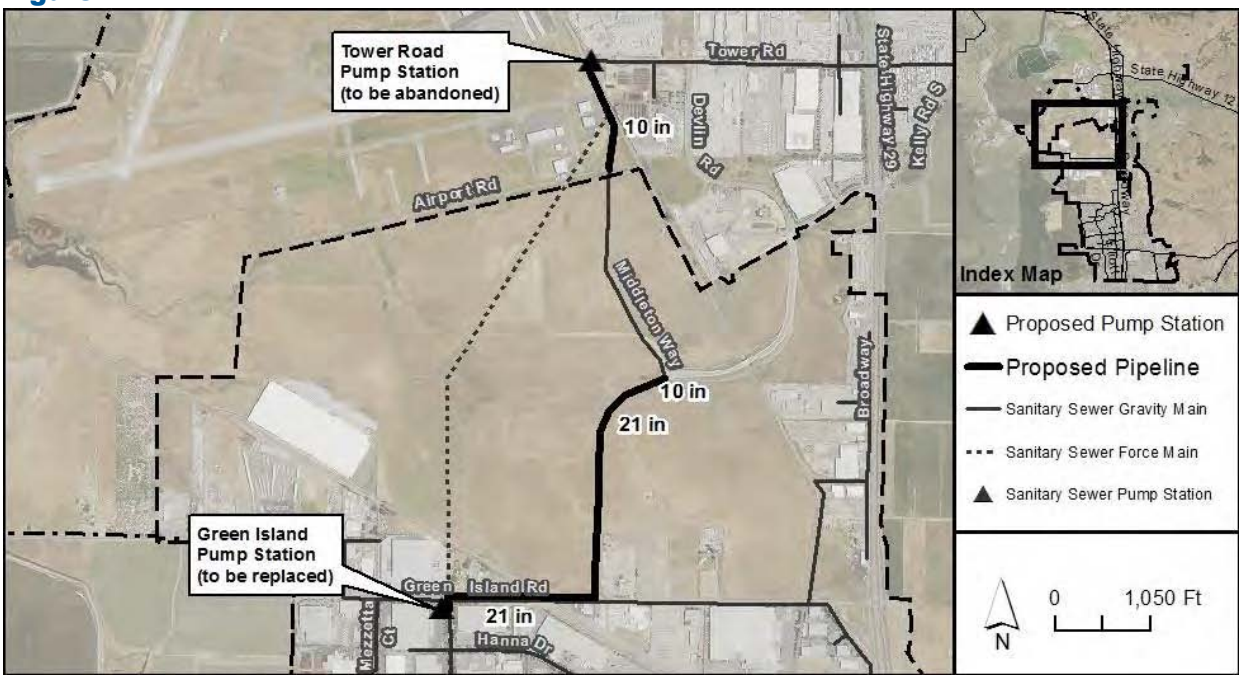


Table 2: CIP – SS2 Summary

CIP Component	Description
Proposed Improvements	• Construct a new 1,455 gpm capacity Green Island Pump Station (GIPS) to replace the existing pump station • Construct associated piping and appurtenances at the GIPS site, including emergency generator • Construct 1,421 LF of 10-inch gravity sewer between TRPS and Middleton Way, including 119 LF of gravity sewer tunneled under the railroad west of TRPS • Construct 4,530 LF of 21-inch gravity sewer by tunneling in Devlin Road and Green Island Road • Abandon TRPS and 18-inch force main between TRPS and GIPS
Additional Project Considerations	• CEQA review, environmental and construction permits, OSHA Tunnel Classification and right-of-way agreement with the railroad for tunneling under the railroad
Project Cost Total [(1)]	$2,400,000 – Wastewater Operations $16,400,000 – Wastewater Capacity $18,800,000 – Project Total

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS3 Huntington Way, Rio Del Mar to American Canyon Road

The existing 15-inch gravity sewer in Huntington Way and the American Canyon Middle School property between Rio Del Mar and American Canyon Road is undersized to convey existing peak wet weather flows. This capacity deficiency results in surcharging of the sewer and potential sanitary sewer overflow within the school property and into the creek located within the school property. During peak flow events, the existing flow split at the intersection of Rio Del Mar and Rio Grande conveys a portion of the wastewater flow west towards the Sunset Meadows Pump Station (SMPS), which results in surcharging of a portion of the sewer between Rio Grande and SMPS.

CIP SS3 includes relaying of 268 LF of the existing 10-inch gravity sewer located west of the flow split to restrict the amount of flow conveyed towards SMPS to 650 gallons per minute (gpm), which is the pump station's firm capacity. Flow reduction to the west at the flow split maintains collection system capacity in the downstream pipelines and SMPS.

CIP SS3 also includes upsizing of 3,134 LF of the existing 15-inch gravity sewer located south of the flow split to a 24- to 30-inch gravity sewer. Alignment of the new sewer would be parallel to the existing sewer, which is located within school property (easement) and Huntington Way. Existing sewer laterals and local collector sewers in the project vicinity would be connected to the new sewer. Trenchless crossing of the creek is anticipated.

Predesign analysis should consider alternatives for CIP SS3, including the following:

- Alternative 1: Construct a new pipeline parallel to the existing 15-inch pipeline. This alternative may reduce the amount of bypass pumping needed during construction, but may necessitate the acquisition of additional easement area. Preliminary evaluation of this alternative finds that it may have a lower capital cost ($2,910,000).

- Alternative 2: Divert all or a portion of flow towards SMPS in order to reduce the peak flow demand in the existing 15-inch gravity sewer in Huntington Way, within the American Canyon Middle School property, and at the Main Basin Pump Station (MBPS). This alternative would involve: replacement of the existing 10- to 15-inch gravity sewer between the flow split and SMPS; upsizing of SMPS to up to 3,774 gpm; and construction of a new force main between SMPS and the 18-inch MBPS force main. Depending on the quantity of flow diverted to SMPS, the existing 15-inch sewer located south of the flow split could be used to convey a portion of the flow to MBPS. Preliminary evaluation of this alternative finds that it may have a higher capital cost ($6,350,000); however, the reduction in peak flow at MBPS may result in a cost savings at MBPS that is similar to or greater than the additional cost for CIP SS3.

