Dopudja & Wells consulting

In conjunction with:

BLACK & VEATCH

Selma-Kingsburg-Fowler County Sanitation District

2024 Collection System Master Plan Update

Revised Draft

PREPARED FOR:

SELMA-KINGSBURG-FOWLER COUNTY SANITATION DISTRICT

2024 Collection System Master Plan Update

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DECEMBER 2024

JON M. WELLS, PRINCIPAL

DATE

Acknowledgments

We appreciate the combined efforts of the entire project team in the development and preparation of the Collections System Master Plan Update. Our project team includes staff from the District, the City of Selma, the City of Kingsburg, and the City of Fowler. The efforts of the following individuals are gratefully acknowledged for their contributions to the completion of the evaluations presented in this report:

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LIST OF ABBREVIATIONS

To conserve space and improve the readability of the 2024 Master Plan Update, the following abbreviations are used throughout this document.

2024 MP Update	2024 Master Plan Update
ADWF	Average Dry Weather Flow
BWF	Base Wastewater Flow
CCTV	Closed-Circuit Television
CIP	Capital Improvement Plan
EPA	Environmental Protection Agency
ESFR	Equivalent Single Family Residential
FM	Flow Monitor
GIS	Geographic Information Systems
gpd	Gallons per Day
GWI	Groundwater Infiltration
LOF	Likelihood of Failure
LS	Lift Station
MCC	Motor Control Center
mgd	Million Gallons per Day
MWLS	Miscellaneous Water Level Sags
PACP	Pipeline Assessment and Certification Program
PDWF	Peak Dry Weather Flow
PLC	Programmable Logic Controller
PWWF	Peak Wet Weather Flow
RDII	Rainfall-Dependent Inflow and Infiltration
SOI	Sphere of Influence
SSMP	Sewer System Management Plan
WWTP	Wastewater Treatment Plan

Executive Summary

This chapter provides a summary of the information contained within the 2024 Collection System Master Plan. This chapter outlines the key results and findings from discussions with the member cities of Selma, Kingsburg, and Selma and the 2024 flow monitoring study.

IN THIS SECTION

- District Description
- 2022/2023 Temporary Flow Monitoring Study
- Existing Dry and Wet Weather Flows
- Rehabilitation and Repair Plan
- Capital Improvement Plans

ES.1 Background

The Selma-Kingsburg-Fowler County Sanitation District (District), established in February 1971 by the Fresno County Board of Supervisors, is a local government agency situated in the central San Joaquin Valley, south of Fresno, California. The District's primary function is to provide comprehensive wastewater management services to Selma, Kingsburg, and Fowler municipalities. Its responsibilities encompass collecting, treating, and disposing wastewater generated by residential, commercial, institutional, and industrial entities within its service area. While the collection systems within individual city boundaries remain under municipal ownership, the District assumes operational and maintenance responsibilities for these assets, including managing shared interceptors and specific lift stations under direct District ownership.

The District finalized the 2016 Master Plan Update in October of 2016. The 2024 Master Plan Update, builds upon previous planning initiatives from the 2016 Master Plan Update aimed to reevaluate development projections, revise flow projections, and formulate an updated Capital Improvement Plan (CIP). This update incorporates operational and condition risk assessments into the CIP prioritization process, ensuring the District's continued efficacy in serving its growing population and meeting future infrastructure demands.

ES.2 Existing System Description

Chapter 2 provides an overview of the study area, population trends, climate, and existing wastewater collection system for the SKF County Sanitation District. This chapter also provides essential context for understanding the current state of the District's wastewater infrastructure and highlights areas of focus for evaluating future needs and planning efforts.

The District's service area encompasses approximately 8,920 acres (13.9 square miles) and includes the area inside the city boundaries for each of the three member cities as well as some surrounding areas southeast of Fowler and east of Kingsburg. The City of Selma is located in the center of the District's service area. The City of Kingsburg is located in the southern part of the service area and is nearest to the WWTP. The city of Fowler is located in the northern-most, farthest upstream, portion of the District.

The three member cities have experienced varying rates of population growth since 2010, with Fowler growing most rapidly at about 2% annually, Kingsburg at 1% annually, and Selma at 0.6% annually.

The region has a Mediterranean climate characterized by hot, dry summers and cool, foggy winters, with most precipitation occurring between October and March. Annual rainfall is typically less than 10 inches, though 2023 saw significantly higher precipitation.

The District's collection system consists of approximately 176 miles of gravity mains ranging from 4 to 42-inches in diameter, 24 lift stations, and four (4) miles of force mains. The gravity mains and a majority of the lift stations are owned and operated by each member city, while the District owns four of the lift stations and manages the maintenance of the mains. The wastewater treatment plant, which has a capacity of eight (8) million gallons per day, utilizes a two-stage screw pump system and covers about 550 acres. Treatment processes include influent screening, grit removal, activated sludge secondary treatment, and effluent disposal via percolation ponds.

ES.3 Land Use and Development

Chapter 3 describes the existing land use, expected development, and population projections for the three member cities. Each member city has an adopted general plan that directs development within its City Limits and Sphere of Influence (SOI). These plans include land use and population projections for each city and the study area. The 2024 Master Plan Update for the SKF County Sanitation District relies on the information from each city’s General Plan as land use type is integral for estimating the wastewater generated by any collection system, as different land uses influence both the volume and nature of the wastewater produced. Accurately predicting wastewater generation from various land use types is essential for appropriately sizing and maintaining sewer system facilities.

Chapter 3 provides each city's land use map with the SOI and general plan boundaries, with assumptions consistent with each city's general plan. These assumptions forecast growth within each SOI, ensuring that the wastewater projections and facilities in the 2016 Master Plan align with each city's development guidelines. Detailed information can be found in the figures and tables in Chapter 3, with existing land use characteristics summarized in Table ES-1.

Different land uses produce varying amounts and types of wastewater, making accurate projections crucial for designing and maintaining adequate sewer infrastructure. This update aligns with each city's growth forecasts to ensure that wastewater facilities can handle increased demand.

Selma, Kingsburg, and Fowler had estimated populations of 24,514, 12,883, and 7,478, respectively, in 2022. The District anticipates serving a total population of 59,946 by 2045, a significant increase from the 2022 estimate of 44,875.

Table ES-1 District Existing Land Use Overview[1]

Land Use Type	Area (acres)	Percent of Total
Low Density Residential	533	17%
Medium Density Residential	928	30%
High Density Residential	1>	1% >
Commercial	398	13%
Public Facilities	49	2%
Park/Open Space	26	1%
Industrial	1069	35%
Other	57	2%
Totals	**3061**	**100%**

[1] Data obtained from GIS provided by the District for this study

ES.4 Existing and Future Flows

Chapter 4 details the existing and future wastewater flows for the District's collection system, based on a 2022/2023 flow monitoring study. It describes various flow components, including Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF), and Peak Wet Weather Flow (PWWF). The District's collection system must handle both dry and wet weather flows, making PWWF the design condition for the 2024 Master Plan Update's hydraulic evaluations. This chapter details the development of PWWF values specific to the District's system. The District's collection system must be designed to convey both dry weather and wet weather flows as described above. Therefore, PWWF is considered the design condition for the hydraulic evaluations contained in the 2024 Master Plan Update. The development of the design condition PWWF values specific to the District's collection system is described below in this chapter.

The study identified high rainfall-dependent inflow and infiltration (RDII) areas, particularly in Fowler. Dry weather flow generation factors were calculated, showing a reduction in residential wastewater generation from previous master planning efforts. Future flow projections were made based on development tiers for each member city.

Selma is projected to experience significant growth across all development tiers. The primary tier shows an ADWF increase of 930,100 gpd, with substantial increases in commercial and medium-density residential areas. Tier 1 development is expected to add 1,202,900 gpd, with a focus on medium-density residential growth. Tier 2 and Tier 3 developments project additions of 2,299,000 gpd and 4,366,700 gpd respectively, with major expansions in residential, commercial, and light industrial areas.

Kingsburg's growth projections are more modest compared to Selma. The primary tier shows an ADWF increase of 425,400 gpd, primarily in low-density residential development. Tier 1 is projected to add 448,400 gpd, with balanced growth across commercial, industrial, and residential sectors. Notably, Tier 2 shows no projected growth, while Tier 3 indicates a significant increase of 817,300 gpd, with emphasis on low-density residential and heavy industrial development.

Fowler demonstrates a significant amount of growth during primary tier development. The primary tier shows a substantial ADWF increase of 2,337,600 gpd, with significant growth in medium-density residential and heavy industrial sectors. Tier 1 is expected to add 1,066,200 gpd, focusing on residential development. Tier 2 projects an additional 991,300 gpd, primarily in residential areas, while Tier 3 shows a more modest increase of 287,800 gpd, concentrated in high-density residential development. Future District-wide flow projections are summarized in Table ES-2.

Table ES-2 District Flow Projections by Development Tier

	Existing	Primary	Tier 1	Tier 2	Tier 3
ADWF	4.15	7.84	10.56	13.85	19.32
PDWF	7.59	14.35	19.33	25.35	35.36
PWWF	15.36	29.02	36.96	42.94	57.97

ES.5 Hydraulic Model Update and Calibration

Chapter 5 of the 2024 Master Plan Update outlines the process of updating and calibrating the District's hydraulic model for the collection system. The chapter covers the model description, hydraulic model updates, dry and wet weather flow calibration, and design and performance criteria.

The comprehensive update and calibration of the hydraulic model through the data gathered from the fifteen (15) flow monitors ensures that the District's collection system is accurately represented and can effectively plan for current and future infrastructure needs. Chapter 5 also identifies potential deficiencies and develop targeted improvements using advanced modeling techniques and rigorous calibration processes. The adherence to stringent design and performance criteria further ensures the reliability and efficiency of the sewer system.

The District's hydraulic model was originally developed using the H2O Map Sewer program and later updated to InfoSewer in the 2016 Master Plan. As part of the 2024 Master Plan Update, the District's hydraulic model was updated from InfoSewer to

InfoSWMM. InfoSWMM offers advanced capabilities for simulating complex hydraulic conditions and identifying system deficiencies. The transition to InfoSWMM represents a significant enhancement in the District's modeling capabilities, ensuring that the hydraulic model is able to identify hydraulic deficiencies in existing and future development scenarios.

Significant revisions were made to the model network, which now simulates a skeletonized system of approximately 73 miles of pipelines and 24 lift stations. The updated model includes all major conveyance gravity mains (12-inch diameter and larger), with smaller diameter pipelines added as needed. The model was cross-checked with the District's Geographic Information Systems (GIS) to ensure accuracy and completeness.

The comparison with GIS data revealed several discrepancies, leading to updates in the hydraulic model. These updates included incorporating structural improvements made since the 2016 Master Plan, correcting inconsistencies in gravity main diameters, and verifying the presence of infrastructure elements. Additionally, basic data checks were performed to identify and rectify missing data and physical inconsistencies, such as reverse pipe slopes.

The calibration of the hydraulic model under dry weather conditions is vital for ensuring that the model accurately reflects the actual performance of the collection system. This process involved determining average dry weather flow (ADWF) and peak dry weather flow (PDWF) at each flow monitoring location. Parcel-level flow monitoring basins sewersheds were created, and wastewater flow generation factors were adjusted until the model's outputs matched the observed values from flow monitoring data.

The steps involved in dry weather calibration included determining the ADWF for the entire collection system, assigning each parcel in the District to a flow monitoring basin, and adjusting diurnal patterns to match observed PDWF values. This rigorous calibration process ensures that the model provides a reliable representation of the system under typical dry weather conditions. ADWF calibration values are summarized in Table ES-3.

Table ES-3 ADWF Calibration Values

Flow Monitor Number	Pipe ID	ADWF from Flow Monitoring	ADWF from Model	% Difference
01	I-130	0.625	0.621	1%
01A	F-231	0.069	0.069	0%
01B	I-185	0.020	0.020	-1%
01C	F-223	0.104	0.104	0%
02	I-661	1.033	1.041	-1%
03	S-711	0.218	0.220	-1%
04	S-752	0.420	0.418	0%
06	I-671	0.504	0.499	1%
06A	S-670	0.130	0.131	0%
06B	S-548	0.158	0.157	1%
06C	S-698	0.155	0.154	1%
07	I-935	2.079	2.259	-9%
08	I-25	0.946	0.966	-2%
09	K-460	0.737	0.773	-5%
09A	K-421	0.333	0.339	-2%

Following the dry weather calibration, the model was calibrated for wet weather conditions to accurately simulate the RDII entering the sewer system during precipitation events. The calibration process involved selecting a representative wet weather event, establishing the RDII flow at each monitoring location, and adjusting R-T-K values to match the observed RDII flows. A secondary storm event was used for model verification, ensuring robustness and accuracy in the simulation of wet weather conditions.

Wet weather calibration is crucial for understanding how the sewer system responds to significant rainfall events. The selected calibration event, which occurred on January 8, 2023, was representative of a 5-year to 10-year return interval event. This event provided a robust basis for calibration, capturing the system's response to substantial inflows. The calibrated model can now simulate RDII accurately, helping the District plan for and mitigate the impacts of future wet weather events.

Finally, Chapter 5 also details the design and performance criteria used in evaluating the District's collection system. These criteria, derived from the District's Construction Standards and industry norms, include parameters for gravity mains, lift stations, and force mains.

ES.6 Existing and Future Capacity Evaluation

Chapter 6 presents a detailed hydraulic evaluation of the District's collection system, addressing both existing and future conditions. The assessment includes gravity mains, wet wells, pump stations, and force mains, focusing on system performance under Peak Wet Weather Flow (PWWF) conditions.

The comprehensive evaluation of the District's collection system under both existing and future conditions highlights the need for targeted infrastructure improvements. Immediate actions include addressing current deficiencies in gravity mains and lift stations. Long-term strategies involve upgrading existing facilities and constructing new infrastructure to accommodate projected growth and ensure the system meets performance criteria. These measures will help maintain the reliability and efficiency of the District's wastewater collection system.

The hydraulic evaluation revealed deficiencies in the existing gravity mains within the District's collection system. In Selma, 7,350 feet of gravity mains were identified as deficient under current conditions, and in Fowler 9,940 feet were identified. A significant portion of these deficiencies were in areas with high Rainfall-Derived Inflow and Infiltration (RDII) values. When RDII rates were reduced by 50% in a sensitivity analysis, the deficiencies decreased. There were no existing deficiencies identified in Kingsburg. The existing gravity main deficiencies are shown on Figure ES-1.

The evaluation of lift stations indicated that a majority of the lift stations have sufficient capacity to convey the design flows. Of the 24 lift stations, three lift stations, notably the Merced, Manning, and North lift stations were found to be deficient, with existing design flows exceeding their firm capacities, summarized in Table ES-4.

Table ES-4 Existing Lift Station Capacity Evaluation

Name	Owned by	Firm Capacity, gpm	Existing Design Flow, gpm	Status
Merced	District	750	1,250	Deficient
Manning	District	750	2,200	Deficient
North	District	1,900	6,900	Deficient

The force main evaluation showed that the majority of the District's force mains operate within acceptable performance criteria under existing conditions. However, the force main associated with the North Lift Station was identified as deficient, with flow velocities reaching approximately 28 fps, significantly exceeding the acceptable limit of 8 feet per second.

The details of the existing capacity evaluation can be found in Chapter 6.

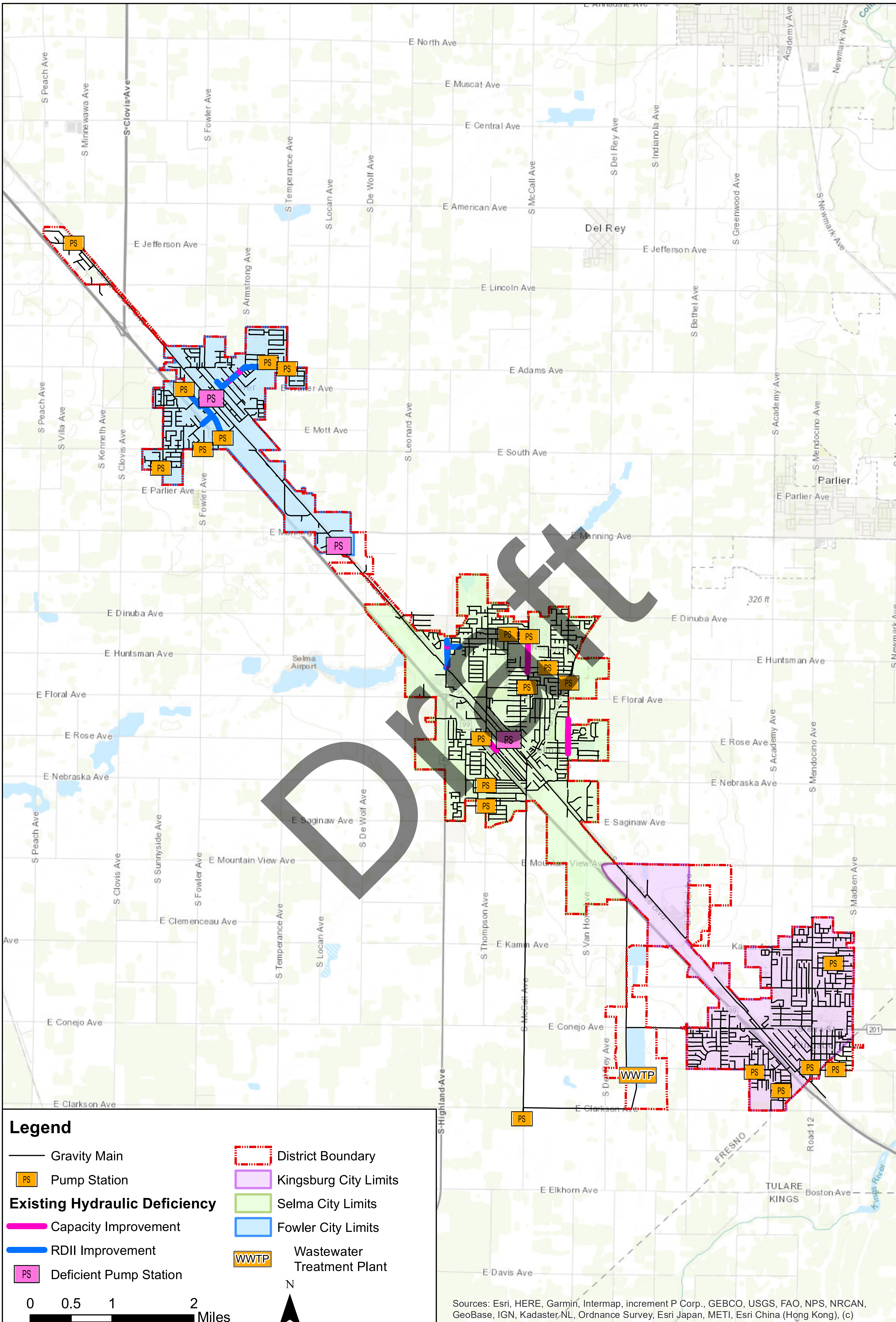

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FIGURE ES-1
EXISTING HYDRAULIC DEFICIENCIES
2024 COLLECTIONS MASTER PLAN UPDATE

The second half of Chapter 6 describes the infrastructure required to convey future design flows,. This infrastructure development is driven by projected increases in wastewater flows due to population growth and expansion to ensure that the collection system can handle these increased flows while maintaining performance criteria and minimizing the need for frequent maintenance and operational disruptions.

As new developments are built and come online, certain sections of the existing infrastructure are projected to become deficient. In Selma, future flows will create deficiencies in 22,590 feet of existing gravity mains, in Kingsburg 11,550 feet of existing gravity mains will be deficient, and in Fowler future developments will lead to deficiencies in 30,140 feet of existing gravity mains. District trunk gravity mains in Golden State Blvd will require parallel capacity expansion in the future.

Additionally, new gravity mains will need to be built to collect and convey wastewater from the new developments. Over 200,000 feet of new gravity mains are required in Selma, approximately 29,000 feet of new gravity mains are required in Kingsburg, and approximately 66,000 feet of new gravity mains are required in Fowler. The required new gravity mains, as well as the deficient existing gravity mains, can be found on Figure ES-2.

The future capacity assessment indicated that several existing lift stations will require capacity upgrades to handle future flows. The three lift stations already identified as deficient under existing conditions, Merced, Manning, and North, will require further upgrades to accommodate projected flow increases. Several other exiting lift stations will require upgrades under future conditions. The future capacity requirements at lift stations is shown in Table ES-5.

Additionally, seven new lift stations are proposed to serve areas where gravity mains alone cannot provide adequate service due to topographic constraints. These new stations will be located in southwestern Fowler, southern Fowler, western Selma, southwestern Selma, northeastern Selma, southeastern Selma, and southwestern Kingsburg. Capacity requirements for these new lift stations are presented in Table ES-6.

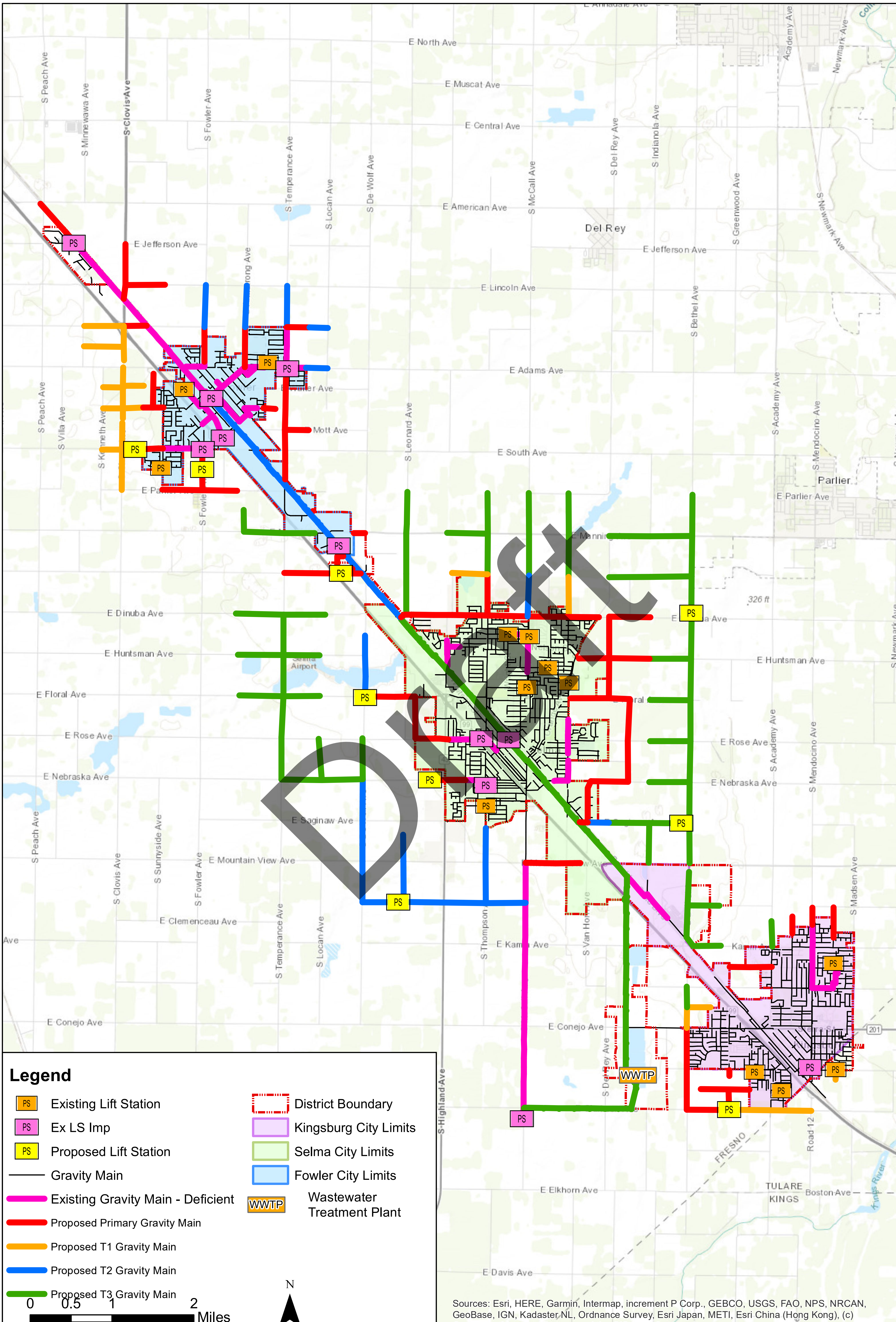

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FIGURE ES-2
FUTURE HYDRAULIC DEFICIENCIES
2024 COLLECTIONS MASTER PLAN

Table ES-5: Existing Lift Station Capacity Requirements with Future Development

Name	Owned by	Firm Capacity, gpm	Primary Design Flow, gpm	Tier 1 Design Flow, gpm	Tier 2 Design Flow, gpm	Tier 3 Design Flow, gpm
Merced	District	750	3,000	3,200	4,000	4,400
Manning	District	750	6,100	8,300	9,000	9,900
North	District	1,900	8,472	9,618	10,014	12,215
18th Ave	District	2,326	1,520	1,870	1,870	2,490
10th St	Fowler	316	200	200	200	200
Peach	Fowler	800	810	810	810	810
Gleason	Fowler	224	60	60	60	60
South Ave	Fowler	417	1,440	1,910	1,940	1,950
Jefferson	Fowler	120	420	450	450	450
Adams	Fowler	478	480	760	2,500	2,500
Randy	Fowler	250	90	90	90	90
Mehlert	Kingsburg	230	40	80	80	80
Kern	Kingsburg	787	30	30	30	30
Skansen	Kingsburg	500	190	200	200	300
Tulare	Kingsburg	250	10	200	200	210
Rose	Selma	865	450	520	1,020	1,920
Goldridge	Selma	100	30	30	30	30
North Hill	Selma	352	10	10	10	10
Dockery	Selma	865	280	280	280	280
Sunset	Selma	669	590	1,150	1,150	1,150
Barbara	Selma	170	12	12	12	12
Valley View	Selma	1,100	400	410	520	520
Maple & McCall	Selma	550	170	170	170	170
Clarkson & McCall	Selma	1,500	1,500	1,950	5,400	10,080

Table ES-6 Proposed Future Lift Stations Required to Convey Design Flows Under Future Conditions

Proposed Future Lift Station	Location	Proposed Firm Capacity, gpm	Primary Design Flow, gpm	Tier 1 Design Flow, gpm	Tier 2 Design Flow, gpm	Tier 3 Design Flow, gpm
Southwestern Fowler	Fowler	675	263	656	654	656
Southern Fowler	Fowler	650	636	625	631	643
Southeastern Fowler	Fowler	575	558	558	558	558
Western Selma	Selma	925	-	-	418	922
Selma - Nebraska	Selma	775	263	573	777	777
Southwestern Selma	Selma	4,600	-	-	768	4,590
Northeastern Selma	Selma	1,825	-	-	-	1,826
Southeastern Selma	Selma	3,250	-	-	-	3,235
Southwestern Kingsburg	Kingsburg	300	223	276	276	277

The force main evaluation for future conditions revealed that several mains will be deficient as flow velocities exceed acceptable limits. Specifically, the Merced, North Ave, South Ave, Adams, Sunset, and Clarkson & McCall force mains will experience significantly higher velocities, necessitating upgrades to maintain system performance.

ES.7 Rehab/Replacement Plan

Chapter 7 outlines the rehabilitation and replacement plan for the District's collection system. It covers assessments of gravity mains, lift stations, and force mains, providing detailed condition evaluations and recommendations for ongoing maintenance and repairs.

The District employs Closed Circuit Television (CCTV) inspections to monitor the condition of gravity mains. In May-June 2021, 95 gravity sewers were inspected, covering over 33,000 feet. Of these, 20% of the segments displayed structural defects with NASSCO scores of 4 or 5. The defects identified necessitate short-term rehabilitation or repair actions. The specific defects are summarized in Table ES-7. The specific recommendations for these segments, along with a prioritized inspection plan, are fully described at the end of Chapter 7.

Table ES-7 Structural Defects Observed in Segments with Scores of 4 or 5

Defect Code	Quantity	Defect Code	Quantity
Broken	25	Hole Void Visible	6
Broken Soil Visible	2	Water Level Sag	119
Broken Void Visible	1	Patch Defective	2
Fracture Hinge - 3	1	Aggregate Projecting	12
Fracture Multiple	109	Tap Break-in Intruding	13
Hole	5		

Black & Veatch assessed nine lift stations in September 2023, evaluating their physical and performance conditions. This assessment included a detailed asset inventory, utilizing a consistent scoring approach to assign condition scores as summarized in table ES-8 below. The assessment revealed varying degrees of deterioration across the lift stations, with specific recommendations for rehabilitating or replacing critical assets.

Table ES-8 Condition Scoring Guide

Observed Condition Score	Description	Useful Life Consumed	Level of Maintenance Currently Required	Improvements Implementation Timeframe
1	Like New Condition	< 5%	Normal Preventative / Predictive Maintenance	20-30 years
2	Minor Defects Only (some wear)	5% - 20%	Normal Preventative / Predictive Maintenance / Minor Corrective Maintenance	15-20 years
3	Moderate Deterioration	21% - 50%	Normal Preventative / Predictive Maintenance / Major Corrective Maintenance	10-15 years
4	Significant Deterioration	50% - 75%	Rehabilitate, if Possible	5-10 years
5	Virtually Unserviceable/Failure Concern	> 75%	Consider Replacement	0-2 Years

Chapter 7 includes detailed record review results for the Merced St, Manning, Rose, Dockery, Sunset, Kern, North 10th St, Peach St, and South Avenue lift stations, including historical information, assessment by discipline, site photos, and recommendations.

Force mains, being buried pressure pipelines, pose significant challenges for inspection and condition management. The recommended plan for force mains includes establishing an asset registry and developing a phased approach for inspection and rehabilitation.

ES.8 Capital Improvement Program

Chapter 8 presents an extensive overview of the planned upgrades, replacements, and expansions for the District's wastewater collection system. This includes improvements to gravity mains, lift stations, and force mains, prioritizing projects based on development timelines, and risk assessments. The chapter also details the methods used to estimate costs and the various techniques for pipeline rehabilitation, repair, and replacement.

The comprehensive CIP outlined in Chapter 8 ensures that the District has a clear, prioritized plan for maintaining and improving its wastewater collection system to meet both current and future needs. By addressing the various components of the system and providing detailed cost estimates and prioritization, the CIP aims to enhance the system's capacity, reliability, and efficiency.

The CIP includes probable construction costs that are based on January 2024 dollars using the Engineering News Record (ENR) Construction Cost Index (CCI) of 13,515 (20-city average). These costs are intended for conceptual-level cost estimating and align with the guidelines of the Association for the Advancement of Cost Engineering (AACE) International for a Class 5 Estimate, which is suitable for long-range capital planning with an accuracy range of -50 percent to +100 percent.

The CIP includes significant expansion in the number of gravity mains in the collection system. The recommended gravity main projects for the existing and future collection system were developed based on the methodologies and criteria presented in previous chapters. The gravity main CIP includes improvements through buildout conditions, with a total estimated cost of $386 million, summarized in table ES-9 below. The projects are prioritized based on development timelines breaking down as follows:

- Existing Conditions Improvements: $14 million (4%)
- Primary Development Timeframe Improvements: $101 million (26%)
- Tier 3 (Buildout) Development Timeframe Improvements: $153 million (40%)

Selma requires the largest portion of the proposed gravity main CIP because Selma has the largest expansion of developed area, while Kingsburg and Fowler have smaller but significant portions based on their projected growth and development needs. The pipeline CIP is summarized in Table ES-9. Pipeline CIP projects are shown on Figure ES-3, ES-4, and ES-5.

Table ES-9 Summary of Proposed Gravity Main CIP Conceptual Capital Costs

Development Timeframe	Selma, dollars	Kingsburg, dollars	Fowler, dollars	District, dollars	2024 MP Update Study Area, dollars
Existing	$5,292,000	$-	$8,743,000	$-	$14,035,000
Primary	$42,350,000	$9,813,000	$48,972,000	$-	$101,135,000
Tier 1	$2,727,000	$8,983,000	$8,153,000	$-	$19,863,000
Tier 2	$64,315,000	$-	$7,794,000	$25,476,000	$97,585,000
Tier 3	$82,057,000	$11,318,000	$2,130,000	$57,510,000	$153,015,000
Total	**$196,741,000**	**$30,114,000**	**$75,792,000**	**$82,986,000**	**$385,633,000**

The proposed lift station CIP addresses capacity increases and rehabilitation needs, with an estimated total cost of $49 million. Chapter 8 provides detailed costs for each lift station, including new constructions and capacity upgrades. The improvements are crucial for ensuring adequate service as the collection system expands to accommodate future development. Force main improvement costs are included in the lift station improvement costs.

In addition to the proposed CIP for capacity improvements, the District's collection system will require regular investment in refurbishment and replacement to maintain its working order. The recommended budgets are as follows, with further details provided in Chapter 8:

- CCTV Inspection Program: $165,000 per year
- Gravity Main Rehabilitation and Replacement: $700,000 per year
- RDII Identification: $75,000 per year for the next five years
- Force Main Asset Registry Establishment: $50,000 per year for the next five years

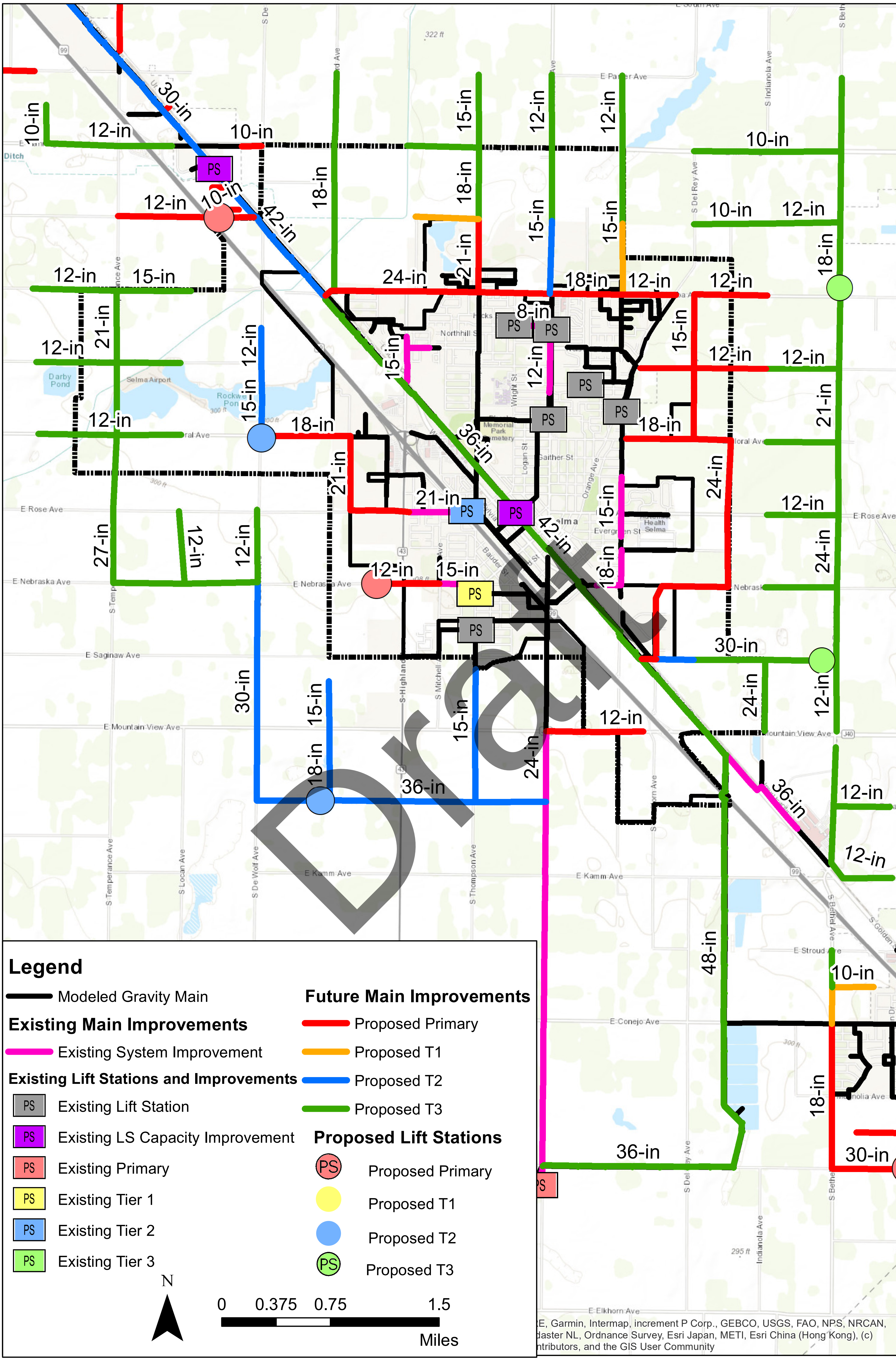

FIGURE ES-3
CITY OF SELMA
CAPITAL IMPROVEMENT PLAN

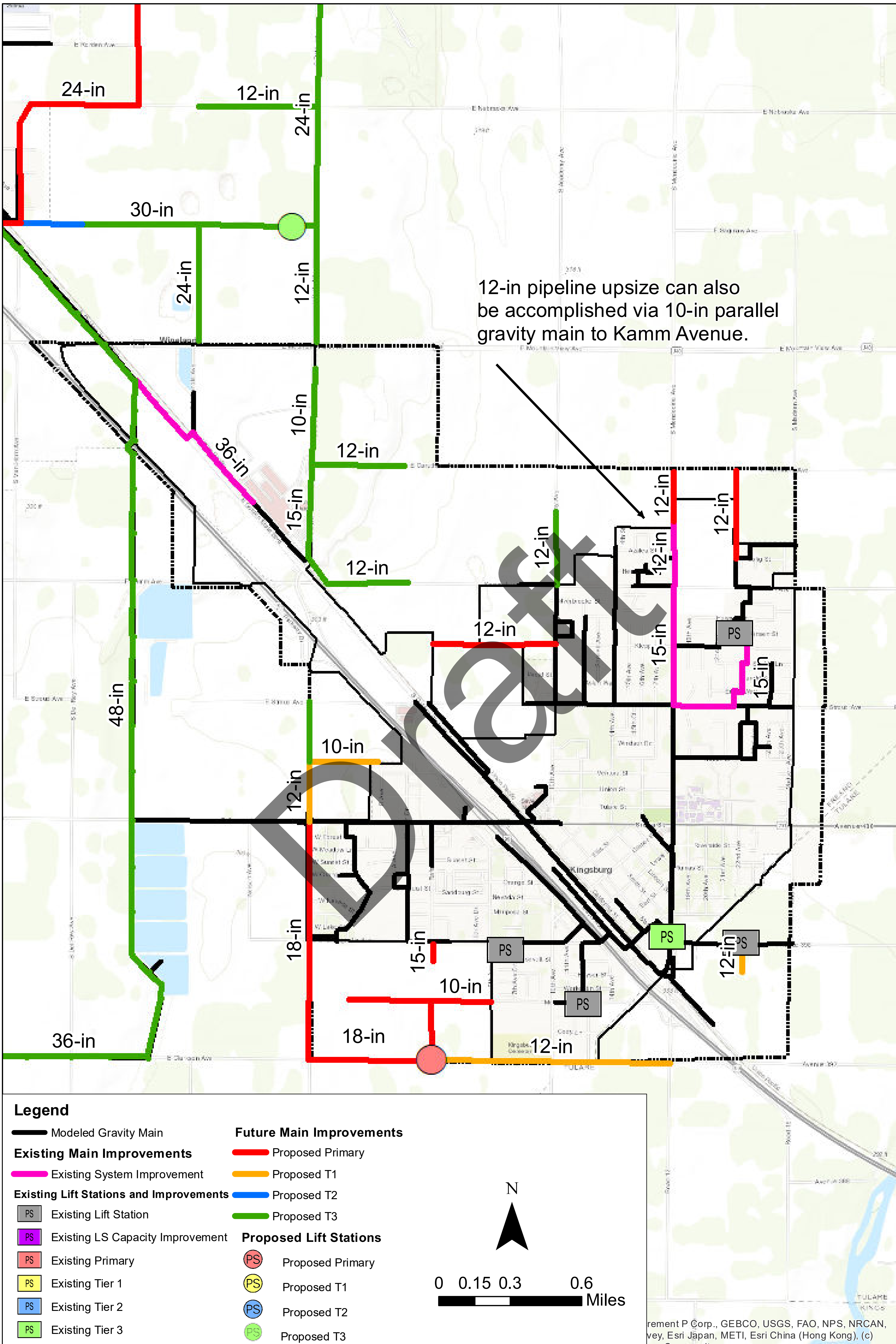

FIGURE ES-4
CITY OF KINGSBURG
CAPITAL IMPROVEMENT PLAN

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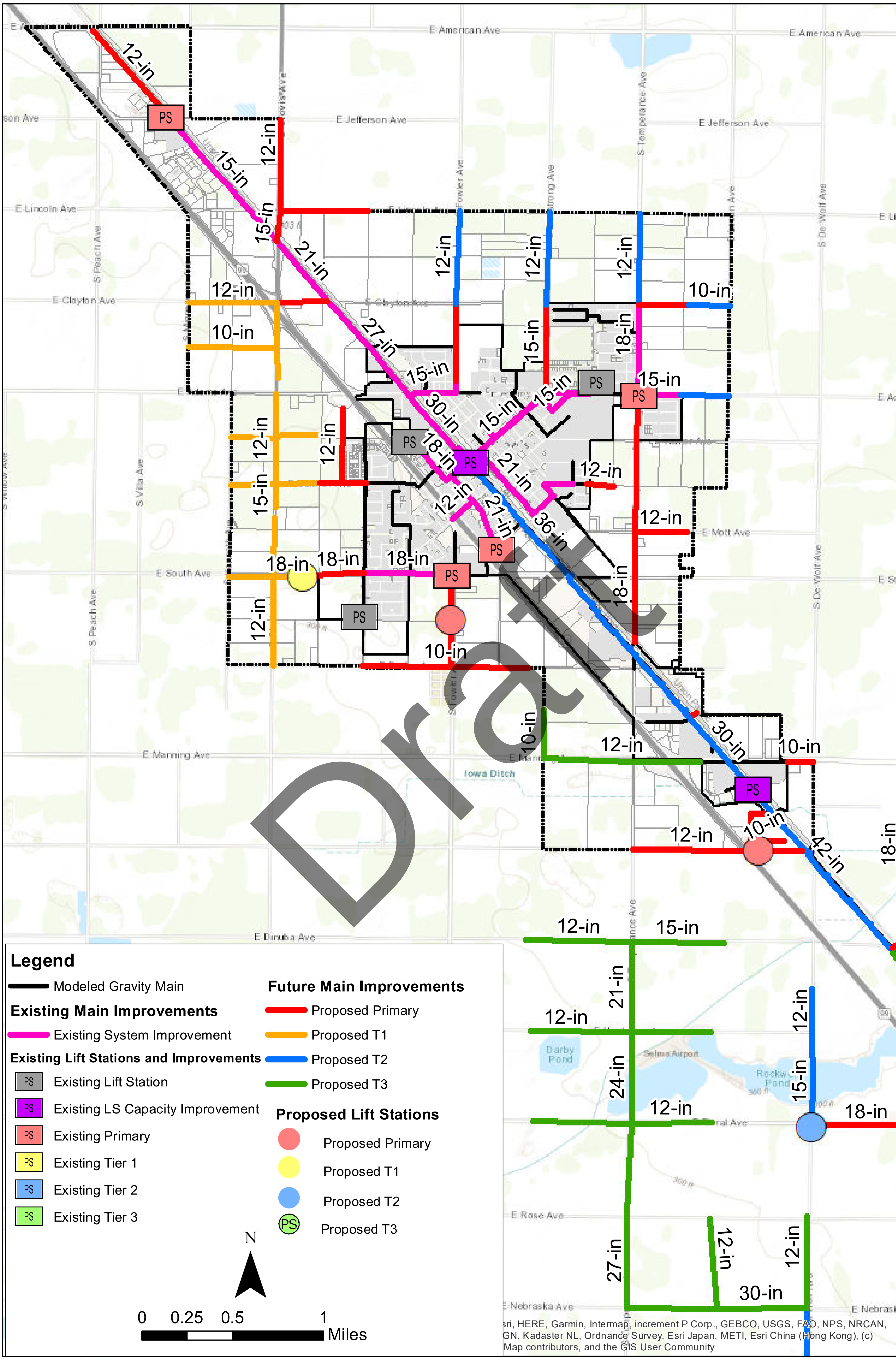

