ALBERT A. WEBB ASSOCIATES

City of Fontana

2023 SEWER MASTER PLAN

July 2024

Prepared for

FONTANA
CALIFORNIA

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2023 Sewer Master Plan

Prepared for:

FONTANA CALIFORNIA

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Table of Contents

List of Tables

List of Figures

List of Appendices

Acknowledgments

Albert A. Webb Associates acknowledges with thanks the information and advice provided by various individuals during the preparation of this report. In particular, they are:

CITY OF FONTANA

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Abbreviations

AACE - International	Association for the Advancement of Cost Engineering - International
AC	Asphalt Concrete
ADS	ADS Environmental Services
ADU	Accessory Dwelling Unit
CCTV	Closed Circuit Television
CIP	Capital Improvement Program or Cast Iron Pipe
City	City of Fontana
CY	Calendar Year
d/D	Depth-over-Diameter
DEIR	Draft Environmental Impact Report
DIA	Diameter
DIP	Ductile Iron Pipe
DOF	Department of Finance
DS	Diversion Structure
DU/acre	Dwelling Unit per acre
EDU	Equivalent Dwelling Unit
ENR-CCI	Engineering News-Record Construction Cost Index
ERSC	Engineering Resources of Southern California
ES	Executive Summary
F	Fahrenheit
FAR	Floor to Area Ratio
FGP	Fontana General Plan
FM	Force Main
ft/s or fsp	Feet per Second
gal/in-dia/mile	gallons per inch diameter per mile
GIS	Geographic Information Systems
gpd/DU	gallons per day per Dwelling Unit
HDPE	High-Density Polyethylene
HP	Horsepower
i.e.,	For Example,
IEUA	Inland Empire Utility Agency
LF	Linear Feet
LS	Lift Station
MCN	Master Case Number
MH	Manhole
MGD	Million Galled per Day
OWTS	Onsite Wastewater Treatment Systems
PA	Planning Areas
PD	Police Department
PF	Peaking Factor
POS	Plan of Service
PVC	Poly-Vinyl Chloride
RCP	Reinforced Concrete Pipe

ROW	Right-Of-Way
SB	Senate Bill
SCAG	Southern California Association of Governments
SF	Square Feet
SOI	Sphere of Influence
SMP	Sewer Master Plan
SP	Specific Plan
USCB	U.S. Census Bureau
VCP	Vitrified Clay Pipe
WEBB	Albert A. Webb Associates
WSA	Water Supply Assessment

Executive Summary

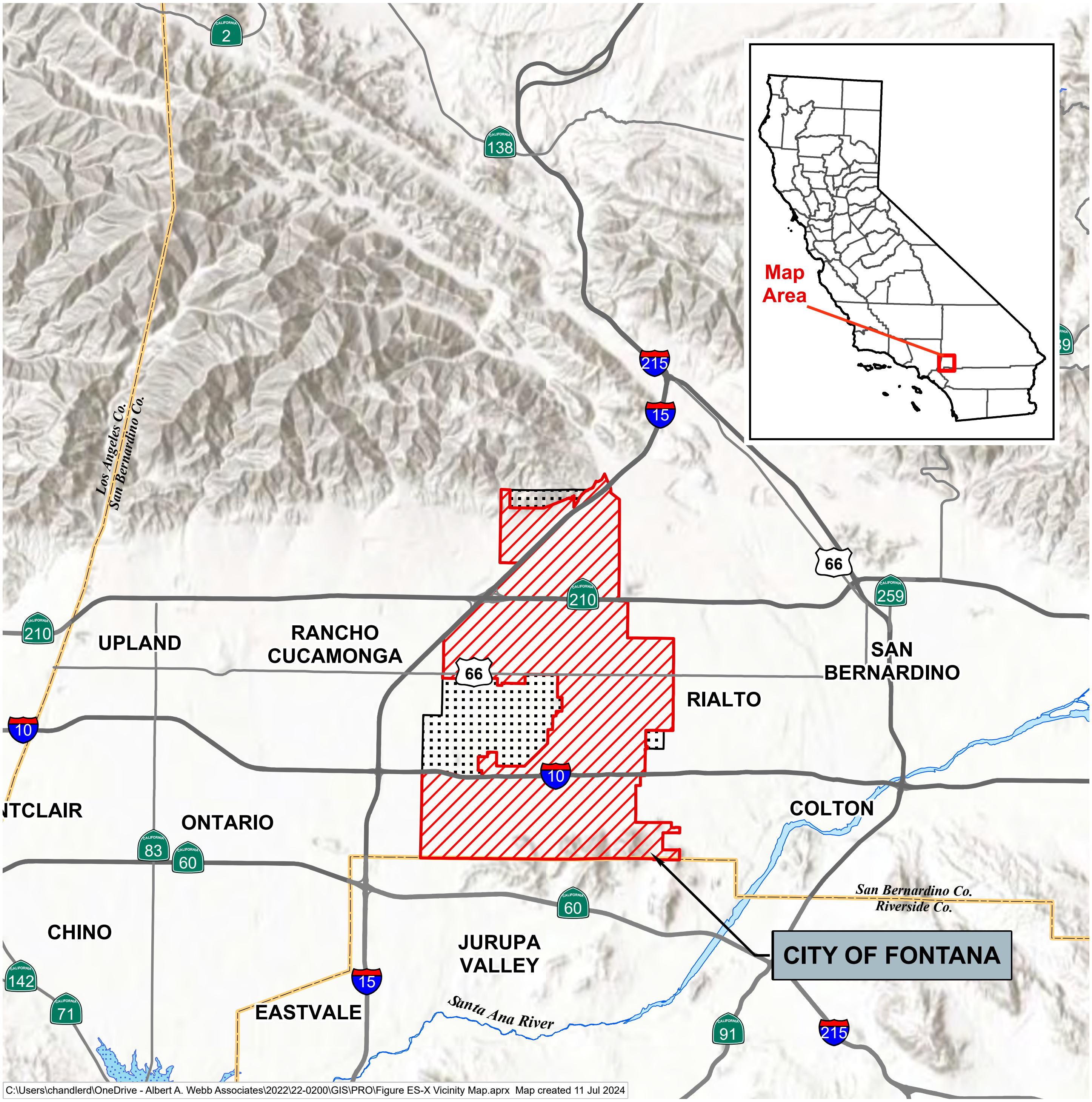
This report documents the 2023 Sewer Master Plan (SMP) Update for the City of Fontana (City). The executive summary is presented to provide background and a summary of key findings and recommendations for managing the City's wastewater collection system, addressing both current and future needs. Focusing on critical areas such as system capacity, infrastructure condition, and hydraulic performance, the SMP outlines necessary upgrades and expansions to maintain high standards of service and sustainability for the community.

Study Area and Population

The study area for the Fontana Sewer Master Plan encompasses the entire sewer service area within the City of Fontana's jurisdiction as well as its Sphere of Influence (SOI), see **Figure ES-1**. This includes residential, commercial, industrial, and undeveloped land expected to be serviced by the City's sewer infrastructure. The system is divided into five distinct tributary areas, each contributing to the overall wastewater flow managed by the City.

The population of Fontana, as of 2022, is approximately 212,800. Fontana has experienced rapid growth over the past few decades, driven by its strategic location in the Inland Empire and its attractive residential and commercial development opportunities. This growth trend is expected to continue, with the population projected to reach approximately 286,700 by 2045. By understanding the study area's demographics and growth patterns, the Fontana Sewer Master Plan provides a detailed framework for managing future wastewater demands, ensuring the City's sewer system remains efficient and reliable.