Alternative 2 may not be feasible to construct due to site constraints at SMPS. The existing pump station is located within a small, narrow property with four adjoining residential properties. Significant bypass pumping may be required to take the existing pump station offline so that the new pump station can be constructed within the footprint of the existing pump station. Impacts to adjacent properties and to vehicles and pedestrians in Wetlands Edge Road would need to be mitigated. Detailed feasibility study is recommended to determine the feasibility of a substantial modification to SMPS.

Hydraulic capacity could be restored within the existing 15-inch pipeline by removing approximately 70 percent (2,087 gpm) of the estimated 2,991 gpm infiltration/inflow (I/I) for the 10-year design storm in the upstream sewer basin. Predesign analysis for CIP SS3 should evaluate the feasibility of removing I/I to offset a portion or all of the CIP SS3 improvements, with a secondary benefit of reducing the amount of I/I that is pumped at the SMPS and MBPS and treated at the City's wastewater treatment plant. Predesign analysis may be combined with study of the Rio Del Mar sewer basin, which is described in CIP SS1.

Figure 3 provides an illustration of project improvements.

Figure 3

Table 3: CIP – SS3 Summary

CIP Component	Description
Proposed Improvements	• Relay 286 LF of 10-inch gravity sewer to the west of the Rio Del Mar and Rio Grande intersection to restrict flows to 650 gpm conveyed to SMPS • Replace 3,134 LF of 15-inch gravity sewer with 24- to 30-inch gravity sewer • Connect sewer laterals and local collector sewers to the new gravity sewer
Additional Project Considerations	• Easement / right-of-way considerations – Temporary and potentially permanent easements within American Canyon Middle School property • Environmental permitting for crossing of the creek located within the school property and construction permits
Project Cost Total [(1)]	$4,580,000 – Wastewater Operations

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS4 Broadway, Donaldson Way East to American Canyon Road

The existing 10-inch gravity sewer in Broadway between Donaldson Way East and American Canyon Road is undersized to convey existing peak wet weather flows. Also, City inspection of the three pipelines immediately upstream of American Canyon Road finds that the bottom of those pipelines is missing, which is suspected to be a significant factor for infiltration/inflow (I/I) during peak wet weather events. The capacity deficiency, together with the noted pipeline condition results in surcharging of the sewer and potential sanitary sewer overflow. Under future flow conditions, the pipeline between Donaldson Way and Poco Way is undersized to convey peak wet weather flows.

CIP SS4 includes upsizing 3,926 LF of the existing 6- and 10-inch gravity sewer to a 15-inch gravity sewer. Alignment of the new sewer would be parallel to the existing sewer, which is located in the southbound lane of Highway 29 (Caltrans right-of-way). Pipe bursting may not be feasible given the close proximity of a water main to the sewer alignment. Trenchless construction should be considered during project predesign to minimize disruption to highway traffic operations. Night work is also anticipated.

Hydraulic capacity could be restored within the existing pipeline north of Donaldson Way East by removing approximately 64 percent (178 gpm) of the estimated 276 gpm infiltration/inflow (I/I) for the 10-year design storm in the upstream sewer basin. Hydraulic capacity cannot be restored within the existing pipeline south of Donaldson Way East because the capacity deficiency exceeds the I/I in the upstream sewer basin.

Replacement of the damaged pipelines will reduce the amount of I/I contribution into the collection system by approximately 486 gpm for the 10-year design storm. Hydraulic evaluation of the collection system accounts for this reduction in I/I, including sizing of downstream CIP projects (e.g., Main Basin Pump Station).

This project is needed, in part, to serve future development.

Figure 4 provides an illustration of project improvements.