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FIGURE ES-5
CITY OF FOWLER
CAPITAL IMPROVEMENT PLAN

Chapter 1 Introduction

This chapter presents the project background and project objectives for the Selma-Kingsburg-Fowler County Sanitation District's collection system, including a summary of previous planning efforts and the organization of the 2024 Collection System Master Plan Update.

IN THIS SECTION

- Background
- Objectives
- Previous Studies
- Report Organization

1.1 Background

The Selma-Kingsburg-Fowler County Sanitation District (District) is located approximately 200 miles north of downtown Los Angeles and 180 miles south of San Francisco in southern Fresno County. The District was formed in February 1971 by the Fresno County Board of Supervisors as a special district to provide wastewater collection, treatment, and disposal services for residential, commercial, and industrial customers located within the service area of the three cities of Selma, Kingsburg, and Fowler (collectively, the member cities). Each member city owns the collection system within its boundary, but the District oversees the maintenance and operation of all of the collection system assets. Additionally, the District owns and operates the large interceptors and lift stations along the interceptors within the system.

1.2 Objectives

The objectives of the 2024 Master Plan Update (2024 MP Update) are to provide a comprehensive evaluation of the collection system, including both capacity and condition elements, and to use this evaluation to provide a clear roadmap for investment in the collection system over the next decade. This roadmap will account for investment in rehabilitation and repair of existing assets as well as investment in new infrastructure required for growth that is identified by the member cities.

The objectives of the 2024 MP Update are accomplished through the performance of the following primary tasks:

- Collect and Review Existing System Data
- Develop Detailed Planning and Land Use Projections
- Devise Flow Monitoring Plan that Gathers Dry and Wet Weather Data
- Evaluate Existing and Future Flow Capacity Using Hydraulic Modeling
- Explore Hydraulic Modeling Software Options to Create Model Transition Plan
- Update Refurbishment and Replacement Plan
- Identify and Prioritize CIP
- Prepare Master Plan
- Develop Master Planning Tools and Training Support
- Audit District's SSMP

1.3 Project Authorization

The District and Dopudja & Wells Consulting (Dopudja & Wells) entered into a professional services agreement on July 14, 2022 to prepare the 2024 Collection

Systems Master Plan. The Dopudja & Wells team includes Black & Veatch Corporation (Black & Veatch), in addition to flow monitoring support from V&A Consulting Engineers (V&A)

1.4 Previous Collection System Planning Efforts

The District completed the 2016 Collection System Master Plan Update (2016 MP Update) in October of 2016. The 2016 MP Update relied upon previously captured flow monitoring data for development of the hydraulic model. A collaborative method incorporating the member cities throughout the process was utilized to develop growth projections for the member cities. A comprehensive CIP was developed from the hydraulic model using these projections. Furthermore, the 2016 MP Update integrated an operational and condition risk assessment into the prioritization of this CIP. The 2024 MP Update has been developed to build seamlessly from the success of the 2016 MP Update.

1.5 Report Organization

The 2024 MP Update contains eight chapters followed by supporting appendices. The chapters are briefly described below:

Chapter 1 – Introduction. This chapter presents background information on the scope and objectives, a summary of the previous planning efforts, and the report organization for the 2024 MP Update.

Chapter 2 – Existing System Description. This chapter defines the study area for the 2024 MP Update, summarizes the historical population trends within the study area, and provides a brief description of the member cities.

Further, Chapter 2 presents an overview of the District's existing wastewater collection system within the study area including gravity mains, lift stations, and force mains.

Chapter 3 – Land Use and Development. This chapter details the existing land use and projected development within the study area as identified by the member cities. The critical data developed in this chapter was collected through close collaboration of the District and the member cities.

Chapter 4 – Existing and Future Flows. This chapter defines the flow monitoring basins and presents the results of the dry weather and wet weather flow monitoring. Additionally, this chapter describes the flow projection methodology and wastewater flow components for the 2024 MP Update.

Chapter 5 – Hydraulic Model Update and Calibration. This chapter explains the process and assumptions associated with updating the collection system hydraulic model. The hydraulic model is the critical tool for evaluating the hydraulic capacity of the collection system, and for identifying improvements required to provide sufficient capacity for the District's customers. Additionally, this chapter contains an overview of the modeling software, the modeled system network, future design flow allocation, and hydraulic capacity evaluation methodology used to accomplish this evaluation.

Chapter 6 – Existing and Future Capacity Evaluation. This chapter summarizes the hydraulic evaluation of the collection system. This chapter synthesizes the existing and future flows developed in Chapter 4 with the hydraulic model tool developed in Chapter 5 to identify existing and future capacity deficiencies in the collection system.

Chapter 7 – Refurbishment and Replacement Plan. This chapter evaluates the collection system assets from a condition and risk of failure perspective. District maintenance history and records, asset useful life, direct physical inspection, and failure consequence projections are all used to classify assets by risk of failure. High risk assets are identified, grouped, and prioritized for rehabilitation and replacement within the collection system.

Chapter 8 – Capital Improvement Program. This chapter synthesizes the results of Chapter 6 and Chapter 7 into a comprehensive CIP for the District's collection system. Cost estimates are provided for projects, and project timing is identified so that District funding requirements can be clearly and consistently established. Where the CIP projects are development driven, the specific development areas requiring the project are clearly identified to maintain transparency for the District's development stakeholders.

Chapter 2 Existing System Description

This chapter describes the study area for the 2024 Master Plan Update, including a summary of the population trends within the study area, a brief description of each City within the study area, and an overview of the District's existing wastewater collection system.

IN THIS SECTION

- Study Area
- Population Trends
- Climate
- Existing Collections Facilities

2.1 Study Area

Located in the heart of the San Joaquin Valley, just south of the City of Fresno, the District currently provides wastewater collection service to the member cities of Selma, Kingsburg, and Fowler, as well as to other small areas surrounding the three member cities, including to the southeast of Fowler, to the south of Selma along McCall Avenue, and to the east of Kingsburg. The District boundary currently encompasses approximately 8920 acres (13.9 square miles).

The District's Collection System flows generally southwest from Fowler, to Selma, and then to Kingsburg before terminating at the Wastewater Treatment Plant (WWTP), which is owned and operated by the District. Figure 2-1 shows the District boundary, each member city's sphere of influence (SOI), each member city's current limits, and the location of the District's WWTP facilities.

The 2016 Master Plan Study Area primarily focused on areas within the member cities' SOIs but outside of existing city limits and on areas specifically identified by the member cities as potential areas of growth. The objective of the 2016 Master Plan was to anticipate infrastructure needs for the 2035 planning horizon and beyond. The 2024 MP Update utilizes development updates to identify infrastructure requirements that correspond to each City's current understanding of projected development. Additionally, the 2024 MP Update evaluates the current condition of infrastructure within the study area to make sure that existing infrastructure can provide service to existing and future customers.

2.1.1 City of Selma

Situated at the center of the District's service area, the City of Selma is located at the crossroads of State Routes 99 and 43. The primary industry in Selma is agricultural followed by forestry and commercial industries. The population estimate, as of April 1, 2020, is 24,430 and has a total area of 5.81 sq. miles, per U.S. Census data.

2.1.2 City of Kingsburg

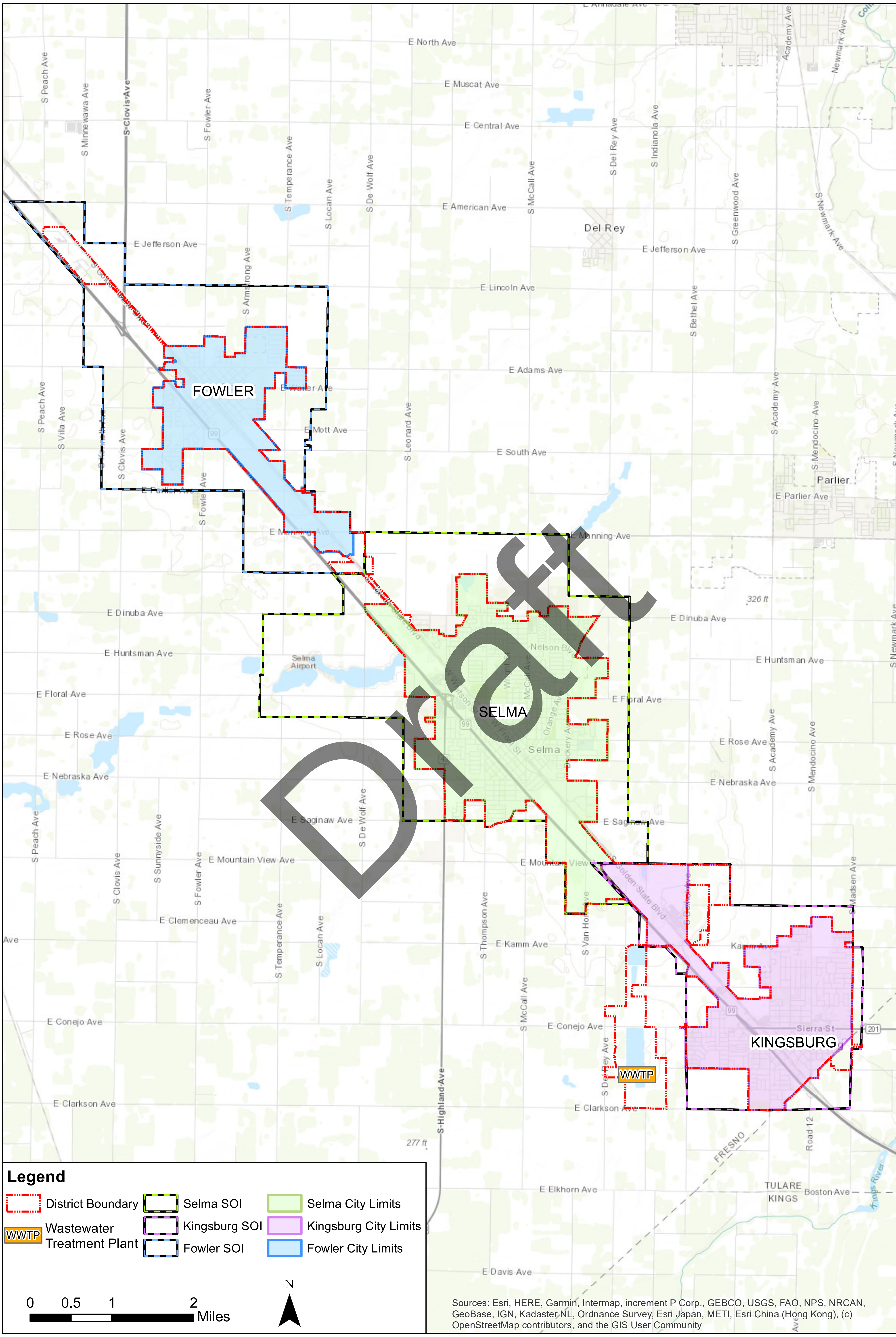
Located at the southern boundary of Fresno County, the City of Kingsburg serves as the southernmost city within the District's service area. Similar to the primary industry in Selma, the Kingsburg economy revolves heavily around agriculture. As of April 1, 2020, the US Census reports the population for the City of Kingsburg at 12,380 persons and covers an area 2.83 sq miles.

2.1.3 City of Fowler

The City of Fowler, located approximately eleven miles south of Fresno city, is the northern most city serviced by the District. Similar to Selma and Kingsburg, Fowler has a strong agricultural industry with several heavy industrial agricultural processing facilities in the Northwest corner of the city. The population estimate as of April 1, 2020 according to US Census, is 7,154, and the total land area covered by the city is 2.53 sq. miles. By population and land area, Fowler is the smallest of the three member cities served by the District.

2.2 Population Trends

The population of the three Cities served by the District has generally been growing in the past few decades. The City of Selma has been growing at a rate of approximately 0.6% per year since 2010. According to US Census estimates, the population growth in Selma has decreased since the 2020 Census. The City of Kingsburg has been experiencing an annual growth rate of approximately 1% since 2010. The City of Fowler has seen the most rapid population growth with an increase in population of around 2% per year since 2010.



Dopudja & Wells consulting

FIGURE 2-1
DISTRICT STUDY AREA
2024 COLLECTIONS MASTER PLAN UPDATE

2.3 Climate

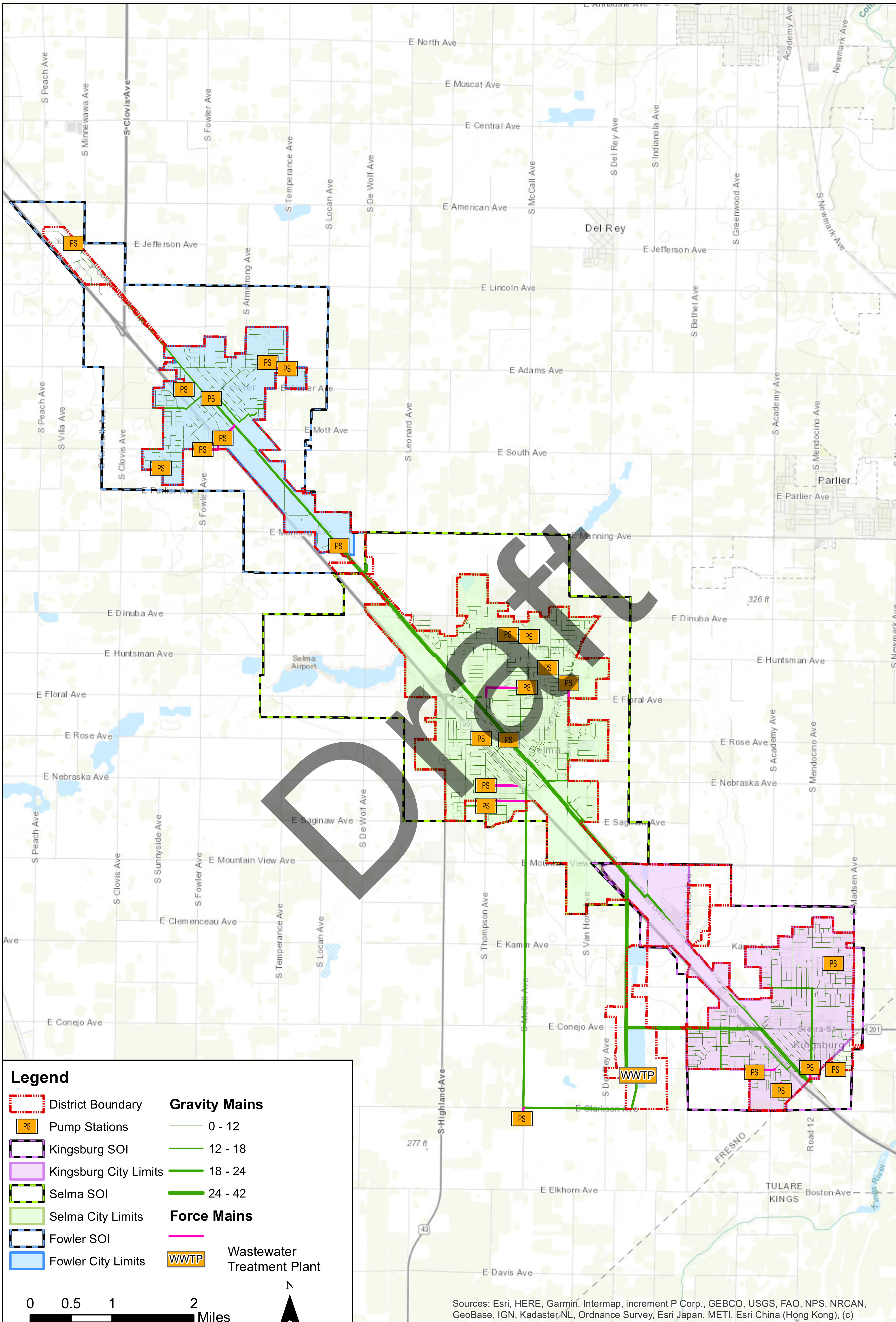
The climate in the District's service area is classified as Mediterranean. Summers are characterized by hot and dry conditions, while winters are cold and cloudy, with fog conditions often persisting for several days. Approximately 80 percent of the annual precipitation occurs between October and March. Rainfall generally consists of less than 10 inches annually; however, the 2023 rain season significantly surpassed the typical annual average.

2.4 Existing Collections System

The following section summarizes the District's existing collection system. Information regarding the existing wastewater collection system facilities was obtained through the District's GIS system, previous reports, and District staff input. The complete collection system, including gravity mains by diameter, force mains, and lift stations, is illustrated on Figure 2-2.

The subsequent sections in this chapter provide information on the following components of the existing collections system:

- Gravity Mains
- Lift Stations and Force Mains
- Sewer Flow Patterns
- Sewer Treatment



Dopudja & Wells consulting

FIGURE 2-2
EXISTING COLLECTION SYSTEM
2024 COLLECTIONS MASTER PLAN UPDATE

2.4.1 Gravity Mains Characteristics

The District's existing collection system consists of roughly 176 miles of gravity mains; each member city owns and operates its own mains. Gravity main diameters vary from 4-inches to 42-inches, as noted in Table 2-1.

Table 2-1 Gravity Pipeline Summary by Diameter[1]

Diameter (inches)	Pipe Length (ft)	Percent of Total
4	965	<1%
6	183,749	24%
8	383,738	49%
10	79,349	10%
12	124,036	16%
14	220	<1%
15	18,433	2%
18	26,080	3%
21	32,788	4%
24	20,249	3%
30	882	0%
33	16,473	2%
36	13,246	2%
39	3,487	0%
42	21,724	3%
Unknown	5,708	1%
Totals	**931,127**	**100.00%**

[1] Data obtained from GIS provided by the District for this study

2.4.2 Lift Station and Force Mains Characteristics

The District's existing collection system contains 24 lift stations, including four (4) District-owned lift stations, seven (7) lift stations owned by Fowler, four (4) lift stations owned by Kingsburg, and nine (9) lift stations owned by Selma. The locations of these lift stations are shown on Figure 2-2. Table 2-2 below provides general information about the existing lift stations within the District's service area.

Table 2-2 Lift Station Data within District Service Area[1]

Name	Owned by	Number of Pumps	Pump Type	Year Built[2]	Firm Capacity, gpm
Merced	District	2	Submersible	1991	750
Manning	District	2	Submersible	1989	750
North	District	2	Submersible	1991	1,900
18th Ave	District	3	Submersible	2023	2,326
10th St	Fowler	2	Submersible	2011	316
Peach	Fowler	2	Submersible	2003	800
Gleason	Fowler	2	Submersible	2015	224
South Ave	Fowler	2	Submersible	2005	417
Jefferson	Fowler	2	Submersible	1995	120
Adams	Fowler	2	Submersible	2004	478
Randy	Fowler	2	Submersible	2023	320
Mehlert	Kingsburg	2	Submersible		230
Kern	Kingsburg	2	Submersible	2011	787
Skansen	Kingsburg	2	Submersible	1999	500
Tulare	Kingsburg	2	Submersible	2020	320
Rose	Selma	2	Submersible		865
Goldridge	Selma	2	Submersible	2003	100
North Hill	Selma	2	Submersible	2013	352
Dockery	Selma	2	Submersible	2003	865
Sunset	Selma	2	Submersible	2011	669
Barbara	Selma	2	Submersible	2011	170
Valley View	Selma	2	Submersible	2006	1,100
Maple & McCall	Selma	2	Submersible		550
Clarkson & McCall	Selma	2	Submersible	1998	1,500

[1] Data obtained from 2016 Masterplan Update, with updated data provided by District staff where necessary.
[2] Indicates year built, year replaced, or year refurbished.

The District's existing collection system consists of roughly 4 miles of force mains. Pipe diameters vary from 4-inches to 24-inches, as noted in Table 2-3 which for gravity mains only.

Table 2-3 Force Main Summary by Diameter[1]

Diameter (inches)	Pipe Length (ft)	Percent of Total
4	2,206	12%
6	8,964	48%
8	5,580	30%
12	983	5%
14	663	4%
24	47	<1%
Unknown	379	2%
Totals	**18,821**	**100.00%**

[1] Data obtained from GIS provided by the District for this study

2.4.3 Sewer Treatment

The District was formed in 1971 by the Fresno County Board of Supervisors as a special district. The wastewater treatment facility has a capacity of eight (8) million gallons per day. The existing wastewater treatment facilities cover approximately 550 acres and operate as a two (2) stage screw pump system.

The wastewater treatment operation in the District involves various treatment and operation units, including influent screening, grit removal, activated sludge, secondary treatment facilities, and percolation ponds for effluent disposal. In addition to treatment, the WWTP also encompasses existing solids handling facilities. These include gravity thickening to separate solids, aerobic digestion to break down organic matter, and centrifuges alongside sludge drying beds for the dewatering of digested sludge, completing the comprehensive treatment cycle.

Chapter 3 Land Use and Development

This chapter details the existing land use, projected development within the study area, and projected development timeline as identified by the member cities.

IN THIS SECTION

- Land Use Classifications
- Projected Land Uses
- Development Timeline

Land use information for the study area was obtained from several sources, Including:

- Discussions with the Cities – Preliminary land use data was acquired from the previous Master Plan study and presented during individual meetings with the City Manager and City Planning Department for the cities of Selma, Kingsburg, and Fowler. Through multiple discussions with the member cities, the District, and DWC, land use classification for immediate developments, future growth, and build-out projections were obtained.
- Land Use Database – Existing land use data in Geographical Information System (GIS) format was obtained from the District and the District assessor. The obtained GIS land use files included existing land use designations within the member city limits, details on land area and ESFR count, and additional detailed descriptions about each parcel.
- General Plan Information – Additional land use data for the cities of Selma, Kingsburg, and Fowler were obtained through the latest General Plan.
- Aerial Photographs – Using Google Maps, aerial photographs of the service area were reviewed to identify any remaining or vacant parcels and properties where actual land use clearly varied from the assigned land use designation or where land use was not defined.

3.1 Land Use Characteristics

Each of the member cities in the District maintains an adopted general plan that guides development within their respective City Limits and SOI. The general plans provide land use information and population projections for each city within the study area. Land use and population information are key components in establishing the amount of wastewater generated. The type of land use along with the population estimates are used to generalize the volume and flow of the various land use types.

The subsequent sections provide a detailed breakdown of land use types within the study area, categorized by member city. These development projections are categorized into three distinct tiers: the Primary Tier encompasses land that is either already developed or in the upcoming development phase; Tier 1 focuses on near-term developments; Tier 2 addresses intermediate-term developments, and Tier 3 pertains to the build-out phase. This tiering system serves the purpose of gauging the progress of each member city within the General Plan Update schedule and determining the most appropriate projection timeframes for development. To the fullest extent feasible, development quantification will be conducted in terms of Equivalent Service Family Residences (ESFRs) for residential land use types and in acres for non-residential land use types.

3.2 District Land Use Summary

The land use information obtained from the sources above was consolidated into six distinct categories: Residential, Commercial, Public Facilities, Park/Open Space, Industrial, and Other (a final category for land use categories including agriculture, mixed use, medical, and other undefined land use categories). Table 3-1 summarizes the distribution of these existing land uses within the District's sewer collection system service area.

Table 3-1 District Existing Land Use Overview[1]

Land Use Type	Area (acres)	Percent of Total
Low Density Residential	533	17%
Medium Density Residential	928	30%
High Density Residential	>1	>1%
Commercial	398	13%
Public Facilities	49	2%
Park/Open Space	26	1%
Industrial	1,069	35%
Other	57	2%
Totals	**3,061**	**100%**

[1] Data obtained from District GIS data

The largest land use classification is residential, accounting for approximately 1,462 acres, which represents approximately 48 percent of the total acreage. Commercial and industrial areas together make up approximately 1,468 acres, or 48 percent of the total. Public facilities, including schools, government buildings, and other institutional facilities, occupy approximately 49 acres, constituting two (2) percent of the total. The two smallest land use classifications throughout the District are the "Park and Open Space" category, covering about one (1) percent of the total land use at 26 acres, and the "Other" land uses accounting for roughly 57 acres, about two (2) percent of total land use.

3.3 City of Selma Land Use Summary

The City of Selma's management, engineering, and planning staff (city staff) provided an updated detailed land use plan for their upcoming developments. As conveyed by city staff, a majority of the city's land has already been developed, with more than 60% of all land parcels currently occupied. The primary focus for development will involve a reorganization of the city's current zoning designations.

The provided detailed land use plan was highly comprehensive and included 26 different land use categories. The subsequent paragraphs elaborate on where the different land categories defined by city staff fit within the previously defined consolidated categories defined for the District.

The residential-related land categories were split by city staff into the following seven (7) sub-categories: Very Low Density, Low Density, Medium Low Density, Medium Density, Medium High Density, High Density, and Residential Reserve. These seven sub-categories were combined to a single "Residential" land use category.

The commercial-related land use categories were split by city staff into the following nine (9) sub-categories: Neighborhood Commercial, Highway Commercial, Central Business District, Community Commercial, Commercial Office, Business Park Reserve, Regional Commercial, Service Commercial, and Commercial Reserve. These nine commercial sub-categories were combined into a single "Commercial" land use category.

The "Industrial" land use category was a consolidation of the following three (3) sub-categories: Light Industrial, Light Reserve Industrial, and Heavy Industrial. Public facilities and Park/Open Space were not split into any sub-categories by Selma city staff, therefore, those categories did not require any consolidation and were used as-is.

The land use categories described above identify the type of development to take place on each parcel. However, the categories do not identify the potential timing of development. Effective infrastructure planning requires an estimate of development timing as well as type. City of Selma staff categorized likely development timing into four categories:

- Primary
- Tier 1
- Tier 2
- Tier 3

Primary development is judged to be most imminent, and Tier 3 development is considered to be furthest from completion. Tier 1 and Tier 2 developments fall between these bookends. These projected timelines are only estimates, and many factors outside the scope of this document will determine actual development timelines. City of Selma development land use categories are shown on Figure 3-1. Projected development tiers for the city are shown on Figure 3-2. Land use type along with development tiers are summarized in Table 3-2.

Table 3-2 Existing and Proposed Land Use – City of Selma[1]

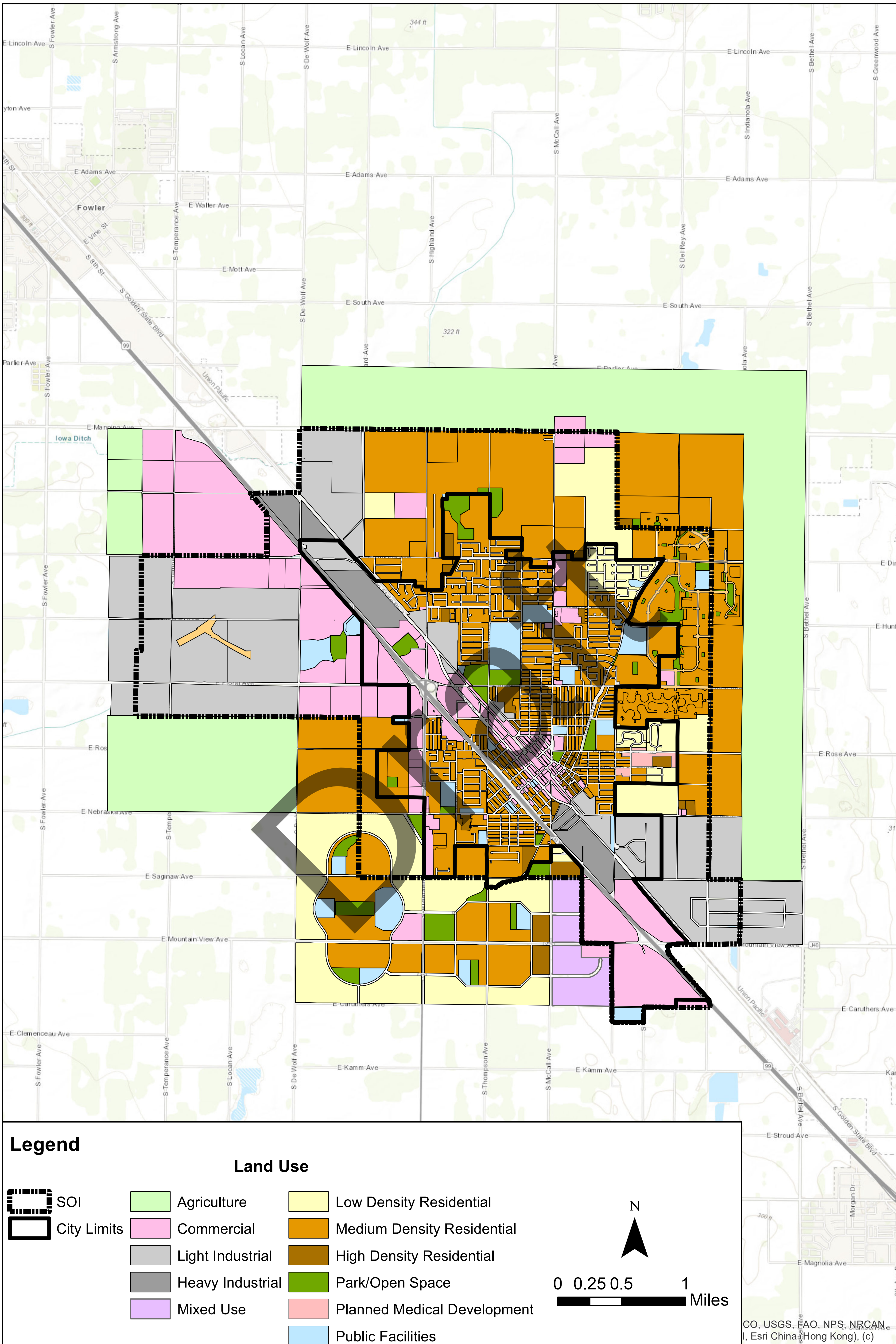
Land Use Classification	LAND USE AREA (acres)			
	Primary	Tier 1	Tier 2	Tier 3
Residential[2]	322	734	1483	1800
Commercial[3]	364	19	257	732
Public Facilities	22	3	69	0
Park/Open Space	20	31	63	3
Industrial[4]	74	54	99	1728
Other[5]	0	22	162	3223
Totals	802	863	2133	7484

[1] Data obtained from sources discussions with the member cities, GIS Data from the District, member city General Plans, and Aerial Photographs.
[2] Includes very low density, low density, medium low density, medium density, medium high density, high density, and residential reserve.
[3] Includes neighborhood commercial, highway commercial, central business district, community commercial, commercial office, business park reserve, regional commercial, service commercial, and commercial reserve.
[4] Includes light industrial, light reserve industrial, and heavy industrial.
[5] Includes parcels with multiple land use designations and parcels that did not fit into other defined categories.

In Selma, the existing land use and near-term development within the service area is primarily composed of Commercial land use, accounting for approximately 45 percent of the total acreage at around 364 acres, representing a significant portion of the overall land use categories. At buildout, the Commercial land use category falls to fourth place, only extending approximately 17 percent of the total land area, or 1,372 acres.

The next largest existing land use category is Residential, which occupies about 40 percent of the land at 322 acres. Residential land use type rises to be the leading land use category when including the full buildout scenario presented by the Planning Department. At buildout, the total acreage covered by the Residential land use expands to approximately 4,339 acres, making up approximately 38 percent of the total land use.

At buildout, city staff anticipates that the land use category denoted as "Other" land uses, presently comprising less than 1 percent of the existing land use distribution, will undergo a substantial expansion, encompassing a little over 30 percent of the overall land use. This expansion is estimated to add over 3,000 acres of land use dedicated to agriculture, covering approximately 29 percent of the total land use.