FIGURE ES-1 REGIONAL LOCATION MAP



LEGEND

Fontana City Limits

Unincorporated Fontana Area (SOI)

Sources: City of Fontana 2023; ESRI 2023

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Existing Wastewater Facilities

The existing wastewater collection system contains approximately 457 miles of sewer lines, 8 active lift stations, 9 inverted siphons, roughly 44,000 service connections, and 5 regional discharge outlets. The collection system consists of primarily Vitrified Clay Pipe (VCP) with the remaining pipes constructed using Ductile Iron Pipe (DIP), Polyvinyl Chloride (PVC), Concrete, Cast Iron Pipe (CIP), Reinforced Concrete Pipe (RCP), and others. The City does not own or operate a wastewater treatment facility; instead, Fontana has acquired discharge capacity rights with Inland Empire Utility Agency (IEUA) and the City of Rialto.

Existing and Projected Wastewater Flows

Existing sewer flows were acquired from the City's master meters at each outlet. Data was recorded over a 12-month span and used to determine the system average daily flow. As of 2022, the total annual average wastewater generation for Fontana reached 14.6 MGD.

Wastewater generation factors (**Table ES-1 – Calibrated Wastewater Generation Factors by Land Use)** were developed using the general plan land use and further refined with targeted sewer flow monitoring to determine inflow/infiltration rates, diurnal pattern for daily average flows, and a peaking factor within each tributary area. The projected average daily flow for the City at buildout is estimated at 25.2 MGD. This value represents the ultimate future buildout for the SOI based on the general plan and is a conservative estimate of the ultimate conditions in the wastewater collection system.

Table ES-1 Calibrated Wastewater Generation Factors by Land Use Type

Land Use Code	Land Use Category	Density (DU/acre) or Intensity (FAR)	Generation Factor (gpd/ac)*
Residential Categories			
R-E (1)	Residential Estate	0.1-2.0	265**
R-PC (2)	Residential Planned Community	3.0-6.5	1,550**
R-SF	Single-Family Residential	2.1-5.0	1,025**
R-M	Medium-Density Residential	5.1-12.0	2,900**
R-MF	Multi-Family Residential	12.1-24.0	4,200
R-MFMH (1)	Multi-Family Medium/High Residential	24.1-39.0	5,200
R-MFH (1)	Multi-Family High Residential	39.1-50.0	5,200
R-T (1)	Trucking Residential	2.0	265
Mixed Use Categories(3)			
RMU (1)	Regional Mixed-Use	12.0-24.0 0.1-1.0 FAR	Varies(3)
WMXU-1	Walkable Mixed-Use 1	3.0-39.0	Varies(3)
WMXU-2 (1)	Walkable Mixed-Use 2	2.10-24.0	Varies(3)
Commercial & Industrial Categories			
C-C (4)	Community Commercial	0.1-1.0 FAR	1,200
C-G (4)	General Commercial	0.1-1.0 FAR	1,200
I-L	Light Industrial	0.1-0.6 FAR	400
I-G (1)	General Industrial	0.1-0.6 FAR	500
Other Categories			
P-PF (4)	Public Facilities	-	1,500
P-R	Recreation Facilities	-	0
P-UC (1)	Public Utility Corridors	-	100
OS	Open Space	-	0

Notes: FAR = floor to area ratio; DU/acre = dwelling unit per acre; gpd/ac = gallons per day per acre.

* Factors assume the typical density of land use categories not the maximum.
** Factors include a 20% increase to account for potential future accessory dwelling units (ADU), see discussion below.
(1) These factors are not based on observed flow monitoring data.
(2) This factor represents all Specific Plans within the City and therefore includes a range of densities and non-residential intensities.
(3) Generation factors for Mixed Use Categories vary and are to be determined based on specific project's residential and commercial land use densities to estimate projected wastewater. For purposes of this study RMU = 3,000, WMXU-1 = 2,600, WMXU-2 = 2,000.
(4) Nominal sample size of observed flow was collected; therefore, these factors are from the previous master plan and/or surrounding agencies.

Design Criteria

The following design criteria was established to evaluate the adequacy of the City's existing system and identify future capital improvements (**Table ES-2 – Design Criteria**).

Table ES-2 Design Criteria

Design Criteria	Value
d/D Ratio for ≤ 12-inch Diameter (Peak Dry Weather)	0.50
d/D Ratio for ≥ 15-inch Diameter (Peak Dry Weather)	0.75
d/D Ratio for Wet Weather Flow	1.0
Manning's n	0.013
Minimum Velocity	2 ft/s
Maximum Velocity (new pipes)	6 ft/s
Maximum Velocity (existing pipes)	8 ft/s
Hazen-Williams Roughness Constant, "C"	120
8-inch Diameter Pipe Slope	0.004 ft/100ft
10-inch Diameter Pipe Slope	0.003 ft/100ft
12-inch Diameter Pipe Slope	0.0024 ft/100ft
15-inch Diameter Pipe Slope	0.0017 ft/100ft
18-inch Diameter Pipe Slope	0.0014 ft/100ft
21 through 36-inch Diameter Pipe Slope	0.0011 ft/100ft
Small Lift Stations	Up to 1 MGD or 750 gpm 10-inch dia. Force Main
Medium Lift Stations	Up to 4 MGD or 2,800 gpm 18-inch dia. Force Main
Large Lift Stations	Up to 5 MGD or 3,500 gpm 20-inch dia. Force Main

Wastewater System Evaluation

Multiple means were used to evaluate the adequacy of the existing wastewater system as well as the sizing of proposed facilities. Interviews were conducted with City Operations staff, and as-built drawings and reports were reviewed. In addition, a hydraulic model was developed based on the City Geographical Information System (GIS) geodatabase. The City's geodatabase was converted to either "links" or "nodes" in the model. The model links include gravity pipes, force main pipes, and pump elements. The model nodes include manhole and wet well elements. Targeted flow monitoring data from March 2023 and other available field flow data were used to compare and calibrate the model flows to accurately represent the City's wastewater system. The model was calibrated for existing and ultimate development conditions within the City. Wastewater generation factors by land use category were developed. Four modeling scenarios were evaluated to identify possible hydraulic deficiencies that can be addressed with future projects as part of the Capital Improvement Program. These scenarios include weather flows for existing dry, existing wet, ultimate dry, and ultimate wet. Other system evaluation components included a review of wastewater treatment capacity rights and lift station pump capacity.

Capital Improvement Program

The Capital Improvement Program (CIP) is recommended to mitigate existing and forecasted hydraulic deficiencies as well as address potential pumping and treatment capacity shortfalls within the collection system. The CIP includes cost estimates that were based on capital construction costs, project costs, construction contingencies, cost index and price escalation, engineering costs, and legal and administrative costs.

Prioritization of wastewater facility improvements were determined based on hydraulic modeling results and were split into two categories. Near-term projects incorporate essential developments that require immediate attention and are recommended to be addressed within 1-5 years. Long-term projects, on the other hand, were given a 6 to 25 year recommended timeline.

Improvements provided on **Table ES-3** were identified as near-term based on existing hydraulic deficiencies, failing to meet City design criteria, and/or required infrastructure for septic system conversion. CIP projects in **Table ES-4** do not require immediate attention but are recommended to satisfy ultimate buildout requirements.