Figure 4

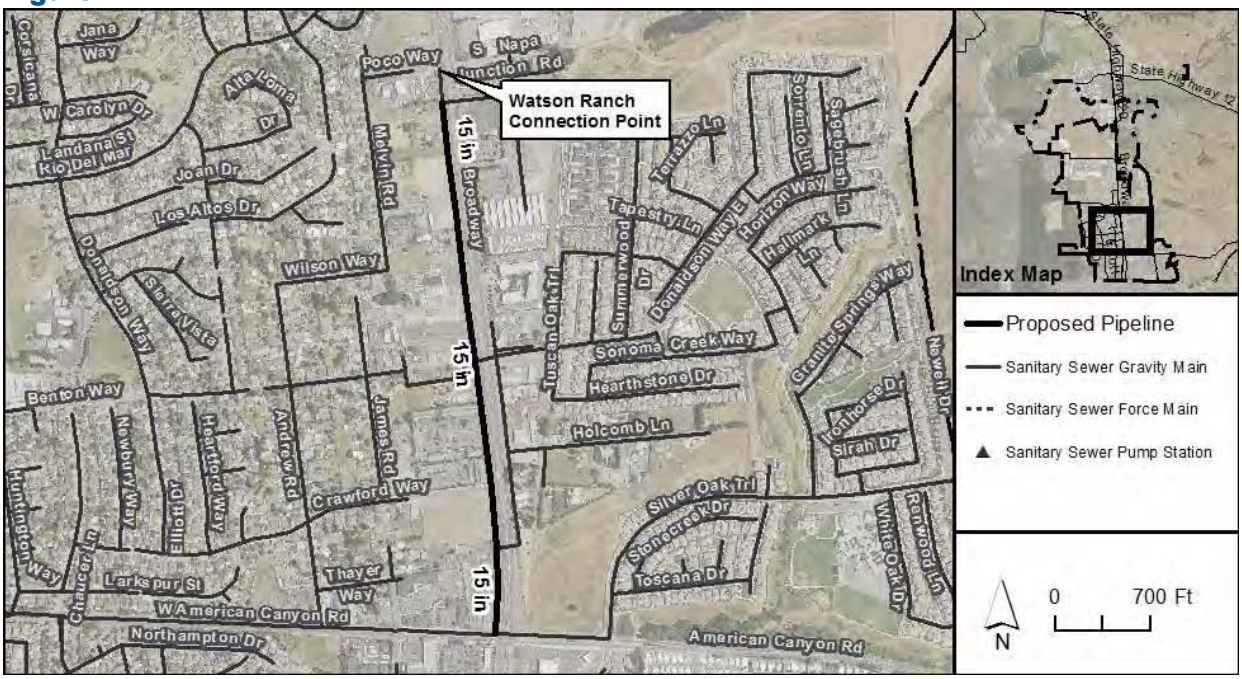


Table 4: CIP – SS4 Summary

CIP Component	Description
Proposed Improvements	• Replace 3,926 LF of 6- and 10-inch gravity sewer with 15-inch gravity sewer • Connect sewer laterals and local collector sewers to the new gravity sewer
Additional Project Considerations	• Easement / right-of-way considerations – Potential temporary easements on private properties located west of and adjacent to Highway 29 to facilitate construction activities • Caltrans encroachment permitting
Project Cost Total [(1)]	$1,280,000 – Wastewater Operations $1,260,000 – Wastewater Capacity $2,540,000 – Project Total

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS5 Summerfield Project

The existing 8-inch pipeline located between Westpark, Independence Drive, and Cartagena Way has hydraulic deficiencies and is difficult for City staff to access manholes.

CIP SS5 includes the relocation of approximately 430 LF of existing 8-inch gravity sewer with approximately 485 LF of new 8-inch gravity sewer. Alignment of the new sewer would be in Westpark and Cartagena Way, including the parking lot at the east end of Cartagena Way. Existing sewers would be abandoned in place. Existing sewer laterals and local collector sewers in the project vicinity would be connected to the new sewer.

Figure 5 provides an illustration of project improvements.

Figure 5

Table 5: CIP – SS5 Summary

CIP Component	Description
Proposed Improvements	• Abandon 430 LF of 8-inch gravity sewer located between Westpark, Independence Drive, and Cartagena Way • Construct 485 LF of 8-inch gravity sewer to relocate abandoned sewer • Connect sewer laterals and local collector sewers to the new gravity sewer
Additional Project Considerations	• Construction permits
Project Cost Total [(1)]	$370,000 – Wastewater Operations

Detailed information for the project cost is provided in Appendix G.

CIP – SS6 Theresa Avenue and Los Altos Drive, north of Rio Del Mar

The existing 6-inch gravity sewer in Theresa Avenue and Los Altos Drive located north of Rio Del Mar is undersized to convey existing peak wet weather flows. This capacity deficiency results in surcharging of the sewer and potential sanitary sewer overflow. Additionally, this gravity sewer contains sags, offset joints, and potentially illicit connection(s).

CIP SS6 includes upsizing 3,318 LF of the existing 6-inch gravity sewer to an 8- to 10-inch gravity sewer. Alignment of the new sewer would be in Theresa Avenue and Los Altos Drive, either parallel to the existing sewer or within the existing pipeline's alignment. Existing sewer laterals and local collector sewers in the project vicinity would be connected to the new sewer. Pipe bursting should be considered during project predesign; however, reconnection of sewer laterals, bypass pumping needs, and potential impacts to adjacent utilities may eliminate this alternative.

Hydraulic capacity could be restored within the existing pipeline by removing approximately 57 percent (236 gpm) of the estimated 416 gpm infiltration/inflow (I/I) for the 10-year design storm in the upstream sewer basin. I/I removal in the upstream basin would also reduce the amount of flow pumped at the Main Basin PS and treated at the City's wastewater treatment plant. This project may be combined with CIP SS4.

Figure 6 provides an illustration of project improvements.

Figure 6

Table 6: CIP – SS6 Summary

CIP Component	Description
Proposed Improvements	• Replace 3,318 LF of 6-inch gravity sewer with 8- and 10-inch gravity sewer • Connect sewer laterals and local collector sewers to the new gravity sewer
Additional Project Considerations	• Construction permits
Project Cost Total [1]	$2,050,000 – Wastewater Operations

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS7 Upsize Main Basin Pump Station

The firm capacity for the existing Main Basin Pump Station (MBPS) is 3,000 gallons per minute (gpm), which is based on operation of three of the four pumps with the fourth pump in standby mode. Existing peak wet weather flow conveyed to MBPS is estimated at 6,330 gpm; the peak flow rate increases to 6,864 gpm for future conditions. Exceeding the pump station capacity could result in significant sanitary sewer overflow at the pump station site and at low points in the upstream collection system. The existing equalization basins at MBPS are assumed to not contribute storage of wastewater for the benefit of reducing the peak flow rates to be pumped by MBPS.

Increase of capacity from 3,000 gpm to 6,864 gpm is anticipated to require the construction of a new pump station at the MBPS site. Construction of a new pump station would allow for operation of the existing pump station during construction. In order to handle the range of dry and wet weather flows conveyed to MBPS, the new pump station should be equipped with multiple pumps, potentially including small and large capacity pumps.

Hydraulic capacity could be restored for the MBPS by removing approximately 73 percent (3,864 gpm) of the estimated 5,298 gpm infiltration/inflow (I/I) for the 10-year design storm in the upstream sewer basin. This amount of I/I reduction is not considered feasible since it may not be achieved even with complete replacement of the upstream collection system (including sewer mains and laterals).

Predesign analysis should consider alternatives for CIP SS7, including the following:

- Alternative 1: Improve the existing pond at the pump station site in order to temporarily store peak flows during storm events. Preliminary evaluation of this alternative finds that this alternative may have a lower capital cost ($8,570,000) compared to a large capacity increase for the pump station. However, a detailed feasibility study is recommended for use of the pond that considers various factors for use of the pond, including: available storage volume, environmental impacts, resource agency permitting, hydraulic considerations, pond lining needs, etc. Use of an extended period simulation (EPS) model may improve the City's understanding of collection system hydraulics relative to peak flow demand at the MBPS.