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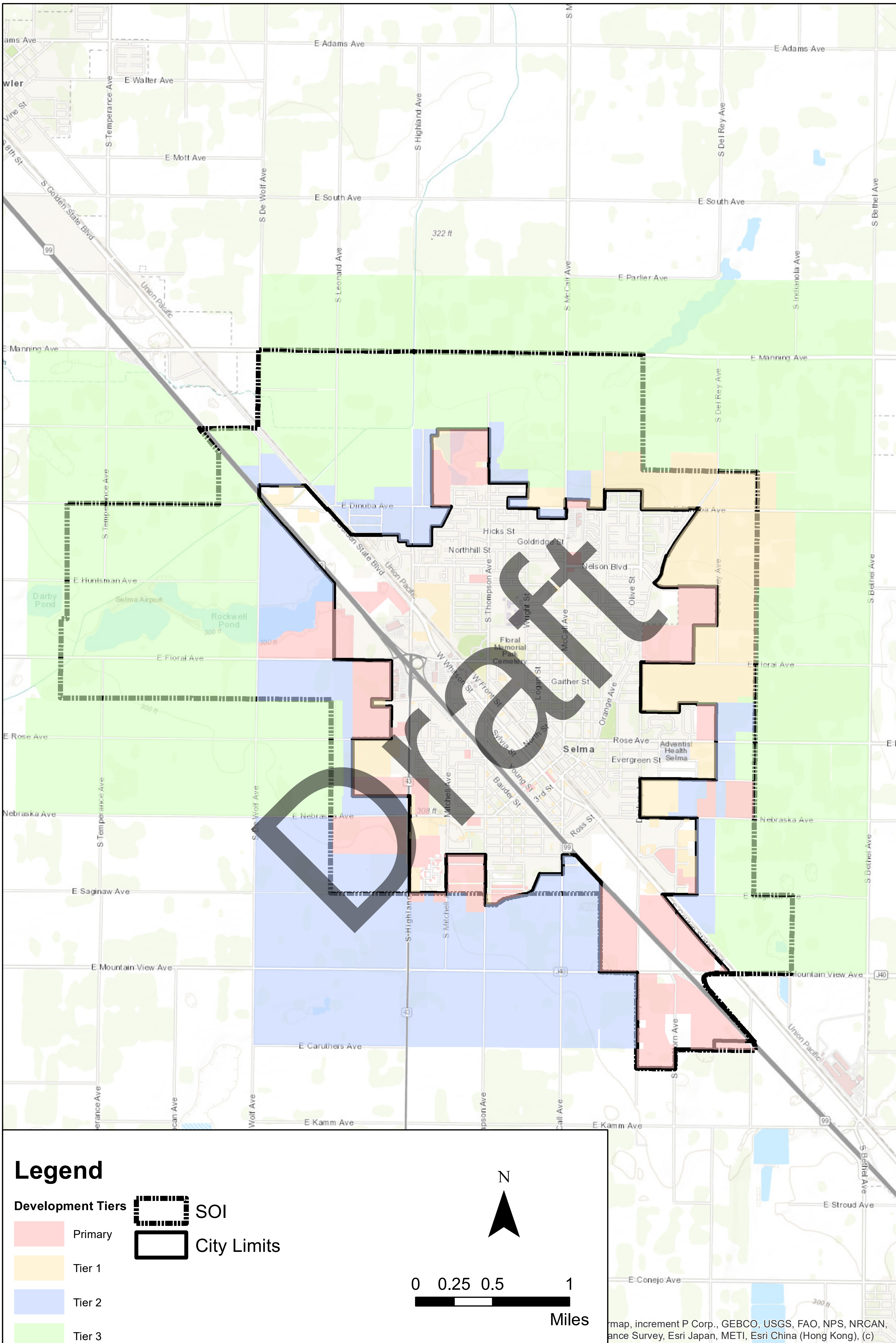
SELMA · KINGSBURG · FOWLER COUNTY SANITATION DISTRICT

FIGURE 3-1
CITY OF SELMA
LAND USE



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SELMA - KINGSBURG - FOWLER COUNTY SANITATION DISTRICT ESTABLISHED FEBRUARY 16, 1971

FIGURE 3-2
CITY OF SELMA
DEVELOPMENT TIERS

3.4 City of Kingsburg Land Use Summary

The City of Kingsburg's management, engineering, and planning staff (city staff) presented an updated land use plan through a combination of in-person meetings and email communications. A detailed land use map was not provided; therefore, the most recent General Plan for the City of Kingsburg and the 2016 Master Plan Update were used as the foundation for determining both existing land use and proposed developments. These determinations were made during discussions with the city.

During these meetings, city staff highlighted existing developments slated for the near term (Primary and Tier 1) and those intended for eventual build-out (Tier 3). Presently, there are no developments categorized Tier 2. Table 3-3 offers a summary of the area and land use type by development tier. Development tiers within the City of Kingsburg by land use type are summarized in Table 3-3. Land use within the City of Kingsburg is shown on Figure 3-3. Development by tier is shown on Figure 3-4.

Since existing land use types and developments were not explicitly discussed, Dopudja & Wells identified existing developments through aerial imagery from Google Maps, placing them within the primary tier. According to the data, the City of Kingsburg appears to be relatively built out, with approximately 50% of its land already developed or earmarked for upcoming projects.

Table 3-3 Existing and Proposed Land Use – City of Kingsburg[1]

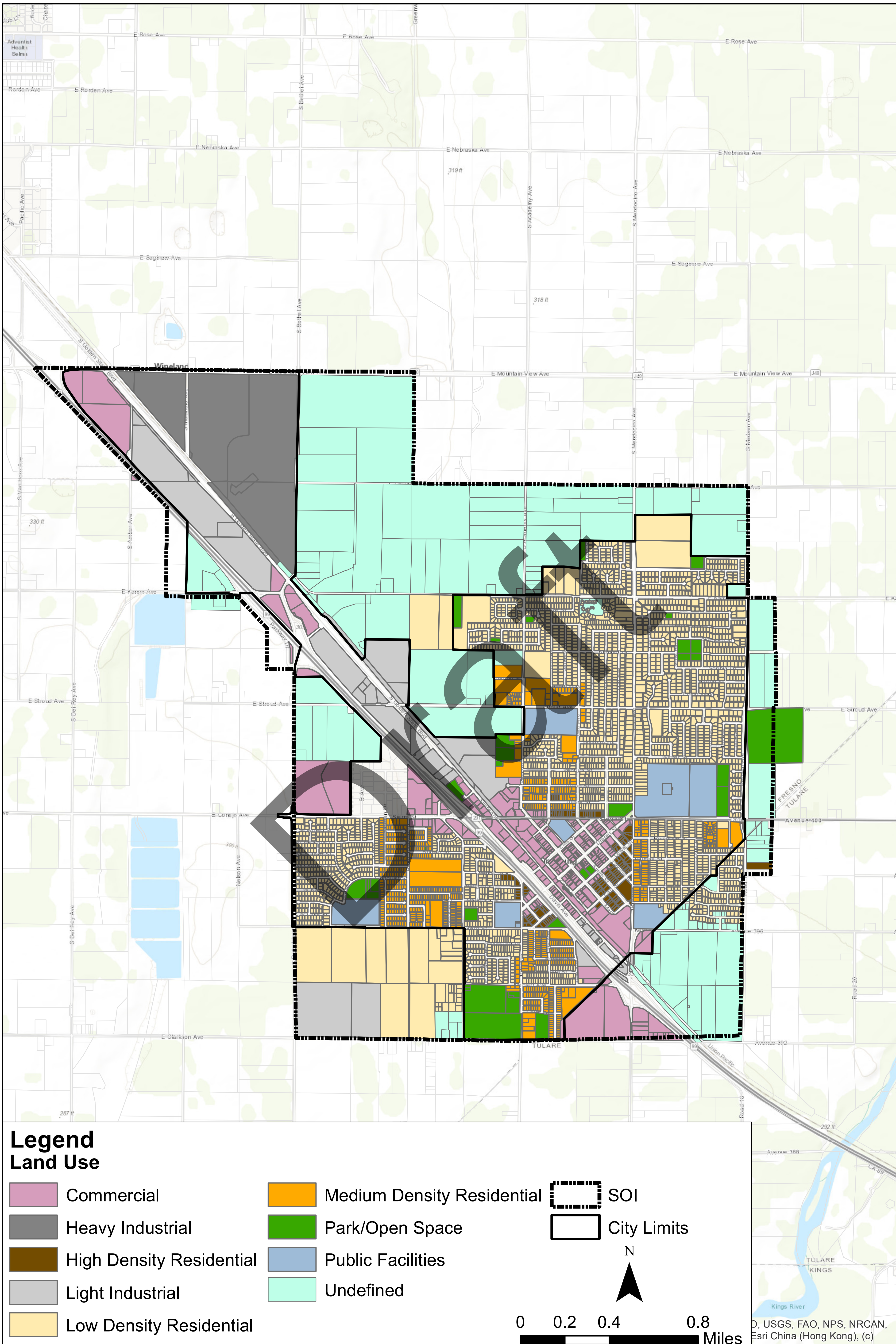
Land Use Classification	Land Use Area (acres)			
	Primary	Tier 1	Tier 2	Tier 3
Residential[2]	332	157	0	411
Commercial[3]	0	66	0	67
Public Facilities	0	1	0	0
Park/Open Space	0	56	0	0
Industrial[4]	59	233	0	399
Other[5]	0	0	0	0
Totals	**392**	**513**	**0**	**878**

Notes:
[1] Data obtained from sources discussions with the member cities, GIS Data from the District, member city General Plans, and Aerial Photographs
[2] Includes very low density, low density, medium low density, medium density, medium high density, high density, and residential reserve.
[3] Includes neighborhood commercial, highway commercial, central business district, community commercial, commercial office, business park reserve, regional commercial, service commercial, and commercial reserve.
[4] Includes light industrial, light reserve industrial, and heavy industrial.
[5] Includes parcels with multiple land use designations and parcels that did not fit into other defined categories.

The City of Kingsburg is already extensively developed. Presently, the prevailing land use and near-term developmental prospects in Kingsburg are predominantly characterized by Residential usage, constituting approximately 54 percent of the total acreage, occupying around 489 acres. Although the Residential land use category maintains its position as the leading land use category in the buildout scenario provided by the Kingsburg Planning Department, its proportion of total land use undergoes a slight reduction, decreasing from 54 percent to 51 percent.

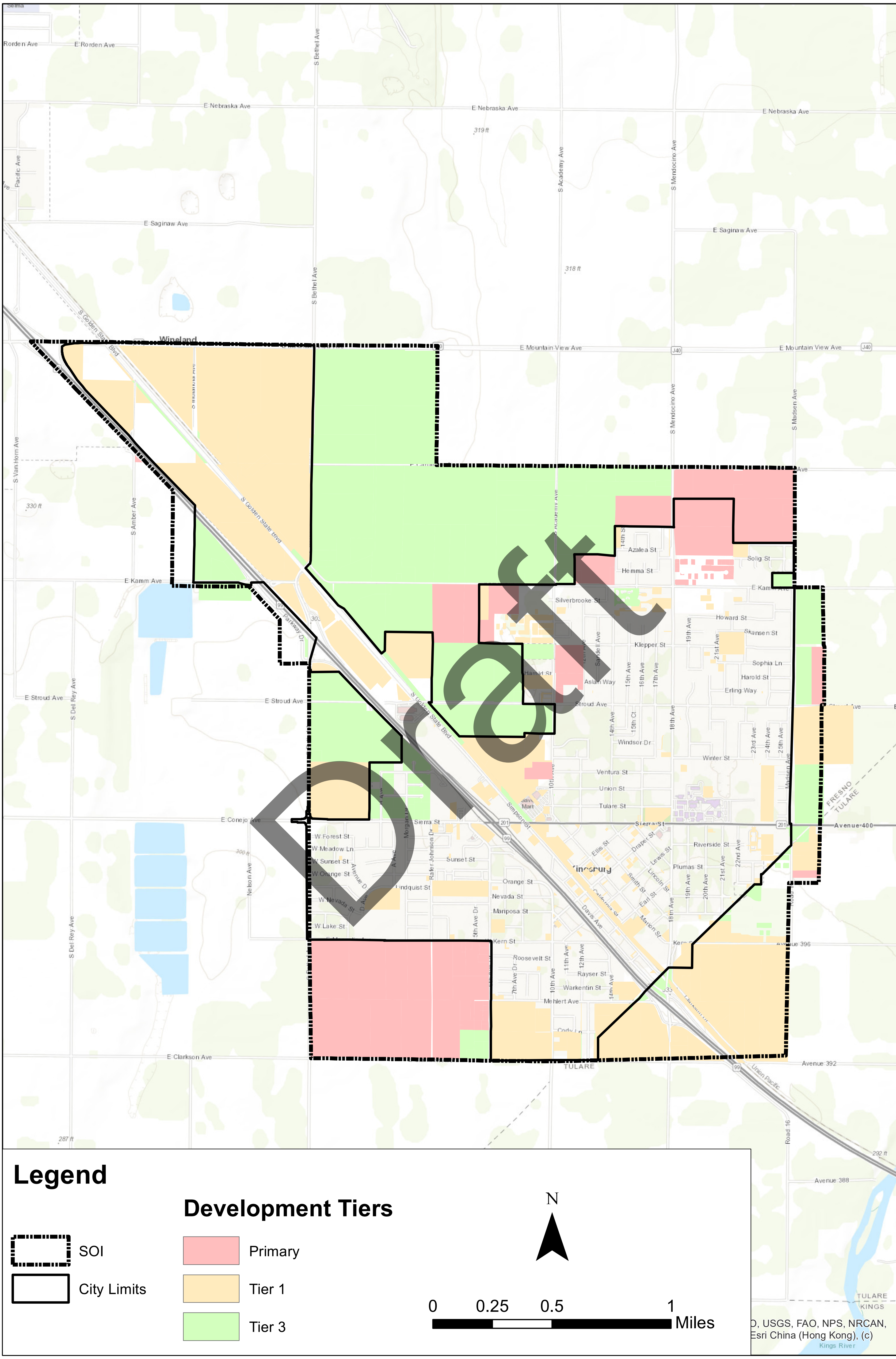
At buildout, the Planning Commission anticipates that the land use category denoted as "Industrial" land uses, presently comprising 32 percent of the existing land use distribution, will continue to expand, encompassing a little under 39 percent of the overall land use. This expansion is estimated to add about 400 acres of land use dedicated to industrial land uses.

The remaining ten (10) percent of existing land use is divided among Commercial and Public Facilities land uses.



Dopudja & Wells consulting

FIGURE 3-3
CITY OF KINGSBURG
LAND USE



Dopudja & Wells consulting

FIGURE 3-4
CITY OF KINGSBURG
DEVELOPMENT TIERS

3.5 City of Fowler Land Use Summary

The City of Fowler is expecting large growth over the next year with new land annexed into the city limits and has completed its General Plan to reflect this addition to the city. The City of Fowler's management, engineering, and planning staff (city staff) provided a detailed tiering structure which guided the other member cities in their future development tiering structure.

The provided detailed land use plan was comprehensive and included twelve (12) different land use categories. The subsequent paragraphs elaborate on where the different land categories defined by city staff fit within the previously defined consolidated categories defined for the District.

The residential-related land categories were split by city staff into the following five (5) sub-categories: Low Density, Medium Low Density, Medium Density, Medium High Density, and High Density. These five sub-categories were combined into a single "Residential" land use category.

The commercial-related land use categories were split into the following three (3) sub-categories: Neighborhood Commercial, Community Commercial, and General Commercial. These three commercial sub-categories were combined into a single "Commercial" land use category. The "Industrial" land use category was a consolidation of the following two (2) sub-categories: Light Industrial and Heavy Industrial. Land use types and development tier projections are summarized in Table 3-4. Land use types in the City of Fowler are shown on Figure 3-5. The development tiers projected for the city are shown on Figure 3-6.

Table 3-4 Existing and Proposed Land Use – City of Fowler[1]

Land Use Classification	LAND USE AREA (acres)			
	Primary	Tier 1	Tier 2	Tier 3
Residential[2]	808	484	695	61
Commercial[3]	34	72	0	3
Public Facilities	26	0	0	0
Park/Open Space	6	5	0	0
Industrial[4]	936	98	0	67
Other[5]	57	29	119	0
Totals	1,867	687	815	130

[1] Data obtained from sources discussions with the member cities, GIS Data from the District, and member city General Plans

[2] Includes low density, medium low density, medium density, medium high density, and high density.

[3] Includes neighborhood commercial, community commercial, and general commercial.

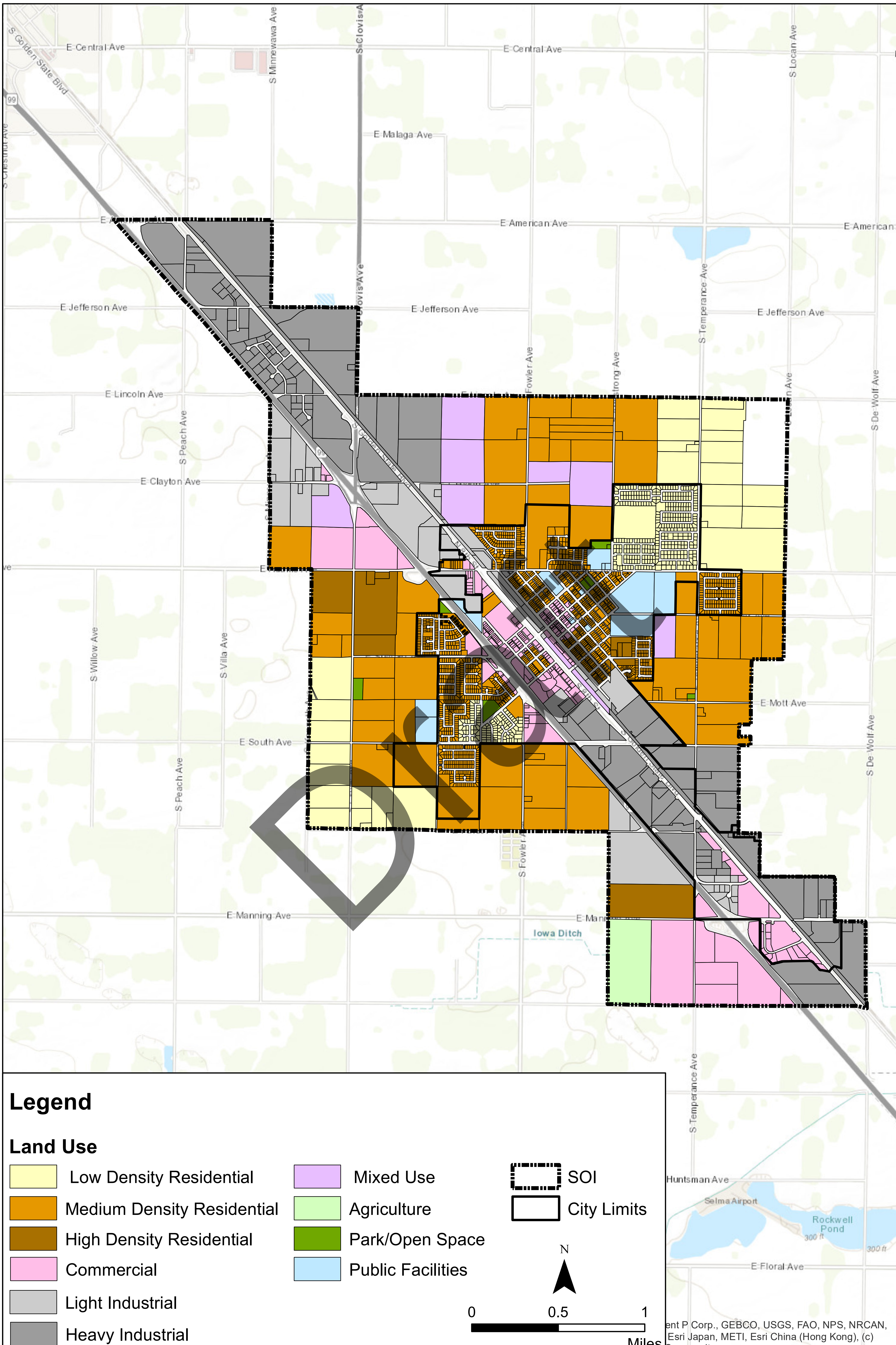
[4] Includes light industrial and heavy industrial.

[5] Parcels with multiple land use categories were designated other.

The City of Fowler is characterized by a significant mixture of land use types, with a notable emphasis on Residential and imminent Industrial development. Currently, the land use area is primarily dominated by Residential land use, which accounts for approximately 43 percent of the total acreage, totaling around 808 acres. In the comprehensive buildout scenario presented by the Planning Department, Residential land use category maintains its position as the leading land use category, increasing from 43 percent of land use types in Fowler to 59 percent.

The second largest existing land use category is Industrial, with approximately 50% of Industrial zoned land in development or earmarked for upcoming projects. At buildout, the Industrial land use category continues to be the second greatest land use type in Fowler, however, there are no additional Industrial developments scheduled for buildout beyond the near-term projects so the total percentage of Industrial land use decreases from 50 percent to 31 percent.

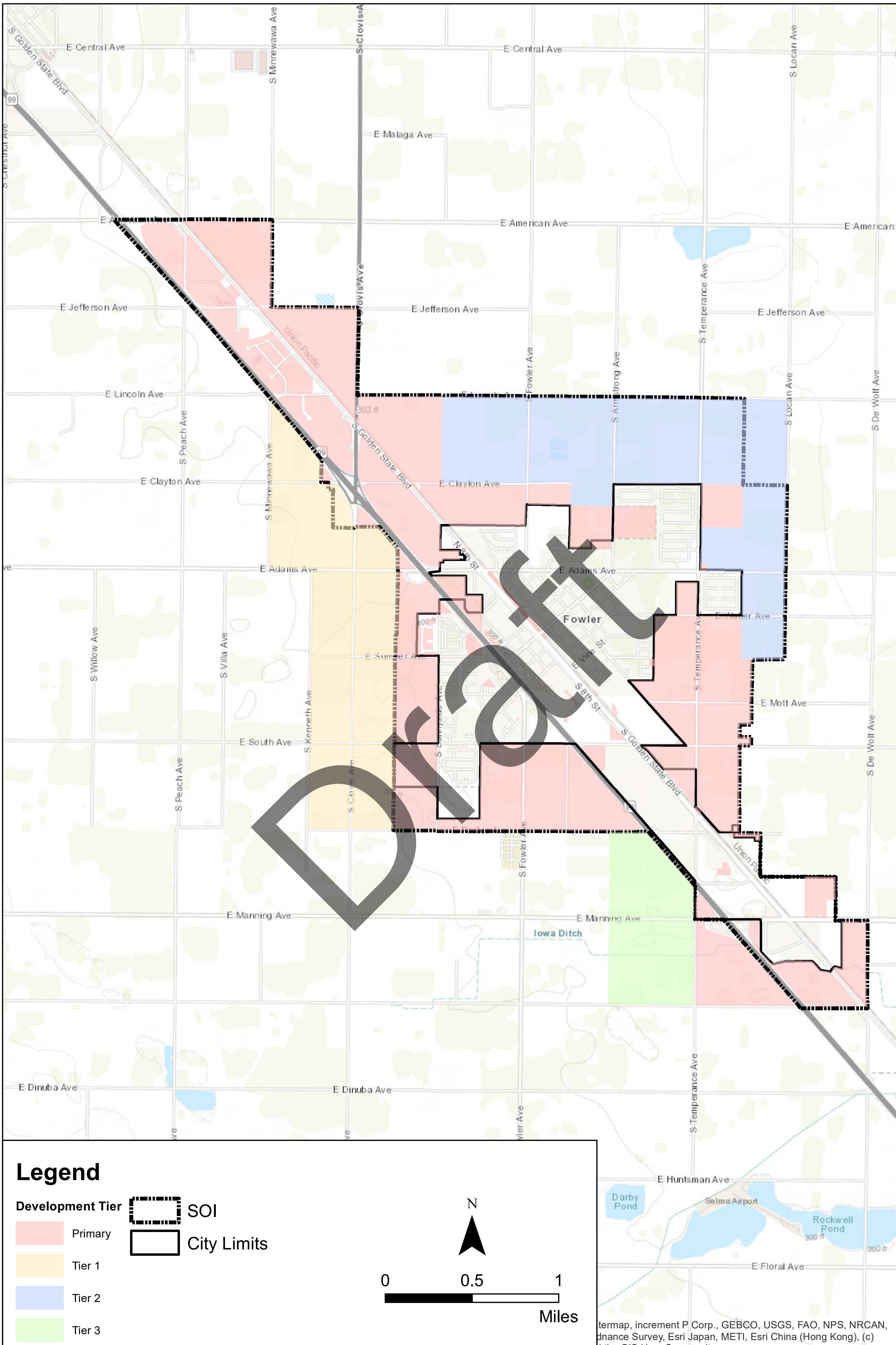
Furthermore, in the buildout projection, the remaining land use is split between Parks/Open Space, Commercial, and Public Facilities.



Dopudja & Wells consulting

Selma - Kingsburg - Fowler County Sanitation District

FIGURE 3-5
CITY OF FOWLER
LAND USE



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SELMA - KINGSBURG - FOWLER COUNTY SANITATION DISTRICT

FIGURE 3-6
CITY OF FOWLER
DEVELOPMENT TIERS

Chapter 4 Existing and Future Flows

This chapter summarizes the methodology, development, and projections of wastewater flows for the District's collection system. A detailed description of existing flows and projected future flows is provided in this chapter.

IN THIS SECTION

- Wastewater Flow Component Description
- 2022/2023 Temporary Flow Monitoring Study
- Existing Dry Weather Flows
- Existing Wet Weather Flows
- Existing and Future Design Flows

4.1 Wastewater Flow Component Description

Collection systems typically convey both sanitary flow, which is the intended use of the collection system, and external flows that enter the collection system infrastructure through defects and imperfections. A realistic evaluation of wastewater flow requires that these components be deconstructed and quantified separately. The detailed flow components that require quantification include:

- Average Dry Weather Flow (ADWF)
- Peak Dry Weather Flow (PDWF)
- Peak Wet Weather Flow (PWWF)

The wastewater flow components described in this section are depicted conceptually on Figure 4-1.

4.1.1 Average Dry Weather Flow

ADWF is generally accepted to include two components: base wastewater flow (BWF) and groundwater infiltration (GWI). BWF represents the sanitary flow contributions from residential, commercial, institutional, and industrial dischargers to the collection system. GWI refers to groundwater that infiltrates into the collection system via defects in wastewater pipes and manholes. Although GWI rates can be influenced by wet weather events (because wet weather events can affect groundwater levels) GWI is present in dry weather conditions and is therefore a component of dry weather flow. However, GWI can have significant variation seasonally because of the wet weather influence. Despite the seasonal variation, GWI is assumed to be constant for any given day.

In some collection systems, GWI is low enough compared to BWF that it can assumed to be negligible. As will be discussed in more detail below, analysis of flow monitoring data in the District's collection system indicates that GWI values are minimal in the District's collection system. Therefore, ADWF in the District's collection system is composed entirely of wastewater generated by the District's customers.

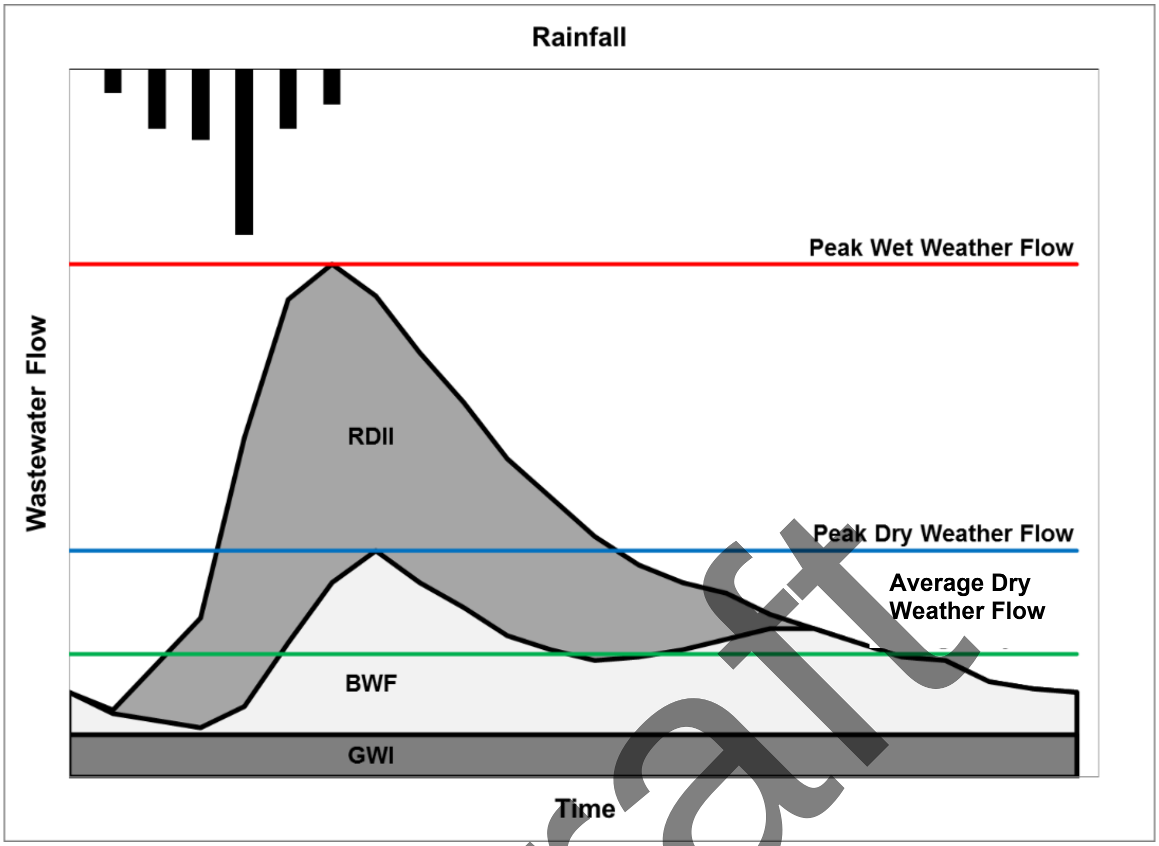

Figure 4-1 Wastewater Components for Typical PWWF Conditions

4.1.2 Peak Dry Weather Flow

While GWI tends to remain relatively constant over any given day, BWF varies throughout the day, but typically follows predictable diurnal patterns depending on the type of land use. For example, residential dischargers tend to produce higher flows in the morning and evening hours, while commercial dischargers tend to have steady discharge during business hours, but very low discharge outside of business hours. Industrial dischargers have flow patterns that depend upon their individual processes.

PDWF is defined as the diurnal flow peak within the collection system during dry weather conditions. PDWF is typically 1.2 to 3.0 times the ADWF, depending on the mixture of discharger types and the size and layout of the collection system. Under static evaluation of a collection system, PDWF values are established from ratios to ADWF values calculated via peaking factor or peaking curve. Under dynamic evaluation of a collection system, PDWF values are established by taking the peak value from a flow hydrograph that is created using diurnal patterns within the collection system. Wastewater flows within the District's Collection System have been monitored and evaluated dynamically using diurnal patterns as will be described in more detail below.

4.1.3 Peak Wet Weather Flow

PWWF is composed of PDWF and rainfall-dependent inflow and infiltration (RDII). RDII consists of stormwater inflow and infiltration that enters the system in direct response to rainfall events, either through direct connections such as holes in manhole covers or illicitly-connected roof leaders or area drains, or through defects in wastewater pipes, manholes, and service laterals. RDII is typically characterized by short-term peak flows that recede relatively quickly after rainfall ends. The magnitudes of RDII flows are related to the intensity and duration of the rainfall but are also related to the degree of soil saturation from earlier (antecedent) rainfall conditions.

The District's collection system must be designed to convey both dry weather and wet weather flows as described above. Therefore, PWWF is considered the design condition for the hydraulic evaluations contained in the 2024 Master Plan Update. The development of the design condition PWWF values specific to the District's collection system is described below in this chapter.

4.2 2022/2023 Temporary Flow Monitoring Study

During typical daily operation of a wastewater collection system, flow values are measured at relatively few locations, usually including at treatment facilities and sometimes large pump facilities. Because of the relative lack of flow data available during typical operations, temporary flow monitoring studies are a critical tool in quantifying wastewater flow and individual flow components. In such studies, flow monitoring devices are inserted at critical points in the collection system to monitor and record flow depth and flow velocity values, from which flow quantity can be calculated. Temporary flow monitoring studies can span durations from several days to several months and are often timed to capture dry weather and wet weather flows so that ADWF, PDWF, and PWWF values can be calculated.

The District understands the importance of directly quantifying wastewater flow, and in decomposing the overall flow values into the components described above. As a result, the District invested significant effort in a temporary flow monitoring study during the winter of 2022/2023. This study (2022/2023 Flow Monitoring Study) took place between December 9, 2022, and January 17, 2023, gathering both dry weather and wet weather flow. The detailed site sheets and results of the 2022/2023 Flow Monitoring Study are provided in Appendix A. The conduct and results of the study are summarized below.

4.2.1 Flow Monitoring Locations

A total of 15 flow monitoring locations were monitored during the temporary flow monitoring study. The temporary flow monitoring locations can be seen on the map shown in Figure 4-2. The schematic relationship between the temporary flow monitoring locations in the collection system is presented in the schematic on Figure 4-3.

The flow monitoring locations were chosen through collaboration with District staff and were chosen to satisfy the following goals:

- Capture flow from the entire collection system
- Confirm flow conditions at District-identified areas of focus
- Repeat previous monitoring locations to provide continuity of data
- Isolate land uses where possible to confirm flow generation values
- Capture flow from sub-areas within all three Member Cities

The 15 temporary flow monitoring locations are summarized in Table 4-1.

Table 4-1 2020 Temporary Flow Monitoring Locations

Flow Monitor Number	Manhole ID	Pipe Diameter, inches	Primary Goal(s) of Flow Monitor
01		24	Re-monitor previous location
01A	3DO0-0400	12	Focus area: confirm high Peach LS RDII
01B	3AO0-0100	12	Focus area: confirm NW Fowler flows
01C	3DG0-0200	12	Focus area: confirm South Ave LS flows
02	2OO0-5100	33	Re-monitor previous location; capture all Fowler flow
03	2NO0-0100	12	Re-monitor previous location; confirm inflow correction
04	2OO0-2600	24	Re-monitor previous location; confirm inflow correction
06	6OO0-3800	21	Re-monitor previous location; confirm inflow correction
06A	6OO0-3900	12	Focus area: sub-basin in Selma
6B	2KO0-0200	12	Focus area: sub-basin in Selma
06C	6WO0-1100	12	Focus area: sub-basin in Selma
07	1OO0-1600	42	Re-monitor previous location; capture major trunk
08	7OO0-0300	36	Re-monitor previous location; capture major trunk
09	7OO0-1400	36	Re-monitor previous location; capture major trunk
09A	7EO0-0800	21	Focus area: Kingsburg CIP area

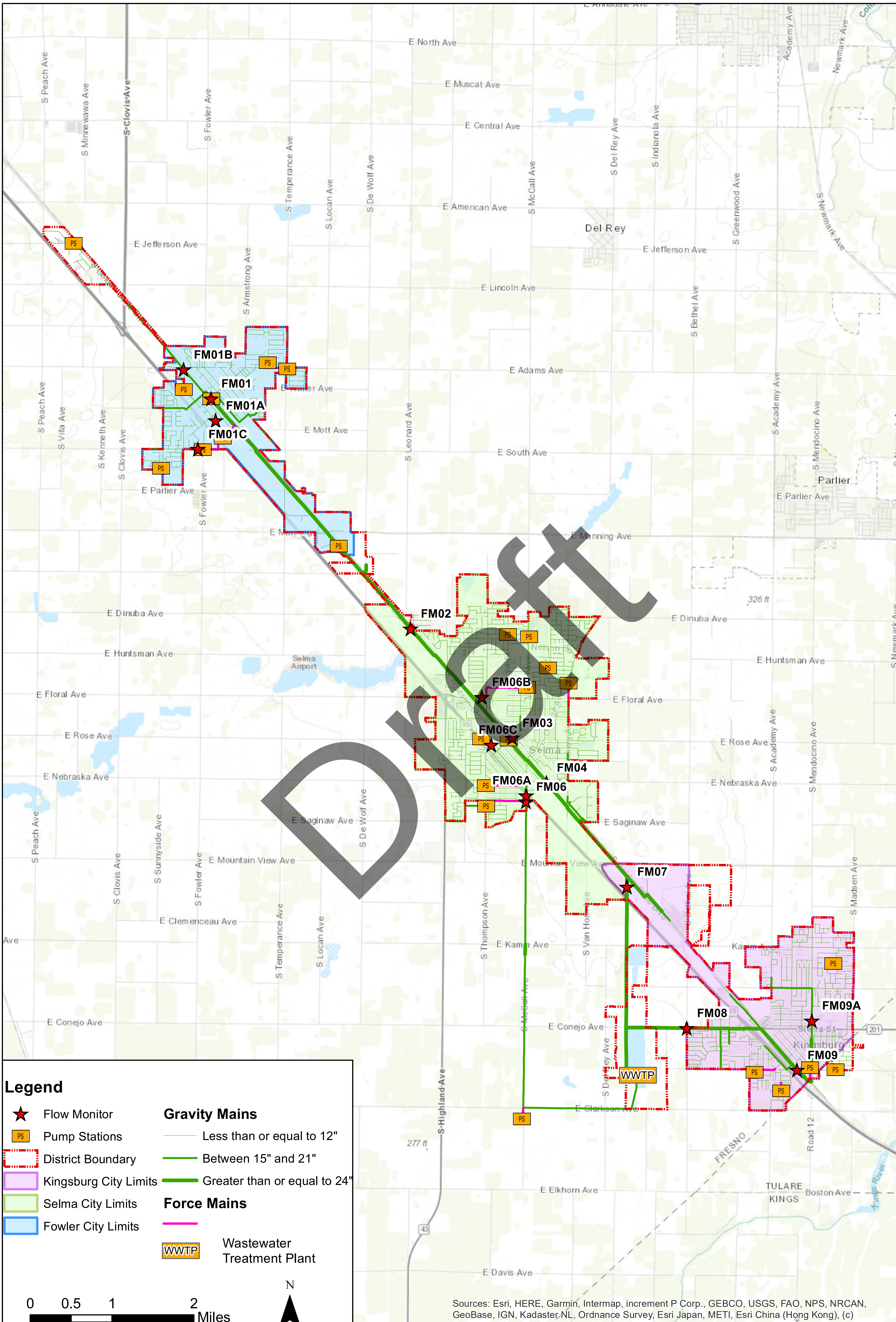

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FIGURE 4-2
LOCATIONS OF FLOW MONITORS
2024 COLLECTIONS MASTER PLAN

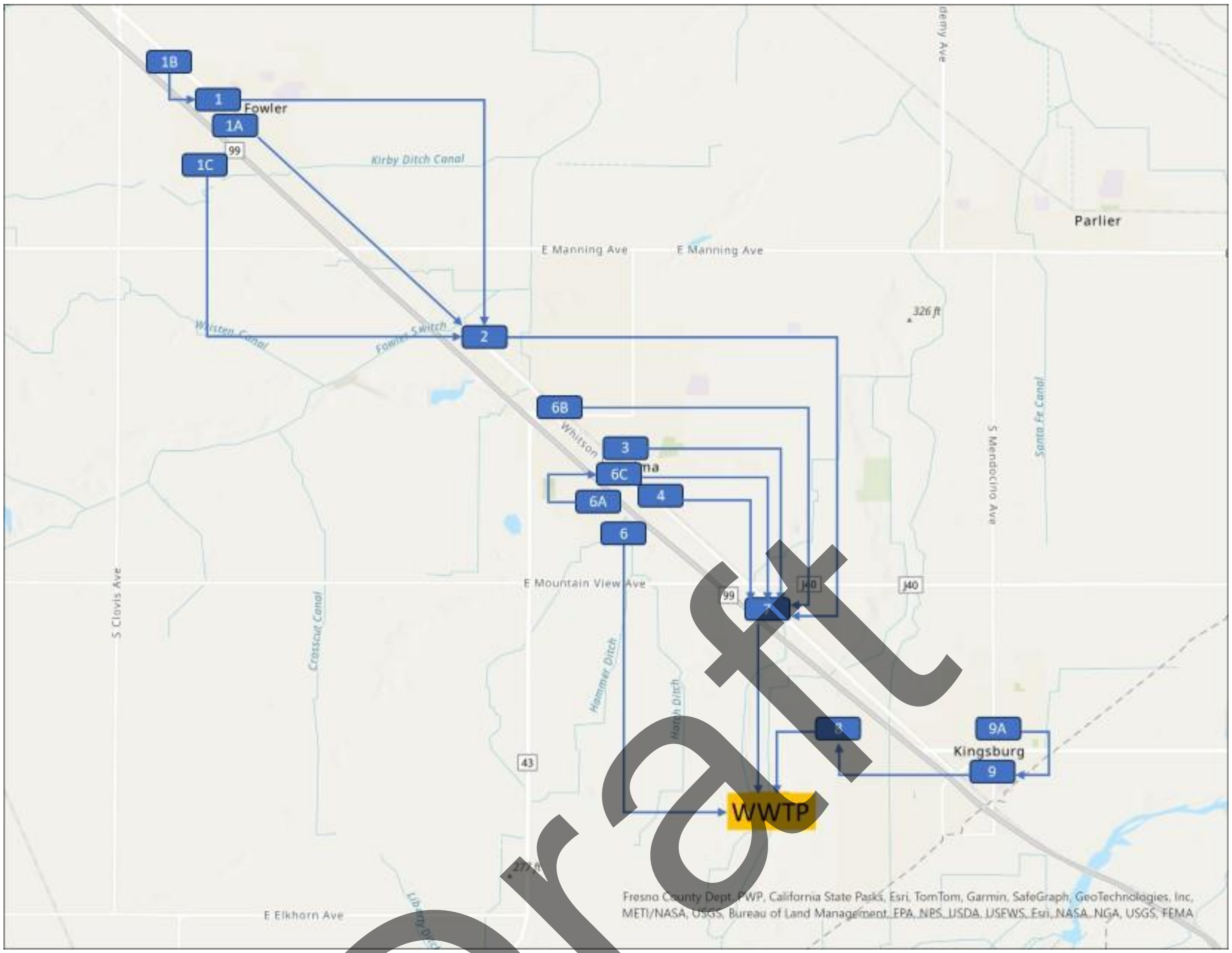

Figure 4-3 Location of Temporary Flow Monitors

4.2.2 Summary of Temporary Flow Monitoring Results

The 2022/2023 Flow Monitoring Study was successful in capturing both dry weather and wet weather flow conditions in the District's collection system. Significant wet weather events occurred from 12/26/2022 to 12/28/2022, and from 1/8/2023 to 1/11/2023. In particular, the 1/8/2023 wet weather event was categorized as having a 5-10 year return frequency for 24-hour rainfall accumulation (National Oceanic and Atmospheric Administration: National Weather Service Precipitation Frequency Data Server). The temporary flow monitors were able to capture the collection system's response to this significant accumulation.