Table ES-3 Proposed Near-Term Improvements

Facility Name	Project ID	Description of Improvement	Estimated Project Cost
Diversion Structures			
San Bernardino Ave and Citrus Ave(1)	-	Change diversion of splitter box. Reconfigure flow direction westerly (MH ID: I24_70)	-
San Bernardino Ave and Poplar Ave(1)	-	Change diversion of splitter box. Reconfigure flow direction westerly (MH ID: H24_88)	-
Cypress Ave and Baseline Ave(1)	-	Change diversion of splitter box. Reconfigure flow direction westerly (MH ID: I26_28)	-
Palmetto Ave and Valley Blvd	H-1	Install diversion stop plate to divert flow into southerly parallel line	$128,000
Alder Ave and Hawthorne Ave	H-3	Install diversion structure to split half flow into Hawthorne Ave and half into Alder Ave	$128,000
		Subtotal Diversion Structures:	$256,000
Pipelines			
Alder Ave. and Hawthorne Ave	H-2	Replace ±1,350 LF of 6" dia. pipe with 10" dia. pipe	$669,000
Granada Ave. and Alder Ave.	H-4	Replace ±2,400 LF of 8"-12" dia. pipe with 12" and 15" dia. pipe	$2,436,000
Marygold Ave. and Palmetto Ave.	H-5	Replace ±1,300 LF of 10" dia. pipe with 15" dia. pipe	$780,000
Juniper Ave. and Randall Ave.	H-6	Replace ±2,650 LF of 18" dia. pipe with 24" dia. pipe	$2,134,000
Oleander Ave. and Orange Way	H-7	Lower invert elevation of manhole L21_22 to increase slope and maximize pipe capacity prior to RR crossing. Replace ±1,000 LF of 12" dia. pipe and ±300 LF of 10" dia. pipe.	$714,000
Arrow Blvd Interceptor	S-1	Proposed ±7,700 LF of 15" dia. pipe, ±5,300 LF of 12" dia. pipe, and ±2,350 of 8" dia. pipe.	$8,907,000
Downtown Core		Refer to Appendix A	$7,871,000
		Subtotal Pipelines:	$23,511,000
		Grand Total:	**$23,767,000**

Notes:
(1) Existing structure present. No cost associated with reconfiguration of existing infrastructure.

Table ES-4 Proposed Long-Term Improvements

Facility Name	Project ID	Description of Improvement	Estimated Project Cost
Pipelines			
Westgate SP Phase 1	H-8	Proposed ±2,520 of 10" dia. and 1,600± of 12" dia. backbone piping for Westgate SP	$2,152,000
Westgate SP Phase 2	H-9	Proposed ±2,560 of 12" dia. backbone piping for Westgate SP	$1,695,000
Arboretum SP	H-10	Proposed ±1,310 of 10" dia. backbone piping for Arboretum Specific Plan	$649,000
Tamarind Ave. and Grevillea St.	H-11	Replace ±1,900 LF of 15" dia. pipe with 18" dia. pipe	$1,273,000
Alder Ave. and Pine Ave.	H-12	Replace ±2,150 LF of 12" dia. pipe with 15" dia. pipe	$1,290,000
Maple Ave	S-2	Proposed 2,650± LF of 15" dia. pipe, 2,650± LF of 12" dia. pipe, and 6,600± of 10" dia. pipe.	$6,355,000
		Subtotal Pipelines:	$13,414,000
Lift Stations			
Tamarind	L-1	Proposed 1.7 MGD lift station (1.3 MGD firm capacity)	$3,000,000
		Subtotal Lift Stations:	$3,000,000
		Grand Total:	**$16,414,000**

SECTION 1 - Introduction

The City of Fontana (City) was incorporated in 1952 and its population as of January 2022 is estimated at 212,809 persons, making it the second-most populous city in San Bernardino County and the 20th most populous in the state.[1] The City is located in southwest San Bernardino County between the Cities of Rialto and Rancho Cucamonga, south of the San Bernardino Mountains and north of the City of Jurupa Valley (**Figure 1-1 – Vicinity Map**). The City's incorporated area encompasses 43.4 square miles and the City Sphere of Influence (SOI) includes an additional 9 square miles. The City provides sewer collection services to the businesses and citizens of Fontana through the City Public Works Department. Because the City does not own or operate any sewer treatment facilities, all wastewater treatment is provided by a combination of facilities owned by the Inland Empire Utilities Agency (IEUA) and the City of Rialto.

1.1 Background

Albert A. Webb Associates (WEBB) was retained by the City in 2022 to prepare this Sewer Master Plan as an update to the prior sewer master plan, Sanitary Sewer System Master Plan for City of Fontana, dated May 2013. This plan will supersede any previous sewer master plans. Future developments that are within the City but outside of an existing wastewater tributary area will need to coordinate with the City individually to determine whether wastewater service can be provided.

1.2 Objectives

The objectives of this Sewer Master Plan are to evaluate the existing system for capacity, identify existing and future deficiencies in the collection system as a result of future developments through build-out of the community, define planning and sizing criteria, size pipes and lift stations to convey build-out peak dry and wet weather flows, and prioritize phased recommended improvements in a Capital Improvement Program (CIP).

1.3 Scope of Work

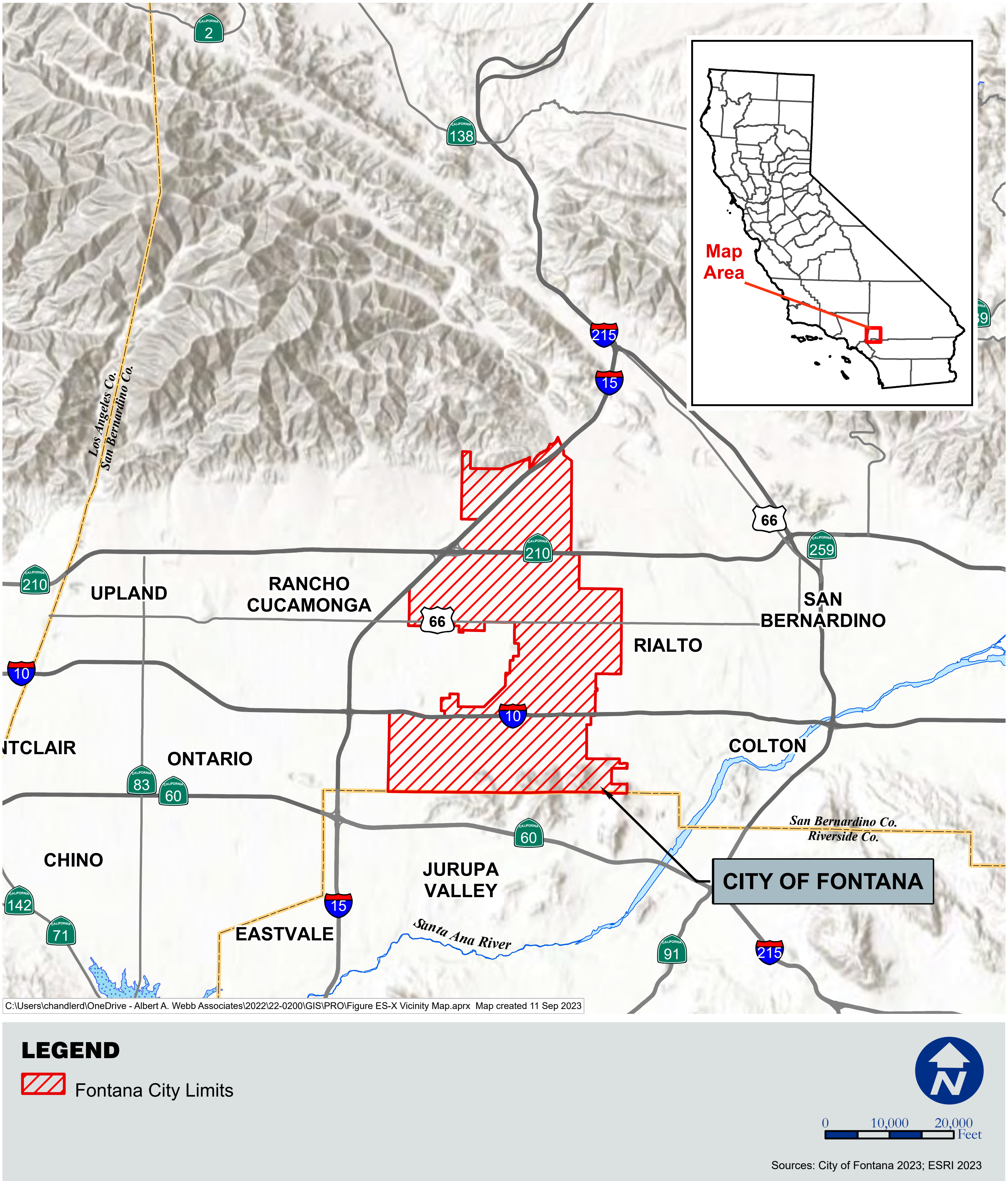
To accomplish the objectives of this report, the scope of the study includes the following:

- Inventory the existing facilities including site visits;
- Review City's relevant planning documents and GIS data;
- Develop flow monitoring plan;
- Define the existing and ultimate tributary area boundaries;
- Establish design criteria;
- Develop and calibrate a hydraulic model;
- Update flow generation and peaking factors;

[1] Source: California Department of Finance, 2022 City Population Rankings.