- Alternative 2: This alternative assumes that project SS3 Alternative 2 is implemented, diverting flow to the SMPS and upsizing those facilities to handle the additional flow. If that alternative were to be implemented than the cost of upgrading the MBPS would be reduced to $5,140,000.

Useable storage volume for the pond is calculated as follows, which should be further evaluated during a feasibility study: based on review of aerial mapping, the pond area is approximately 2.3 acres. Assuming an average storage depth of 5 feet, the pond would hold approximately 3.75 million gallons (MG) of wastewater. It may be feasible to increase the pond storage depth by excavation of the pond bottom or raising of the surrounding levee

70 percent reduction in I/I is generally accepted in the wastewater industry as the upper bound for I/I rehabilitation projects. To achieve that level of I/I reduction, complete rehabilitation of the upstream collection system may be required, which is anticipated to be cost prohibitive. The approximate cost for rehabilitation of one mile of sewer mainline and associated manholes and sewer laterals is $3 million. The addition of upper lateral rehabilitation increases this cost. The project cost provided on the following page is $12.86 million. That budget would afford the rehabilitation of approximately 4.3 miles of I/I rehabilitation. Upon more detailed I/I study of the MBPS sewer basin, it may require rehabilitation of more than 4.3 miles of sewer main and associated manholes and laterals to achieve the I/I reduction necessary to avoid upgrade of the pump station.

Predesign for the pump station improvements should evaluate partial reduction of I/I contributing to the MBPS in order to reduce the scope of pump station improvements and the flow velocity within the pump station's existing 18-inch discharge force main to under 10 feet per second (fps).

Figure 7 provides an illustration of project improvements.

Figure 7

Table 7: CIP – SS7 Summary

CIP Component	Description
Proposed Improvements	• Construct a new 6,864 gpm capacity pump station • Construct associated piping and appurtenances at the pump station site, including emergency generator
Additional Project Considerations	• CEQA review, environmental and construction permits
Project Cost Total (1)	$11,990,000 – Wastewater Operations $870,000 – Wastewater Capacity $12,860,000 – Project Total

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS8 Broadway, Cartagena Way to Mobile Home Park Entrance

The existing 10-inch pipeline located in Broadway between the entrance to the Las Casitas mobile home park and Cartagena Way is undersized to convey peak wet weather flow.

CIP SS8 includes the upsizing of 1,111 LF of existing 10-inch gravity sewer to a 15-inch sewer. Alignment of the new sewer would be in Broadway, either parallel to the existing sewer or within the existing pipeline's alignment. Existing sewer laterals and local collector sewers in the project vicinity would be connected to the new sewer. Pipe bursting should be considered during project predesign; however, reconnection of sewer laterals, bypass pumping needs, and potential impacts to adjacent utilities may eliminate this alternative.

Hydraulic capacity could be restored within the existing pipeline by removing approximately 25 percent (28 gpm) of the estimated 111 gpm infiltration/inflow (I/I) for the 10-year design storm in the upstream sewer basin. I/I removal in the upstream basin would also reduce the amount of flow pumped at the Main Basin Pump Station and treated at the City's wastewater treatment plant.

Figure 8 provides an illustration of project improvements.

Figure 8

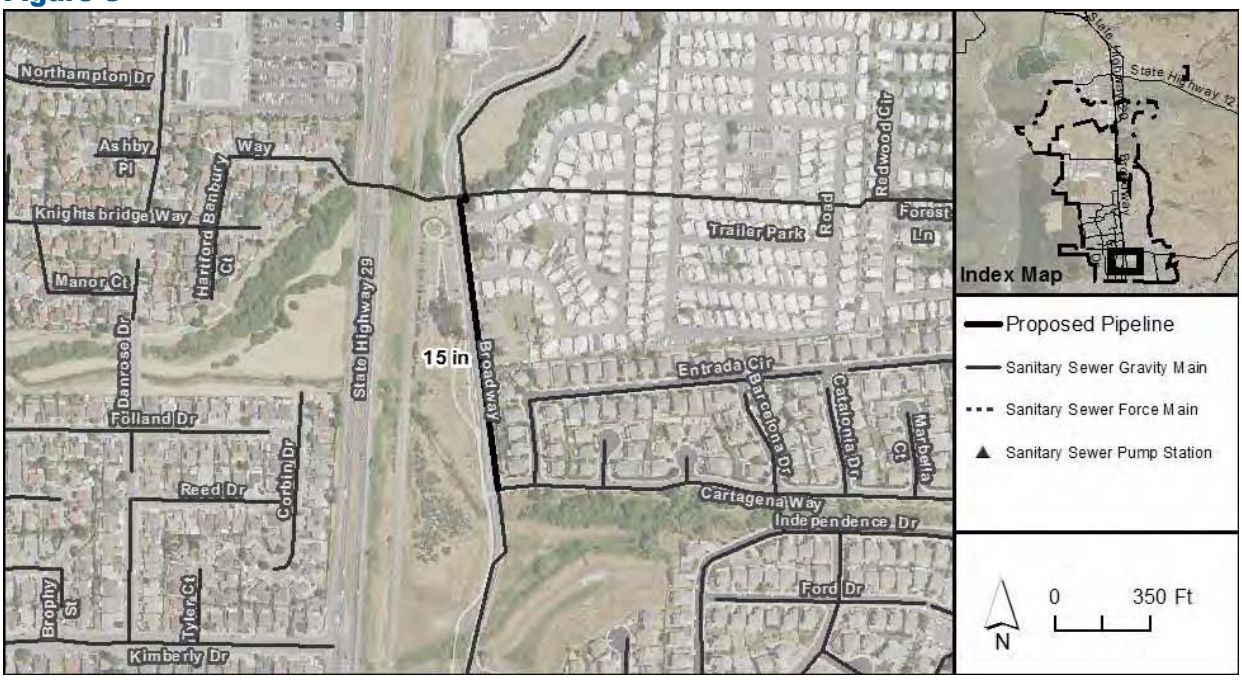


Table 8: CIP – SS8 Summary

CIP Component	Description
Proposed Improvements	• Replace 1,111 LF of 10-inch gravity sewer with 15-inch gravity sewer in Broadway • Connect sewer laterals and local collector sewers to the new gravity sewer
Additional Project Considerations	• Construction permits
Project Cost Total (1)	$680,000 – Wastewater Operations