The following critical results were identified from the 2022/2023 Flow Monitoring Study:

1. The last comprehensive flow monitoring study was performed in the District's collection system in 2005. At that time, high values of rapid-response inflow were identified in Selma, and cross connections between stormwater drains and the collection system were suspected. The District prioritized cross connection identification and correction in response to these results. For the 2022/2023 Flow Monitoring Study, FM06 and FM07 were repeated from the 2005 study, and FM06A, FM06B, and FM06C were located to add more resolution to basins within Selma. The results of the 2022/2023 Flow Monitoring Study indicate that the focus on cross connection removal was successful, and the collection system in and around Selma now exhibits typical inflow and infiltration values. This typical RDII response for the 1/8/2023 wet weather event is shown for FM06C on Figure 4-4.

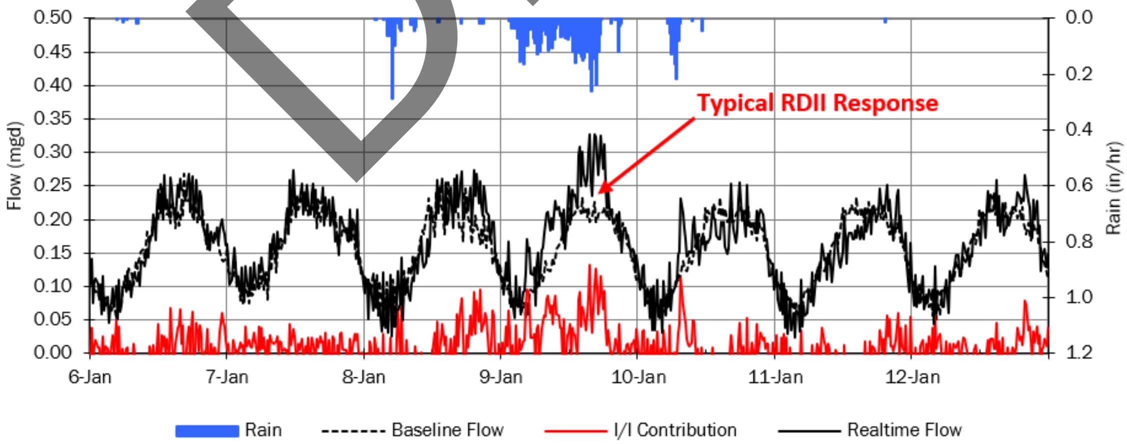

Figure 4-4 Flow and Rain Hydrograph for FM06C

2. Results from the 2022/2023 Flow Monitoring Study indicate the District's collection system has significant RDII response in and around Fowler. FM02 captures all flow from Fowler. The significant RDII response at that flow monitoring location can be seen on Figure 4-5. Detailed examination indicates

that this RDII response is a mixture of rapid inflow and slower response infiltration.

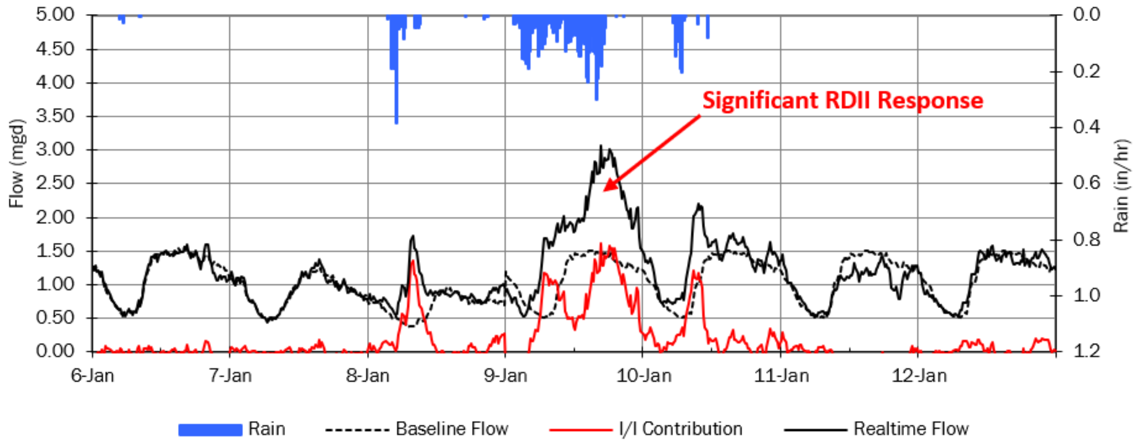

Figure 4-5 Flow and Rain Hydrograph for FM02

3. Within the larger area tributary to FM02 that was identified above as a high RDII response area, a smaller area tributary to FM01A was identified as having a particularly significant RDII response with sharp inflow. As can be seen on Figure 4-6, the amount of RDII response is four times higher than the PDWF at the temporary flow monitoring location. Further, this RDII response was rapid, with extra flow measured in the collection system immediately following precipitation. Such large and sharp response to precipitation is often associated with storm drain basins being cross connected to the collection system. District O&M staff have identified a mobile home community located north of the 10th Street Lift Station in the tributary area suspected of draining directly into the collection system. District staff suspected that high RDII response would be found at this location because the Peach Lift Station directly downstream of the FM01A location often struggles to keep up with influent flows during wet weather events.

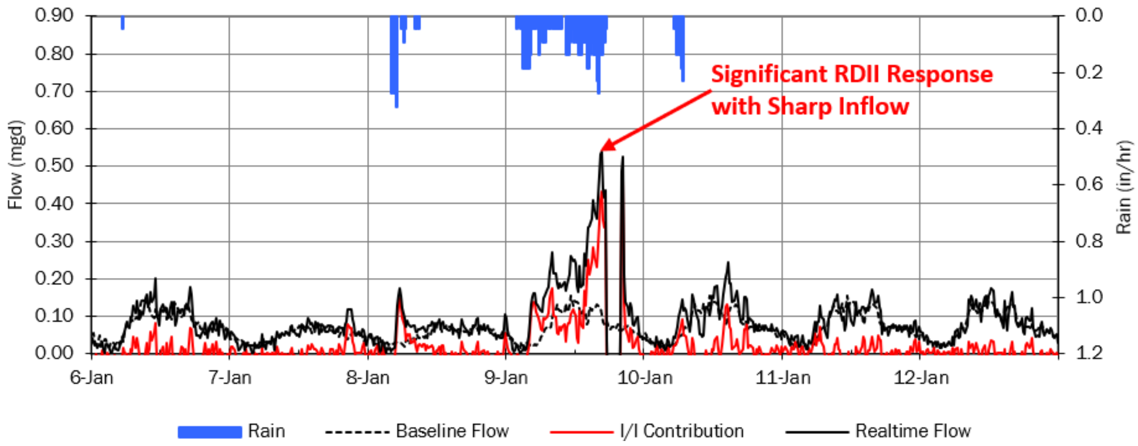

Figure 4-6 Flow and Rain Hydrograph for FM01A

In addition to the critical results identified above, the 2022/2023 Flow Monitoring Study quantified ADWF values and PDWF values at each flow monitoring location. These ADWF and PDWF values were used in conjunction with flow data from the District's WWTP to quantify existing dry weather flows and dry weather flow generation factors for the District's collection system. The ADWF and PDWF values at each temporary flow monitoring location are shown in Table 3-2.

Table 4-2 Summarized Flow Monitoring Results

Flow Monitor Number	ADWF, mgd	PDWF, mgd
01	0.625	0.873
01A	0.069	0.154
01B	0.020	0.068
01C	0.104	0.188
02	1.033	1.553
03	0.218	0.451
04	0.420	0.652
06	0.504	0.778
06A	0.130	0.222
06B	0.158	.304
06C	0.155	0.268
07	2.079	3.013
08	0.946	1.514
09	0.737	1.269
09A	0.333	0.575

4.3 Existing Dry Weather Flows

District wastewater flows are measured continuously at the WWTP. Flows from 2015 to 2022 were evaluated to remove wet weather flow components and identify ADWF over this time period. The results of this evaluation can be found in Table 4-3.

Table 4-3 ADWF at Influent to WWTP in mgd

2015	2016	2017	2018	2019	2020	2021	2022
4.57	4.12	4.58	3.97	4.10	4.14	4.16	4.14

As shown in the table, dry weather flows decreased markedly from the 2015/2017 timeframe to the 2021/2022 timeframe, even as growth and development has occurred in the District. This decrease is typical of collection systems throughout California, resulting from the extended drought and subsequent water conservation focus in the state. Decreased indoor water usage results in decreased daily wastewater flows. Much of this decrease has come from improvements in water efficiency in appliances and appurtenances, rather than behavioral changes. Therefore, there has been only moderate rebound in wastewater flows as the drought has receded, and only minor rebound if any is expected going forward.

For the 2024 Master Plan Update, existing ADWF is calculated to be 4.15 mgd. This value taken from the WWTP corresponds well to the flows measured during the 2022/2023 Flow Monitoring Study and is used as the calibration value for the dry weather flow generation factors developed as described below.

4.3.1 Dry Weather Flow Generation Factors

The existing ADWF value of 4.15 mgd was evaluated with respect to existing land use within the District as described in Chapter 3 to calculate dry weather wastewater flow generation factors. The evaluation was performed both at the District-wide level and at the level of individual flow monitors from the 2022/2023 Flow Monitoring Study to develop representative wastewater generation values.

Because the District has a well-developed industrial base that is served by the collection system, there are significant industrial discharges into the collection system. These discharges vary widely by type of industry and sometimes by season, so they are accounted for separately so as not to skew the development of typical generation factors. The following industrial discharges presented in Table 4-4 were accounted for individually prior to development of the dry weather flow generation factors.

Table 4-4 Significant Industrial Dischargers with Maximum Industrial Discharge for Design Flow

Description	Address	City	Maximum Industrial Discharge, mgd
Bee Sweet/Citrus Processing	416 E. South Ave.	F	0.1494
Boghosian Raisin/Raisin Processing	726 S. 8th St., Fowler	F	0.0071
Fowler Dehydrator/Grape Dehydrating	8th St. (adjacent to Boghosian Raisin)	F	0.0132
Guardian Industries/Glass Manufacturing	11535 E. Mountain View Ave.	K	0.1157
Lion Dehydrator/Grape Dehydrating	9400 S. De Wolf Ave.	S	0.0097
Lion Raisin/Raisin Processing	9500 S. De Wolf Ave.	S	0.0066
National Raisin/Raisin Processing	626 S. 5th St.	F	0.2100
Sun Maid Growers Bethel Ave./Raisin Processing	13525 S. Bethel Ave.	K	0.2233

With the significant industrial dischargers removed from the flow values, wastewater generation factors were calculated for the 2024 Master Plan Update as shown in Table 4-5. The residential wastewater flow generation factor was calculated to be 230 gpd/ESFR. This value represents a 15% reduction from the value used by the District for previous planning efforts. Such a reduction is typical for generations factors in collection systems in California, and the reduction comports well with the ADWF flow values presented in Table 4-3 above.

Table 4-5 Wastewater Flow Generation Factors

Land Use Designation	Flow Coefficient
Residential Land Use (gpd/ESFR)	
Residential	230
Commercial and Industrial (gpd/acre)	
Industrial	725
Commercial	725
Other (gpd/acre)	
Community Facility/School	650
Park/Open Space	200

4.3.2 Existing Peak Wet Weather Flow Diurnal Curves

The 2024 Master Plan Update uses a typical method for calculating PDWF by applying a diurnal pattern to the ADWF for each collection system user. The diurnal pattern approximates the variation in wastewater discharge over a typical 24-hour period, and varies according to whether the user is primarily residential or non-residential. Existing diurnal patterns differ according to the region of the collection system as identified by the 2022/2023 Flow Monitoring Study. A typical residential diurnal pattern is shown on Figure 4-7. A typical non-residential diurnal pattern is shown on Figure 4-8.

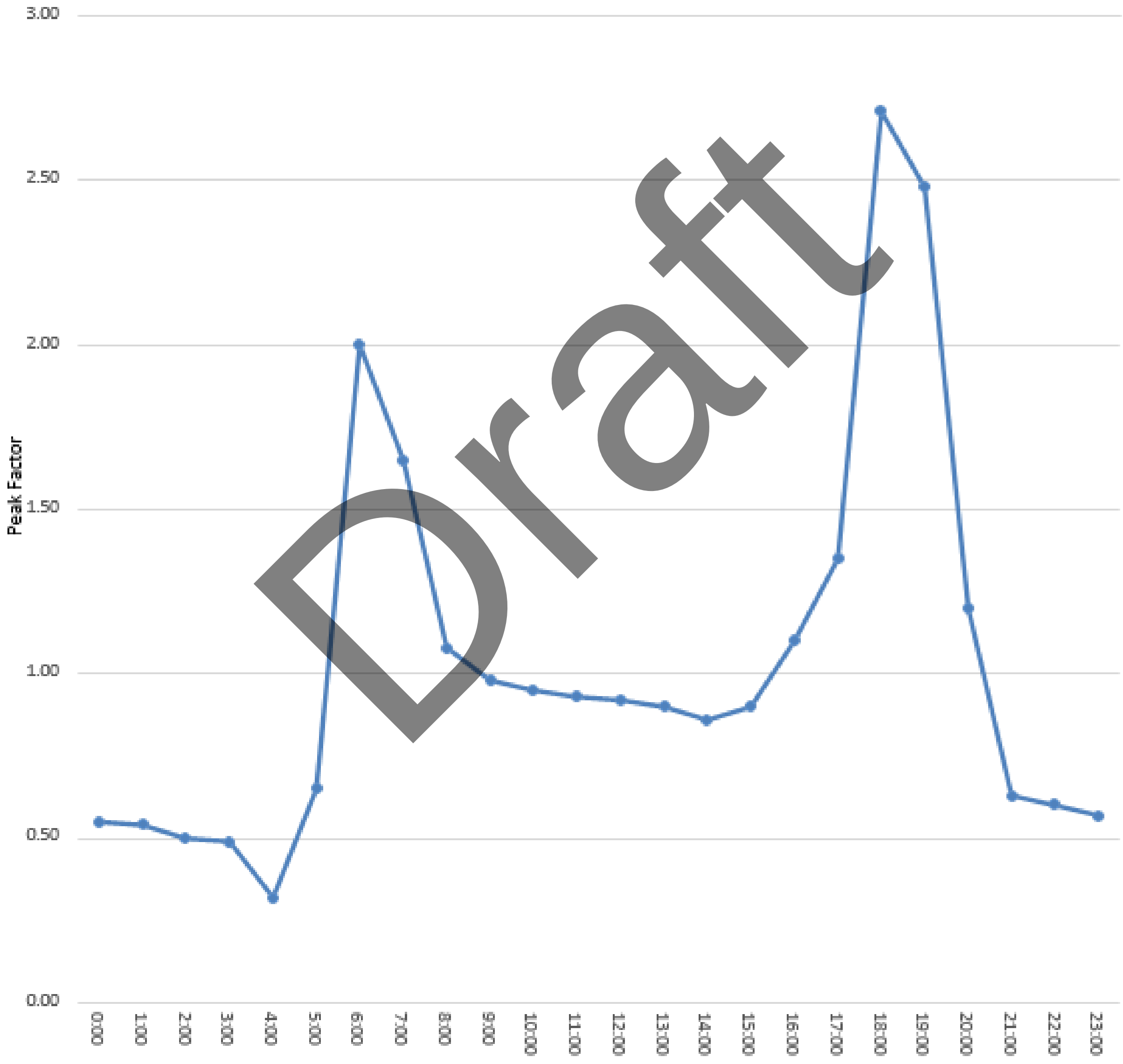

Figure 4-7 Typical Residential Diurnal Curve

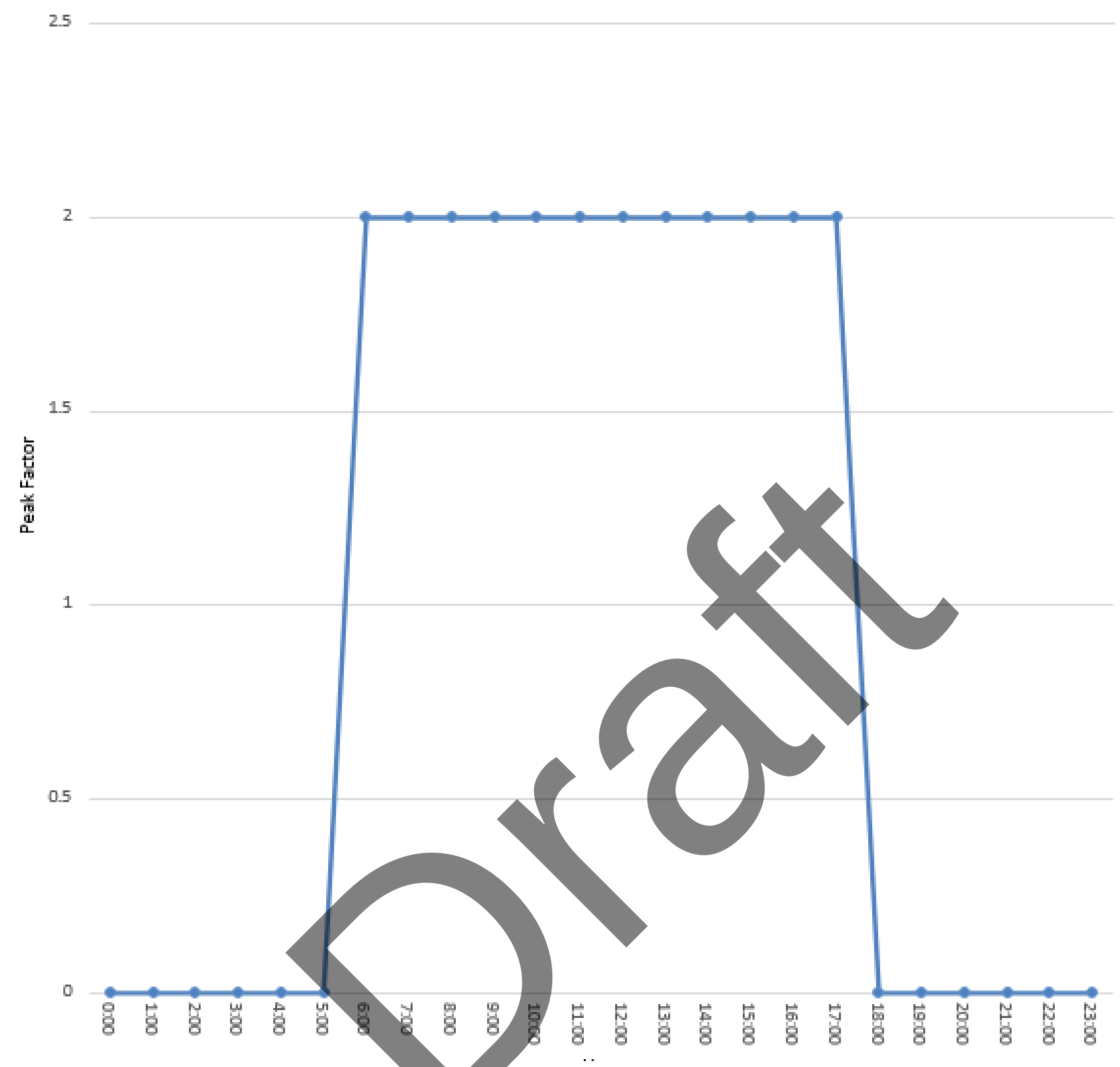

Figure 4-8 Typical Non-Residential Diurnal Curve

4.4 Existing Wet Weather Flows

As described above, collection systems must be sized and designed to carry both wastewater and the inflow and infiltration that enter a collection system during wet weather events. The 2022/2023 Flow Monitoring Study captured several wet weather events that impacted flows in the District's collection system. The 1/8/2023 wet weather event was used to generate existing wet weather flow factors to quantify representative wet weather flow for the 2024 Master Plan Update.

4.4.1 Existing Wet Weather Flow Factors

Consistent with how wet weather flow factors have been developed in the past, and typical of collection system master planning, R-T-K factors were used in the 2024 Master Plan Update to quantify RDII and generate wet weather flows for hydraulic evaluation. R-T-K factors are used in the hydraulic model to generate hydrographs from each tributary area that represent estimated flows during and immediately after rainfall events caused by potential seepage of precipitation into the collection system. The R-T-K factors generate a series of three triangular hydrographs that represent short-term, medium-term, and long-term rainfall response. The R-T-K factors include:

- **R-factor**: The percentage of rainfall that enters the system in the form of RDII.
- **T-factor**: The time from the storm onset to the runoff peak.
- **K-factor**: A constant used in defining the ratio of the "time to recession" to the "time to peak" of the hydrograph.

Components of the R-T-K hydrograph are provided courtesy of the EPA Office of Research and Development and are presented on Figure 4-9.

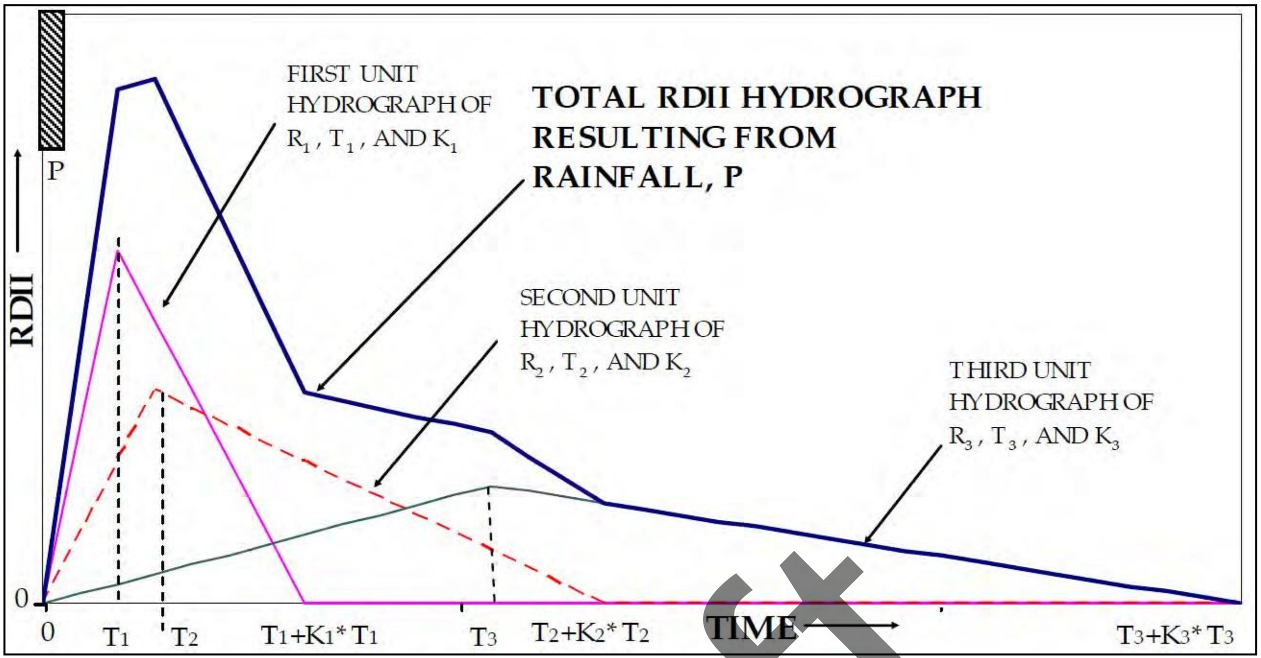

Figure 4-9 Components of RTK Hydrograph

R-T-K flow factors were calibrated for the 1/8/2023 wet weather event and were verified against other events from the 2022/2023 Flow Monitoring Study. The calibrated R-T-K factors are presented in Table 4-6.

Table 4-6 R-T-K Factors for RDII Generation in Hydraulic Model by Flow Monitor Basin

Description	FM01	FM01A	FM01B	FM01C	FM02	FM03	FM04	FM06	FM06A	FM06B	FM06C	FM07	FM08	FM09	FM09A
R1: Triangle 1 Rainfall Volume	0.1	0.35	0.11	0.001	0.25	0.001	0.005	0	0.08	0.05	0.01	0.44	0.007	0.006	0.01
R2: Triangle 2 Rainfall Volume	1	1	1	0.9	1	0.5	1.7	1.5	1	1	1	0.8	0.8	1	2
R3: Triable 3 Rainfall Volume	1	1	1	1.1	1	9	2	0.5	1	1	1	0.5	2	3.5	4
T1: Time to Peak 1 (hr)	0.8	1.5	0.9	0.9	0.5	1.5	0.9	2.0	2.0	0.9	0.8	1.5	0.9	0.9	0.5
T2: Time to Peak 2 (hr)	0.9	1.6	1.0	1.0	1.0	1.6	1.0	2.1	2.1	1.0	0.9	1.6	1.0	1.0	1.0
T3: Time to Peak 3 (hr)	1.0	1.7	1.1	1.1	4.0	1.7	1.1	2.2	2.2	1.1	1.0	1.7	1.1	1.1	4.0
K1: Recession Constant 1	1.0	2.0	2.0	2.0	2.0	0.5	0.5	1.0	1.0	0.5	1.0	2.0	2.0	2.0	2.0
K2: Recession Constant 2	1.1	2.5	2.5	2.5	3.0	0.5	1.0	0.5	0.5	1.0	1.1	2.5	2.5	2.5	3.0
K3: Recession Constant 3	1.2	3.0	3.0	3.0	3.0	0.50	1.5	0.25	0.25	1.5	1.2	3.0	3.0	3.0	3.0

4.4.2 Wet Weather Design Storm

The R-T-K factors provided above describe the relationship between the amount of rainfall that occurs during a wet weather event and the amount and timing of flow that ends up in the collection system. Therefore, use of the R-T-K factors also requires establishment of a typical and representative amount of rainfall. The amount and timing of the rainfall is quantified in a design storm for collection system planning.

Selection of a design storm is typically based on an allowable level of risk within the collection system, and the description of the design storm is most often expressed as the return period and duration of the storm. It is recognized that while wet weather overflows are highly undesirable, the cost of providing capacity increases as the return period of the design storm, and therefore the design flow, increases. Regulatory agencies have not adopted standard criteria for return periods, so wastewater agencies utilize a target return period based on a balance of desired level of service, potential impacts of overflows, and cost of providing capacity. The District developed a 10-year return period, 24-hour duration design storm for the 2006 Master Plan. This design storm was retained for the 2016 Master Plan Update. For consistency in evaluating infrastructure capacity, this design storm is also maintained for the 2024 Master Plan Update. A 10-year, 24-hour design storm is common and within accepted practice for wastewater agencies within California.

The amount of rainfall in the design storm was developed from the National Oceanic and Atmospheric Administration Atlas 2 Isopluvial Map of California. Total rainfall of 2.1 inches was approximated as the 10-year, 24-hour storm. (In a given year, there is a 10 percent chance that there will be a 24-hour period with 2.1 inches or greater of rainfall). Total rainfall in a design storm is typically distributed over the storm duration using either a synthetic distribution such as one of the Soil Conservation Service distributions, or using a distribution from a real storm that was recorded. Flow and rainfall monitoring that was conducted for the 2006 Master Plan captured a robust 24-hour storm over January 1 and January 2, 2006. The rainfall distribution from this storm was incorporated into the District's design storm. The resulting 10-year, 24-hour design storm, developed for the 2006 Master Plan and used as well in the 2016 Master Plan Update, is presented on Figure 4-10. Using the same 10-year, 24-hour design storm for each master plan update provides consistency in infrastructure planning.

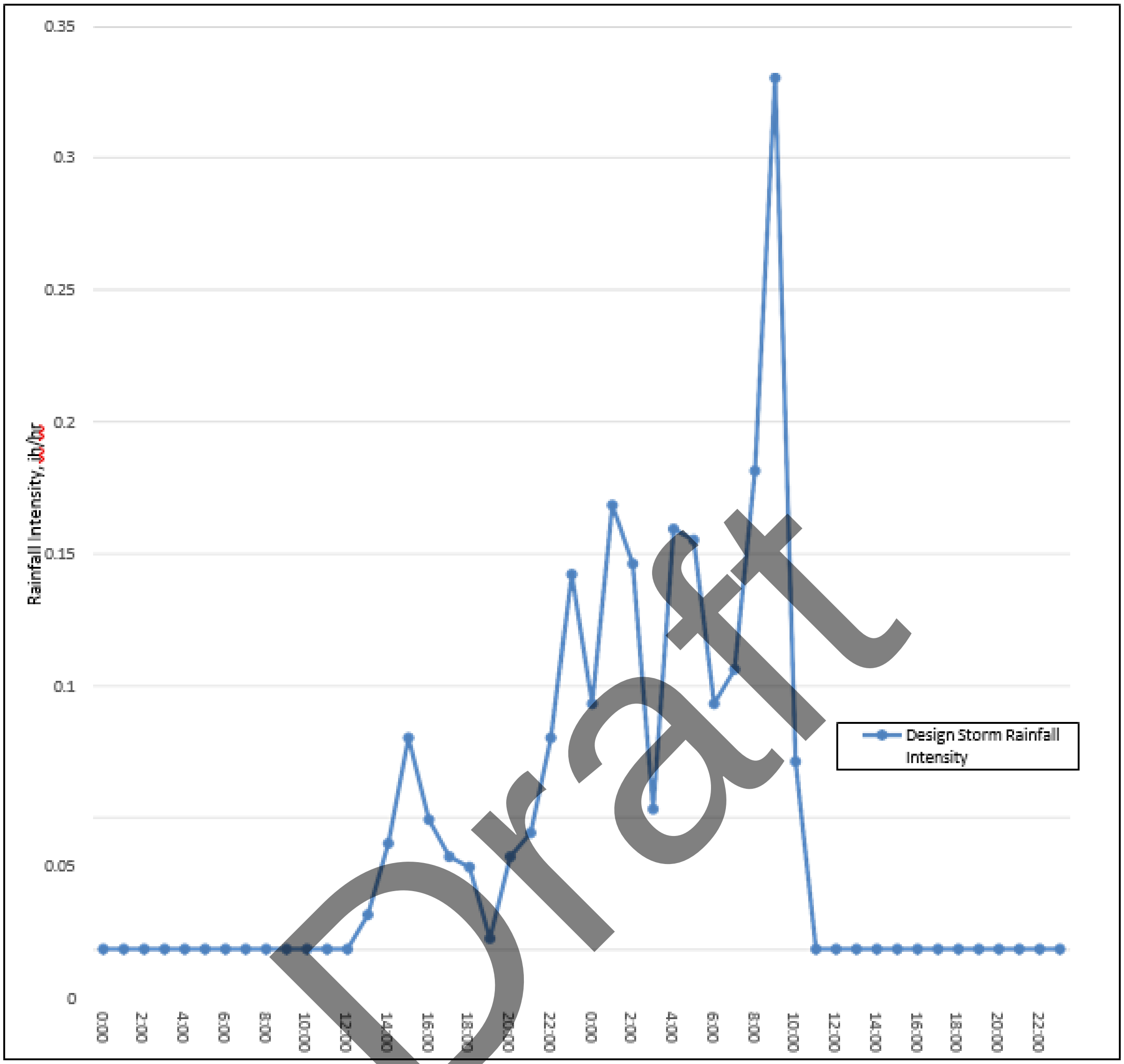

Figure 4-10 10-year, 24-hour Design Storm

4.5 Existing and Future Design Flow

The dry weather and wet weather wastewater generation factors described above were applied to the development projections provided in Chapter 3 to develop dry weather and wet weather flow projections for the 2024 Master Plan Update. Based upon the dry weather generation factors, increased ADWF values were calculated by development tier for each member city. ADWF increases for Selma, Kingsburg, and Fowler are shown by development tier in Table 4-7, Table 4-8, and Table 4-9 respectively.

Table 4-7 Selma Projected Development ADWF by Land Use Category (All values in gpd)

Summarized Land Use Category	Primary	Tier 1	Tier 2	Tier 3
Commercial	325,800	22,300	186,200	532,600
Light Industrial	11,500	54,100	51,000	1,226,700
Heavy Industrial	-	3,600	22,500	27,700
Park/Open Space	4,000	6,300	12,900	500
Public Facilities	12,600	1,800	44,700	-
Low Density Residential	72,700	60,100	505,600	80,300
Medium Density Residential	503,500	976,400	1,205,400	2,453,400
High Density Residential	-	62,300	103,600	45,500
Mixed Use	-	16,000	167,100	-
Total	930,100	1,202,900	2,299,000	4,366,700

Table 4-8. Kingsburg Projected Development Flows by Land Use Category (All values in gpd)

Summarized Land Use Category	Primary	Tier 1	Tier 2	Tier 3
Commercial	200	84,400	-	50,100
Light Industrial	42,900	73,500	-	52,100
Heavy Industrial	-	95,500	-	239,500
Park/Open Space	-	11,200	-	-
Public Facilities	-	800	-	-
Low Density Residential	382,300	178,200	-	475,100
Medium Density Residential	-	4,700	-	500
High Density Residential	-	100	-	-
Mixed Use	-	-	-	-
Total	425,400	448,400	0	817,300

Table 4-9. Fowler Projected Development Flows by Land Use Category (All values in gpd)

Summarized Land Use Category	Primary	Tier 1	Tier 2	Tier 3
Commercial	24,700	51,900	-	2,200
Light Industrial	93,200	71,100	-	48,300
Heavy Industrial	585,400	-	-	-
Park/Open Space	1,300	900	-	-
Public Facilities	17,100	-	-	-
Low Density Residential	44,600	77,200	143,700	-
Medium Density Residential	1,530,200	403,600	761,000	-
High Density Residential	-	440,700	-	237,300
Mixed Use	-	-	-	-
Mixed Use - Industrial/Commercial	-	20,800	-	-
Mixed Use - Residential/Industrial	26,900	-	57,700	-
Mixed Use - Residential/Open Space	-	-	28,900	-
Mixed Use - Residential/Public Facilities	14,200	-	-	-
Total	2,337,600	1,066,200	991,300	287,800

Diurnal patterns as described above were applied to the ADWF projections to create PDWF projections. The wet weather flow generation factors described above were applied to the projected ADWF and PDWF values to produce PWWF values The PWWF values constitute the design conditions for the infrastructure in the collection system. ADWF, PDWF, and PWWF values derived from the hydraulic model of the collection system (more fully described in Chapter 5) are presented for each development tier in Table 4-10.

Table 4-10 Design Flows by Development Tiers (All values in mgd)

	Existing	Primary	Tier 1	Tier 2	Tier 3
ADWF	4.15	7.84	10.56	13.85	19.32
PDWF	7.59	14.35	19.33	25.35	35.36
PWWF	15.36	29.02	36.96	42.94	57.97

Chapter 5 Hydraulic Model Update and Calibration

This chapter outlines the steps taken to update and calibrate the District's hydraulic model for average and peak flow and level information at each of the 15 flow monitoring sites. The chapter also includes process and results of the calibration for total RDII and peak RDII values. Finally, this chapter provides the Design and Performance Criteria used in the 2024 Master Plan Update.

IN THIS SECTION

- Model Description
- Hydraulic Model Update
- Existing System Dry Weather Calibration
- Existing System Wet Weather Calibration
- Design and Performance Criteria

As part of the 2024 Master Plan Update, an updated hydraulic model of the sanitary sewer system has been developed and utilized for the collection system hydraulic analysis. Chapter 5 contains a summary overview of the model software, the modeled system network, future design flow allocation, and hydraulic capacity evaluation using the design flow described in Chapter 4.

5.1 Model Description

There are two types of hydraulic models used to simulate a sewer collection system:

1) a steady state/static simulation

2) an extended period/dynamic simulation.

Simulations from a steady state model represent a snapshot of the system performance at a given point in time under specific sewage generation conditions (typically a peak flow condition). An extended period/dynamic model employs a continuous simulation of the changes in system flow rates and is typically used to analyze the operational performance of the system over a 24-hour or longer period. Extended period/dynamic modeling requires more extensive data input than a steady-state model, including various 24-hour diurnal patterns for various land use categories within the sewer collection system and a representation of time-varying RDII response to rainfall. For the purposes of the 2024 Master Plan, as with the 2006 and 2016 Master Plan, an extended period/dynamic simulation has been used in system analyses to analyze the operational performance of the District's collection system over a 48-hour period.

5.2 Hydraulic Model Update

This section describes the collection system hydraulic model, describes the additional facilities added into the hydraulic model as part of the 2024 Master Plan Update, and provides a summary of the existing and future timeframe flow allocation of the hydraulic model.

5.1.1 Hydraulic Model Software Update

As part of the 2016 Master Plan, the hydraulic model developed as part of the 2006 Master Plan (H2O Map Sewer) was updated to an InfoSewer model, a product of Innovyze, Inc. as the modeling program. As part of this Master Plan, the InfoSewer model was updated to an InfoSWMM model, a product of Innovyze now owned by Autodesk. InfoSWMM is a fully dynamic wastewater modeling software application. The InfoSWMM model, updated appropriately, is used to identify hydraulic deficiencies under existing and future timeframe conditions and to evaluate potential relief sewers or other infrastructure improvements to address the possible hydraulic deficiencies.