- Identify and prioritize needed improvements;
- Prepare a Capital Improvement Plan;
- Prepare a summary report;
- Prepare connection fee study; and
- Prepare a sewer lift station condition analysis.

FIGURE 1-1 VICINITY MAP



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SECTION 2 - Land Use and Population

2.1 Study Area Boundary and Composition

The study area for this Sewer Master Plan is the City's existing sewer service area. The sewer service area consists of the incorporated City limits and the City SOI, as shown in **Figure 2-1 – Sewer Service Area**. This plan assumes the existing and ultimate sewer service areas are the same. The City has five sewer tributary areas, as shown on **Figure 2-2 – Sewer Tributary Areas.** Data collection for this Sewer Master Plan included meeting with staff from the Fontana Planning Department, a review of pertinent planning documents prepared by the City and its consultants in addition to sewer system-related data generated by the City. The planning documents reviewed for this report include the *City of Fontana General Plan* (FGP) (adopted 2018), *City of Fontana General Plan Draft Environmental Impact Report* (DEIR), City land use plan as of October 3, 2022, and land use plans for each of the active Specific Plans from the City's website.

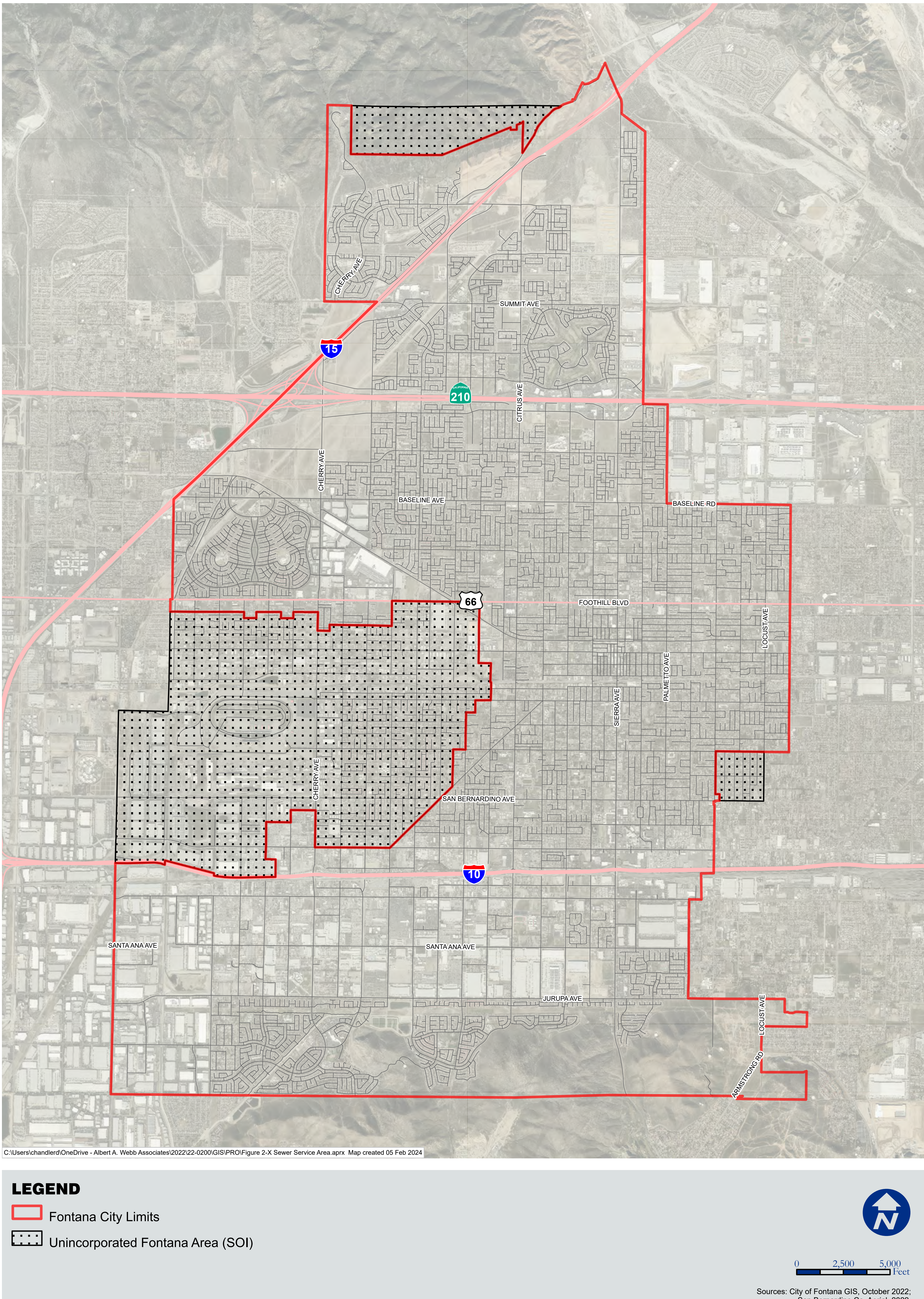
2.2 Topography

The City as a whole is relatively flat that generally slopes downward to the south and includes an alluvial plain with mild slopes between one and three percent. The only significant areas of topographic relief being at the northern and southern city limits. The northern city limits include the foothills of the San Gabriel Mountains and the southern city limits include the Jurupa Hills (Figure 2-1). Surface elevations in the City range from approximately 850 to 2,740 feet above mean sea level (amsl). (FGP DEIR, p. 13)

2.3 Climate

Summer in the City can be extremely hot and dry, with average temperatures in the mid-90s and exceeding 100 degrees Fahrenheit several times a year. Average winter lows are in the low 40s and an average rainfall depth of about 10 inches per year (WestYost, p. 3-4).

FIGURE 2-1 EXISTING SEWER SERVICE AREA



Sources: City of Fontana GIS, October 2022; San Bernardino Co. Aerial, 2022.