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS9 Elliott Drive, Bedford Lane to Northampton Drive and Chaucer Lane, Northampton Drive to West American Canyon Road

The existing 12-inch gravity sewer in Elliott Drive starting just south of Bedford Lane and the existing 15-inch sewer in Chaucer Lane to the north of Northampton Drive are undersized to convey existing peak wet weather flows. These capacity deficiencies result in surcharging of the sewers and potential sanitary sewer overflow.

CIP SS9 includes upsizing 601 LF of the existing 12- and 15-inch gravity sewer in Elliott Drive and Chaucer Lane to 18- to 24-inch gravity sewers.

Alignment of the new sewers would be in Elliott Drive and Chaucer Lane, either parallel to the existing sewers or within the existing pipelines' alignments. Existing sewer laterals and local collector sewers in the project vicinity would be connected to the new sewers. Pipe bursting should be considered during project predesign; however, reconnection of sewer laterals, bypass pumping needs, and potential impacts to adjacent utilities may eliminate this alternative.

Hydraulic capacity could be restored within the existing pipelines by removing approximately 38 percent (442 gpm) of the estimated 1,178 gpm infiltration/inflow (I/I) for the 10-year design storm in the upstream sewer basin. I/I removal in the upstream basin would also reduce the amount of flow pumped at the Main Basin Pump Station and treated at the City's wastewater treatment plant.

Figure 9 provides an illustration of project improvements.

Figure 9

Table 9: CIP – SS9 Summary

CIP Component	Description
Proposed Improvements	• Replace 601 LF of 12- and 15-inch gravity sewer with 18- to 24-inch gravity sewer • Connect sewer laterals and local collector sewers to the new gravity sewer
Additional Project Considerations	• Construction permits
Project Cost Total [1]	$1,090,000 – Wastewater Operations

(1) Detailed information for the project cost is provided in Appendix G.

CIP – SS10 Broadway north of Rio Del Mar

The existing 8-inch gravity sewer in the western margin of the Broadway / Highway 29 right-of-way (Caltrans) between Rio Del Mar and Napa Junction Road is undersized to convey existing peak wet weather flows. This capacity deficiency results in surcharging of the sewer and potential sanitary sewer overflow. Addressing the hydraulic deficiency would also address potential structural issues with the pipelines.

CIP SS10 includes upsizing 2,110 LF of the existing 8-inch gravity sewer to a 10-inch gravity sewer. Alignment of the new sewer would either be parallel to the existing sewer or within the existing pipeline's alignment. Existing sewer laterals and local collector sewers in the project vicinity would be connected to the new sewer. Pipe bursting and trenchless construction should be considered during project predesign to minimize disruption to highway traffic operations. Night work is also anticipated.

Hydraulic capacity could be restored within the existing pipeline by removing approximately 55 percent (172 gpm) of the estimated 310 gpm infiltration/inflow (I/I) for the 10-year design storm in the upstream sewer basin, which overlaps with the sewer basin associated with CIP SS1. I/I removal in the upstream basin would also reduce the amount of flow pumped at the Main Basin PS and treated at the City's wastewater treatment plant.

Figure 10 provides an illustration of project improvements.

Figure 10

Table 10: CIP – SS10 Summary

CIP Component	Description
Proposed Improvements	• Replace 2,110 LF of 8-inch gravity sewer with 10-inch gravity sewer • Connect sewer laterals and local collector sewers to the new gravity sewer
Additional Project Considerations	• Easement / right-of-way considerations – Potential temporary easements on private properties located west of and adjacent to Highway 29 to facilitate construction activities • Caltrans encroachment permitting
Project Cost Total [(1)]	$1,030,000 – Wastewater Operations

(1) Detailed information for the project cost is provided in Appendix G.

City of American Canyon
Wastewater Collection System Master Plan
Planning Level Opinion of Probable Cost

ENR Construction Cost Index:	
Jul-15	11,155.07

Date: 5/2/2016

CIP Project; CIP-SS1: Rio Del Mar Basin

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$226,000	$226,000
Temporary Traffic Control (5%)		1	LS	$189,000	$189,000
Temporary Bypass Pumping		1	LS	$332,000	$332,000
Cleaning and CCTV Inspection		11,040	LF	$10	$110,400
6" Pipe - CIPP Rehabilitation	6	7,800	LF	$90	$702,000
8" Pipe - CIPP Rehabilitation	8	3,240	LF	$120	$388,800
Sewer Lateral Rehabilitation		230	EA	$8,000	$1,840,000
Sewer Manhole Rehabilitation		60	EA	$4,000	$240,000
Pre- and Post-Construction I/I Assessment		1	LS	$150,000	$150,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$4,179,000
Construction Subtotal (Rounded)					$4,180,000
Contingency (25%) (Rounded)					$1,045,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$5,230,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$1,307,500
Inspection/CM/ESDC (12% of Construction)	$627,600
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$7,170,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS2: Napa Logistics and Green Island Pump Station (Exist.)