5.1.2 Model Network Revisions

The hydraulic model simulates a skeletonized system with approximately 73 total miles of modeled pipelines and 22 lift stations. The skeletonized system includes all the major conveyance gravity mains 12-inch diameter and larger. Additional smaller diameter pipelines were added to the model as needed to keep tributary areas at a reasonable size and to provide hydraulic conductivity.

The hydraulic model, as developed for the 2016 Master Plan, was compared against the District's collection system Geographic Information Systems (GIS) to determine if additional existing sewers needed to be added to the model system. The comparison yielded the following general classes of updates to the hydraulic model:

- Structural improvements or developments that have occurred since the time of the 2016 Master Plan Update were updated into the model.
- Instances of inconsistent gravity main diameters between the hydraulic model and the GIS were identified and investigated.
- Infrastructure that appeared in the hydraulic model, but not in the District's GIS was investigated to determine which source correctly represented field conditions. The hydraulic model was updated as appropriate.

In addition to the comparisons described above, basic data checks were conducted of the updated model for missing data and physical inconsistencies (e.g., reverse pipe slopes or diameter changing from larger to smaller rather than vice versa). Figure 5-1 presents the updated model network for the 2024 Master Plan Update hydraulic evaluation.

5.2 Existing System Dry Weather Flow Calibration

After the hydraulic network was refined and confirmed as above, the District's hydraulic model was calibrated to confirm that the computer simulation will accurately estimate the operation of the collection system under dry weather flow conditions. The major steps in the dry weather flow calibration included the following:

1. Determine the ADWF for the entire collection system (described in Chapter 4).
2. Determine the ADWF at each flow monitoring location (described in Chapter 4).
3. Create parcel-level flow monitoring basin sewersheds by assigning each parcel in the District to a flow monitoring basin.
4. Using these sewersheds, adjust wastewater flow generation factors until ADWF values in the model match ADWF values from the flow monitoring at each flow monitoring location.

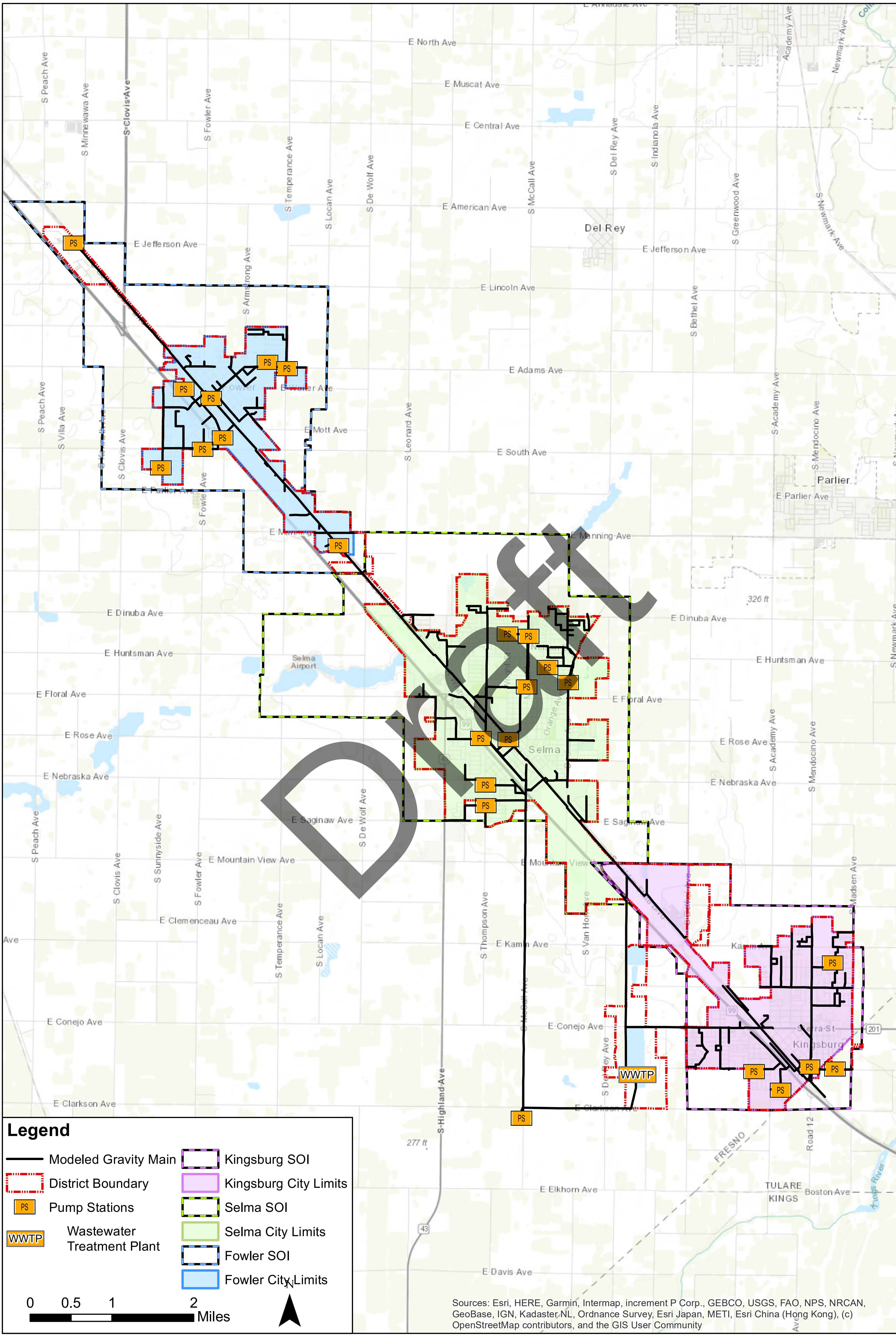

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FIGURE 5-1
MODELED NETWORK
2024 MASTER PLAN UPDATE

5. Once ADWF calibration is established for each flow monitoring location, adjust diurnal patterns until PDWF values in the model match the flow monitoring values at each flow monitoring location.

An example dry weather calibration for ADWF and PDWF is shown on Figure 5-2 for FM 06. ADWF calibration values for all 15 flow monitoring locations are shown in Table 5-1. All dry weather calibration plots can be found in Appendix B.

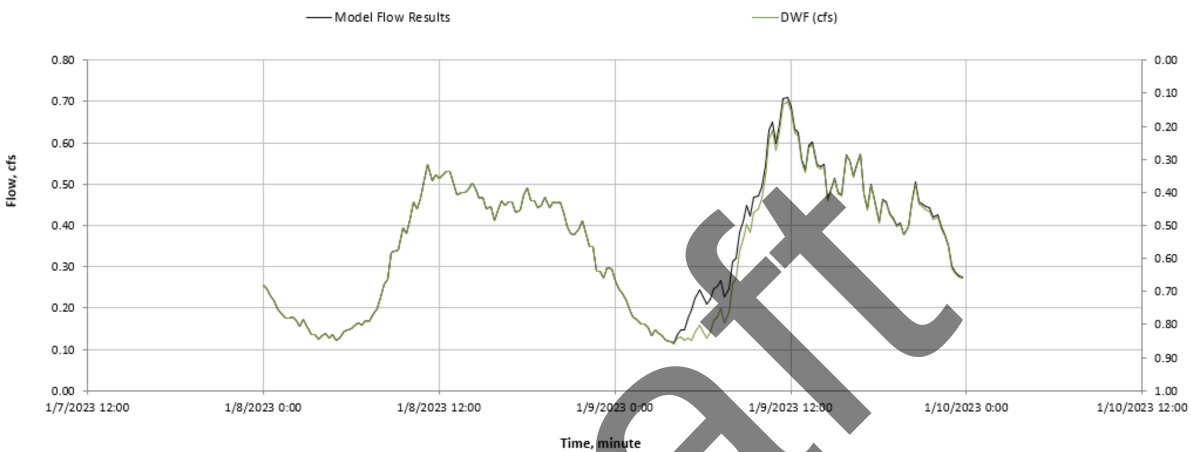

Figure 5-2. Dry Weather Calibration Plot for FM06

Table 5-1. ADWF Calibration Values

Flow Monitor Number	Pipe ID	ADWF from Flow Monitoring	ADWF from Model	% Difference
01	I-130	0.625	0.621	1%
01A	F-231	0.069	0.069	0%
01B	I-185	0.020	0.020	-1%
01C	F-223	0.104	0.104	0%
02	I-661	1.033	1.041	-1%
03	S-711	0.218	0.220	-1%
04	S-752	0.420	0.418	0%
06	I-671	0.504	0.499	1%
06A	S-670	0.130	0.131	0%
06B	S-548	0.158	0.157	1%
06C	S-698	0.155	0.154	1%
07	I-935	2.079	2.259	-9%
08	I-25	0.946	0.966	-2%
09	K-460	0.737	0.773	-5%
09A	K-421	0.333	0.339	-2%

5.3 Existing System Wet Weather Flow Calibration

Following completion of dry weather calibration, the District's hydraulic model was calibrated for wet weather conditions. A hydraulic model that is sufficiently calibrated to wet weather flow is then expected to simulate inflow and infiltration entering the sewer collection system during a precipitation event. Wet weather flow calibration consists of the following steps:

1. Identify a representative wet weather calibration event from the flow monitoring data. The event should represent a time period with significant rainfall, and without extensive flow anomalies that would impact the accuracy of calibration results. As described in Chapter 4, the 1/8/2023 wet weather event was chosen for calibration. This event was between a 5-year and 10-year return interval event for 24-hour accumulation.
2. Establish the amount if RDII flow present in the total flow at each flow monitoring location.
3. Starting at upstream flow monitoring basins and working downstream to the WWTP, adjust R-T-K values (described in Chapter 4) for each flow monitoring basin to match RDII flows. Match peak flows primarily, and also consider total volume with temporal distribution of flows.
4. After complete collection system calibration, choose a second storm for flow comparison to serve as model verification.

The results of the process described above are the calibrated R-T-K values that were presented in Chapter 4. A sample calibration plot representing FM 06 can be seen on Figure 5-3. All wet weather calibration plots can be found in Appendix C.

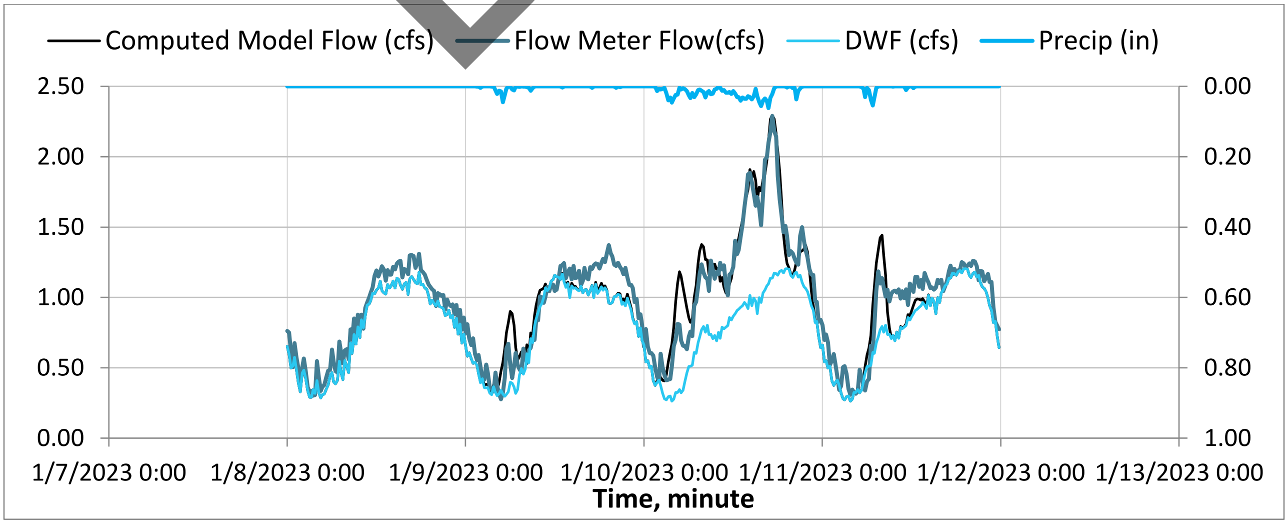

Figure 5-3. Wet Weather Calibration Plot for FM06

5.4 Design and Performance Criteria

The capacity of the District's collection system is evaluated as part of the 2016 Master Plan Update based on the performance criteria defined in the following sections. The criteria include standards from the District's Collection System Construction Standards (Construction Standards), as well as other industry typical criteria. The planning criteria address the gravity main capacity, gravity main slopes, maximum depth of flow within a gravity main, lift station wet well capacity criteria, lift station capacity criteria, and force main velocity criteria.

5.4.1 Gravity Mains

Capacity analysis of the District's gravity mains is performed using the hydraulic model in accordance with the criteria established in this section. The District's Construction Standards stipulate general policies of the District and outline sewer design criteria. Some of these criteria are discussed below. If not discussed in the 2016 Master Plan Update, it should be assumed that the design criteria conform to the District's Construction Standards.

Gravity Main Capacity

Gravity main flow capacities depend on the roughness of the pipe interior, its geometric configuration (cross-section and length), and slope. The Continuity equation and the Manning equation for steady-state flow are used to calculate flow in a gravity main:

Continuity Equation: $Q = V*A$

Where:

Q = peak flow, cubic feet per second (cfs)

V = velocity, feet per second (fps)

A = cross-sectional area of pipe, sq. ft.

Manning Equation: $V = (1.486*R^{2/3}*S^{1/2})/n$

Where:

V = velocity, fps

n = Manning's coefficient of friction

R = hydraulic radius (area divided by wetted perimeter), ft

S = slope of pipe, feet per foot

Manning's Coefficient (n)

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 typically ranges between 0.011 and 0.017, with 0.013 being a typical value used for sewer system master planning. The default value for the Manning coefficient used in the 2024 Master Plan is 0.013, which is consistent with the District's Construction Standards.

Flow Depth Criteria (d/D)

The primary criterion used to identify capacity-deficient trunk sewers or to size new improvements is the maximum flow depth to pipe diameter ratio (d/D). This approach is consistent with both the 2006 Master Plan and the District's Construction Standards. The d/D value is defined as the depth (d) of flow in a pipe during peak flow conditions divided by the pipe's diameter (D). The District's construction standards define the acceptable d/D values for various pipe diameters.

When designing sewers, it is common practice to adopt variable flow depth criteria for different pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values used for smaller pipes which may experience flow peaks greater than design flow or may experience blockages from debris, paper or rags.

According to District Construction Standards, sewers less than 12 inches in diameter shall be designed to flow half full at peak flow rates. Sewers 12 inches to 18 inches in diameter shall be designed to flow two-thirds depth at peak flow rates. Sewers larger than 18-inches diameter shall be designed to flow at 90 percent depth at peak flow rate. The maximum allowable d/D ratios for design flow conditions are summarized in Table 5-2.

Table 5-2. d/D Ratios for Design Flow Conditions

Gravity Main Diameter	Design Flow Maximum d/D Ratio
Less than 12 inches	0.50
Greater than or equal to 12 inches, but less than or equal to 18 inches	0.67
Greater than 18 inches	0.90

Design Velocities and Minimum Slopes

In order to minimize the settlement of sewage solids, the District's Construction Standards requires that sewer velocity be equal to or greater than 2 feet per second (fps) for all gravity mains when flowing at their maximum capacity. At this velocity, the sewer flow will typically provide self-cleaning for the gravity main. Table 5-3 lists the recommended minimum slopes and their corresponding maximum flows for maintaining velocities greater than 2 fps when the gravity main is flowing at maximum depth.

The District's Construction Standards also list the "Absolute Minimum Slope" for commonly used gravity main sizes. The absolute minimum slopes are not used as criteria in the 2024 Master Plan Update because these minimum slopes result in velocities that are less than 2 fps at maximum flow depth.

Table 5-3. Gravity Main Minimum Slope and Maximum Flow Criteria[a]

Gravity Main Diameter	Minimum Slope[b], feet/feet	Absolute Minimum Slope, feet/feet	Design Flow Maximum d/D Ratio	Maximum Flow, mgd	Maximum Flow, ESFRs
6-inch	0.0050[c]	0.0045	0.50	0.181	230
8-inch	0.0033[c]	0.0025	0.50	0.224	290
10-inch	0.0025[c]	0.0019	0.50	0.354	470
12-inch	0.0016[c]	0.0012	0.67	0.727	960
15-inch	0.0012[c]	0.0009	0.67	1.142	1,500
18-inch	0.0009[c]	0.0007	0.67	1.608	2,110
21-inch	0.0007[c]	0.0006	0.90	2.888	3,800
24-inch	0.0006[c]	0.0005	0.90	3.818	5,040
27-inch	0.0006	0.0005	0.90	5.227	6,890
30-inch	0.0005	0.0005	0.90	6.319	8,320
33-inch	0.0005	0.0005	0.90	8.148	10,730
36-inch	0.0004	0.0004	0.90	9.191	12,110
42-inch	0.0003	0.0003	0.90	12.006	15,810
48-inch	0.0003	0.0003	0.90	17.141	22,590
54-inch	0.0003	0.0003	0.90	23.466	30,920
60-inch	0.0002	0.0002	0.90	25.375	33,430
66-inch	0.0002	0.0002	0.90	32.718	43,110
72-inch	0.0002	0.0002	0.90	41.263	54,360
84-inch	0.0002	0.0002	0.90	62.241	82,010

[a] Source: 2016 Master Plan updated with latest flow values.
[b] Recommended minimum slope for maximum gravity main flow at various d/D values and minimum velocity of 2 fps.
[c] District Construction Standards for standard minimum slopes of gravity mains. Construction Standards provided slopes for diameters less and or equal to 24-inch only. Slopes for gravity mains 27-inch diameter and greater were calculated based upon maximum d/D and minimum velocity criteria.

Changes in Gravity Main Sizes

When a smaller gravity main joins a larger one, the invert of the larger gravity main will be lowered such that a constant energy gradient is maintained. An approximate method for maintaining a constant energy gradient is to place the 0.80 d/D point of both gravity mains at the same elevation. Placing the 0.80 d/D point at the same elevation can be effectively accomplished by matching the gravity main soffits for the differently-sized gravity mains.

5.4.2 Lift Stations

Lift Stations

The District's Construction Standards require that all sewage lift stations have sufficient capacity to pump the peak design flow with the largest pump out of service (firm capacity). Standby power is not required per the District's Construction Standards but should be considered by the District as standard on all new lift stations, and should be considered as part of all lift station rehabilitation projects.

Force Mains

The District's Construction Standards do not include specific hydraulic criteria for force mains. Force main hydraulic criteria are often based on velocity in the force main. Force mains are typically sized such that the velocity in the force main will exceed 3 fps under normal operating conditions so that the force main will remain free of settled debris. Similarly, force mains are typically sized such that the maximum velocity in the force main will not exceed 8 fps under peak conditions. This maximum velocity prevents excessive wear and tear on the force main and limits excessive energy expenditures in the lift station due to the high losses that result from higher velocities.

For the 2016 Master Plan Update, the force main design criteria of a minimum velocity of 3 fps under normal operating conditions and a maximum velocity of 8 fps under peak operating conditions are applied. The Hazen-Williams formula is used to calculate the velocity of force mains. The formula is:

Velocity Equation: $V = 1.32 * C * R^{0.63} * S^{0.54}$

Where:

V = velocity, fps

C = Hazen-Williams roughness coefficient

R = hydraulic radius (area divided by wetted perimeter), ft

S = slope of pipe, feet per foot

The value of the Hazen-Williams roughness coefficient varies with the type of pipe material and is influenced by the type of construction and age of the pipe. A value of 120 is assumed to be the default value for the 2024 Master Plan Update.

Chapter 6 Existing and Future Capacity Evaluation

This section presents the results of the hydraulic evaluation of the District's collection system under existing and then future conditions. Collection system capacity for gravity mains, wet wells, pump stations, and force mains is assessed with respect to the system's performance under the existing PWWF design flow condition described in Chapter 4 using the hydraulic model and performance criteria described in Chapter 5.

IN THIS SECTION

- Existing Capacity Evaluation
- Future Capacity Evaluation

6.1 Existing Capacity Evaluation

This section presents the results of the hydraulic evaluation of the District's collection system under existing conditions.

6.1.1 Existing Gravity Main Hydraulic Evaluation

Existing gravity mains exceed the performance criteria under existing design flows in a number of locations in Selma and Fowler. All gravity mains in Kingsburg have sufficient capacity for existing design flows.

As described in Chapter 4, temporary flow monitoring performed for the 2024 Master Plan Update identified areas of the collection system with high RDII values. The RDII values contribute to gravity main hydraulic deficiencies in these areas. As part of determining whether hydraulic improvement should include RDII reduction or infrastructure capacity increases, sensitivity analysis was completed with regard to RDII reduction. RDII rates were reduced by 50% in the high RDII areas to quantify impact of RDII rates on capacity deficiencies.

The gravity mains failing to meet performance criteria in the District's collection system under existing conditions are displayed on Figure 6-1. These gravity mains are summarized by member City below.

Selma

Within Selma, a total of 7,350 feet of gravity mains were identified as deficient under existing conditions. These gravity mains are categorized by diameter in Table 6-1.

Table 6-1 Selma Deficient Gravity Mains

Diameter, inches	Deficiency, feet
6	1,230
8	1,830
10	820
12	3,470
Total	**7,350**

Several of these deficiencies were in high RDII areas. When RDII is reduced by 50% in these areas, the number of deficiencies decreases to 5,050 feet.

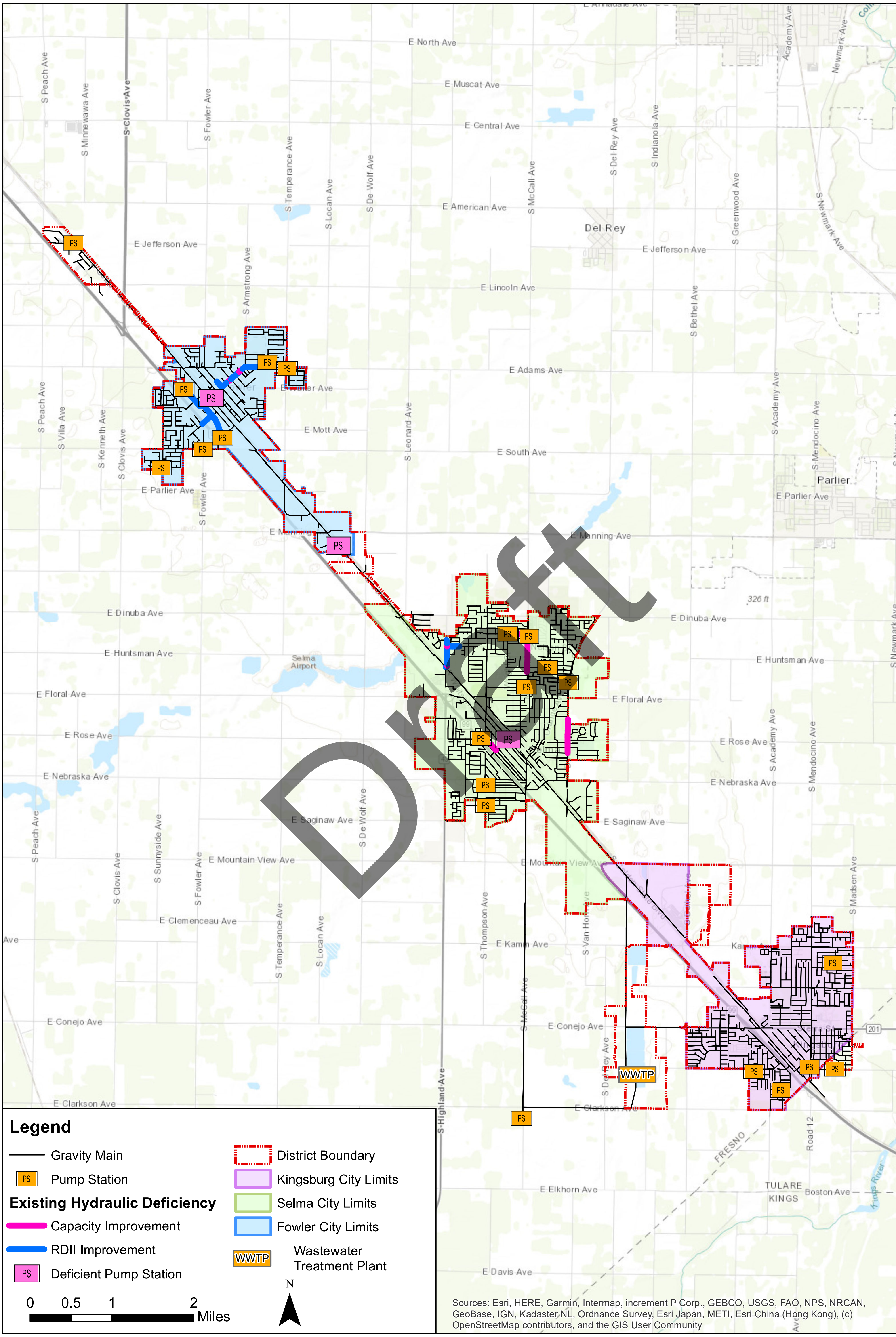

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FIGURE 6-1
EXISTING HYDRAULIC DEFICIENCIES
2024 COLLECTIONS MASTER PLAN UPDATE

The existing gravity main hydraulic deficiencies in Selma include the following:

- 12-inch and 10-inch gravity mains in S. Highland Ave. and Nelson Blvd. These gravity mains are north of and drain to Golden State Blvd. These gravity mains show high RDII response, and the capacity deficiencies can potentially be corrected with RDII investigation and removal.
- 6-inch gravity mains in Goldridge St. between Goldridge LS and McCall Ave.
- 8-inch gravity mains in McCall Ave. between Hillcrest St. and Dennis Dr. There are parallel gravity mains in McCall Ave. in this area, and the west-most gravity main is deficient under existing conditions. The area is upstream of Maple LS.
- 12-inch gravity mains in Dockery Ave. between Stillman St. and Mill St. These gravity mains are downstream of Dockery LS.

Kingsburg

There are no existing gravity main deficiencies within Kingsburg.

Fowler

Within Fowler, a total of 9,940 feet of gravity mains were identified as deficient under existing conditions. These gravity mains are categorized by diameter in Table 6-2.

Table 6-2 Fowler Deficient Gravity Mains

Diameter, inches	Deficiency, feet
6	400
8	4,230
10	470
12	4,840
Total	**9,940**

The majority of these deficiencies were in high RDII areas. When RDII is reduced by 50% in these areas, the number of deficiencies decreases to only 700 feet.

The existing gravity main deficiencies in Fowler include the following:

- 8-inch and 12-inch gravity mains in 10th St., Fresno St., alleys, and general right of way between the 10th St. LS and Peach LS. This area exhibits high RDII values, and the hydraulic deficiencies can be remediated through reduction of RDII tributary to the Peach LS.
- 8-inch and 12-inch gravity mains in Adams Ave. and Merced St. en route to Golden State Blvd. The majority of these hydraulic deficiencies can be eliminated through reduction of RDII values in the basins tributary to these gravity mains.

6.1.2 Existing Lift Station Hydraulic Evaluation

As described in Chapter 5, the District's performance standards require that all collection system lift stations have sufficient capacity to convey design flows, even with the largest pump out of service. This capacity requirement is defined as the "firm capacity" of the lift station. Each existing lift station's firm capacity was compared to the existing design flow conveyed to the lift station. If the modeled design flow is greater than the lift station's firm capacity, then the lift station is considered to have insufficient capacity. The majority of the collection system lift stations have sufficient firm capacity to convey existing design flows; however, the hydraulic model identified several lift stations that lack this capacity under existing conditions. A detailed comparison of lift station capacity and current flow demands is provided in Table 6-3. The location of these deficient lift stations are presented on Figure 6-1.

Table 6-3: Existing Lift Station Capacity Evaluation

Name	Owned by	Firm Capacity, gpm	Existing Design Flow, gpm	Status
Merced	District	750	1,250	Deficient
Manning	District	750	2,200	Deficient
North	District	1,900	6,900	Deficient
18th Ave	District	2,326	1,300	Sufficient
10th St	Fowler	316	30	Sufficient
Peach	Fowler	800	150	Sufficient
Gleason	Fowler	224	30	Sufficient
South Ave	Fowler	417	150	Sufficient
Jefferson	Fowler	120	20	Sufficient
Adams	Fowler	478	200	Sufficient
Randy	Fowler	250	30	Sufficient
Mehlert	Kingsburg	230	40	Sufficient
Kern	Kingsburg	787	20	Sufficient
Skansen	Kingsburg	500	80	Sufficient
Tulare	Kingsburg	250	70	Sufficient
Rose	Selma	865	170	Sufficient
Goldridge	Selma	100	30	Sufficient
North Hill	Selma	352	10	Sufficient
Dockery	Selma	865	280	Sufficient
Sunset	Selma	669	410	Sufficient
Barbara	Selma	170	-	Sufficient
Valley View	Selma	1,100	150	Sufficient
Maple & McCall	Selma	550	150	Sufficient
Clarkson & McCall	Selma	1,500	1,100	Sufficient

Several of the District's lift stations are hydraulically deficient under existing conditions as shown in the table above. These lift stations were identified in previous planning efforts, and improvement designs are currently under way to provide necessary capacity for both existing and future requirements.

6.1.3 Existing Force Main Hydraulic Evaluation

Force main velocities under existing design flow conditions are shown in Table 6-4. As shown in the table, only the District's North LS has a force main velocity that exceeds the performance criteria of 8.0 fps. This force main is currently under design for capacity improvements including lift station capacity.

Table 6-4: Existing Force Main Capacity Evaluation

Name	Owned by	Force Main Diameter, in	Existing Design Flow Velocity, fps	Status
Merced	District	8	7.98	Sufficient
Manning	District	30	1.00	Sufficient
North	District	10	28.19	Deficient
18th Ave	District	14	2.71	Sufficient
10th St	Fowler	8	0.19	Sufficient
Peach	Fowler	6	1.70	Sufficient
Gleason	Fowler	4	0.77	Sufficient
South Ave	Fowler	8	0.96	Sufficient
Jefferson	Fowler	6	0.23	Sufficient
Adams	Fowler	6	2.27	Sufficient
Randy	Fowler	6	0.34	Sufficient
Mehlert	Kingsburg	4	1.02	Sufficient
Kern	Kingsburg	4	0.51	Sufficient
Skansen	Kingsburg	6	0.91	Sufficient
Tulare	Kingsburg	4	1.79	Sufficient
Rose	Selma	12	0.48	Sufficient
Goldridge	Selma	6	0.34	Sufficient
North Hill	Selma	6	0.11	Sufficient
Dockery	Selma	8	1.79	Sufficient
Sunset	Selma	6	4.65	Sufficient
Barbara	Selma	4	0.36	Sufficient
Valley View	Selma	8	0.96	Sufficient
Maple & McCall	Selma	6	1.70	Sufficient
Clarkson & McCall	Selma	12	3.12	Sufficient

6.2 Future Capacity Evaluation

The infrastructure required to convey the future (Primary Development, Tier 1 Development, Tier 2 Development, and Tier 3 Development) design flows, which are described in Chapter 4, is described in the sections below. This infrastructure includes upgrades to existing infrastructure as well as new infrastructure required to serve development. A discussion of the methodologies used to assign future flows and to develop new infrastructure is included below.

6.2.1 Development Methodology for New Collection System Infrastructure

In general, development of the new collection system infrastructure for future flows is governed by the limits and criteria presented in Chapter 5. It is the District's, as well as the Cities', preference to avoid the construction of pump stations where possible and to utilize gravity mains to the extent practicable. The topographic data used during the development of the new infrastructure was obtained from 10-foot contour interval data in GIS format from Fresno County.

Overall development of the proposed alignments for the new infrastructure was intended to reflect the following major considerations:

- The alignment should respect, to the degree practicable, the barriers presented by parcel boundaries, existing roads, canals, and other land features.
- Regional topography and minimum slope considerations should allow the remote future connections to be served by the proposed trunk sewer.
- Construction, operation, and maintenance costs associated with the proposed alignment should be manageable.

The required collection system infrastructure for future design flows can be seen on Figure 6-2, identified by development timeframe.

6.2.2 Load Allocation for Future Design Flows

Tributary areas were identified for allocating wastewater flows to the appropriate modeled gravity main, either existing or new. Each tributary area has at least one connection node in the hydraulic model. Current and future land uses for each tributary area were tabulated using the land use information in Chapter 2 and the development information presented in Chapter 3 as applicable.

The tributary area load allocations were loaded into the modeled collection system network. The load allocation is based upon the local topography. Certain larger tributary areas were loaded to more than one manhole, with each link representing an equal percentage of the total projected flows from a given parcel. The intent of this methodology was to load wastewater flows as realistically as possible in the hydraulic model.

6.2.3 Future Gravity Mains Hydraulic Evaluation

The existing infrastructure that does not meet the District's performance criteria with future design flows, as well as the new gravity mains required to convey future design flow, are described below.

Selma

Some of the increased flows from new development are routed through existing infrastructure, leading to capacity deficiencies in the existing collection system. The existing gravity mains in Selma with capacity deficiencies under future flows are shown on Figure 6-2 and summarized in Table 6-5 by development timeframe.

Table 6-5 Selma Deficient Gravity Mains per Time Frame

Development Time Frame	Gravity Main, feet
Primary	3,810
Tier 1	-
Tier 2	18,780
Tier 3	-
Total	**22,590**

The existing gravity mains with hydraulic deficiencies which develop under future flow conditions include the following:

- 12-inch gravity mains in Rose Ave. just upstream of Rose LS. These gravity mains become deficient under Primary timeframe as development occurs to the west and northwest of the Rose LS.
- 21-inch gravity mains in McCall Ave. south of Mountain View Ave. into the Clarkson McCall LS are deficient under Tier 2 Development conditions. These gravity mains become deficient as flows from east of McCall Ave. are added at Mountain View Ave., and as flows from the western and southwestern portion of Selma's proposed development are added at Caruthers Ave. when new infrastructure is built there.

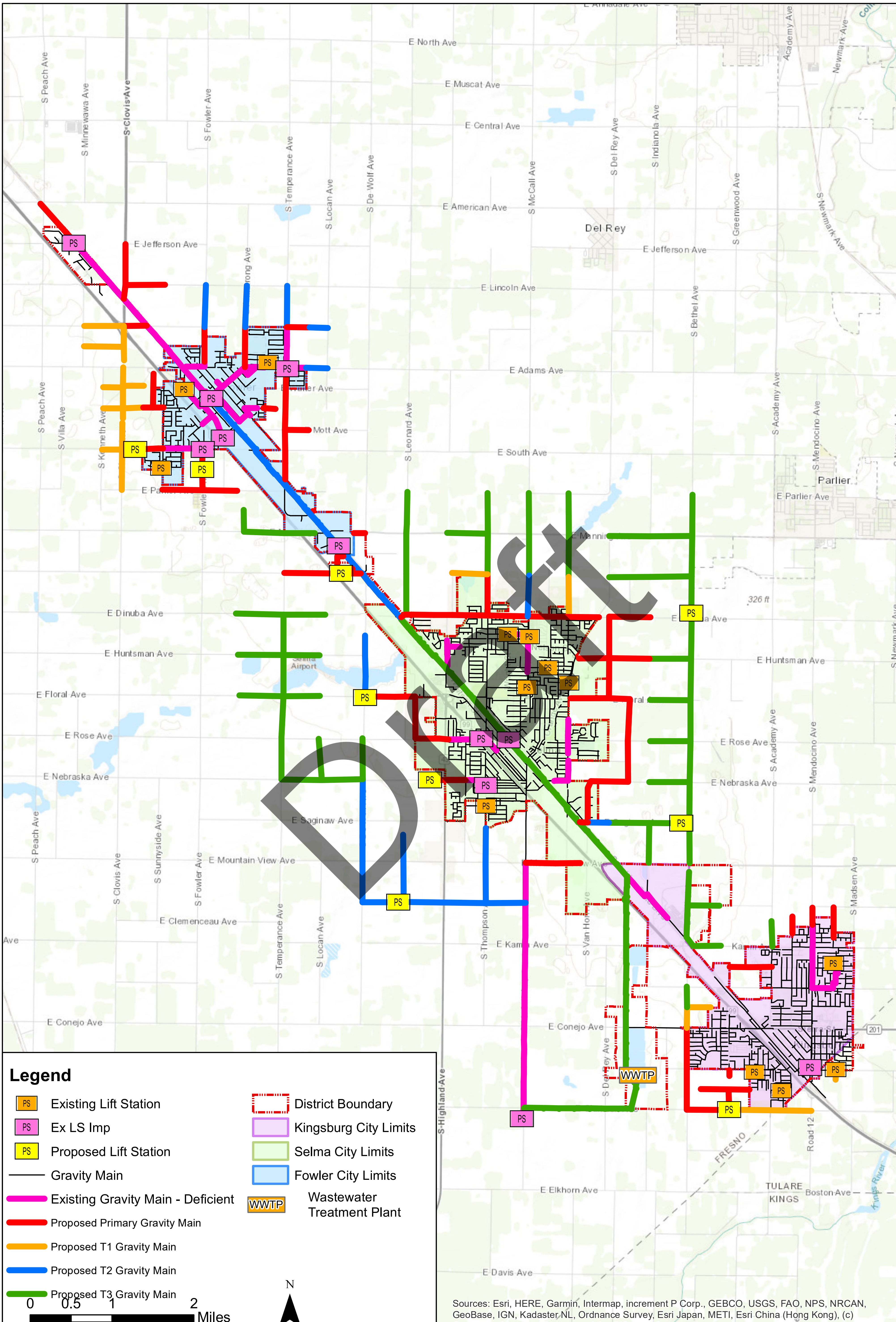

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FIGURE 6-2
FUTURE HYDRAULIC DEFICIENCIES
2024 COLLECTIONS MASTER PLAN

Additionally, new gravity mains are required in Selma to collect and convey wastewater flow from new developments. These new gravity mains are shown on Figure 6-2 and summarized in Table 6-6 by development timeframe.

Table 6-6 Selma Required New Gravity Mains per Time Frame

Development Time Frame	Gravity Main, feet
Primary	53,640
Tier 1	4,890
Tier 2	35,320
Tier 3	114,720
Total	**208,570**

The new gravity mains include the following general locations within Selma:

- New gravity mains in Dinuba Ave to capture flows from north of Selma. These gravity mains have been designed and are required for Primary development flows.
- New gravity mains extending north from the proposed Dinuba gravity mains to convey flows from north of Selma to Dinuba Ave.
- New gravity mains immediately east of Selma to serve the Amberwood Development. These gravity mains have been designed and are required for Primary development flows.
- New gravity mains in Bethel Ave. from Parlier Ave. south to Saginaw Ave., with east/west tributary mains. These gravity mains are required for the Tier 1 development projected east of Selma out to Bethel Ave. Two new lift stations are required for this alignment as well.
- New gravity mains extending west from existing gravity mains in Nebraska Ave. tributary to the Sunset LS to serve Primary and Tier 2 development both north and south of Nebraska Ave.
- New gravity mains in Rose Ave., Floral Ave., and De Wolf Ave tributary to the Rose LS. These gravity mains will serve Primary, Tier 1, and Tier 2 development immediately to the west and northwest of Rose LS. A new lift station will be required in this gravity main alignment.
- New gravity mains in Temperance Ave., Nebraska Ave., De Wolf Ave., and Caruthers Ave. to serve Tier 2 and Tier 3 development at the western edge and southwestern edge of Selma's SOI. These gravity mains will require tributary mains throughout the alignment as well as a new lift station in Caruthers Ave.