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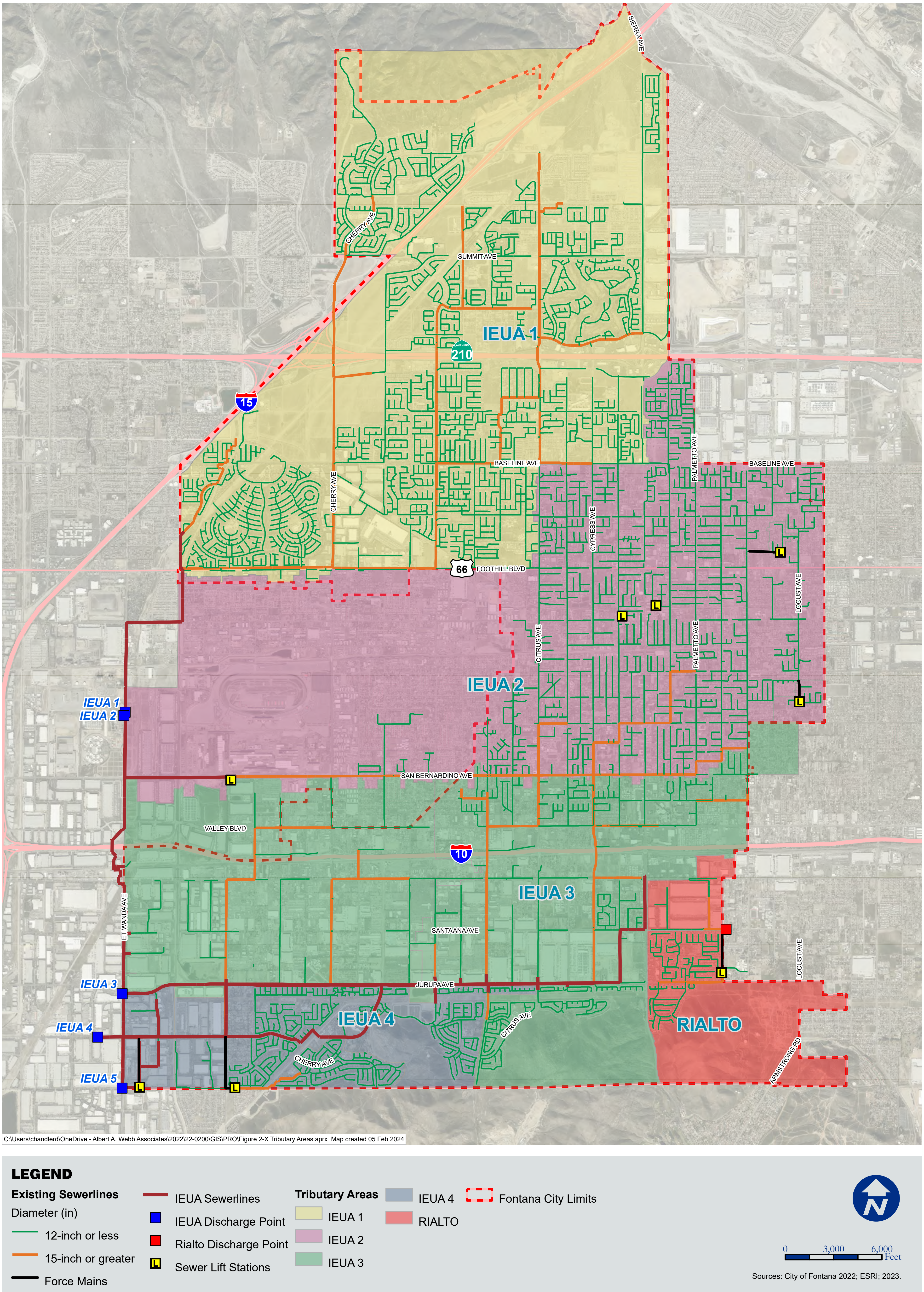
FIGURE 2-2

SEWER TRIBUTARY AREAS



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2.4 Land Uses

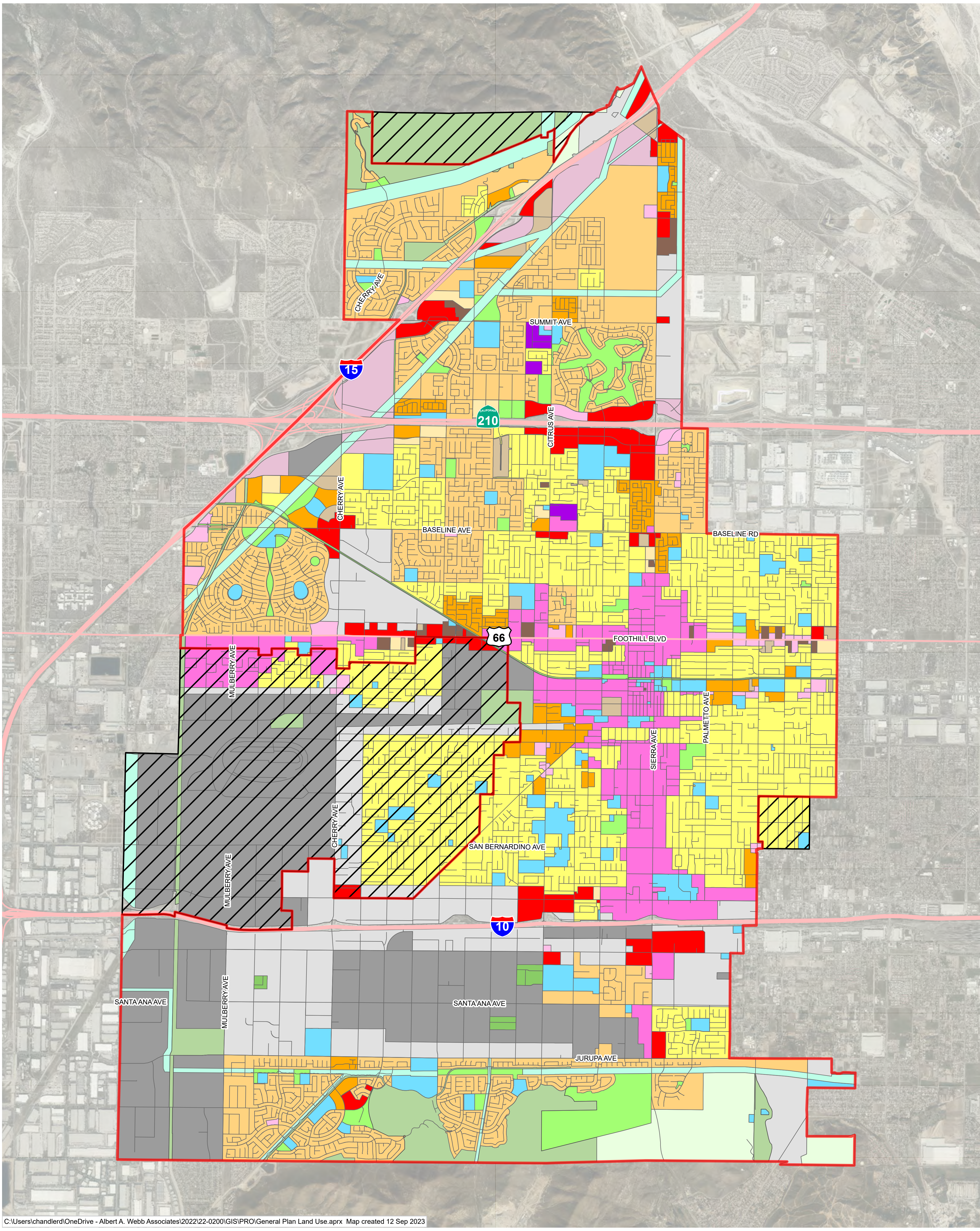
The guide for this study for future land use within any city or county is that jurisdiction's General Plan Land Use Element; thus, the basis for land use and population projections to be used in this Sewer Master Plan are the land uses shown in **Figure 2-3 – General Plan Land Use Plan**. The General Plan land use designations on Figure 2-2 are based on GIS shape files (current as of October 3, 2022) provided by the City and modified as noted herein by WEBB based on consultation with City staff.

There are approximately 27,750 acres of incorporated City and as shown in **Table 2-1**, Residential Planned Community (R-PC) occupies the largest area of the City.

Table 2-1 City Land Use Designations

Land Use Category	Land Use Code	Zoning Code	Designation	Density (du/ac) or Intensity (FAR)	Incorporated City	
					Area (Acres)	% of Area
Commercial	C-C	C-1	Community Commercial	0.1 - 1.0 FAR	271	1.0%
	C-G	C-2	General Commercial	0.1 - 1.0 FAR	830	3.0%
Industrial	I-G	M-2	General Industrial	0.1 - 0.6 FAR	2,795	10.1%
	I-L	M-1	Light Industrial	0.1 - 0.6 FAR	3,087	11.1%
Open Space	OS	OS-N OS-R	Open Space	n/a	1,042	3.8%
Public Facilities	P-PF	P-PF	Public Facilities	n/a	1,150	4.1%
	P-R	-	Recreation Facilities	n/a	927	3.3%
	P-UC	P-UC	Public Utility Corridors	n/a	979	3.5%
Residential	R-E	R-E	Residential Estates	2 du/ac	634	2.3%
	R-PC (Specific Plans)	R-PC	Residential Planned Community	3.0 - 6.4 du/ac	5,978	21.5%
	R-SF	R-1	Single Family	2.1 - 5 du/ac	5,401	19.5%
	R-M	R-2	Medium Density	5.1 - 12 du/ac	890	3.2%
	R-MF	R-3	Multi-Family	12.1 - 24 du/ac	174	0.6%
	R-MFMH	R-4	Multi-Family/High	24.1 - 39 du/ac	225	0.8%
	R-MFH	R-5	Multi-Family High	39.1 - 50 du/ac	121	0.4%
	R-T		Residential Trucking	2 du/ac	61	0.2%
Mixed Use	WMXU-1		Walkable Mixed-Use Corridor Downtown	0.2 - 2 FAR, 3 - 39 du/ac	1,766	6.4%
	WMXU-2		Walkable Mixed Use Urban Village	0.2 - 1.0 FAR, 2.1 - 24 du/ac	66	0.2%
	RMU	R-MU	Regional Mixed Use	0.1 - 1 FAR, 12-24 du/ac	545	2%
Right-Of-Way	ROW		Right-of-Way	n/a	805	2.9%
				Rounding Error Correction	4.788	-
				Sum	**27,750**	**100%**