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
New Green Island Pump Station (950 gpm)		1	LS	$1,400,000	$1,400,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$1,400,000
Construction Subtotal (Rounded)					$1,400,000
Contingency (25%) (Rounded)					$350,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$1,750,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$437,500
Inspection/CM/ESDC (12% of Construction)	$210,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$2,400,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS2: Napa Logistics and Green Island Pump Station (Future)

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$604,000	$604,000
Temporary Traffic Control (3%)		1	LS	$302,000	$302,000
Potholing		1	LS	$36,000	$36,000
Shoring and Trench Safety		1	LS	$150,000	$150,000
Dewatering		1	LS	$580,000	$580,000
Temporary Bypass Pumping		1	LS	$72,000	$72,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$72,000	$72,000
New Green Island Pump Station (1,455 gpm)		1	LS	$1,800,000	$1,800,000
10" Pipe - Tower Rd PS to Devlin Rd (invert 10' or less)	10	1,221	LF	$104	$126,984
10" Pipe - Tower Rd PS to Devlin Rd (invert over 10' to 18')	10	81	LF	$123	$9,963
18" Casing under Southern Pacific RR (10" trunk sewer to Tower Rd PS)	18	119	LF	$750	$89,250
10" Pipe - Railroad Crossing to Tower Rd PS (invert 10' or less)	10	119	LF	$104	$12,376
Tunneling Sending and Receiving Pits for Tunneled Portion to Tower Rd PS		1	LS	$250,000	$250,000
30" Casing under Southern Pacific RR (21" trunk sewer)	30	350	LF	$1,000	$350,000
21" Pipe - Devlin Rd to Green Island Pump Station (tunneled)	21	4,180	LF	$750	$3,135,000
Tunneling Sending and Receiving Pits for Tunneled Portion		1	LS	$1,500,000	$1,500,000
Tunneling Sending and Receiving Pits for RR Crossing (Green Island Rd)		1	LS	$500,000	$500,000
15" Pipe - Railroad Crossing to Green Island PS (open cut) (invert over 10' to 18')	15	1,115	LF	$161	$179,515
48" Manholes - for 8" and 12" Pipelines		26	EA	$15,000	$390,000
60" Manholes (invert 18' or more)		11	EA	$50,000	$550,000
Abandon Existing 18" Force Main		1	LS	$5,000	$5,000
Abandon Tower Rd PS and Demolish Green Island PS		1	LS	$150,000	$150,000
Misc. Utility Relocations and Lateral/Service Replacements		1	LS	$100,000	$100,000
Pavement Overlay		-	TN	$120	
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$10,965,000
Construction Subtotal (Rounded)					$10,970,000
Contingency (25%) (Rounded)					$2,743,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$13,720,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$3,430,000
Inspection/CM/ESDC (12% of Construction)	$1,646,400
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$18,800,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS3: Huntington Way

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$142,000	$142,000
Temporary Traffic Control (5%)		1	LS	$119,000	$119,000
Potholing		1	LS	$41,000	$41,000
Shoring and Trench Safety		1	LS	$69,000	$69,000
Dewatering		1	LS	$205,000	$205,000
Temporary Bypass Pumping		1	LS	$18,000	$18,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$35,000	$35,000
10" Pipe (invert 10' or less)	10	268	LF	$104	$27,872
24" Pipe (invert 10' or less)	24	213	LF	$199	$42,387
24" Pipe (invert over 10' to 18')	24	46	LF	$228	$10,488
27" Pipe (invert 10' or less)	27	151	LF	$293	$44,243
27" Pipe (invert over 10' to 18')	27	1,236	LF	$329	$406,644
30" Pipe (invert over 10' to 18')	30	1,488	LF	$359	$534,192
60" Manholes for 18" - 36" Pipes (invert over 10' to 18')		4	EA	$20,000	$80,000
60" Manholes for 18" - 36" Pipes (invert 18' or more)		6	EA	$25,000	$150,000
42" Casing under Creek (27" trunk sewer)		200	LF	$1,500	$300,000
Tunneling Sending and Receiving Pits for Creek		1	LS	$250,000	$250,000
Reconnect Sewer Laterals		32	EA	$5,000	$160,000
Misc. Utility Relocations		1	LS	$30,000	$30,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$2,665,000
Construction Subtotal (Rounded)					$2,670,000
Contingency (25%) (Rounded)					$668,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$3,340,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$835,000
Inspection/CM/ESDC (12% of Construction)	$400,800
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$4,580,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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ALT. 1 - Construct Parallel 15-inch Sewer
CIP Project; CIP-SS3: Huntington Way

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$89,000	$89,000
Temporary Traffic Control (5%)		1	LS	$75,000	$75,000
Potholing		1	LS	$41,000	$41,000
Shoring and Trench Safety		1	LS	$69,000	$69,000
Dewatering		1	LS	$205,000	$205,000
Temporary Bypass Pumping		1	LS	$18,000	$18,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$35,000	$35,000
10" Pipe (invert 10' or less)	10	268	LF	$104	$27,872
15" Pipe (invert 10' or less)	15	364	LF	$138	$50,232
15" Pipe (invert over 10' to 18')	15	2,770	LF	$161	$445,970
48" Manholes for 10" - 15" Pipes (invert over 10' to 18')		4	EA	$10,000	$40,000
48" Manholes for 10" - 15" Pipes (invert 18' or more)		6	EA	$12,000	$72,000
30" Casing under Creek (15" trunk sewer)		200	LF	$1,200	$240,000
Tunneling Sending and Receiving Pits for Creek		1	LS	$250,000	$250,000
Misc. Utility Relocations		1	LS	$30,000	$30,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$1,689,000
Construction Subtotal (Rounded)					$1,690,000
Contingency (25%) (Rounded)					$423,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,120,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$530,000
Inspection/CM/ESDC (12% of Construction)	$254,400
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$2,910,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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ALT. 2 - Divert Flow to SMPS
CIP Project; CIP-SS3: Huntington Way