Kingsburg

Some of the increased flows from new development are routed through existing infrastructure, leading to capacity deficiencies in the existing collection system. The existing gravity mains in Kingsburg with capacity deficiencies under future flows are shown on Figure 6-2 and summarized in Table 6-7 by development timeframe.

Table 6-7 Kingsburg Deficient Gravity Mains per Time Frame

Development Time Frame	Gravity Main, feet
Primary	-
Tier 1	7,620
Tier 2	-
Tier 3	3,930
Total	**11,550**

The existing gravity mains with hydraulic deficiencies under future flow conditions include the following:

- 10-inch and 12-inch gravity mains in 18th Ave from north of Solig St. to Stroud Ave. These gravity mains are deficient under Primary development conditions.
- 12-inch gravity mains from Skansen LS south to Stroud Ave. and west along Stroud Ave. to 18th St. These gravity mains are deficient under Primary development conditions.
- 24-inch gravity mains in Golden State Blvd are deficient under Tier 3 development conditions. These gravity mains are deficient because of flows from new development areas east of Bethel Ave.

Additionally, new gravity mains are required in Kingsburg to collect and convey wastewater flow from new developments. These new gravity mains are shown on Figure 6-2 and summarized in Table 6-8 by development timeframe.

Table 6-8 Kingsburg Required New Gravity Mains per Time Frame

Development Time Frame	Gravity Main, feet
Primary	15,350
Tier 1	7,220
Tier 2	-
Tier 3	6,610
Total	**29,180**

The new gravity mains include the following general locations within Kingsburg:

- New gravity mains in Mendocino Ave. (18th Ave.) from existing gravity main north to Caruthers Ave. for Primary development east and west of Mendocino Ave.
- New gravity mains in 22nd Ave. (extended) from existing gravity mains in Solig St. north to Caruthers Ave. for Primary development north of existing customers.
- New gravity mains extending west of 10th Ave. in Klepper St. (extended) for Primary and Tier 3 development north and south of Klepper St.
- New gravity mains in Bethel Ave. from Mountain View flowing to existing gravity mains in Golden State Blvd. (with tributary east/west gravity mains) to serve Tier 3 development east of Bethel Ave.
- New gravity mains in Bethel Ave. from Stroud Ave. south to Conejo Ave. to serve Tier 1 and Tier 3 development north of Conejo Ave. and east of Bethel Ave.
- New gravity mains in Clarkson Ave. and Bethel Ave. from Clarkson Ave. to Conejo Ave. to convey Primary and Tier 1 development at the southern edge of Kingsburg. This development includes new Tier 1 development in Tulare County south of Golden State Blvd. These gravity mains will require a new lift station and force main to accommodate the flat topography in the area.
- New gravity main tributary to the Tulare LS to convey flow from the Tier 1 development in Tulare County north of Golden State Blvd.

Fowler

Some of the increased flows from new development in Fowler are routed through existing infrastructure, leading to capacity deficiencies in the existing collection system. The existing gravity mains in Fowler with capacity deficiencies under future flows are shown on Figure 6-2 and summarized in Table 6-9 by development timeframe.

Table 6-9 Fowler Deficient Gravity Mains per Time Frame

Development Time Frame	Gravity Main, feet
Primary	26,190
Tier 1	-
Tier 2	3,850
Tier 3	110
Total	**30,150**

The existing gravity mains with hydraulic deficiencies under future flow conditions include the following:

- 12-inch and 18-inch gravity mains in Golden State Blvd. between Jefferson LS and Merced LS. These gravity mains are deficient under Primary development conditions as they convey flow from development along both sides of Golden State Blvd.
- 12-inch gravity mains in Adams Ave downstream of new gravity mains in Fowler Ave. en route to Golden State Blvd. These gravity mains are deficient under Primary development conditions.
- 10-inch and 15-inch gravity mains in 7th St., Peach St., 5th St., and Summer Ave. downstream of new gravity mains in Summer Ave. These gravity mains are deficient under Primary development conditions for developments east of Christopher Ct.
- 12-inch gravity mains in South Ave. directly upstream of the South LS are deficient under Primary development conditions. These gravity mains will receive flow from new gravity mains extending west along South Ave. to accommodate new development to the west to Kenneth Ave.
- 12-inch gravity mains in Temperance Ave. and Adams Ave. directly tributary to the Adams LS are deficient under Primary development conditions. These gravity mains will receive flow new gravity mains extending to the north and east.

Additionally, new gravity mains are required in Fowler to collect and convey wastewater flow from new developments. These new gravity mains are shown on Figure 6-2 and summarized in Table 6-10 by development timeframe.

Table 6-10 Fowler Required New Gravity Mains per Time Frame

Development Time Frame	Gravity Main, feet
Primary	41,680
Tier 1	17,270
Tier 2	9,430
Tier 3	4,570
Total	**72,950**

The new gravity mains include the following general locations within Fowler:

- New gravity mains in Golden State Blvd. upstream of Jefferson LS to American Ave. These gravity mains will serve Primary development alongside Golden State Blvd up to American Ave.
- New gravity mains in Clovis Ave. from Golden State Blvd. north to Jefferson Ave to serve Primary development.
- New gravity mains in Clovis Ave. from Clayton Ave. south to South Ave. and then

east along South Ave. towards the South LS. These gravity mains will serve Primary and Tier 1 development west of Fowler to Kenneth Ave and Minnewawa Ave.

- New gravity mains in Parlier Ave., and Fowler Ave., tributary to the South Lift Station. These gravity mains, which will also require a lift station, will serve Primary development south of Fowler to Parlier Ave.
- New gravity mains in Temperance Ave. south of Adams Ave. to Golden State Blvd. to serve Primary development along Temperance Ave.
- New gravity mains in Fowler Ave., Armstrong Ave., and Temperance Ave. north of Adams Ave. and Clayton Ave. to serve Primary and Tier 2 development north Fowler to Lincoln Ave.

District

The District is responsible for the larger diameter gravity mains that convey flow from multiple cities to the WWTP. No new District gravity mains are required for future development. However, extensive portions of the District gravity mains are hydraulically deficient with future flows added. These gravity mains can be seen on Figure 6-2 and are summarized in Table 6-11 by development timeframe.

Table 6-11 District Deficient Gravity Mains per Time Frame

Development Time Frame	Gravity Main, feet
Primary	-
Tier 1	-
Tier 2	18,850
Tier 3	35,730
Total	**54,580**

6.2.4 Future Lift Station Hydraulic Evaluation

The hydraulic modeling evaluation indicates that there are several existing lift stations that lack firm capacity under future flow conditions. Firm capacity and design flow capacity requirements by development timeframe are provided in Table 6-12 for the collection system's existing lift stations.

Table 6-12: Existing Lift Station Capacity Requirements with Future Development

Name	Owned by	Firm Capacity, gpm	Primary Design Flow, gpm	Tier 1 Design Flow, gpm	Tier 2 Design Flow, gpm	Tier 3 Design Flow, gpm
Merced	District	750	3,000	3,200	4,000	4,400
Manning	District	750	6,100	8,300	9,000	9,900
North	District	1,900	8,472	9,618	10,014	12,215
18th Ave	District	2,326	1,520	1,870	1,870	2,490
10th St	Fowler	316	200	200	200	200
Peach	Fowler	800	810	810	810	810
Gleason	Fowler	224	60	60	60	60
South Ave	Fowler	417	1,440	1,910	1,940	1,950
Jefferson	Fowler	120	420	450	450	450
Adams	Fowler	478	480	760	2,500	2,500
Randy	Fowler	250	90	90	90	90
Mehlert	Kingsburg	230	40	80	80	80
Kern	Kingsburg	787	30	30	30	30
Skansen	Kingsburg	500	190	200	200	300
Tulare	Kingsburg	250	10	200	200	210
Rose	Selma	865	450	520	1,020	1,920
Goldridge	Selma	100	30	30	30	30
North Hill	Selma	352	10	10	10	10
Dockery	Selma	865	280	280	280	280
Sunset	Selma	669	590	1,150	1,150	1,150
Barbara	Selma	170	12	12	12	12
Valley View	Selma	1,100	400	410	520	520
Maple & McCall	Selma	550	170	170	170	170
Clarkson & McCall	Selma	1,500	1,500	1,950	5,400	10,080

Note: Pump Station capacity results related in terms of ESFRs available can be found in Appendix E.

Additionally, nine new lift stations are required to serve future timeline development because minimum slope and minimum cover criteria do not allow service entirely by gravity mains. These proposed future lift stations can be seen in Table 6-13.

Table 6-13 Proposed Future Lift Stations Required to Convey Design Flows Under Future Conditions

Proposed Future Lift Station	Location	Proposed Firm Capacity, gpm	Primary Design Flow, gpm	Tier 1 Design Flow, gpm	Tier 2 Design Flow, gpm	Tier 3 Design Flow, gpm
Southwestern Fowler	Fowler	675	263	656	654	656
Southern Fowler	Fowler	650	636	625	631	643
Southeastern Fowler	Fowler	575	558	558	558	558
Western Selma	Selma	925	-	-	418	922
Selma - Nebraska	Selma	775	263	573	777	777
Southwestern Selma	Selma	4,600	-	-	768	4,590
Northeastern Selma	Selma	1,825	-	-	-	1,826
Southeastern Selma	Selma	3,250	-	-	-	3,235
Southwestern Kingsburg	Kingsburg	300	223	276	276	277

Note: Pump Station capacity results related in terms of ESFRs available can be found in Appendix E.

6.2.5 Future Force Main Hydraulic Evaluation

Force main velocities under future design flow conditions are shown in Table 6-14. As can be seen, several force mains, notably the Merced, North Ave, South Ave, Adams, Sunset, and Clarkson & McCall, are deficient under future flow conditions

Table 6-14: Force Main Capacity Under Future Flow Conditions

Name	Owned by	Force Main Diameter, in	Primary Design Flow Velocity, fps	Tier 1 Design Flow Velocity, fps	Tier 2 Design Flow Velocity, fps	Tier 3 Design Flow Velocity, fps
Merced	District	8	13.21	33.70	44.11	61.73
Manning	District	30	1.56	4.04	4.63	5.29
North	District	10	30.48	50.17	56.17	65.00
18th Ave	District	14	2.71	3.17	3.90	3.90
10th St	Fowler	8	1.21	1.28	1.28	1.28
Peach	Fowler	6	8.96	8.06	7.26	7.26
Gleason	Fowler	4	1.53	1.53	1.53	1.53
South Ave	Fowler	8	0.96	9.19	12.19	12.38
Jefferson	Fowler	6	0.45	4.77	5.11	5.11
Adams	Fowler	6	3.74	5.45	8.62	28.37
Randy	Fowler	6	0.34	1.02	1.02	1.02
Mehlert	Kingsburg	4	1.02	1.02	2.04	2.04
Kern	Kingsburg	4	0.51	0.77	0.77	0.77
Skansen	Kingsburg	6	0.91	2.16	2.27	2.27
Tulare	Kingsburg	4	1.79	0.26	5.11	5.11
Rose	Selma	12	0.48	1.28	1.48	2.89
Goldridge	Selma	6	0.34	0.34	0.34	0.34
North Hill	Selma	6	0.11	0.11	0.11	0.11
Dockery	Selma	8	1.79	1.79	3.89	4.15
Sunset	Selma	6	4.65	6.70	11.01	13.05
Barbara	Selma	4	0.31	0.31	0.31	0.31
Valley View	Selma	8	0.96	2.55	2.62	3.32
Maple & McCall	Selma	6	1.70	1.93	1.82	1.93
Clarkson & McCall	Selma	12	3.12	4.26	5.53	15.32

Chapter 7 Rehab/Replacement Plan

This chapter details the rehabilitation and repair plan development for the District's collection system. It covers the analysis of inspection and field data to address defects in gravity mains and lift stations. This chapter also outlines funding recommendations for future investigations, with the goal of creating a comprehensive strategy within the existing asset management framework.

IN THIS SECTION

As described in Chapter 6, the District's collection system has been evaluated to determine the capacity required to collect and convey existing and projected future flows. In addition to having sufficient capacity, collection system infrastructure must be in sufficient condition to perform these activities. The following sections describe the results of the condition assessment that was performed on the collection system infrastructure, as well as provide a plan for ongoing and proactive condition management.

7.1 Gravity Main Assessment

The 2016 MP Update performed a comprehensive risk assessment of the gravity mains in the collection system, and recommended a systematic gravity main inspection program based upon these priorities. As identified in the program, the District regularly performs Closed Circuit Television (CCTV) inspection of the gravity mains within the collection system. The results of these inspections are used to inform rehabilitation and replacement priorities and to program further inspections.

7.1.1 Recent Gravity Sewer Inspections

The District inspected 95 gravity sewers in May-June of 2021 distributed amongst the member cities for a total inspection distance of over 33,000 feet. Total lengths inspected per gravity main diameter can be seen below in Table 7-1. Of the 95 inspected gravity sewers, 19 segments (20%), contained structural defects with associated NASSCO scores of 4 or 5.

Table 7-1 Gravity Sewers Inspected by Diameter

Pipe Diameter (in)	Length Inspected (ft)
6	13,153
8	2,065
10	2,974
12	6,149
15	3,528
18	292
21	3,279
24	1,807
TOTAL	33,248

Multiple structural defects with an assigned NASSCO score of a 4 or 5 were observed within the nineteen (19) segments; a full breakdown of the observed defects can be seen in Table 7-2.

Table 7-2 Summary of Structural Defects Observed in Segments with Scores of 4 or 5

Defect Code	Quantity	Defect Code	Quantity
Broken	25	Hole Void Visible	6
Broken Soil Visible	2	Water Level Sag	119
Broken Void Visible	1	Patch Defective	2
Fracture Hinge - 3	1	Aggregate Projecting	12
Fracture Multiple	109	Tap Break-in Intruding	13
Hole	5		

7.1.2 Gravity Main Rehabilitation and Repair Recommendations

Specific rehabilitation and repair recommendations for the 19 gravity sewer segments that contained structural defects scored as a 4 or 5 are provided in Table 7-3. The closed-circuit television recordings were not provided as part of this assessment, so scoring was based solely on the defect code and not the full defect severity. Due to the nature of miscellaneous water level sags (MWLS) within a gravity sewer system, any MWLS with a water level greater than 30% of the piping diameter would be recommended for replacement. For this assessment the water level at each observed MWLS was not provided, so a score indicating water level greater than 30% was assigned.

A prioritized inspection plan for regular gravity main inspection, rehabilitation, and repair is provided at the end of this chapter.

Table 7-3 Structural Defects Observed in Segments with Scores of 4 or 5

Location	Sewer Structure 1 (Upstream)	Sewer Structure 2 (Downstream)	Diameter of Pipe (in)	Length in Feet (ft)	Recommendation	MWLS Observed	Current Maintenance Interval	Timeframe
Selma	2NH0-0100	2NO0-0800	6	473	Replacement	Yes	Monthly	0-2 Years
Kingsburg	7EDK-0102_Reverse	7EDK-0101_Reverse	6	677	Replacement	Yes	N/A	0-2 Years
Selma	2NJA-0100	2NJ0-0100	6	631	Replacement	Yes	Quarterly	0-2 Years
Selma	2NO0-0600	2NO0-0500	15	316	Replacement	Yes	N/A	0-2 Years
Selma	2NO0-1500	2NO0-1400	12	154	Replacement	Yes	N/A	0-2 Years
Kingsburg	7FA0-0300	7FA0-0200	10	940	Replacement	Yes	Quarterly	0-2 Years
Kingsburg	7EBC-0301	7EBC-0300	6	480	Replacement	Yes	Monthly	0-2 Years
Selma	2VIA-0100	2VI0-0100	6	611	Replacement	Yes	Yearly	0-2 Years
Kingsburg	7EB0-0500	7EB0-0400	12	283	Structural Repair	No	Yearly	2-5 Years
Selma	2VI0-0201	2VI0-0200	6	305	Replacement	Yes	N/A	0-2 Years
Selma	2NO0-1300	2NO0-1200	12	335	Replacement	Yes	N/A	0-2 Years
Fowler	3CB0-0100	3CO0-0200	10	468	Replacement	Yes	N/A	0-2 Years
Selma	2NO0-0500	2NO0-0300	15	258	Replacement	Yes	Bi-monthly	0-2 Years
Selma	2NO0-1100	2NO0-0900	12	165	Replacement	Yes	N/A	0-2 Years
Kingsburg	7EG0-0150	7EG0-0100	12	198	Replacement	Yes	N/A	0-2 Years

7.2 Lift Station Assessment

The primary objective of the lift station assessment is to assess the condition and provide recommendations for the lift stations based upon physical condition. Nine lift stations were assessed in the field by Black & Veatch in September 2023. The locations as well as a summary of the 9 lift stations assessed are shown in Figure 7-1 and Table 7-4 below. The results of these field assessments are used as a basis for prioritizing the 22 lift stations.

Figure 7-1 Selma-Kingsburg-Fowler County Sanitation District Lift Stations Assessed

Table 7-4 Lift Station Summary

Lift Station	Location	Wet Well Volume, gal	# of Pumps	Firm Pumping Capacity, gpm	Discharge Pipe Diameter
Merced Street	Fowler	7,883	2	750	6”
Manning	Fowler	10,296	2	750	8”
Rose Street	Selma	8,105	2	865	6”
Dockery	Selma	4,227	2	865	6”
Sunset	Selma	4,864	2	669	6”
Kern	Kingsburg	4,234	2	878	4”
North 10th Street	Fowler	1,692	2	316	4”
Peach Street	Fowler	3,807	2	800	6”
South Avenue	Fowler	6,909	2	417	8”

Using District-provided data, Black & Veatch created an asset inventory which identified the structural/architectural, electrical and power, mechanical, instrumentation and control (I&C), and site / civil assets to be assessed. Prior to a field assessment, Black & Veatch populated and analyzed the asset inventory and other District-provided data to understand asset background. Along with the District’s input, Black & Veatch developed a condition scoring approach to use during the field assessment of the assets, applying defendable scores through a consistent process.

Inspection field work was conducted by Black & Veatch condition assessment professionals on September 11, 2023. Field data was collected using ESRI® Survey123, a custom cloud-based electronic field form. Each asset was scored using a 1 to 5 scale based on its visual, physical condition. Additionally, the field team assessed the performance condition of each asset by interviewing District staff with the historical Operation & Maintenance (O&M) knowledge during the site visit regarding asset reliability and operability. Following field work, Black & Veatch subject matter experts correlated desktop and field data to assign final physical and performance condition scores for each asset.

This condition assessment report is the culmination of the condition assessment and provides an analysis of the background data provided by the District, key findings of the field assessment, and high-level recommendations based on data interpretation.

7.2.1 Condition Assessment Approach

This section discusses the approach used to review the background data, create the electronic field forms, and complete the condition scoring of the lift station assets.

Record Review

The District provided facility background data for Black & Veatch to review and analyze prior to a field assessment. The record review included analyzing available background data from the 2016 Collection System Master Plan and the Capital Improvement Program (CIP) Report. Table 7-5 highlights data provided for each specific lift station assessed in the field. Following receipt of the background data, the data was reviewed and compiled for analysis. Completing a thorough background data review aided the condition assessment by evaluating the feasibility of determining a baseline condition and verifying condition scores assigned during the field assessment.

Table 7-5 District Provided Background Data

Lift Station	Data Provided
Merced Street	○ Installation year ○ Maintenance issues ○ Lift station capacity deficiencies ○ Replacement and refurbishment plans
Manning	○ Installation year ○ Maintenance issues ○ Lift station capacity deficiencies ○ Replacement and refurbishment plans
Rose Street	○ Full replacement year ○ Maintenance issues
Dockery	○ Installation year ○ Maintenance issues ○ Replacement and refurbishment plans
Sunset	○ Installation/rehabilitation year ○ Maintenance issues ○ Lift station risk assessment results
Kern	○ Installation/rehabilitation year

Table 7-5 District Provided Background Data

Lift Station	Data Provided
North 10th Street	o Installation/rehabilitation year
Peach Street	o Installation year o Maintenance issues
South Avenue	o Installation year

Field Assessment

The Survey123 application was used to collect conditions on individual assets, including:

- General asset information (component, asset class, description, location)
- Visual condition observations
- Photographs
- Performance notes provided by District subject matter expert interviews

Condition Scoring

Black & Veatch developed a condition score of 1 to 5 based on the observed condition, summarized in Table 7-6. The matrix incorporates asset disciplines (structural / architectural, mechanical, electrical and power, I&C, site / civil), condition categories (physical, performance) and provides additional details to aid in scoring asset condition. The complete condition score matrix is presented in Appendix D.

The likelihood of failure (LOF) score was assigned based on the maximum condition score (physical, performance) for each asset to ensure LOF scores reflect the worst-case condition. Using the maximum condition score decouples the two scores to prevent underperforming or physically failed assets from being overlooked.

Table 7-6 Inspection Matrix

Observed Condition Score	Description	Useful Life Consumed	Level of Maintenance Currently Required	Improvements Implementation Timeframe
1	Like New Condition	< 5%	Normal Preventative / Predictive Maintenance	20-30 years
2	Minor Defects Only (some wear)	5% - 20%	Normal Preventative / Predictive Maintenance / Minor Corrective Maintenance	15-20 years
3	Moderate Deterioration	21% - 50%	Normal Preventative / Predictive Maintenance / Major Corrective Maintenance	10-15 years
4	Significant Deterioration	50% - 75%	Rehabilitate, if Possible	5-10 years
5	Virtually Unserviceable/Failure Concern	> 75%	Consider Replacement	0-2 Years

The condition scoring matrix was referenced assign condition scores for the field assessment presented in Section 7.2.3.

7.2.2 Record Review Results

This section discusses the record review performed prior to the field assessment. The results include lift station descriptions and project request summaries for the 9 lift stations assessed in the field. This information provides insight on future modifications and cost projections.

The **Merced Street Lift Station**, installed in 1991, is located in Fowler, California and owned by the District. The station is located in the median of a busy street near businesses and a railroad. The station has two pumps to convey wastewater, with a firm capacity of 750 gallons per minute (gpm) and pump capacity deficiency of 450 gpm. Previously identified maintenance issues include pump wear due to sand and the need for electrical upgrades. A request was submitted to replace the electrical panel with a similar panel and in 2023 District performed a repair & rehabilitation project of the lift station including, a new transformer, control panel, and lighting power panel. Part of a District wide SCADA project, the PLC components and SCADA tower were upgraded in 2006. The asset inventory for the Merced Street Lift Station is presented in 7.3.

The **Manning Lift Station**, installed in 1971 and refurbished in 1989, is located in Fowler, California and owned by the District. The station is located near a busy street and warehouses. The station has two pumps to convey wastewater, with a firm capacity of 750 gpm and a pump capacity deficiency of 1,460 gpm. Previously identified maintenance issues include pump wear due to sand and corrosion issues on the discharge force main. A request was submitted to replace many assets including guides, discharge piping, and wet well liners. Part of a District wide SCADA project, the PLC components and SCADA tower were upgraded in 2006. The asset inventory for the Manning Lift Station is presented in 7.3.

The **Rose Street Lift Station**, fully replaced in 1994, is located in Selma, California and owned by the City of Selma. The station is located in a residential neighborhood. Previously identified maintenance issues include corrosion at the discharge elbow and t-lock liner issues at the wet well. Part of a District wide SCADA project, the PLC components and SCADA tower were upgraded in 2006. The asset inventory for the Rose Street Lift Station is presented in 7.3.

The **Dockery Lift Station**, installed in 1965 and rehabilitated in 2003, is located in Selma, California and owned by the City of Selma. The station is located near a residential neighborhood and farmland. Previously identified maintenance issues include grease buildup in the wet well. A request was submitted to refurbish the wet well and replace the pumps, SCADA, MCC, pump discharge piping, and valving. This project is estimated to cost $500,000 and take place in 2029-2030. The asset inventory for the Dockery Lift Station is presented in 7.3.

The **Sunset Lift Station**, installed in 1991 and rehabilitated in 2011, is located Selma, California and owned by the City of Selma. The station is located near a residential area and undeveloped land. New motor control center (MCC) panel and pumps were installed in 2012. The wet well and pump discharge vault are in the street. Minor maintenance issues were previously identified. The asset inventory for the Sunset Lift Station is presented in 7.3.

The **Kern Lift Station**, installed in 1980 and rehabilitated in 2011, is located in Kingsburg, California and owned by the City of Kingsburg. The station is located in a residential neighborhood. The asset inventory for the Kern Lift Station is presented in 7.3.

The **North 10th Street Lift Station**, installed in 1965 and rehabilitated in 2011, is located in Fowler, California and owned by the City of Fowler. The station is located near houses and undeveloped land. The asset inventory for the North 10th Street Lift Station is presented in 7.3.

The **Peach Street Lift Station**, installed in 1961 and rehabilitated in 2003, is located in Fowler, California and owned by the City of Fowler. The station is located near a warehouse and undeveloped land. Previously identified maintenance issues include a recurring cockroach and rat issue. The asset inventory for the Peach Street Lift Station is presented in 7.3.

The **South Avenue Lift Station**, installed in 1991 and rehabilitated in 2005, is located in Fowler, California and owned by the City of Fowler. The station is located near a residential area and farmland. The asset inventory for the South Avenue Lift Station is presented in 7.3.

7.2.3 Field Assessment Results

The total number of assets for the 9 lift stations assessed in the field was 101. Figure presents a breakdown of the asset disciplines. A further breakdown of assets by discipline can be seen in Figure 7-3.

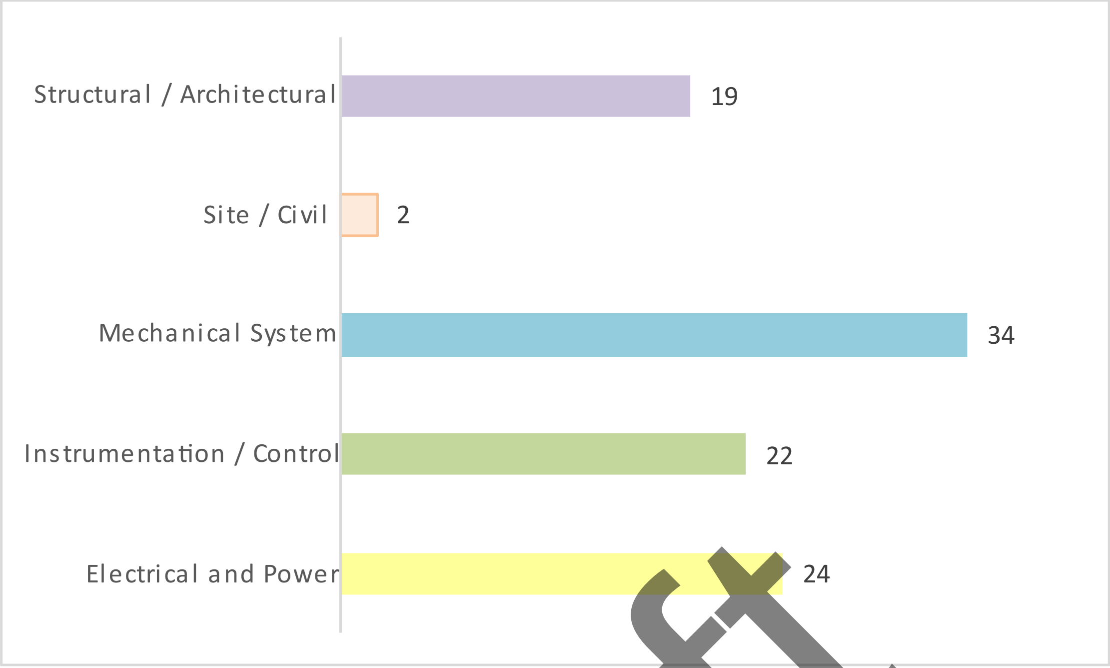


Figure 7-2 Number of Assessed Assets by Discipline

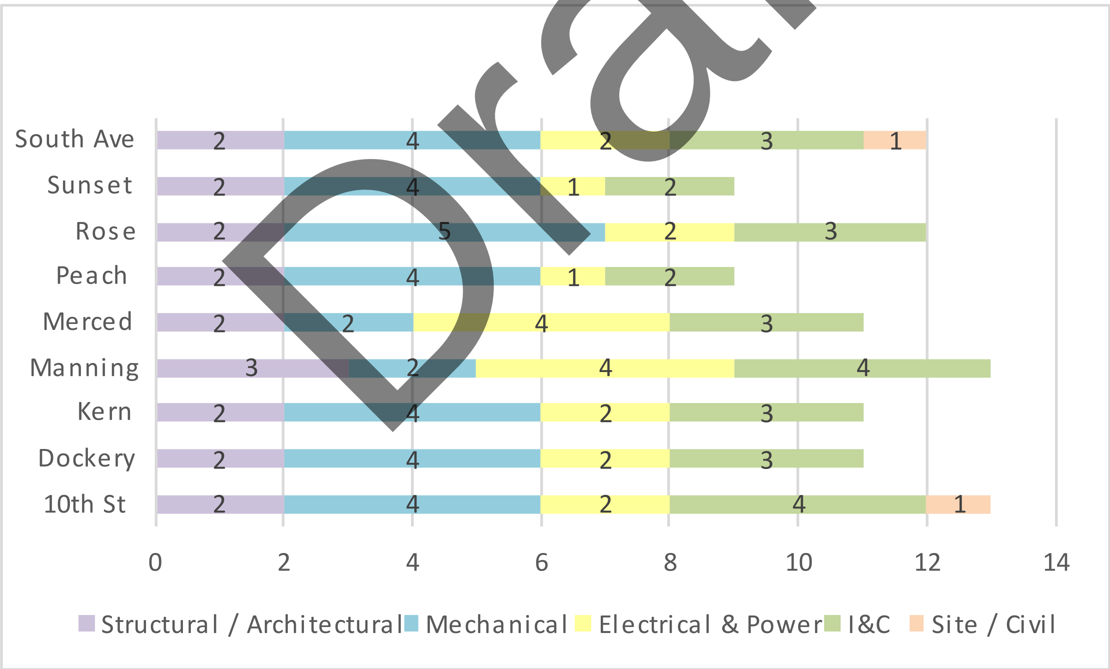


Figure 7-3 Number of Assessed Assets by Lift Station and Discipline

Table 7-7 Lift Station Assessment Scoring Summary

Lift Station	Average Physical Score	Average Performance Score
Merced Street	2.7	2.7
Manning	3.2	3.2
Rose Street	3.0	3.0
Dockery	2.6	2.6
Sunset	3.1	3.1
Kern	2.3	2.3
North 10th Street	2.8	2.9
Peach Street	3.7	3.7
South Avenue	3.1	3.1

On September 11, 2023, Black & Veatch visited the 9 lift stations and assessed the condition of each asset with support from District staff. At a facility level, 60 out of the 101 total assets (59%) were assigned a physical score 3, and 59 out of the of 101 total assets (58%) were assigned a performance score of 3.

Table 7-8 presents a statistical summary of the condition scores assigned for each asset discipline considering all 9 lift stations. Of the 101 total assets, the minimum condition score was 1.0, the average physical condition score was 2.9, and the average performance condition score was 2.9, and the maximum condition score was 4.0.

Table 7-8 Field Assessment Score Summary for All Lift Stations

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	19	34	20	26	2	101
Average Physical Score	3.0	3.1	2.8	2.8	1.5	2.9
Average Performance Score	3.0	3.1	2.8	2.8	1.5	2.9
Minimum LOF Score	1.0	1.0	1.0	1.0	1.0	1.0
Average LOF Score	3.0	3.1	2.8	2.8	1.5	2.9
Maximum LOF Score	4.0	4.0	4.0	4.0	2.0	4.0

The following subsections present a summary of the condition scores by each lift station.

Merced Street Lift Station Field Assessment

Table 7-9 presents the statistical summary of the condition scores assigned for each asset discipline at the Merced Street Lift Station. Of the 11 total assets, the minimum condition score was 1.0, the average physical condition score was 2.7 and the average performance condition score was 2.7, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 1.0, an average of 2.7, and a maximum of 4.0.

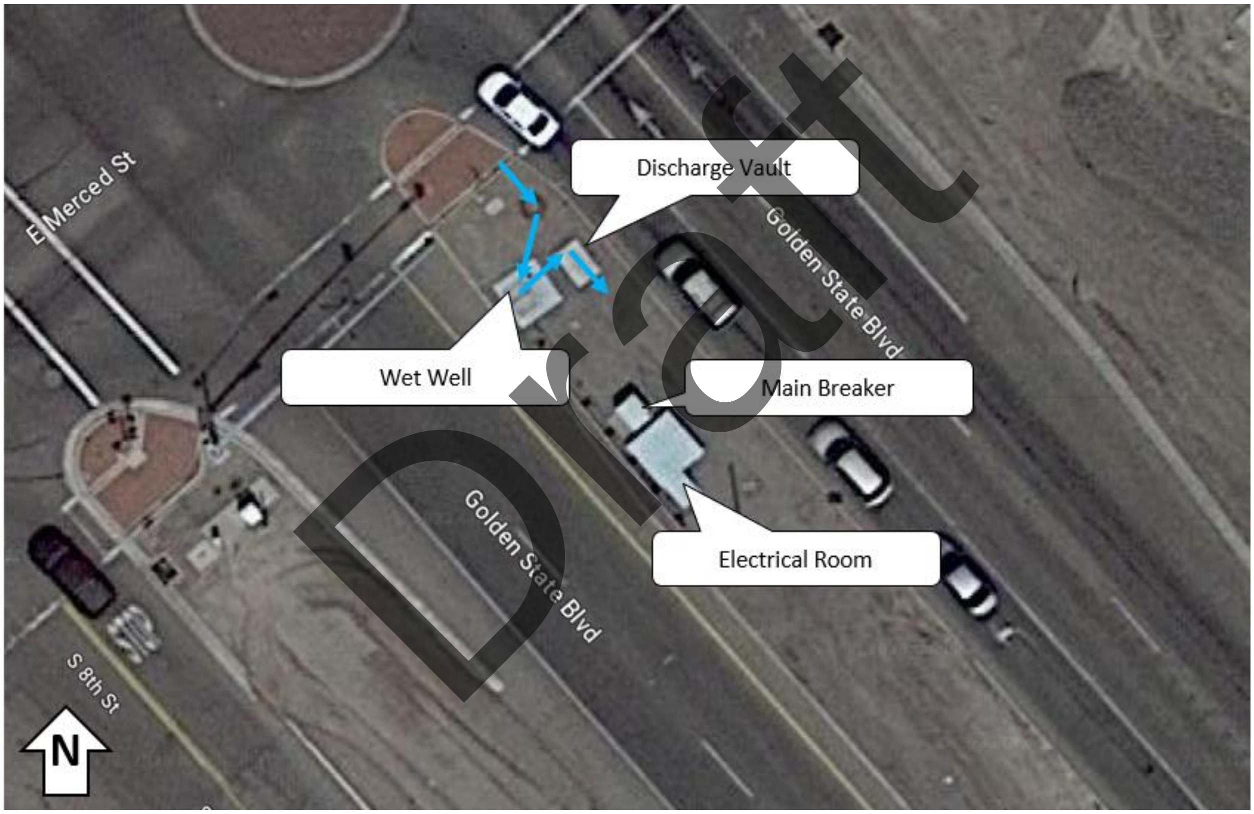


Figure 7-4 Aerial View of Merced Lift Stations

Table 7-9 Field Assessment Score Summary for Merced Street Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	2	4	3	N/A	11
Average Physical Score	2.5	3.0	2.5	3.0	N/A	2.7
Average Performance Score	2.5	3.0	2.5	3.0	N/A	2.7
Minimum LOF Score	2.0	2.0	1.0	3.0	N/A	1.0
Average LOF Score	2.5	3.0	2.5	3.0	N/A	2.7
Maximum LOF Score	3.0	4.0	3.0	3.0	N/A	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-1: Electrical & Power – Main Breaker not Upgraded in 2023

Photo 7-2 : Site / Civil – Wet well t-lock liner pulling away

Photo 7-3: Mechanical – Worn pump discharge piping

Photo 7-4: Structural / Architectural – Cracks on asphalt near pump discharge piping vault

Manning Lift Station Field Assessment

Table 7-10 presents the statistical summary of the condition scores assigned for each asset discipline at the Manning Lift Station. Of the 13 total assets, the minimum condition score was 3.0, the average physical condition score was 3.2 and the average performance condition score was 3.2, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 3.0, an average of 3.2, and a maximum of 4.0.