FIGURE 2-3 GENERAL PLAN LAND USE MAP



LEGEND

- Unincorporated Fontana Area (SOI)
- City of Fontana

Land Use

- R-E Residential Estates
- R-PC Residential Planned Community
- R-SF Single Family Residential
- R-M Medium Density Residential
- R-MF Multi-Family Residential
- R-MFMH Multi-Family Medium/High Residential
- R-MFH Multi-Family High Residential
- R-T Residential Trucking
- WMXU-1 Walkable Mixed Use Corridor Downtown
- WMXU-2 Walkable Mixed Use Urban Village
- C-C Community Commercial
- C-G General Commercial
- RMU Regional Mixed Use
- I-L Light Industrial
- I-G General Industrial
- P-PF Public Facilities
- P-R Recreation Facilities
- P-UC Public Utility Corridors
- OS Open Space

0 2,500 5,000 Feet

Sources: City of Fontana GPLU, October 2022; San Bernardino Co. Aerial, 2020.

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2.4.1 Sphere of Influence / Unincorporated San Bernardino County

Approximately 5,750 acres of unincorporated San Bernardino County make up the City's Sphere of Influence (SOI), all of which is considered for this analysis to be part of the City sewer service area (see Figure 2-1). As shown in **Table 2-2**, General Industrial (I-G) occupies the largest area in the SOI.

Table 2-2 City Sphere of Influence Land Use Designations

Land Use Category	Land Use Code	Zoning Code	Designation	Density (du/ac) or Intensity (FAR)	City Sphere of Influence Area (Acres)	City Sphere of Influence % of Area
Commercial	C-C	C-1	Community Commercial	0.1 - 1.0 FAR	15	0.3%
	C-G	C-2	General Commercial	0.1 - 1.0 FAR	55	1.0%
Industrial	I-G	M-2	General Industrial	0.1 - 0.6 FAR	2,538	44.1%
	I-L	M-1	Light Industrial	0.1 - 0.6 FAR	523	9.1%
Open Space	OS	OS-N OS-R	Open Space	n/a	612	10.6%
Public Facilities	P-PF	P-PF	Public Facilities	n/a	87	1.5%
	P-R	-	Recreation Facilities	n/a	3	0.1%
	P-UC	P-UC	Public Utility Corridors	n/a	146	2.5%
Residential	R-E	R-E	Residential Estates	2 du/ac	21	0.4%
	R-PC (Specific Plans)	R-PC	Residential Planned Community	3.0 - 6.4 du/ac	0	0.0%
	R-SF	R-1	Single Family	2.1 - 5 du/ac	1,453	25.3%
	R-M	R-2	Medium Density	5.1 - 12 du/ac	0	0
	R-MF	R-3	Multi-Family	12.1 - 24 du/ac	0	0
	R-MFMH	R-4	Multi-Family/High	24.1 - 39 du/ac	0	0
	R-MFH	R-5	Multi-Family High	39.1 - 50 du/ac	0	0
	R-T		Residential Trucking	2 du/ac	0	0
Mixed Use	WMXU-1		Walkable Mixed-Use Corridor Downtown	0.2 - 2 FAR, 3 - 39 du/ac	244	4.2%
	WMXU-2		Walkable Mixed Use Urban Village	0.2 - 1.0 FAR, 2.1 - 24 du/ac	0	0
	RMU	R-MU	Regional Mixed Use	0.1 - 1 FAR, 12-24 du/ac	0	0
Right-Of-Way	ROW		Right-of-Way	n/a	47	0.8%
				Rounding Error Correction	4.788	-
				Sum	**5,749**	**100%**

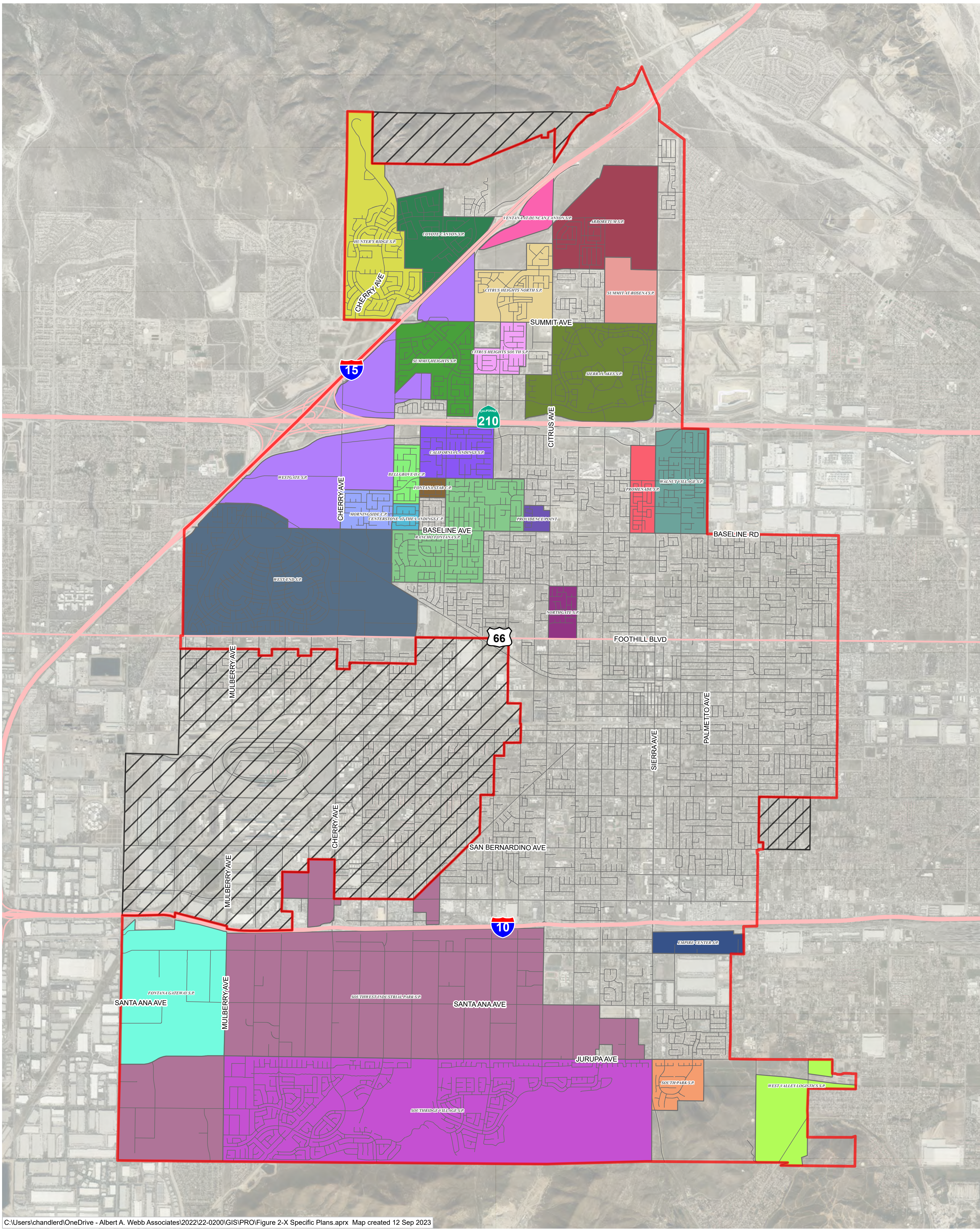
2.4.2 Specific Plans

As shown on **Figure 2-4** (next page), the City currently has 23 Specific Plans that each have unique land use plans to guide development of a variety of land uses (identified as R-PC in Tables 2-1 and 2-2, above). By visual inspection of aerial imagery, one Specific Plan is undeveloped (West Gate) and six are partially developed (i.e., Walnut Village, Empire Center, Fontana Promenade, Ventana, West Valley Logistics, and Arboretum).