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$199,000	$199,000
Temporary Traffic Control (5%)		1	LS	$166,000	$166,000
Potholing		1	LS	$17,000	$17,000
Shoring and Trench Safety		1	LS	$28,000	$28,000
Dewatering		1	LS	$84,000	$84,000
Temporary Bypass Pumping		1	LS	$250,000	$250,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$14,000	$14,000
18" Pipe (invert 10' or less)	18	560	LF	$159	$89,040
18" Pipe (invert over 10' to 18')	18	840	LF	$183	$153,720
60" Manholes for 18" - 36" Pipes (invert 10' or less)		3	EA	$15,000	$45,000
60" Manholes for 18" - 36" Pipes (invert over 10' to 18')		4	EA	$20,000	$80,000
Upgrade Sunset Meadows Pump Station Capacity to 3,774 gpm		1	LS	$2,500,000	$2,500,000
16" SSFM from SMPS to 18-inch SSFM	16	100	LF	$250	$25,000
Connection to 18-inch SSFM	16	1	LS	$15,000	$15,000
Misc. Utility Relocations		1	LS	$30,000	$30,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$3,696,000
Construction Subtotal (Rounded)					$3,700,000
Contingency (25%) (Rounded)					$925,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$4,630,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$1,157,500
Inspection/CM/ESDC (12% of Construction)	$555,600
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$6,350,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS4: Broadway North of American Canyon Rd (Exist.)

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$37,000	$37,000
Temporary Traffic Control (10%)		1	LS	$62,000	$62,000
Potholing		1	LS	$25,000	$25,000
Shoring and Trench Safety		1	LS	$41,000	$41,000
Dewatering		1	LS	$121,000	$121,000
Temporary Bypass Pumping		1	LS	$31,000	$31,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$21,000	$21,000
15" Pipe (invert 10' or less)	15	1,508	LF	$138	$208,104
15" Pipe (invert over 10' to 18')	15	496	LF	$161	$79,856
48" Manholes for 10" - 15" Pipes (invert 10' or less)		3	EA	$8,000	$24,000
48" Manholes for 10" - 15" Pipes (invert over 10' to 18')		2	EA	$10,000	$20,000
Reconnect Sewer Laterals		6	EA	$5,000	$30,000
Misc. Utility Relocations		1	LS	$25,000	$25,000
Additional Pavement Restoration in Caltrans Right-of-Way		1	LS	$15,000	$15,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$740,000
Construction Subtotal (Rounded)					$740,000
Contingency (25%) (Rounded)					$185,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$930,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$232,500
Inspection/CM/ESDC (12% of Construction)	$111,600
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$1,280,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS4: Broadway North of American Canyon Rd (Future)

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$74,000	$74,000
Temporary Traffic Control (10%)		1	LS	$123,000	$123,000
Potholing		1	LS	$48,000	$48,000
Shoring and Trench Safety		1	LS	$79,000	$79,000
Dewatering		1	LS	$236,000	$236,000
Temporary Bypass Pumping		1	LS	$20,000	$20,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$40,000	$40,000
15" Pipe (invert 10' or less)	15	1,618	LF	$138	$223,284
15" Pipe (invert over 10' to 18')	15	2,308	LF	$161	$371,588
48" Manholes for 10" - 15" Pipes (invert 10' or less)		2	EA	$8,000	$16,000
48" Manholes for 10" - 15" Pipes (invert over 10' to 18')		8	EA	$10,000	$80,000
Reconnect Sewer Laterals		16	EA	$5,000	$80,000
Misc. Utility Relocations		1	LS	$50,000	$50,000
Additional Pavement Restoration in Caltrans Right-of-Way		1	LS	$30,000	$30,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$1,471,000
Construction Subtotal (Rounded)					$1,480,000
Contingency (25%) (Rounded)					$370,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$1,850,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$462,500
Inspection/CM/ESDC (12% of Construction)	$222,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$2,540,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS5: Summerfield Project

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$11,000	$11,000
Temporary Traffic Control (5%)		1	LS	$9,000	$9,000
Potholing		1	LS	$6,000	$6,000
Shoring and Trench Safety		1	LS	$9,000	$9,000
Dewatering		1	LS	$26,000	$26,000
Temporary Bypass Pumping		1	LS	$22,000	$22,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$3,000	$3,000
8" Pipe (invert 10' or less)	8	485	LF	$91	$44,135
Abandon 8" Pipe	8	430	LF	$20	$8,600
48" Manholes for 8" - 15" Pipes (invert 10' or less)		4	EA	$8,000	$32,000
Reconnect Sewer Laterals		5	EA	$5,000	$25,000
Misc. Utility Relocations		1	LS	$5,000	$5,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$201,000
Construction Subtotal (Rounded)					$210,000
Contingency (25%) (Rounded)					$53,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$270,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$67,500
Inspection/CM/ESDC (12% of Construction)	$32,400
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$370,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS6: Theresa Avenue and Los Altos Drive

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$62,000	$62,000
Temporary Traffic Control (5%)		1	LS	$52,000	$52,000
Potholing		1	LS	$40,000	$40,000
Shoring and Trench Safety		1	LS	$67,000	$67,000
Dewatering		1	LS	$200,000	$200,000
Temporary Bypass Pumping		1	LS	$34,000	$34,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$17,000	$17,000
8" Pipe (invert 10' or less)	8	1,772	LF	$91	$161,252
10" Pipe (invert 10' or less)	10	1,546	LF	$104	$160,784
48" Manholes for 10" - 15" Pipes (invert 10' or less)		12	EA	$8,000	$96,000
Reconnect Sewer Laterals		54	EA	$5,000	$270,000
Misc. Utility Relocations		1	LS	$25,000	$25,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$1,186,000
Construction Subtotal (Rounded)					$1,190,000
Contingency (25%) (Rounded)					$298,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$1,490,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$372,500
Inspection/CM/ESDC (12% of Construction)	$178,800
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$2,050,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS7: Main Basin Pump Station (Exist.)