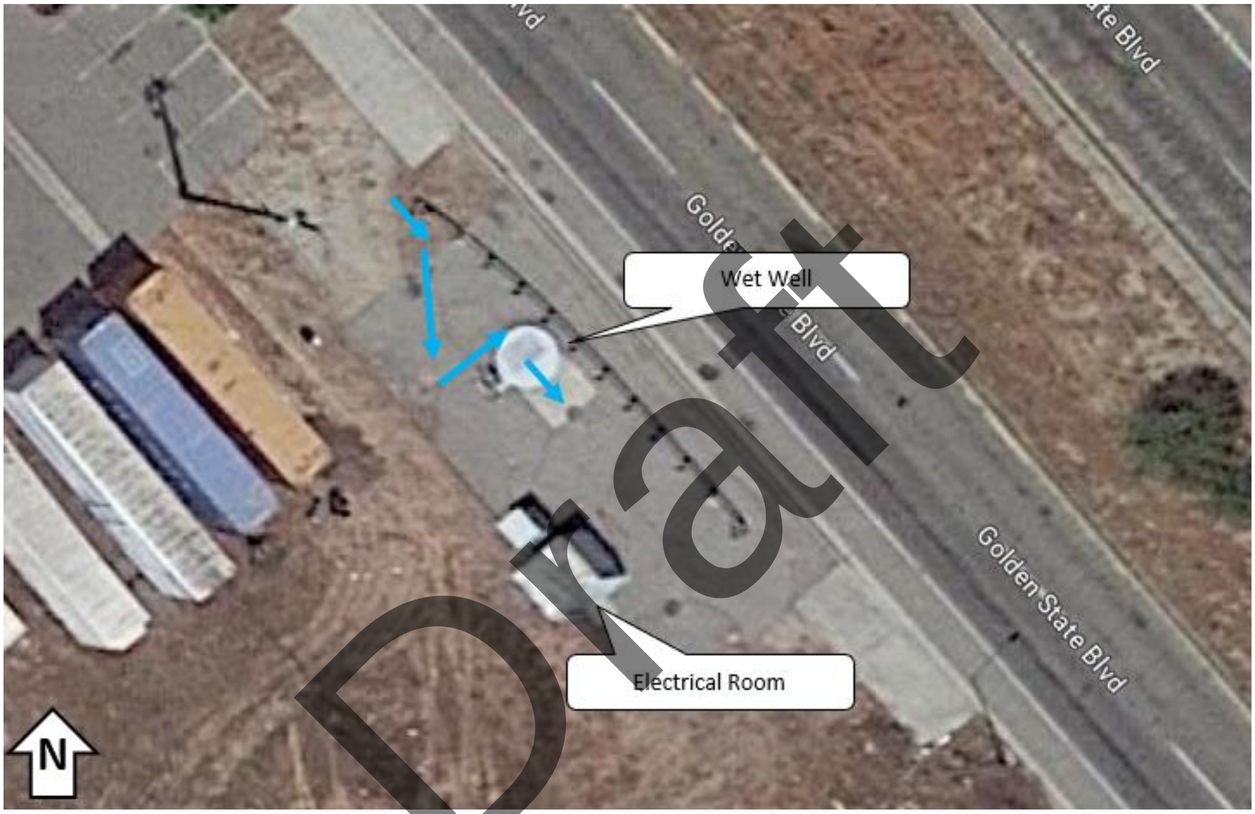


Figure 7-5 Aerial View of Manning Lift Stations

Table 7-10 Field Assessment Score Summary for Manning Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	3	2	4	4	N/A	13
Average Physical Score	3.0	3.5	3.0	3.3	N/A	3.2
Average Performance Score	3.0	3.5	3.0	3.3	N/A	3.2
Minimum LOF Score	3.0	3.0	3.0	3.0	N/A	3.0
Average LOF Score	3.0	3.5	3.0	3.3	N/A	3.2
Maximum LOF Score	3.0	4.0	3.0	4.0	N/A	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-5: Site / Civil – Cracks on concrete next to wet well cover

Photo 7-6: Structural / Architectural – Minor corrosion on guide rails

Photo 7-7: Site / Civil – Wet well t-lock liner pulling away

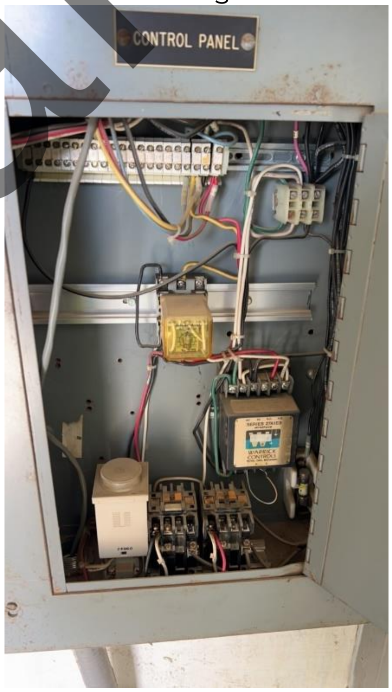


Photo 7-8: Electrical & Power – Replaced control panel in building

Rose Street Lift Station Field Assessment

Table 7-11 presents the statistical summary of the condition scores assigned for each asset discipline at the Rose Street Lift Station. Of the 12 total assets, the minimum condition score was 1.0, the average physical condition score was 3.0 and the average performance condition score was 3.0, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 1.0, an average of 3.0, and a maximum of 4.0.

Figure 7-6 Aerial View of Rose Lift Station

Table 7-11 Field Assessment Score Summary for Rose Street Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	5	2	3	N/A	12
Average Physical Score	3.0	3.0	3.0	3.0	N/A	3.0
Average Performance Score	3.0	3.0	3.0	3.0	N/A	3.0
Minimum LOF Score	3.0	1.0	3.0	3.0	N/A	1.0
Average LOF Score	3.0	3.0	3.0	3.0	N/A	3.0
Maximum LOF Score	3.0	4.0	3.0	3.0	N/A	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-9 Mechanical – Corrosion on Discharge Piping

Photo 7-10 Site / Civil – Minor cracks and spalling along top of wet well

Photo 7-11 Mechanical – Minor bubbling on wet well t-lock

Photo 7-12 Site / Civil – Minor cracks, voids, and spalling in pump discharge piping concrete vault

Dockery Lift Station Field Assessment

Table 7-12 presents the statistical summary of the condition scores assigned for each asset discipline at the Dockery Lift Station. Of the 11 total assets, the minimum condition score was 1.0, the average physical condition score was 2.6 and the average performance condition score was 2.6, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 1.0, an average of 2.6, and a maximum of 4.0.

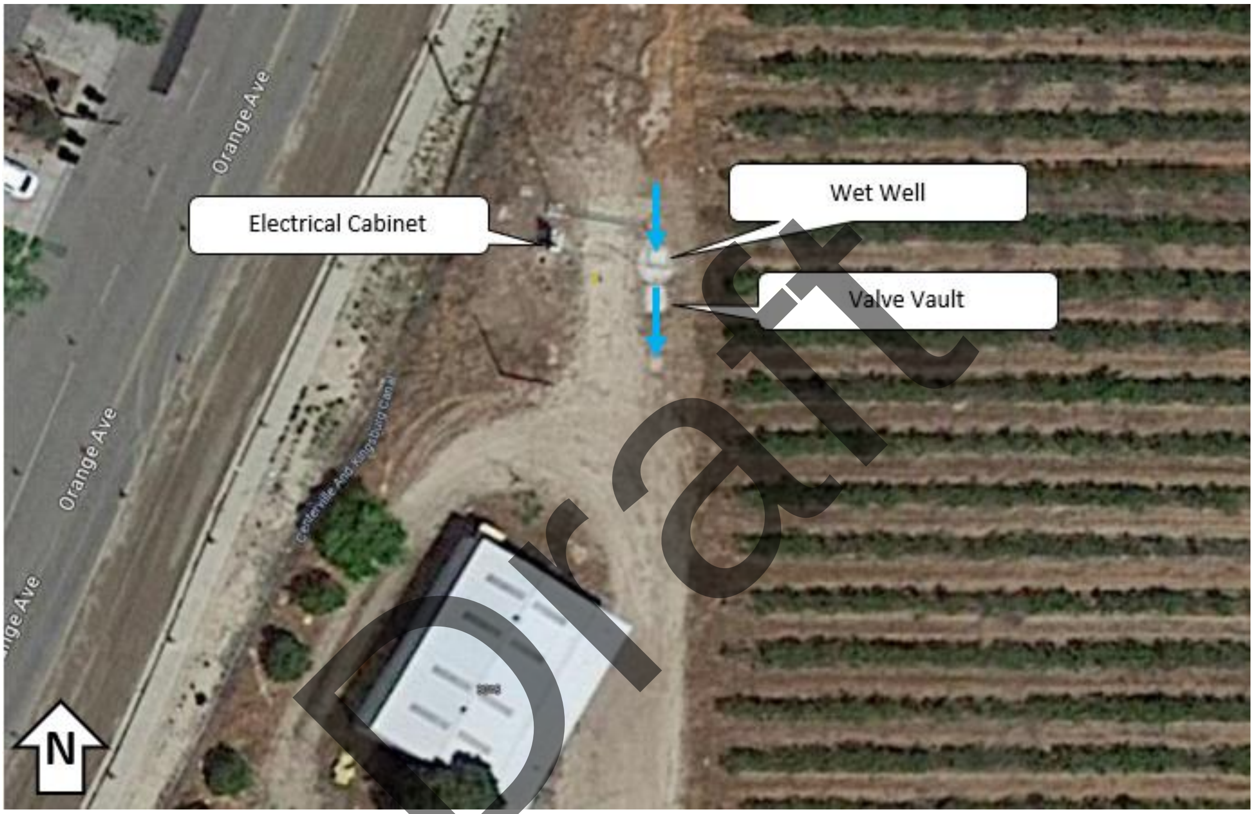


Figure 7-7 Aerial View of Dockery Lift Station

Table 7-12 Field Assessment Score Summary for Dockery Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	4	2	3	N/A	11
Average Physical Score	2.5	3.0	2.5	2.0	N/A	2.6
Average Performance Score	2.5	3.0	2.5	2.0	N/A	2.6
Minimum LOF Score	2.0	2.0	2.0	1.0	N/A	1.0
Average LOF Score	2.5	3.0	2.5	2.0	N/A	2.6
Maximum LOF Score	3.0	4.0	3.0	3.0	N/A	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-13 Site / Civil – Standing water in pump discharge piping vault

Photo 7-14 Electrical & Power – Broken hasp on power panel

Photo 7-15 Mechanical – Corrosion on pump discharge piping

Photo 7-16 Electrical & Power – Power panel installed last year

Sunset Lift Station Field Assessment

Table 7-13 presents a statistical summary of the condition scores assigned for each asset discipline at the Sunset Lift Station. Of the 9 total assets, the minimum condition score was 2.0, the average physical condition score was 3.0 and the average performance condition score was 3.0, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 2.0, an average of 3.1, and a maximum of 4.0.

Figure 7-8 Aerial View of Sunset Lift Station

Table 7-13 Field Assessment Score Summary for Sunset Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	4	1	2	N/A	9
Average Physical Score	3.5	3.3	3.0	2.5	N/A	3.1
Average Performance Score	3.5	3.3	3.0	2.5	N/A	3.1
Minimum LOF Score	3.0	3.0	3.0	2.0	N/A	2.0
Average LOF Score	3.5	3.3	3.0	2.5	N/A	3.1
Maximum LOF Score	4.0	4.0	3.0	3.0	N/A	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-17 Site / Civil – Handle missing on wet well cover

Photo 7-18 Site / Civil – Concrete cracks next to pump discharge piping vault, minor spalling, rusted lid bolts

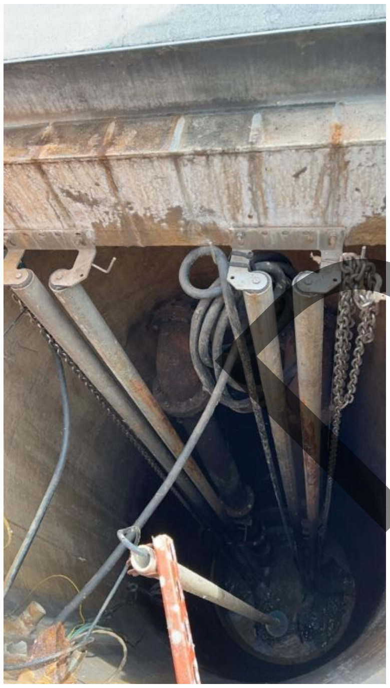


Photo 7-19 Structural / Architectural – Corrosion on guide rails

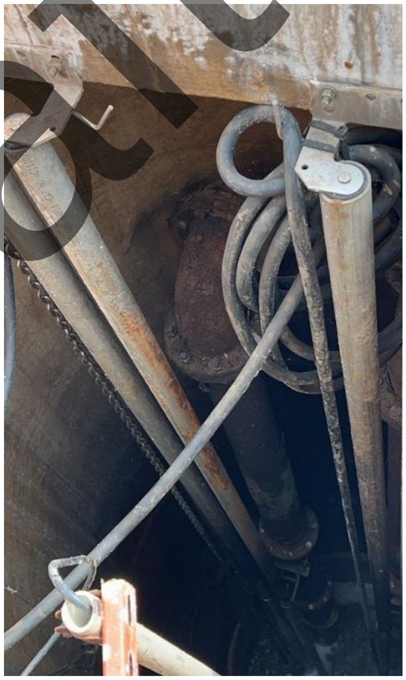


Photo 7-20 Mechanical – Worn pump discharge piping

Kern Lift Station Field Assessment

Table 7-14 presents the statistical summary of the condition scores assigned for each asset discipline at the Kern Lift Station. Of the 11 total assets, the minimum condition score was 2.0, the average physical condition score was 2.3 and the average performance condition score was 2.3, and the maximum condition score was 3.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 2.0, an average of 2.3, and a maximum of 3.0.

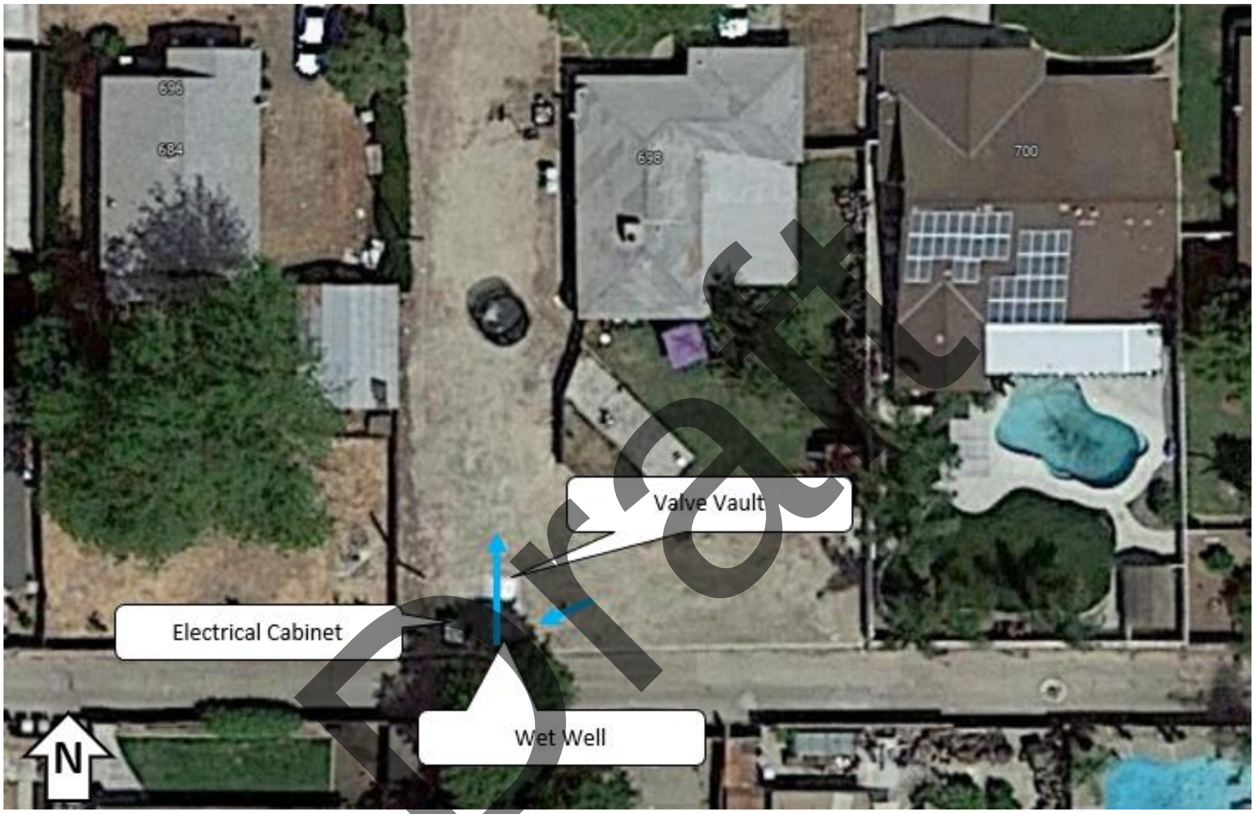


Figure 7-9 Aerial View of Kern Lift Station

Table 7-14 Field Assessment Score Summary for Kern Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	4	2	3	N/A	11
Average Physical Score	2.5	2.5	2.0	2.0	N/A	2.3
Average Performance Score	2.5	2.5	2.0	2.0	N/A	2.3
Minimum LOF Score	2.0	2.0	2.0	2.0	N/A	2.0
Average LOF Score	2.5	2.5	2.0	2.0	N/A	2.3
Maximum LOF Score	3.0	3.0	2.0	2.0	N/A	3.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-21 Electrical & Power – Control panel rehabilitated in 2012

Photo 7-22 Electrical & Power – PLC panel rehabilitated in 2012

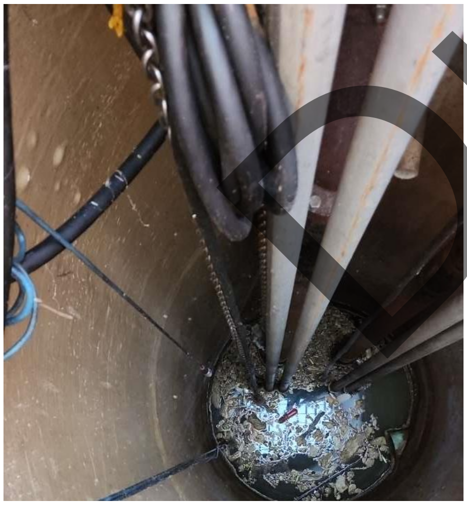


Photo 7-23 Structural / Architectural – Minor bubbling on wet well

Photo 7-24 Electrical – Ultrasonic level transducer

North 10th Street Lift Station Field

Table 7-15 presents the statistical summary of the condition scores assigned for each asset discipline at the North 10th Street Station. Of the 13 total assets, the minimum condition score was 1.0, the average physical condition score was 2.8 and the average performance condition score was 2.9, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 1.0, an average of 2.9, and a maximum of 4.0.

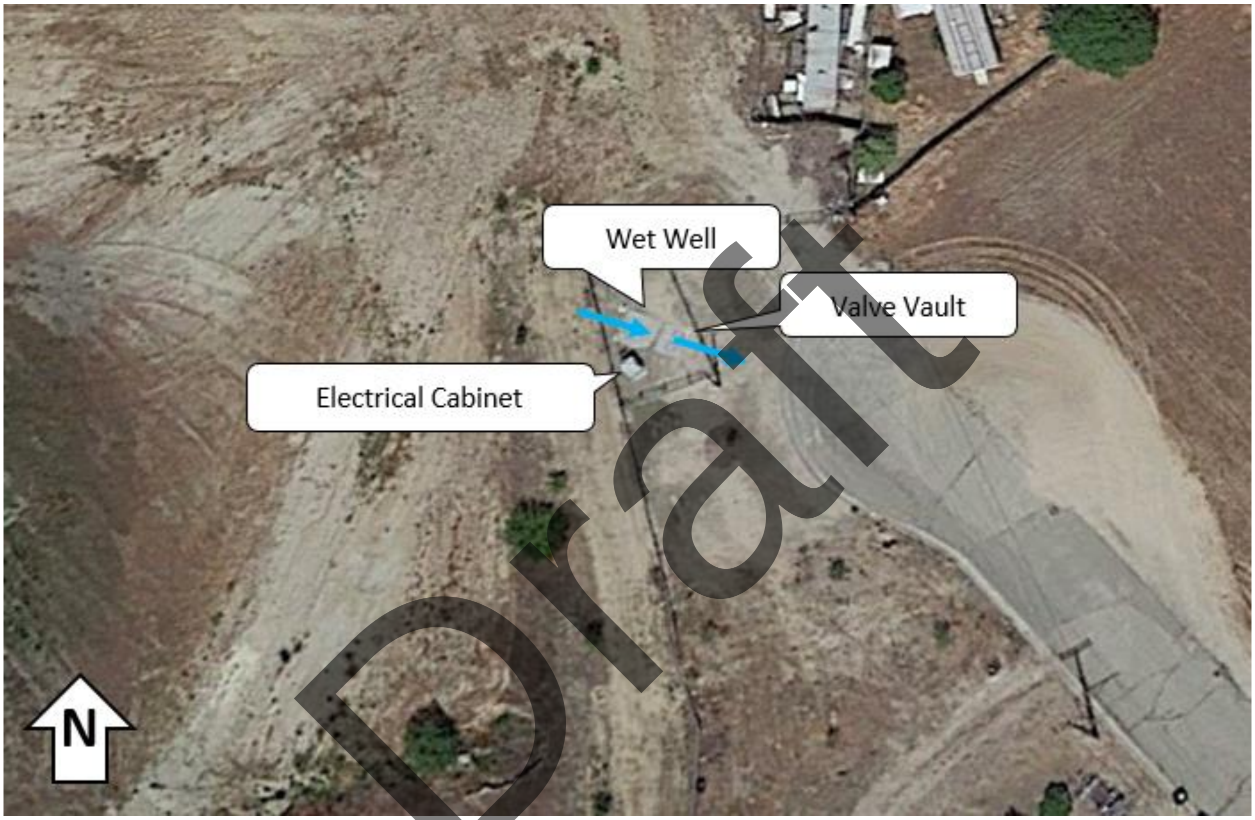


Figure 7-10 Aerial View of North 10th Street Lift Stations

Table 7-15 Field Assessment Score Summary for North 10th Street Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	4	2	4	1	13
Average Physical Score	2.5	3.3	3.0	3.0	1.0	2.8
Average Performance Score	2.5	3.3	3.3	3.0	1.0	2.9
Minimum LOF Score	1.0	3.0	3.0	3.0	1.0	1.0
Average LOF Score	2.5	3.3	3.3	3.0	1.0	2.9
Maximum LOF Score	4.0	4.0	4.0	3.0	1.0	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-25 Site / Civil – Chain link fence in good condition

Photo 7-26 Structural/Architectural – Wet well liner defects

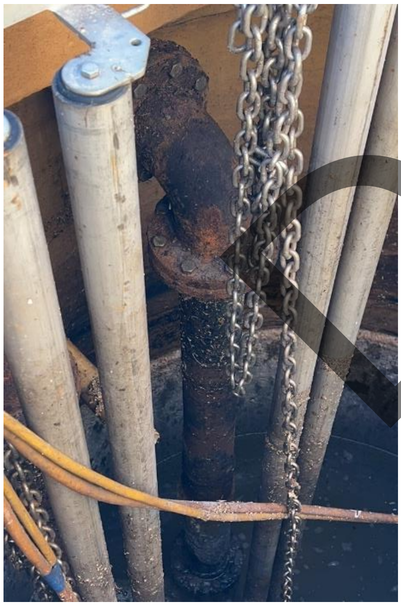


Photo 7-27 Mechanical – Corrosion on pump discharge piping

Photo 7-28 Electrical – Meter/Main Panel

Peach Street Lift Station Field Assessment

Table 7-16 presents the statistical summary of the condition scores assigned for each asset discipline at the Peach Street Lift Station. Of the 9 total assets, the minimum condition score was 2.0, the average physical condition score was 3.7 and the average performance condition score was 3.7, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 2.0, an average of 3.7, and a maximum of 4.0.

Figure 7-11 Aerial View of Peach Street Lift Station

Table 7-16 Field Assessment Score Summary for Peach Street Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	4	1	2	N/A	9
Average Physical Score	4.0	4.0	3.0	3.0	N/A	3.7
Average Performance Score	4.0	4.0	3.0	3.0	N/A	3.7
Minimum LOF Score	4.0	4.0	3.0	2.0	N/A	2.0
Average LOF Score	4.0	4.0	3.0	3.0	N/A	3.7
Maximum LOF Score	4.0	4.0	3.0	4.0	N/A	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-29 Mechanical – Check valve from original plant

Photo 7-30 Site / Civil – Wet well from original plant

Photo 7-31 Site / Civil – Pump discharge piping vault, planning on putting in new vault

Photo 7-32 Mechanical – Corrosion on guide rails

South Avenue Lift Station Field Assessment

Table 7-17 presents the statistical summary of the condition scores assigned for each asset discipline at the South Avenue Lift Station. Of the 12 total assets, the minimum condition score was 2.0, the average physical condition score was 3.1 and the average performance condition score was 3.1, and the maximum condition score was 4.0. The LOF score was assigned based on the maximum condition score for each asset, resulting in a minimum LOF score of 2.0, an average of 3.1, and a maximum of 4.0.

Figure 7-12 Aerial View of South Avenue Lift Station

Table 7-17 Field Assessment Score Summary for South Avenue Lift Station

Discipline	Structural / Architectural	Mechanical	Electrical & Power	I&C	Site / Civil	Overall
Asset Count	2	4	2	3	1	12
Average Physical Score	3.5	3.3	3.0	3.0	2.0	3.1
Average Performance Score	3.5	3.3	3.0	3.0	2.0	3.1
Minimum LOF Score	3.0	3.0	3.0	3.0	2.0	2.0
Average LOF Score	3.5	3.3	3.0	3.0	2.0	3.1
Maximum LOF Score	4.0	4.0	3.0	3.0	2.0	4.0

The following photographs provide a representation of the asset condition observed during the field assessment.

Photo 7-33 Electrical & Power – Meter/main section replaced in 2005

Photo 7-34 Site / Civil – Worn lid and safety cover for wet well

Photo 7-35 Mechanical – Corrosion on discharge piping

Photo 7-36 Site / Civil – Sand buildup in discharge piping vault

7.2.4 Results Discussion & Conclusions

Based on the desktop and field assessment, this section presents data interpretation and correlations along with conclusions.

Condition Score Distribution

The Assets appeared to be normally distributed with most of the condition scoring being a 3, as seen in Figure 7-13. A total of 5 assets had a condition score of 1 since they were installed within the last two years and/or showed minimal signs of wear. Of the 20 assets that had a condition score of 4, a total of 12 assets (60%) were categorized as mechanical, and a total of 7 assets (35%) were Pump Discharge Piping.

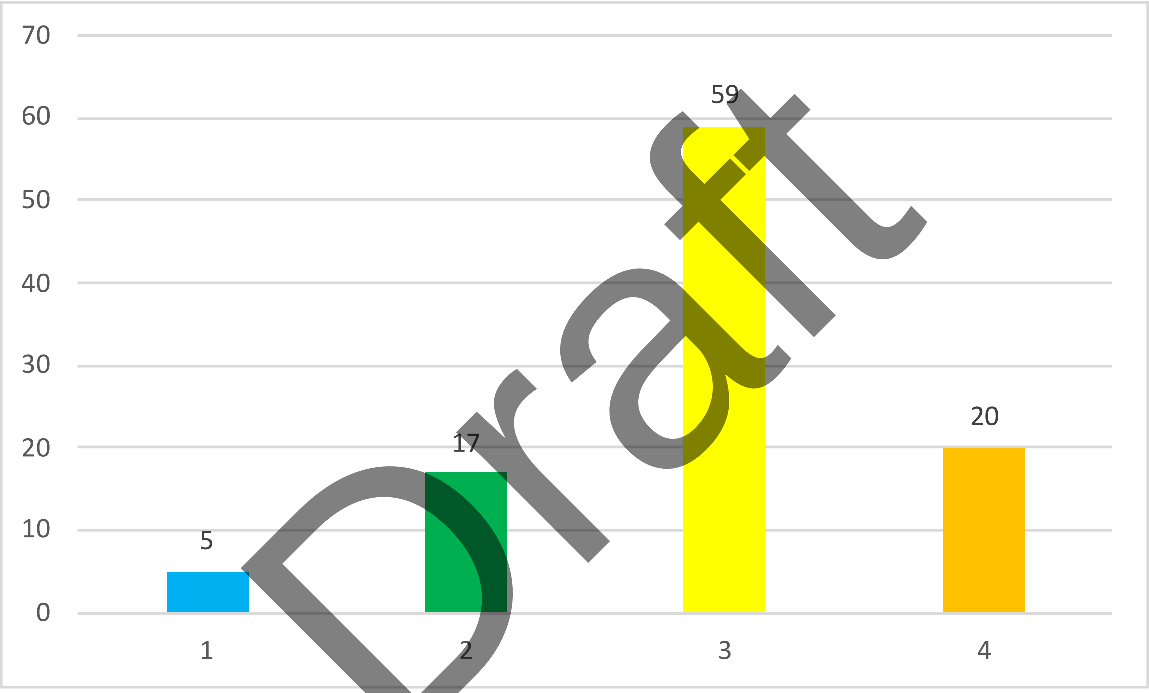


Figure 7-13 Number of Assets by Condition Score

1. The Electrical, instrumentation & control, civil, and structural disciplines appeared to have scores that were normally distributed as seen in Figure 7-14. This provides evidence that only the mechanical asset class is deteriorating at a rate more quickly than expected.

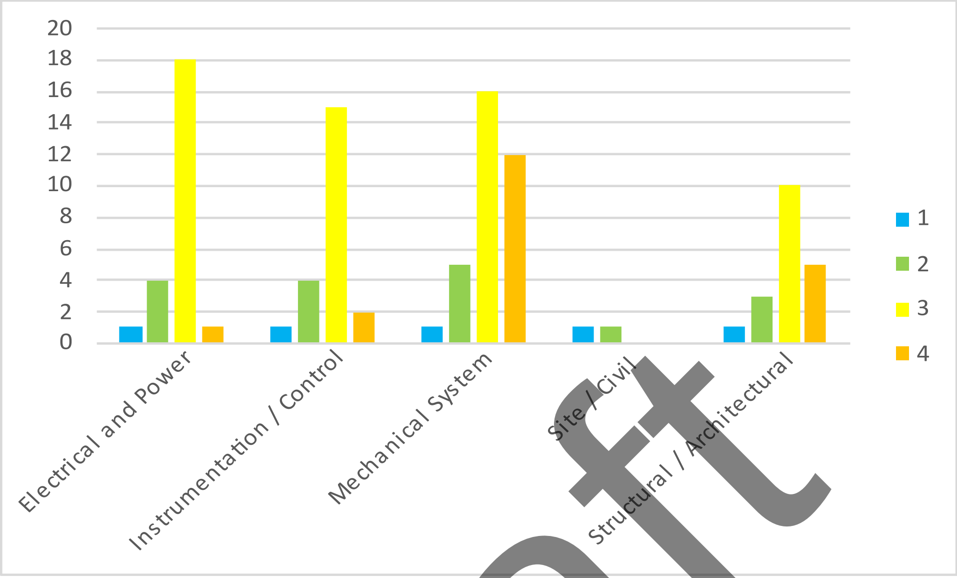


Figure 7-14 Number of Assets by Condition Score and Discipline

2. Condition scoring appeared to be uniformly distributed amongst the nine (9) stations, seen in Figure 7-15 below. As expected, the oldest lift station, Peach, had the highest quantity of assets scored a 4 (35%).

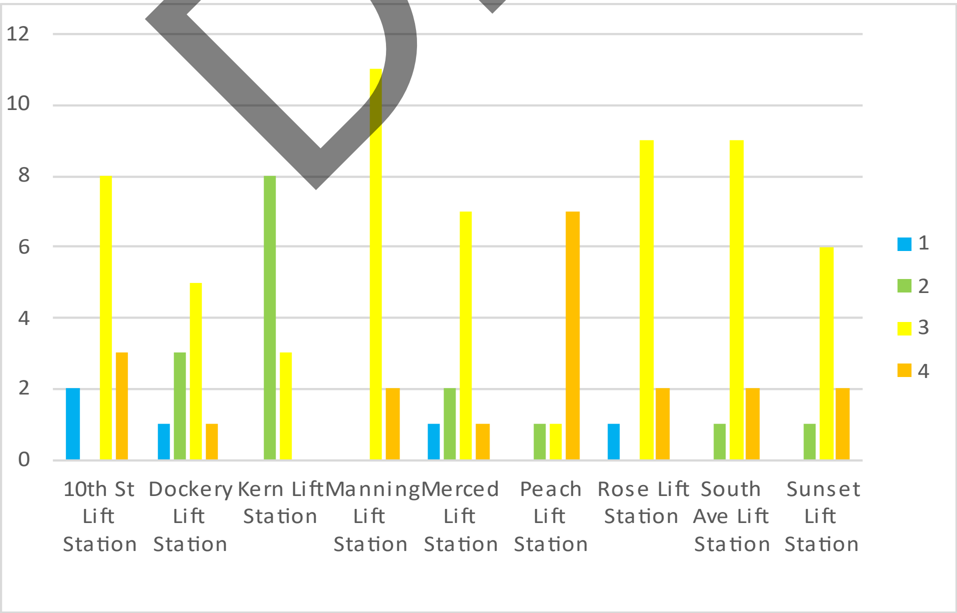


Figure 7-15 Number of Assets by Condition Score and Installation Decade

3. Figure 7-16 shows asset condition scores grouped by installation year and indicated no strong correlation between condition and age.

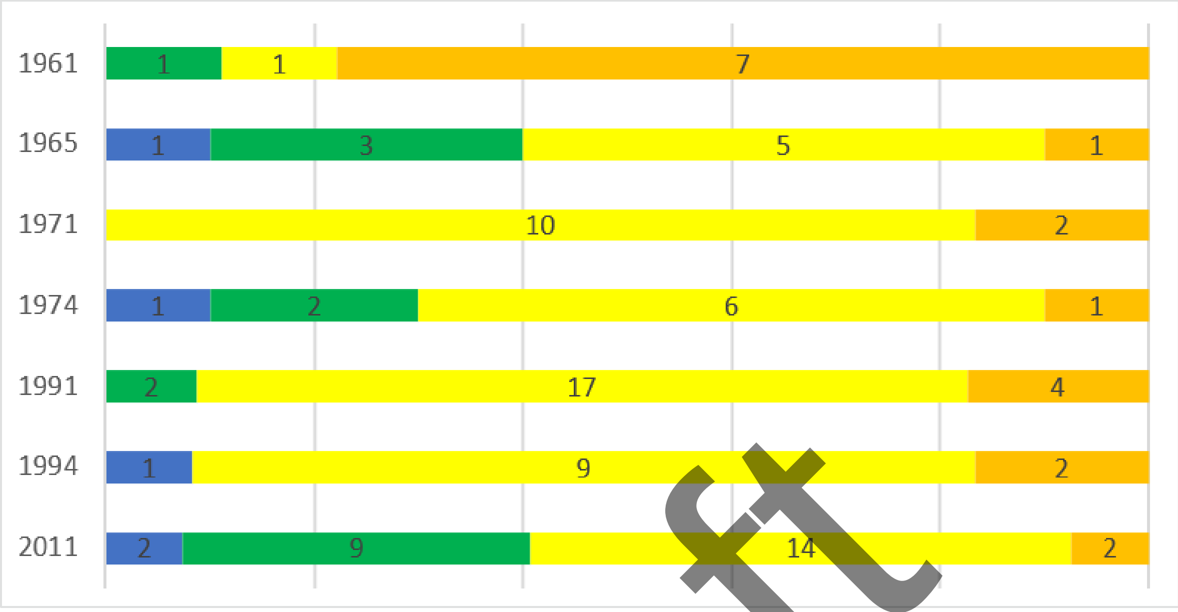


Figure 7-16 Number of Assets by Condition Score and Installation Decade

7.2.5 Recommendations

This condition assessment focused on 9 lift stations under District operation and maintenance. Having data for the 9 lift stations provides a baseline, allowing recommendations to be made for the remaining 13 lift stations.

Recommendations are currently limited to physical and performance scores which are valuable in identifying the current condition of assets. Based on the results of this condition assessment, Black & Veatch recommends the high-level alternatives presented in this section and summarized in Table 7-18. Costs for these recommendations are included in Chapter 8 of this master plan.

Table 7-18 Lift Station Recommendations

Lift Station	Asset Name	No. of Assets	High-Level Alternative	Implementation Timing
Merced Street	Pump Discharge Piping	2	Replace	Within 5-10 years
Manning	Level Transducer Control	1	Replace	Within 5-10 years
	Submersible Pumps (Guide Rails)	2	Replace	Within 5-10 years
Rose Street	Check Valve 2	1	Replace	Within 5-10 years
	Pump Discharge Piping	2	Replace	Within 5-10 years
Dockery	Pump Discharge Piping	2	Replace	Within 5-10 years
Sunset	Pump Discharge Piping Vault	1	Repair	Within 5-10 years
	Pump Discharge Piping	2	Replace	Within 5-10 years
North 10th Street	Wet Well	1	Rehabilitate	Within 5-10 years
	Pump Discharge Piping	2	Replace	Within 5-10 years
	Meter/Main Panel (Phase Monitor)	1	Replace	Within 5-10 years
Peach Street	Level Transducer	1	Replace	Within 5-10 years
	Pump Discharge Piping Vault	1	Replace	Within 5-10 years
	Wet Well	1	Replace	Within 5-10 years
	Check Valves	2	Replace	Within 5-10 years
	Submersible Pumps (Guide Rails)	2	Replace	Within 5-10 years
	Pump Discharge Piping	2	Replace	Within 5-10 years
South Avenue	Pump Discharge Piping Vault	1	Repair	Within 5-10 years
	Pump Discharge Piping	2	Replace	Within 5-10 years
Clarkson	Full Rehabilitation	-	Full Rehabilitation	Within 5-10 years
North	Full Rehabilitation	-	Full Rehabilitation	Within 5-10 years
South Ave	Full Rehabilitation	-	Full Rehabilitation	Within 5-10 years

7.3 Force Main Assessment

As buried pressure pipelines in the collection system, force mains are the most difficult assets to inspect and manage for condition and performance. Force mains were not inspected or assessed as part of this master plan. In the ongoing rehabilitation and repair plan sections below, a phased approach for force main asset management is presented.

7.4 Ongoing Rehabilitation and Replacement Plan

The following recommendations are provided for ongoing, comprehensive, rehabilitation and repair within the collection system.

7.4.1 Gravity Main Rehabilitation and Replacement Plan

As described in Section 7.1 above, the District most recently completed 33,000 feet of CCTV inspection throughout the collection system in 2021. Approximately 20% of the inspected gravity main segments were found to have Structural PACP codes of 4 or 5, requiring rehabilitation or repair action in the next 5 years.

The District is currently programing approximately 51,000 feet of CCTV inspection in the collection system per year. This amount of inspection equates to approximately 15% of the smaller diameter collection gravity mains in the system that can be regularly inspected and rehabilitated. This percentage is appropriate for long-term planning, and costs for this program are included in Chapter 8 of this 2024 MP Update. Additionally, costs for the rehabilitation and repair that will be required for the gravity mains as the inspections identify priorities are included in Chapter 8.

7.4.2 Lift Station Rehabilitation and Replacement Plan

The lift station assessment described above is built upon a detailed asset registry developed specifically for the District. This registry is spreadsheet-based and is designed to be maintained and updated by the District.

As the District and its contractors continue to inspect and maintain the lift stations throughout the collection system, the information gathered should be transferred to and maintained in this asset registry. As the asset registry is updated, new priorities will be identified for rehabilitation, repair, and replacement.

The costs for the rehabilitation and repair priorities identified in Section 7.2 above are provided in Chapter 8 of this master plan.

7.4.3 Force Main Rehabilitation and Replacement Plan

As described throughout this chapter above, the District maintains a robust inspection and rehabilitation/repair program for gravity mains and lift stations. Typical of many wastewater utility agencies, the District's inspection and rehabilitation/repair program for force mains is in a more rudimentary state owing to the difficulty of inspecting and maintaining buried pressure pipelines within the collection system.

It is recommended that the District prioritize building an inspection and rehabilitation/repair plan for force mains utilizing the following three phases:

- **Phase 1** – Establish an asset registry for force mains within the collection system. Because the current plans and as-builts for force mains within the District appear to be incomplete, the establishment of an asset registry will include field survey and potholing to determine the alignments and materials of the various force mains.
- **Phase 2** – Establish risk factors for the assets catalogued in Phase 1. Prioritize physical inspection where required.
- **Phase 3** – Develop a rehabilitation and repair plan based upon the results of Phase 2.

Costs for Phase 1 are included in Chapter 8 of the 2024 MP Update.