This master plan uses the land use designations from the General Plan land use plan provided by the City, which identifies residential Specific Plans with one code (R-PC) regardless of the range of densities allowed. Therefore, the sewage generation rate for R-PC discussed later in this report represents an amalgamation of residential land uses.

FIGURE 2-4

SPECIFIC PLANS



LEGEND

- Unincorporated Fontana Area (SOI)
- City of Fontana

Specific Plans

- ARBORETUM S.P.
- BELLGROVE II C.P.
- CALIFORNIA LANDINGS S.P.
- CENTERSTONE AT THE LANDINGS C.P.
- CITRUS HEIGHTS NORTH S.P.
- CITRUS HEIGHTS SOUTH S.P.
- COYOTE CANYON S.P.
- EMPIRE CENTER S.P.
- FONTANA GATEWAY S.P.
- FONTANA STAR C.P.
- HUNTER'S RIDGE S.P.
- MORNINGSIDE C.P.
- NORTHGATE S.P.
- PROMENADE S.P.
- PROVIDENCE POINT
- RANCHO FONTANA S.P.
- SIERRA LAKES S.P.
- SOUTH PARK S.P.
- SOUTHRIDGE VILLAGE S.P.
- SOUTHWEST INDUSTRIAL PARK S.P.
- SUMMIT AT ROSENA S.P.
- SUMMIT HEIGHTS S.P.
- VENTANA AT DUNCAN CANYON S.P.
- WALNUT VILLAGE S.P.
- WEST END S.P.
- WEST VALLEY LOGISTICS S.P.
- WESTGATE S.P.

0 2,500 5,000 Feet

Sources: City of Fontana SP, October 2022; San Bernardino Co. Aerial, 2020.

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2.4.3 Septic Systems

According to City data, onsite wastewater treatment systems (OWTS) or “septic tanks” serve approximately 3,672 parcels (1,671 acres) located within the City, and 4,659 parcels (2,880 acres) in the SOI. City data on the land uses served by septic systems are shown on **Figure 2-5**. Data for septic systems in the SOI are shown in **Figure 2-6**.