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
New Main Basin Pump Station (6,330 gpm)		1	LS	$7,000,000	$7,000,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$7,000,000
Construction Subtotal (Rounded)					$7,000,000
Contingency (25%) (Rounded)					$1,750,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$8,750,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$2,187,500
Inspection/CM/ESDC (12% of Construction)	$1,050,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$11,990,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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ALT. 1 - Improve Storage Pond to Reduce PWWF Capacity
CIP Project; CIP-SS7: Main Basin Pump Station (Exist.)

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Improve Storage Pond to Provide 3.75 MG Storage		1	LS	$2,000,000	$2,000,000
New Main Basin Pump Station (4,000 gpm)		1	LS	$3,000,000	$3,000,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$5,000,000
Construction Subtotal (Rounded)					$5,000,000
Contingency (25%) (Rounded)					$1,250,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$6,250,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$1,562,500
Inspection/CM/ESDC (12% of Construction)	$750,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$8,570,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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ALT. 2 - Divert Flow to SMPS to Reduce PWWF Capacity
CIP Project; CIP-SS7: Main Basin Pump Station (Exist.)

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Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Divert Flow to SMPS Under Separate CIP (SS3)					
New Main Basin Pump Station (4,000 gpm)		1	LS	$3,000,000	$3,000,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$3,000,000
Construction Subtotal (Rounded)					$3,000,000
Contingency (25%) (Rounded)					$750,000
Total Estimate of Probable Construction Cost (Rounded) (1)					**$3,750,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$937,500
Inspection/CM/ESDC (12% of Construction)	$450,000
Easement/Land Acquisition (1)	0
Project Total (Rounded)	**$5,140,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS7: Main Basin Pump Station (Future)

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
New Main Basin Pump Station (6,864 gpm)		1	LS	$7,500,000	$7,500,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$7,500,000
Construction Subtotal (Rounded)					$7,500,000
Contingency (25%) (Rounded)					$1,875,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$9,380,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$2,345,000
Inspection/CM/ESDC (12% of Construction)	$1,125,600
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$12,860,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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CIP Project; CIP-SS8: Broadway, Cartagena Way to Trailer Park Rd

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$21,000	$21,000
Temporary Traffic Control (5%)		1	LS	$17,000	$17,000
Potholing		1	LS	$14,000	$14,000
Shoring and Trench Safety		1	LS	$23,000	$23,000
Dewatering		1	LS	$67,000	$67,000
Temporary Bypass Pumping		1	LS	$17,000	$17,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$6,000	$6,000
15" Pipe (invert 10' or less)	15	276	LF	$138	$38,088
15" Pipe (invert over 10' to 18')	15	835	LF	$161	$134,435
48" Manholes for 10" - 15" Pipes (invert 10' or less)		1	EA	$8,000	$8,000
48" Manholes for 10" - 15" Pipes (invert over 10' to 18')		2	EA	$10,000	$20,000
Reconnect Sewer Laterals		2	EA	$5,000	$10,000
Misc. Utility Relocations		1	LS	$10,000	$10,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$386,000
Construction Subtotal (Rounded)					$390,000
Contingency (25%) (Rounded)					$98,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$490,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$122,500
Inspection/CM/ESDC (12% of Construction)	$58,800
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$680,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

City of American Canyon
Wastewater Collection System Master Plan
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ENR Construction Cost Index:	
Jul-15	11,155.07

Date: 5/2/2016

CIP Project; CIP-SS9: Elliott Drive south of Northampton

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$34,000	$34,000
Temporary Traffic Control (5%)		1	LS	$28,000	$28,000
Potholing		1	LS	$8,000	$8,000
Shoring and Trench Safety		1	LS	$13,000	$13,000
Dewatering		1	LS	$37,000	$37,000
Temporary Bypass Pumping		1	LS	$10,000	$10,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$7,000	$7,000
18" Pipe (invert over 10' to 18')	18	218	LF	$183	$39,894
18" Pipe (invert 18' or more)	18	199	LF	$208	$41,392
24" Pipe (invert over 10' to 18')	24	184	LF	$228	$41,952
60" Manholes for 18" - 36" Pipes (invert 10' or less)		2	EA	$15,000	$30,000
60" Manholes for 18" - 36" Pipes (invert over 10' to 18')		9	EA	$20,000	$180,000
60" Manholes for 18" - 36" Pipes (invert 18' or more)		3	EA	$25,000	$75,000
Reconnect Sewer Laterals		11	EA	$5,000	$55,000
Misc. Utility Relocations		1	LS	$25,000	$25,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$626,000
Construction Subtotal (Rounded)					$630,000
Contingency (25%) (Rounded)					$158,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$790,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$197,500
Inspection/CM/ESDC (12% of Construction)	$94,800
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$1,090,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

City of American Canyon
Wastewater Collection System Master Plan
Planning Level Opinion of Probable Cost

ENR Construction Cost Index:	
Jul-15	11,155.07

Date: 5/2/2016

CIP Project; CIP-SS10: Broadway north of Rio Del Mar

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$30,000	$30,000
Temporary Traffic Control (10%)		1	LS	$49,000	$49,000
Potholing		1	LS	$26,000	$26,000
Shoring and Trench Safety		1	LS	$43,000	$43,000
Dewatering		1	LS	$85,000	$85,000
Temporary Bypass Pumping		1	LS	$22,000	$22,000
Handling, Treatment, and Disposal of Contaminated Soil and GW		1	LS	$11,000	$11,000
10" Pipe (invert 10' or less)	10	1,810	LF	$104	$188,240
10" Pipe (invert over 10' to 18')	10	300	LF	$123	$36,900
48" Manholes for 10" - 15" Pipes (invert 10' or less)		7	EA	$8,000	$56,000
Reconnect Sewer Laterals		5	EA	$5,000	$25,000
Misc. Utility Relocations		1	LS	$10,000	$10,000
Additional Pavement Restoration in Caltrans Right-of-Way		1	LS	$10,000	$10,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$593,000
Construction Subtotal (Rounded)					$600,000
Contingency (25%) (Rounded)					$150,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$750,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$187,500
Inspection/CM/ESDC (12% of Construction)	$90,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$1,030,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

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