Chapter 8 Capital Improvement Program

Chapter 8 provides an overview of the recommended Capital Improvement Program (CIP) for the gravity main, lift stations, and force mains that have been identified for improvement in Chapter 6 and Chapter 7. This CIP has been prioritized based on the development timeline and risk assessment performed and includes conceptual costs for the recommended projects.

IN THIS SECTION

- Basis for Capital Improvement Costs
- Proposed Capital Improvement Program
- Proposed Inspection and Rehabilitation/Replacement Program

8.1 Basis for Capital Improvement Costs

The following sections describe the methods and associated costs evaluated for completing rehabilitation, repair, and replacement projects in the District's collection system for both capacity enhancement and condition repair. Construction costs are presented in January 2024 dollars based on an Engineering News Record (ENR) Construction Cost Index (CCI) of 13,515 (20-city average). Construction costs are to be used for conceptual-level cost estimating only. The cost estimates prepared for the 2024 Master Plan Update are in accordance with the guidelines of the Association for the Advancement of Cost Engineering (AACE) International for a Class 5 Estimate, suitable for long-range capital planning, with an accuracy range of -50 percent to +100 percent. In other words, estimates may be 50% less to 100% more than actual costs.

8.1.1 Pipeline Rehabilitation, Repair, and Replacement Methods and Conceptual Costs

The following rehabilitation, repair, and replacement methods are potential options for the District's gravity main and force main projects: open cut construction, pipe bursting, pipe reaming, and tunneling. For projects that require the installation of a new relief sewer to address wet weather flows, in-situ methods for the existing pipe, such as the use of cured-in-place pipe, may be considered in conjunction with construction of the new relief sewer pipeline. Specific to the District's projects, factors that determine the most cost-effective rehabilitation method include geological and physical setting, existing pipeline material and condition, and available construction access.

OPEN CUT CONSTRUCTION

Description: Open cut or open trench construction, also known as cut and cover, has historically been the most widely used approach for sewer pipe replacements. A trench is excavated that is approximately 18 inches to two feet wider than the replacement pipe, and six to 12 inches deeper than the bottom of pipe. A new pipe is installed, backfill material placed and compacted, and pavement and surface facilities restored. Often, the new pipe is installed in a different location than the original pipe, and the original pipe abandoned in place. In this case, sewer flow continues through the original pipe, and a planned shutdown is scheduled during the "tie-in," when the new pipe is connected to the existing pipe. Alternatively, the existing pipe is removed to allow replacement of the new pipe in the same location. The existing flow is bypassed through a temporary pumped system during construction operations.

Advantages and Limitations: Historically, open cut construction has been more cost effective than trenchless technologies, and consequently, more widely used for pipe replacement. Open cut construction is appropriate in most soil conditions, and could be beneficial in locations where significant utility crossings are present, depending on the depths of existing utilities. An open trench can be adjusted in the field to avoid existing underground obstructions, or to otherwise relocate the new pipe. This method enables installation of a larger diameter pipeline where capacity issues are present, or improved materials when available or needed.

One limitation to open cut construction is in shoring and dewatering. Shoring of the trench walls is required for personnel safety and an engineered shoring system is required when a trench is greater than five feet in depth, in accordance with California Labor Code Section 6705. Excavation below the groundwater table, or in soils that permit infiltration of groundwater into the open trench necessitate aggressive dewatering methods. The added cost of these requirements can decrease the economic viability of open cut construction in specific situations. For pipeline installations in new alignments, a geotechnical investigation is recommended during the design phase to determine shoring requirements and whether groundwater is anticipated during construction.

Open cut construction is also difficult where construction access is limited, or on steep hillsides. Open cut construction also impacts surface features and traffic, may introduce safety concerns in highly used or highly traveled locations, and creates temporary noise and dust impacts. Historically, CalTrans has required trenchless construction methods to be used for the installation of new pipelines within their rights of way.

Probable Unit Costs: The unit cost of open cut construction varies depending on site conditions and construction access limitations. Unit costs have been established for typical conditions within the District's study area and then these costs have been escalated where appropriate based upon factors that complicate design and construction. In the District's service area, typical conditions are defined as lightly developed areas with paved roads, alleys, or open right of way above the gravity main alignment, depth of installation less than 12 feet, and consolidated soils above the water table. Escalation factors have been developed for deep installation, for highly developed/congested installation, and for other specific factors as appropriate.

The probable unit costs for open cut gravity main installation include excavation, shoring, pipe installation, backfill, and compaction, as well as typical placeholders for mobilization, paving, traffic control, and pipeline appurtenances. The costs were developed from previously established District costs, adjusted to calibrate to recently completed projects within the District's service area. Bids for construction of gravity mains both in open alignments and in congested alleys were reviewed for this calibration of projected costs.

Typical Construction Condition:	**$22** per inch-diameter per foot of pipe
Deep construction conditions (Depth greater than 12 feet):	**$26** per inch-diameter per foot of pipe
Urban/congested construction conditions:	**$31** per inch-diameter per foot of pipe

PIPE BURSTING

Description: Pipe bursting is a trenchless construction method by which existing pipe is replaced with the same size or typically one size larger pipe in the same location. Pipe bursting is most effective in replacing pipes that are less than 24 inches in diameter and are at least 4 feet deep. This method is the most cost effective when there are few lateral connections, when the old pipe is structurally deteriorated or is easily fractured (e.g., vitrified clay pipe), and when additional capacity is needed and trenchless methods are desired or required.

A conical pipe bursting head is conveyed through the pipe, exerting outward forces that fracture the existing pipe and displace fragments outward into the soil. The head is driven by pneumatic pressure, hydraulic expansion, or static pull; the head is connected to and pulls in the new pipe. The pipe bursting head is inserted and also retrieved through new access pits that are located at approximately 400 to 500 foot intervals.

The optimal pull length is dependent upon the size of the host pipe, the degree of upsize required, and the type of soil in the surrounding subsurface. Additional pits, typically two feet wide by two feet long, are required at each service lateral connection and at crossing utilities. Pipes suitable for pipe bursting are those made of brittle materials, such as vitrified clay. Special bursting heads with cutting elements are required for more ductile pipe materials such as steel, polyvinyl chloride (PVC) and ductile iron. Typically, the replacement pipe material will be high-density polyethylene (HDPE) or fused PVC. Construction using PVC requires longer pit lengths than with HDPE because PVC requires a longer bending radius.

Advantages and Limitations: Pipe bursting is quickly gaining popularity as a replacement methodology for small diameter sewers. If HDPE pipe is used, a relatively small pit (as compared to an open trench) is required for entry of the pipe bursting head, which can be extracted through an existing manhole. Pipe bursting replaces the existing pipe by up to two diameter sizes without significant open trenching, and therefore reduces surface impacts. The unit cost of pipe bursting is decreasing, and often comparable to open cut methods.

Existing conditions must be considered carefully when specifying pipe bursting. Flowing soils such as sand, highly incompressible soils such as rock, installations below the groundwater table, sensitive utilities located within two to three pipe diameters of the pipe to be burst, historical point repairs that are not conducive to bursting such as steel couplings, or significant sags or pipe collapses will limit the success of pipe bursting operations. Pipe bursting may also create ground vibrations and outward ground displacements adjacent to the pipe alignment; these displacements are exacerbated in shallow installations or when the pipe is significantly upsized. When the existing pipe is shallow, this ground displacement may be controlled by saw cutting pavement over the pipe in advance of the bursting operation. This approach localizes surface heave and provides for more simplified trench patch repair.

Pipe bursting is performed between pits spaced 400-500 feet apart. A manhole can be used in lieu of the receiving pit. During the pipe bursting process, the rehabilitated pipe segment must be taken out of service by rerouting or bypassing sewer flows. Laterals are reconnected through external pits after the pipe bursting activities are completed.

Probable Unit Costs: The unit cost of pipe bursting varies depending on site conditions and construction access limitations. In the prioritized CIP developed for the 2024 Master Plan Update, pipe bursting was specified for specific projects which called for a single increment diameter increase, and for which conditions were judged favorable for pipe bursting.

For the District's projects, the following unit costs (rounded to the dollar) were applied:

Pipe Bursting Normal Conditions: **$26** per inch diameter per foot of pipe

CURED IN PLACE PIPE (CIPP)

Description: CIPP is a trenchless repair method that installs a resin-saturated felt liner into the host pipe through existing manholes. The liner is made of interwoven polyester and may be fiber-reinforced for additional strength. Commonly manufactured resins include unsaturated polyester, vinyl ester, and epoxy, each having distinct chemical resistance to domestic wastewater. The CIPP liner is installed by inversion using water or pressurized air; after the liner is in place, the resin-impregnated tube is cured using hot water, steam, or high-intensity ultraviolet light, creating a seamless pipe that fits tightly against the host pipe wall. Laterals are then connected to the mainline pipe using a remote-controlled cutting device.

Advantages and Limitations: CIPP is a viable rehabilitation technology in 6-inch or larger gravity sewers where the existing pipe has sufficient capacity. Because laterals are connected from inside the lined pipe, little or no trenching is required. Therefore, CIPP may be a preferred alternative in pipelines where trenching would be cost-prohibitive. The CIPP method can be used to address structural problems such as cracks and structurally deficient segments, as well as root intrusions because the liner forms itself generally to the shape of the host pipe and can span gaps caused by roots up to one inch in diameter. Larger gaps and alignment deficiencies such as offset joints and sags would require a point repair prior to lining.

The flexibility of the resin tube allows installation through existing bends, further minimizing the need for excavation. The liner is resistant to chemical attack, eliminates groundwater from entering the sewer, and retards further corrosion and erosion of the pipeline.

The thickness of CIPP liner typically ranges from ½ inch to 1 inch and therefore, the final inside diameter is approximately 1 to 2 inches less than the inside diameter of the existing pipe. The liner typically has less flow friction compared to the host pipe, so the reduction in diameter does not result in a reduction in hydraulic capacity, particularly for pipes above 8 inches in diameter.

CIPP installation requires bypass pumping and groundwater dewatering, if in a high groundwater area. Installation length is generally limited to approximately 800 feet due to curing limitations. Therefore, if manholes are located farther apart than 800 feet, intermediate trenched access locations are required. Another challenge associated with using CIPP is the procurement, treatment, and/or disposal of water used during the curing process; during the curing process of any resin system, volatile organic compounds are released and must be closely monitored.

CIPP is a viable alternative to pipeline replacement when pipeline replacement options are cost-prohibitive, and when existing pipe diameter can be reduced without compromising system performance. CIPP is not recommended when pipeline slopes or other constraints limit the use of hydroflushing as a cleaning method.

Probable Unit Costs: The cost of CIPP varies significantly depending on site access, pipeline configuration, liner specifications, curing method, ease of disposal of curing water, and bidding climate. However, for conceptual estimating purposes, CIPP installation costs range from $20 to $30 per inch diameter per foot of liner installed in normal conditions. For the 2024 Master Plan Update, it is assumed that all of the District's projects will require the installation of new, larger pipe to address capacity constraints. However, during preliminary design, the opportunity to provide smaller, parallel relief sewers in conjunction with repair of the existing pipe using CIPP liner should be considered.

PIPE REAMING

Description: Pipe reaming is very similar to pipe bursting in that an existing pipe is drilled out and a new pipe of equal or greater diameter inserted in its place. Because pipe reaming does not displace the broken pieces of the old pipe into the soil, this method is better suited to pipe rehabilitation where nearby pipes or utilities might be impacted by the displaced soil.

Pipe reaming employs a directional drill that pulverizes and grinds up the existing pipe while a new pipe is inserted behind it. The old pipe is accessed by an insertion trench, and the drill head is pulled through the pipe by a drill line which runs from an insertion trench where the pipe is accessed to the next manhole. The broken pipe is carried away through the old pipe by drill fluid and collected at the downstream manhole.

Pipe reaming can be used to remove brittle pipes such as those composed of vitrified clay, PVC, asbestos concrete, or ductile iron. Fused PVC or HDPE are typically used for replacement pipes. Pipe reaming has been effective at replacing sections of sewer over 1,000 feet in length or more with little soil disruption.

Advantages and Limitations: Like other trenchless technologies, pipe reaming is advantageous when trying to minimize the impact of construction on traffic and business. When using pipe reaming as a rehabilitation technology, adequate space must be available for the insertion pit and the heavy machinery necessary for directional drilling and handling of the solids generated by the drilling process. Pipe reaming can become very expensive if there are a large number of laterals that must be reconnected to the replaced pipe.

Probable Unit Costs: Similar to pipe bursting, the unit cost of pipe reaming varies depending on site conditions and construction access limitations. However, in paved roadways underlain by generally cohesive soils above the groundwater table, and in areas without significant utility or traffic issues, pipe reaming costs range from $30 to $40 per inch diameter per foot of pipe installed. For the 2016 Master Plan Update, it was assumed that pipelines would be installed using open cut methods or pipe bursting. The costs for pipe reaming are included for reference, in the event that preliminary design indicates that pipe reaming may be more feasible for a particular project.

TUNNELING

Description: Where open cut construction is not feasible, practical, or cost effective, trenchless methods can be used to install the sewer pipe. Commonly used trenchless methods include jack-and-bore above the water table, micro tunneling below the water table, and horizontal direction drilling. These methods involve pre-drilling the pipeline alignment and then installing new pipe through the opening. When installed below Caltrans or railroad right of ways, an additional casing may be required by the governing jurisdiction.

Advantages and Limitations: Tunneling presents similar advantages to pipe bursting and pipe reaming related to minimized surface impacts when compared to open cut construction. Pipe size increase is not limited with tunneling methods and longer lengths of pipe can be replaced through a single bore.

Tunneling requires precise location of existing utilities and is not always appropriate where the new pipeline must maintain a precise slope or avoid numerous underground facilities. Additionally, tunneling requires an understanding of the materials to be tunneled through.

Tunneling requires experienced equipment operators that are skilled with the location and guidance of the necessary equipment. Tunneling is assumed to be required along and across Caltrans and railroad rights-of-way.

Probable Unit Costs: The unit cost of tunneling varies depending on site conditions and construction access limitations. However, in areas without significant utility or traffic issues, tunneling costs are generally 2.0 to 3.0 times the cost of open cut construction.

For the District's projects, the following unit costs (rounded to the dollar) were applied:

Pipe Bursting Normal Conditions: **$75** per inch diameter per foot of pipe

8.1.2 Pipeline Inspection Methods and Conceptual Costs

Both the hydraulic analysis described in Chapter 6 and the risk analysis described in Chapter 7 identified gravity mains that require physical inspection to confirm condition, slope, and/or hydraulic capacity before the nature and extent of the required CIP project can be finalized. Further, the risk assessment has identified the need for regular inspection of gravity main assets to better quantify condition information for targeted preventative maintenance and rehabilitation.

For the 2024 Master Plan Update, inspection in most cases comprises CCTV inspection of the gravity main. However, in some cases inspection indicates that vertical surveying should be performed to establish the invert elevation and rim elevations of the upstream and downstream manholes so that a slope may be established.

Probable Unit Costs: CCTV inspection costs can vary depending on the amount of heavy cleaning/root cutting, flow diversion, pipe diameter, traffic control, and property owner coordination necessary. The District should attempt to establish large volume contracts in order to minimize costs. Assuming such contracts can be secured, $3.00 per linear foot is assumed for inspection costs.

8.1.3 Lift Station Construction, Upgrade, and Rehabilitation Methods and Conceptual Costs

The following sections describe development of probable costs for new lift station construction and for lift station rehabilitation and repair.

LIFT STATION CONSTRUCTION CONCEPTUAL COSTS

The hydraulic analysis in Chapter 6 identified new lift stations required to provide service as the collection system is expanded for development. It is assumed that future lift stations will be built from scratch in relatively open locations with only minor existing utility conflicts. Parametric cost curves based upon historical values for complete construction at various capacity levels were used as probable unit costs.

LIFT STATION REHABILITATION AND REPAIR PROBABLE COSTS

As described in the rehabilitation and repair section of Chapter 7, lift stations in the District were evaluated for condition and performance in five asset disciplines:

- Structural/Architectural
- Mechanical
- Electrical and Power
- Instrumentation and Control (I&C)
- Site Civil

Individual assets within the disciplines at each lift station were evaluated and recommended for replacement or improvements where necessary. Therefore, lift station upgrade and rehabilitation costs are based directly on replacement costs for the required assets. Where capacity increases are required at a lift station, direct costs for larger pumps and motors are assessed.

8.1.4 Lateral Replacement Methods and Conceptual Costs

The analysis of service calls within the District performed for the risk assessment that is described in Chapter 6 found that District Operations and Maintenance crews regularly respond to collection system problems that originate in the laterals, rather than the gravity mains. As a means to reduce unplanned maintenance calls and to conserve and protect the integrity of the collection system, the 2024 Master Plan Update provides recommendations for regular lateral replacement. Replacement of lateral, including the installation of a clean-out and backflow prevention device, when needed, is assumed to cost $10,000 per replacement.

8.1.5 Contingency and Implementation Costs

Contingency cost and implementation mark-ups must be reviewed on a case-by-case basis because they will vary considerably with each construction project.

However, to assist District staff with budgeting for these recommended collection system improvements, the following percentages were developed:

- **Contingency:** **30 percent**
- **Implementation Costs:** **30 percent**

Design:	10 percent
Construction Management and Inspection:	10 percent
Permitting, Regulatory and CEQA Compliance:	5 percent
District Administration, Outreach, and Legal:	5 percent

The total contingency and implementation costs are compounded, so the total markup of the base construction cost is 30 percent x 30 percent = 69 percent. For the 2024 Master Plan, it is assumed that new facilities will be developed in public rights-of-way or on public property. Therefore, land acquisition costs have not been included. Proposed costs do not include costs for annual operation and maintenance.

8.2 Proposed Capacity CIP

Proposed CIP projects have been developed to meet the hydraulic capacity requirements presented in Chapter 5. The projects are categorized by the development timeline for which they are required.

8.2.1 Proposed Gravity Main CIP

The recommended gravity main projects for the existing and future collection system were developed based on the methodologies and criteria presented in previous chapters. Additionally, already-designed plans such as the Dinuba North Line and the Amberwood Development lines have been integrated into the proposed CIP.

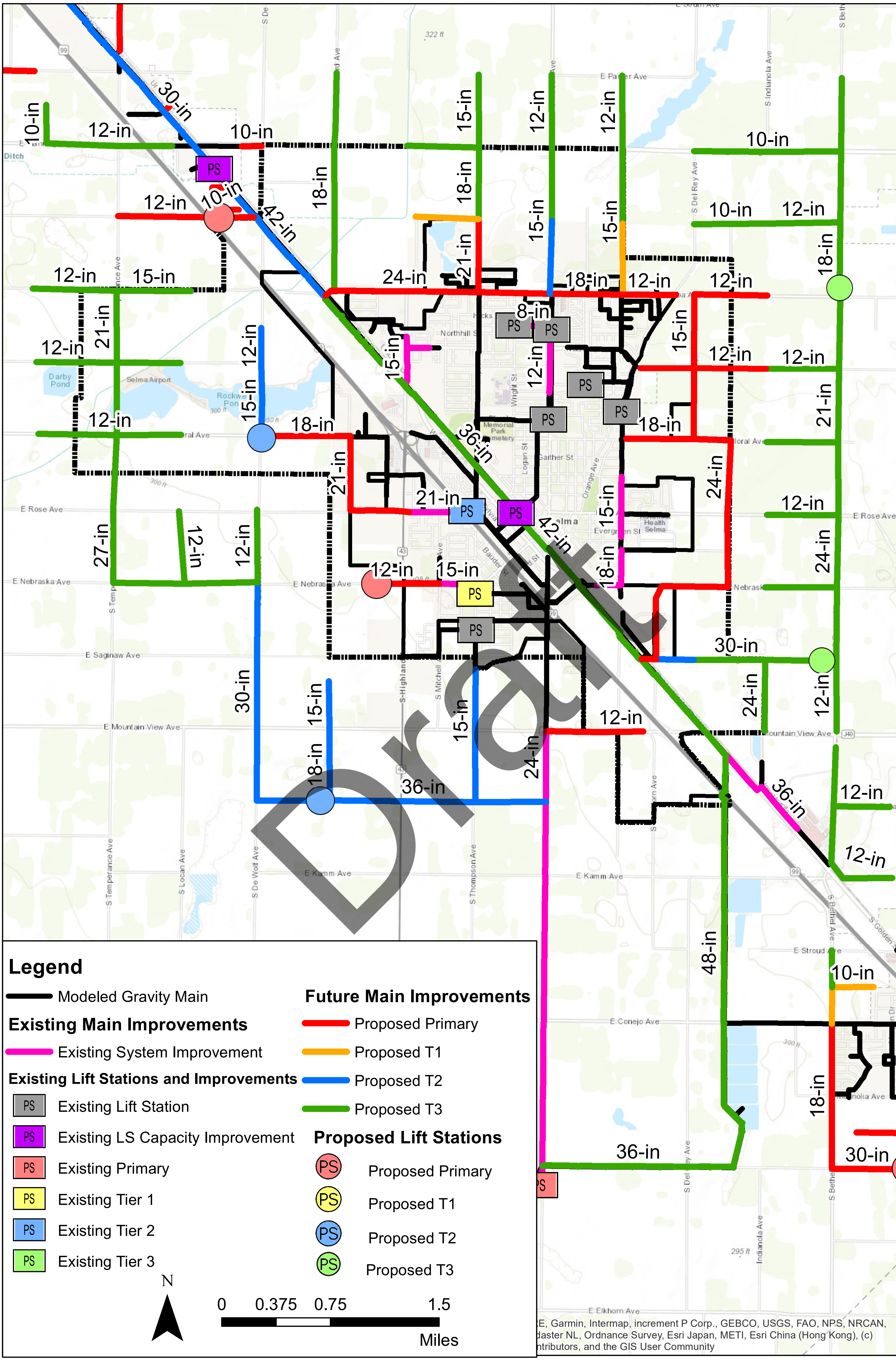
For gravity main capacity improvement projects identified as part of the 2024 Master Plan, replacement or new gravity mains were sized to convey design flows. Existing pipe slopes and depths were preserved when upsizing sewers in-place. Diameters were increased as minimally as possible to prevent oversizing and subsequent low velocities during dry weather conditions. Model runs with all capacity projects in place were made to determine the impact of increased capacity from upstream projects on peak flows in pipes downstream of those projects to verify that no additional collection system capacity deficiencies would result.

The proposed gravity main CIP for Selma can be seen on Figure 8-1, for Kingsburg on Figure 8-2, and for Fowler on Figure 8-3. The CIP projects are labeled on these figures. The projects are listed in detail for each City in Appendix E. The development timeline, prioritization, and estimated conceptual costs are included for each project in the Appendix.

The proposed CIP for gravity mains is summarized in Table 8-1. Estimated conceptual capital costs are summarized by development timeline and member city in the table. As shown in Table 8-1, approximately $386M in gravity main improvements are required to meet the collection system requirements of the development and design flows that are described in Chapter 4, which includes improvements through buildout conditions. Approximately four percent of the improvements, estimated at $14M, are required for existing conditions. Another 26 percent of the gravity main improvements totaling approximately $101M are required for development that is projected to occur in the Primary development timeframe. Forty percent of the improvements are not required until the Tier 3 development timeframe at the end of the study period (buildout).

Table 8-1 Summary of Proposed Gravity Main CIP Conceptual Capital Costs

Development Timeframe	Selma, dollars	Kingsburg, dollars	Fowler, dollars	District, dollars	2024 MP Update Study Area, dollars
Existing	$5,292,000	$-	$8,743,000	$-	$14,035,000
Primary	$42,350,000	$9,813,000	$48,972,000	$-	$101,135,000
Tier 1	$2,727,000	$8,983,000	$8,153,000	$-	$19,863,000
Tier 2	$64,315,000	$-	$7,794,000	$25,476,000	$97,585,000
Tier 3	$82,057,000	$11,318,000	$2,130,000	$57,510,000	$153,015,000
Total	**$196,741,000**	**$30,114,000**	**$75,792,000**	**$82,986,000**	**$385,633,000**



Dopudja & Wells consulting

FIGURE 8-1
CITY OF SELMA
CAPITAL IMPROVEMENT PLAN

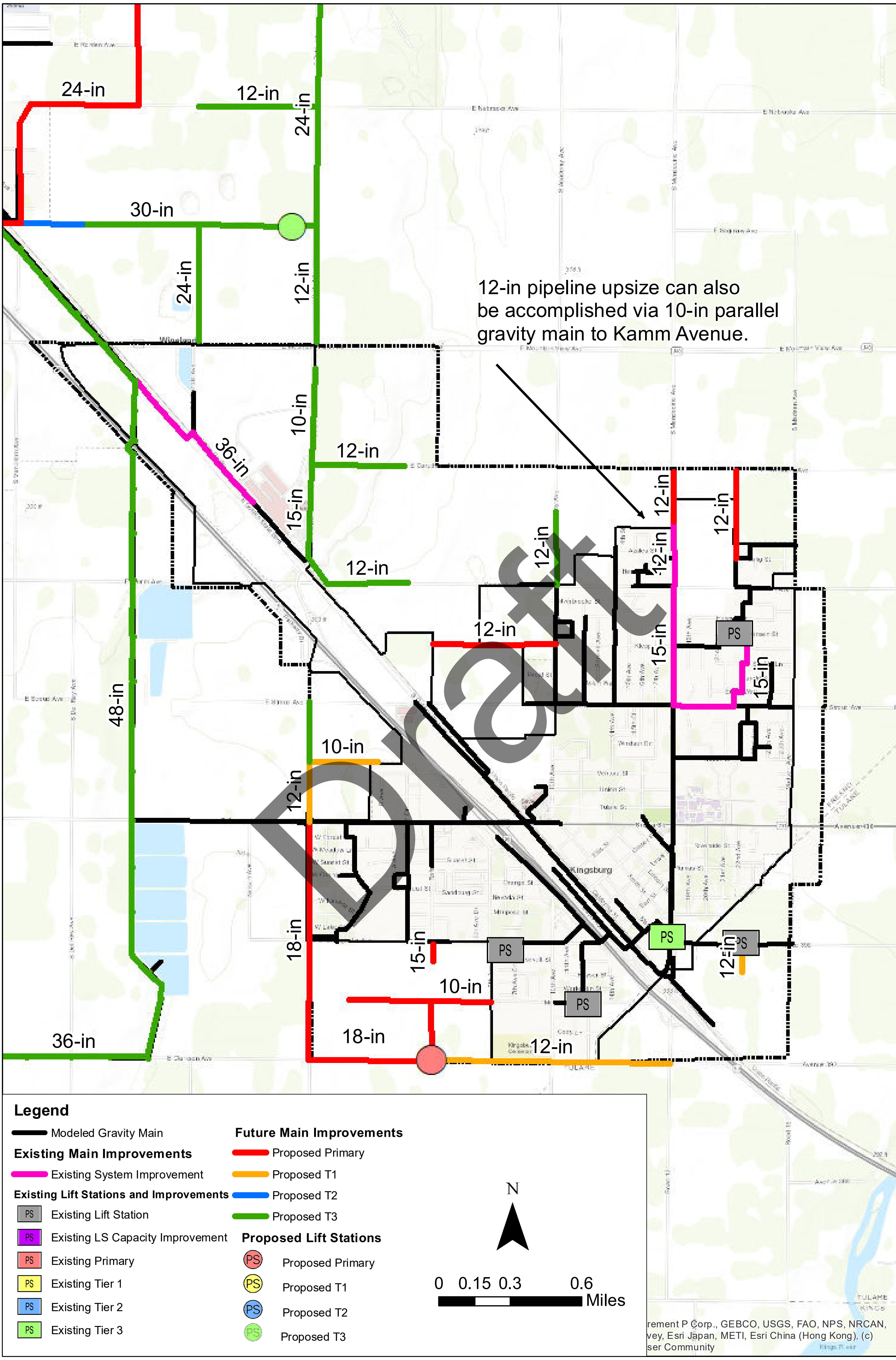


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FIGURE 8-2
CITY OF KINGSBURG
CAPITAL IMPROVEMENT PLAN

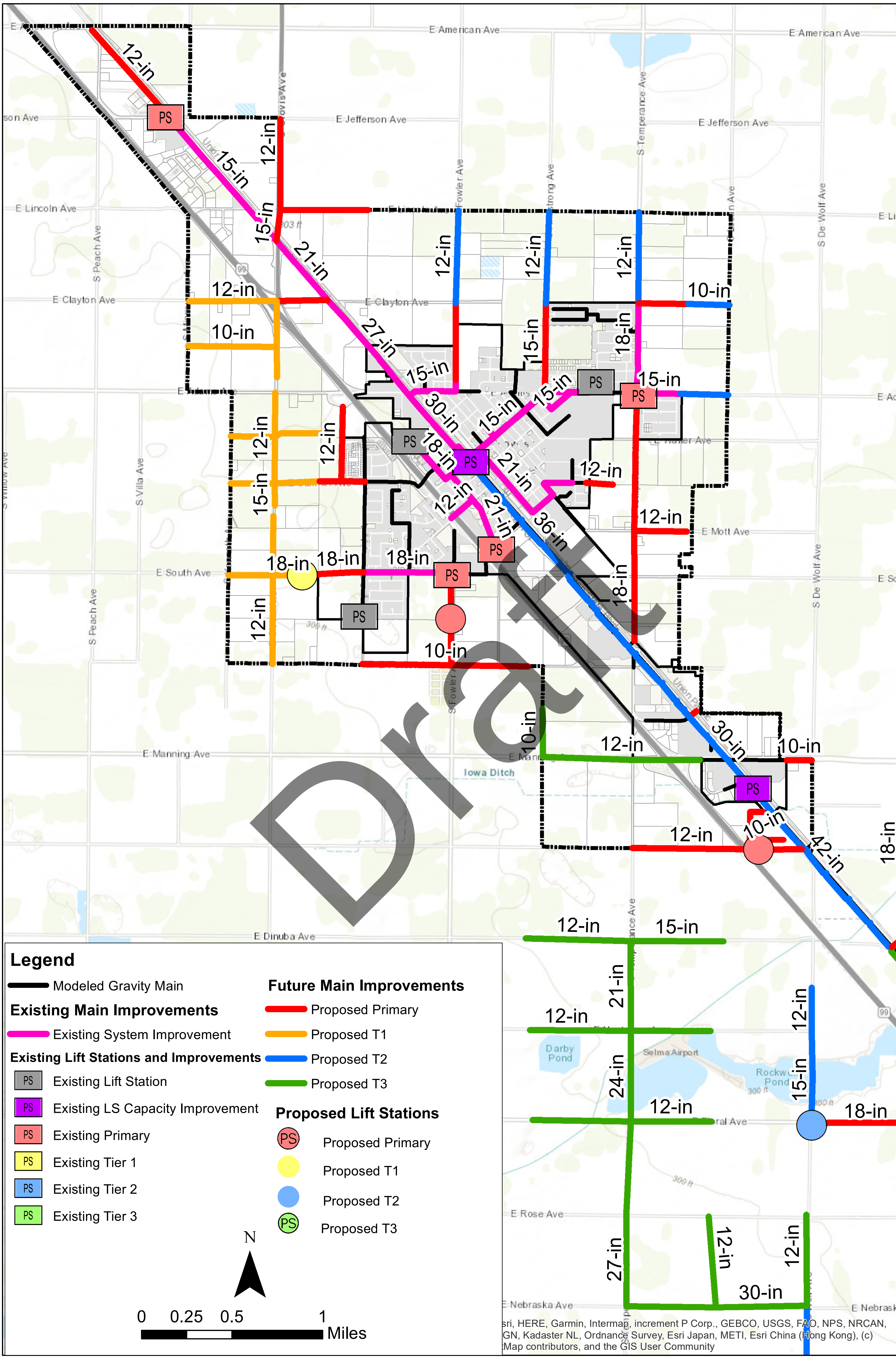

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FIGURE 8-3
CITY OF FOWLER
CAPITAL IMPROVEMENT PLAN

Geographically, Selma requires the largest portion of the proposed gravity main CIP compared to the other member cities, with the majority of the projects being required for the 2035 development timeframe. Fowler's required portion of the CIP is smaller, but most of Fowler's required gravity mains are required sooner, under Primary development. It should be noted that Fowler identified more Primary development for this study than in previous studies, particularly along the Golden State Blvd corridor. Also, it should be noted that the CIP values presented in Table 8-1 do not account for the RDII reduction identified in Chapter 6 as a possible alternative to improved gravity mains. If RDII reduction is implemented successfully, the number and size of gravity mains required will be decreased in Fowler, particularly under existing conditions. Kingsburg's required gravity main costs are smallest of the three cities, but larger than those identified in previous studies. Kingsburg identified more potential growth than previously in the 2024 MP Update.

The District's portion of the proposed gravity main CIP totals approximately $83M, most of which is in the Tier 3 development timeframe. The projects in the District's proposed gravity main comprise parallel construction projects along the Golden State Interceptor to provide needed capacity in this interceptor for development upstream.

The gravity main diameters required for specific improvements can be found in the detailed project descriptions in Appendix E.

8.2.2 Proposed Lift Station CIP

As described in Chapter 5, the hydraulic model identified existing lift stations that have insufficient capacity under existing design flows. The model also identified existing lift stations that have insufficient capacity under future design flows. Finally, the hydraulic model was used to identify the capacity and location of proposed lift stations needed in the future to convey flow from development. The proposed lift station CIP has been developed from these results. The required lift station capacity increases with estimated conceptual capital costs are provided in Table 8-2. The location of these lift stations can be seen on Figure 8-1 through Figure 8-3.

Table 8-2 Proposed Lift Station Capacity CIP with Estimated Capital Costs

Lift Station Name	Lift Station ID	Location	Timeframe	Action	Required Design Firm Capacity, gpm	Estimated Conceptual Capital Cost, dollars
Merced	D-1	Fowler	Existing	Capacity / Rehabilitation	9,675	$3,075,000
Manning	D-2	Fowler	Existing	Capacity / Rehabilitation	12,100	$4,727,000
North	D-3	Selma	Existing	Capacity / Rehabilitation	18,175	$8,680,000
18th Ave	D-4	Selma	Tier 3	Capacity / Rehabilitation	2,500	$1,899,000
South Ave	F-5	Fowler	Primary	Capacity / Rehabilitation	1,950	$2,008,000
Jefferson	F-6	Fowler	Primary	Capacity / Rehabilitation	450	$664,000
Adams	F-7	Fowler	Tier 1	Capacity / Rehabilitation	2,500	$1,899,000
Rose	S-3	Selma	Tier 2	Capacity / Rehabilitation	1,925	$1,550,000
Sunset	S-7	Selma	Tier 1	Capacity / Rehabilitation	1,150	$1,122,000
Clarkson & McCall	S-11	Selma	Primary	Capacity Upgrade	10,100	$3,364,000
Southwestern Fowler	N/A	Fowler	Tier 1	New Construction	675	$1,313,000
Southern Fowler	N/A	Fowler	Primary	New Construction	675	$1,291,000
Southeastern Fowler	N/A	Fowler		New Construction	575	$1,220,000
Western Selma	N/A	Selma	Tier 2	New Construction	925	$1,548,000
Southwestern Selma	N/A	Selma	Tier 2	New Construction	5,350	$1,409,000
Northeastern Selma	N/A	Selma	Tier 3	New Construction	1,825	$5,665,000
Southeastern Selma	N/A	Selma	Tier 3	New Construction	3,250	$2,445,000
Selma - Nebraska	N/A	Selma		New Construction	775	$4,012,000
Southwestern Kingsburg	N/A	Kingsburg	Primary	New Construction	300	$970,000
Total						**$48,861,000**

As described in Chapter 7, the three District lift stations Merced Street, Manning, and North Street were previously identified as critical for both capacity upgrade and rehabilitation as part of the 2016 MP Update. The required upgrades for these lift stations are currently under design. The required hydraulic capacity at these lift stations is being phased in to manage costs over time. The costs in Table 8-2 reflect the full costs of all required hydraulic capacity through Tier 3 development requirements (buildout). In addition to the capacity requirement upgrades,

8.2.3 Proposed Force Main CIP

Force main improvement costs for hydraulic capacity requirements are included in the costs of lift station improvements as shown above.

8.3 Proposed Inspection and Rehabilitation/Replacement Budgets

In addition to the proposed CIP for the capacity improvements described above, the District's collection system will require regular investment in refurbishment/replacement (R/R) to maintain the working order of the collection system. In order to prioritize R/R projects for gravity mains, the condition of individual gravity mains must be assessed in a systematic manner so that needed repairs can be located and planned for.

8.3.1 CCTV Inspection Program

As detailed in Chapter 7, it is recommended that the District continue its ongoing CCTV Inspection Program in order to collect information about the condition of the existing gravity mains. As has been done in recent years, the risk assessment prioritization from the 2016 MP Update should be used for inspection prioritization.

At a unit cost of $3.00/foot inspected, which includes inspection and minor review of inspection data, a yearly budget of $165,000 for inspection is recommended. This budget will allow for inspection of approximately 22,000 feet in Selma, 15,000 feet in Kingsburg, and 15,000 feet in Fowler, for a total of 52,000 feet per year.

8.3.2 Refurbishment/Replacement Program

As detailed in Chapter 7, approximately 20% of the inspected gravity mains from previous years had defects rated 4 or 5, which would require rehabilitation or replacement within five years. Detailed cost estimates for rehabilitation or repair were developed for the inspected gravity mains which scored 4 or 5, and these estimates totaled $3.5 million over five years. Because it is expected that future years will produce similar results, it is recommended that $700,000 per year be budgeted for gravity main rehabilitation and replacement.

8.3.3 RDII Identification

As detailed in several previous chapters, RDII values were measured to be high in the northern part of the collection system, primarily in Fowler. The proposed gravity main and lift station capacity improvements provided in this chapter all assume that the high RDII values remain, and that the RDII flow must be conveyed through the collection system. Therefore, removal of significant RDII from the system could produce notably smaller improvement costs, particularly in Fowler and in the trunk mains that carry Fowler flow.

It is recommended that $75,000 per year be budgeted for the next five years for RDII identification. This budget can used for:

- Targeted micro-basin flow monitoring
- Smoke testing
- Connection testing/dye testing
- Physical survey and inspection.

It is recommended that RDII identification be prioritized in the Peach LS tributary basin first, followed by other areas in Fowler, and finally in the northwestern portion of Selma.

8.3.4 Force Main Rehabilitation and Replacement Plan

As detailed in Chapter 7, it is recommended that the District prioritize building an inspection and rehabilitation/repair plan for force mains utilizing the following three phases:

- **Phase 1** – Establish an asset registry for force mains within the collection system. Because the current plans and as-builts for force mains within the District appear to be incomplete, the establishment of an asset registry will include field survey and potholing to determine the alignments and materials of the various force mains.
- **Phase 2** – Establish risk factors for the assets cataloged in Phase 1. Prioritize physical inspection where required.
- **Phase 3** – Develop a rehabilitation and repair plan based upon the results of Phase 2.

To accomplish Phase 1, it is recommended that $50,000 be budgeted per year over the next five years to establish the force main asset registry across the District.