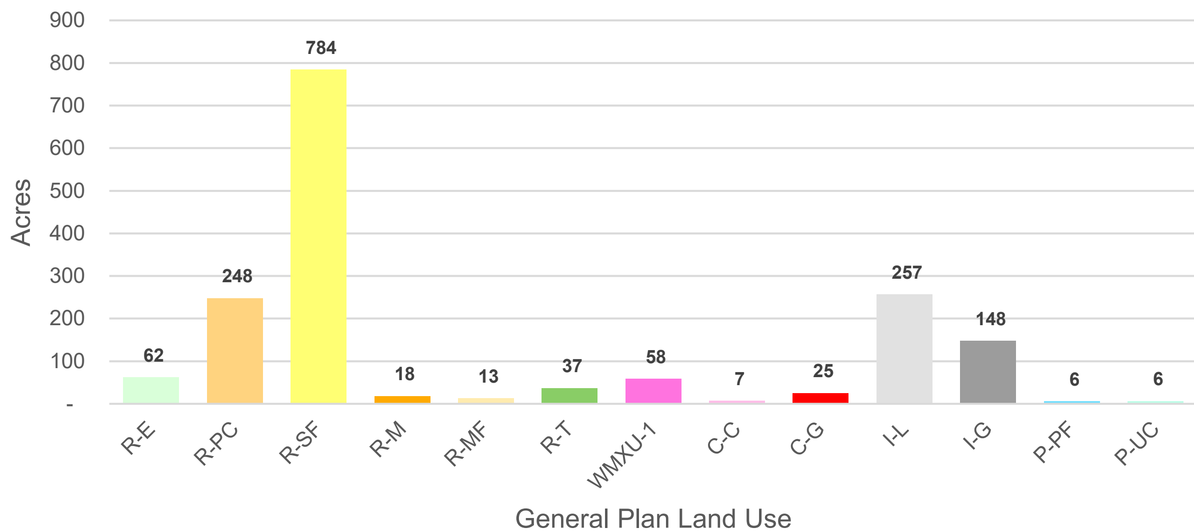


Figure 2-5 Septic Properties within City Limits

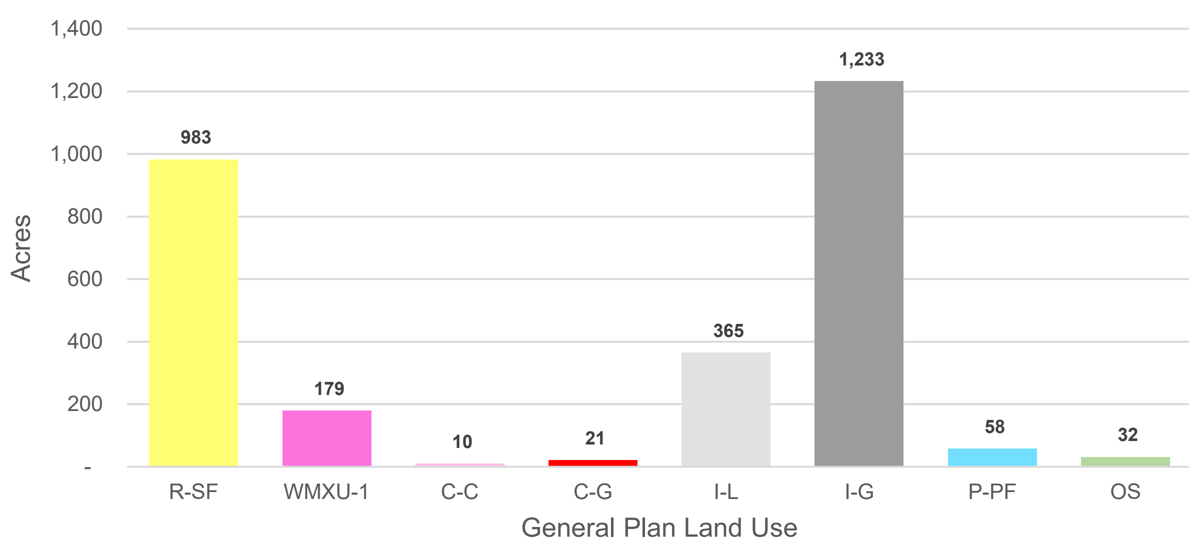


Figure 2-6 Septic Properties within SOI Limits

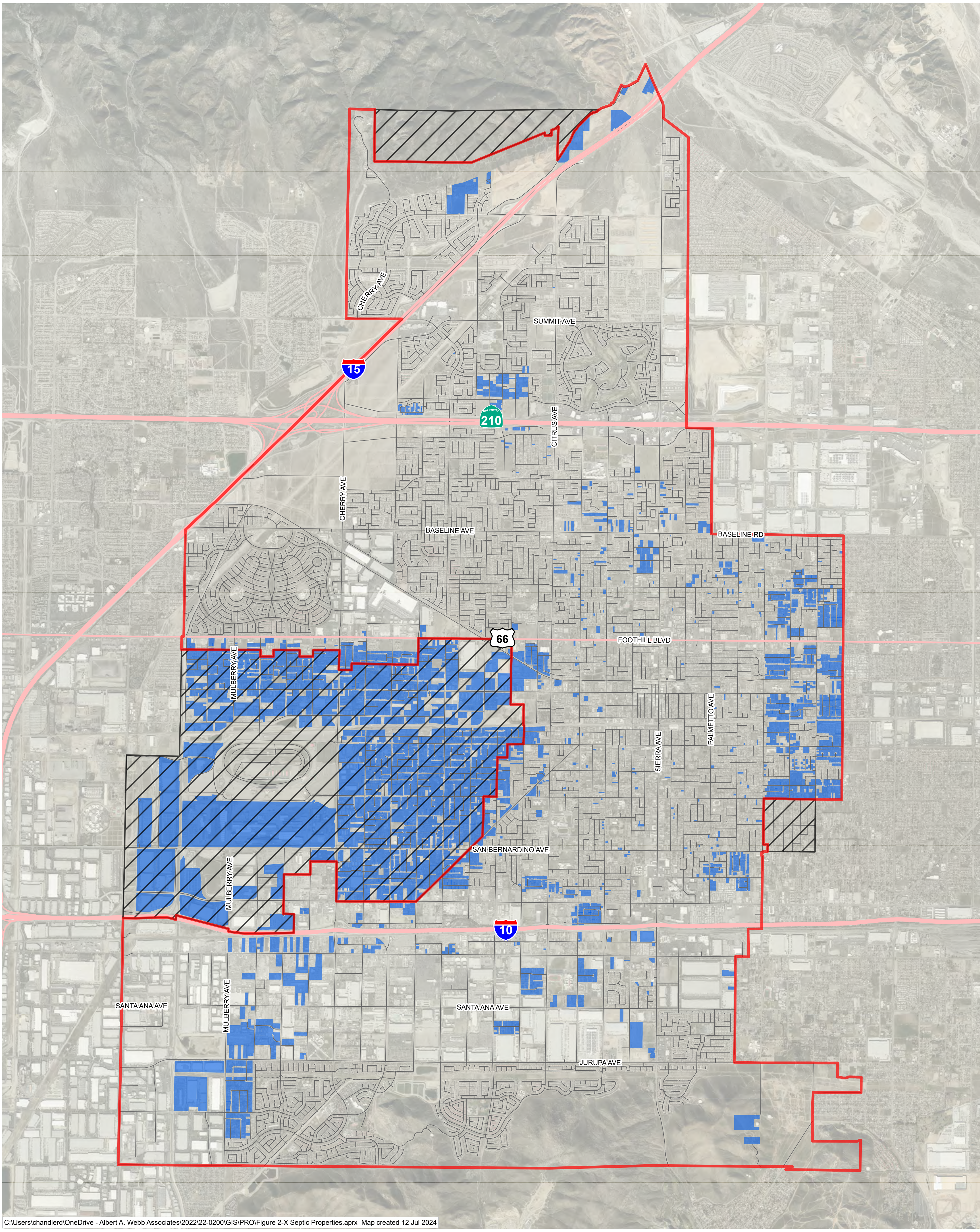
In 2018, SB 1215[1] was signed into law, establishing funding and the regulatory framework for a statewide Wastewater Consolidation Program to facilitate the consolidation of inadequate onsite sewage treatment systems (septic) with existing sewer systems. The legislation authorizes the State Water Board to assist public agencies, water districts, cities, or municipalities with a disadvantaged community where septic systems have failed or can threaten safe drinking water sources. Funding for this program comes in the form of grants allocated from the Clean Water State Revolving Fund, which is available for eligible community consolidation projects. Maximum allowable funding for an individual consolidation project is $8 million or up to $75,000 per household connection.

The City desires to have all properties connected to the sewer system in the future; however, properties are converted currently on a case-by-case basis from septic to sewer. See **Figure 2-7** for the location of all private septic sewer systems within the City's SOI.

[1] California Water Boards, *Wastewater Consolidation Program* (Wastewater Consolidation Program | Central Valley Regional Water Quality Control Board (ca.gov))

FIGURE 2-7

PROPERTIES ON SEPTIC



LEGEND

- Unincorporated Fontana Area (SOI)
- City of Fontana
- Septic Properties (8,331)

0 2,500 5,000 Feet

Sources: City of Fontana GIS, October 2022;
San Bernardino Co. Aerial, 2022.

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2.4.4 Master Case Numbers

The City maintains a list of development project applications called “Master Case Numbers” or the MCN list. Approved projects and in-process projects larger than 20 acres are shown below in **Table 2-3**. The MCN list serves as a tool for City planning staff to organize, track, and outline existing and future development projects throughout the City’s service area. MCN projects were evaluated in the master plan using their designated general plan land use and implemented in the model analysis.

Table 2-3 MCN Projects Larger than 20 Acres

MCN Project Name	Acres
Approved Projects	
Casa Grande Warehouse Project	21.28
Victoria Homes Tract 20229	21.86
Fontana Santa Ana Industrial Center	22.97
Fontana Foothills Commerce Center	33.69
Sierra Business Center	34.19
Frome Subdivision Tract 20018	36.91
Ventana Project	37.06
Goodman Industrial Park III	48.22
Landmesser Lot Line Adjustment	49.55
Target Warehouse Generator	73.88
Arboretum Gardens – G8, G9, G10	76.10
Ventana Specific Plan Amendment	90.41
Narra Hills (Formerly Monarch Hills)	102.41
I-15 Logistics Center	104.49
Gardens At The Arboretum	126.57
West Valley Logistics Center	104.49
Approved Projects Subtotal	**1,172.76**
In Process Projects	
Duke Warehouse	24.73
The Gardens At The Arboretum	25.23
The Heights At Southridge	36.86
Westgate Specific Plan Amendment	810.00
In Process Projects Subtotal	**896.83**
Total Projects	**2,069.58**

2.4.5 Downtown Core Project, Sierra Avenue Corridor Redevelopment ("SB 2 Grant Project")

At the conclusion of this master plan analysis, the City initiated its Downtown Core Project, which would allow for redevelopment and higher densities in the City's downtown area. The City adopted the "Fontana Forward" 2025-2035 General Plan Update in 2018. As part of that update, the City Council approved Chapter 14, Downtown Area Plan, with the goal of creating a vibrant, mixed-use area with quality housing and retail options. The City is seeking to improve the Form Based Code (FBC) in the project area with straightforward development guidelines, a stronger residential presence, more support for mixed-uses, a streamlined development process, and development incentives exclusive to the project area.

WEBB was put under contract with the City to execute a sewer hydraulic analysis using revised generation factors based on proposed land use changes within the Downtown Core Project area differing than those created herein to further enhance our findings in the master plan. Proposed sewerlines, within the Downtown Core Project, were sized and evaluated based on the maximum development potential in each FBC District while existing adjacent downstream facilities were analyzed for potential deficiencies or surcharge. Proposed land use changes and model result exhibits can be found in **Appendix A**. Although master plan findings do not reflect changes made to the downtown area, it was verified that no additional upsizing changes were needed downstream besides what was identified in **Appendix A**.

2.4.6 Speedway Commerce Center II Specific Plan

The Speedway Commerce Center II Specific Plan is for the future development of approximately 433 acres of the approximately 522-acre site that is currently developed with the Auto Club Speedway, formerly known as the California Speedway, in San Bernardino County and within the City's SOI. The Project consists of the development of six separate planning areas with 10 parcels for up to 6,600,000 square feet of high cube logistics and e-commerce uses, approximately 261,360 square feet of accessory commercial uses, approximately 98 acres of vehicle parking/drop lot areas and associated open space and internal public roadways. Each planning area contains sub-areas to accommodate the vehicle parking, drop lots, and open space uses. The Project would surround the Next Gen in California Project approved by the County in June 2021 and to be developed on approximately 90 acres of the existing Auto Club Speedway site. Sewer generation calculations were revised to reflect the updated land use zoning of each designated planning area and were incorporated in the hydraulic model analysis. **Figure 2-8** below depicts the Speedway Commerce Center II modified land use plan.

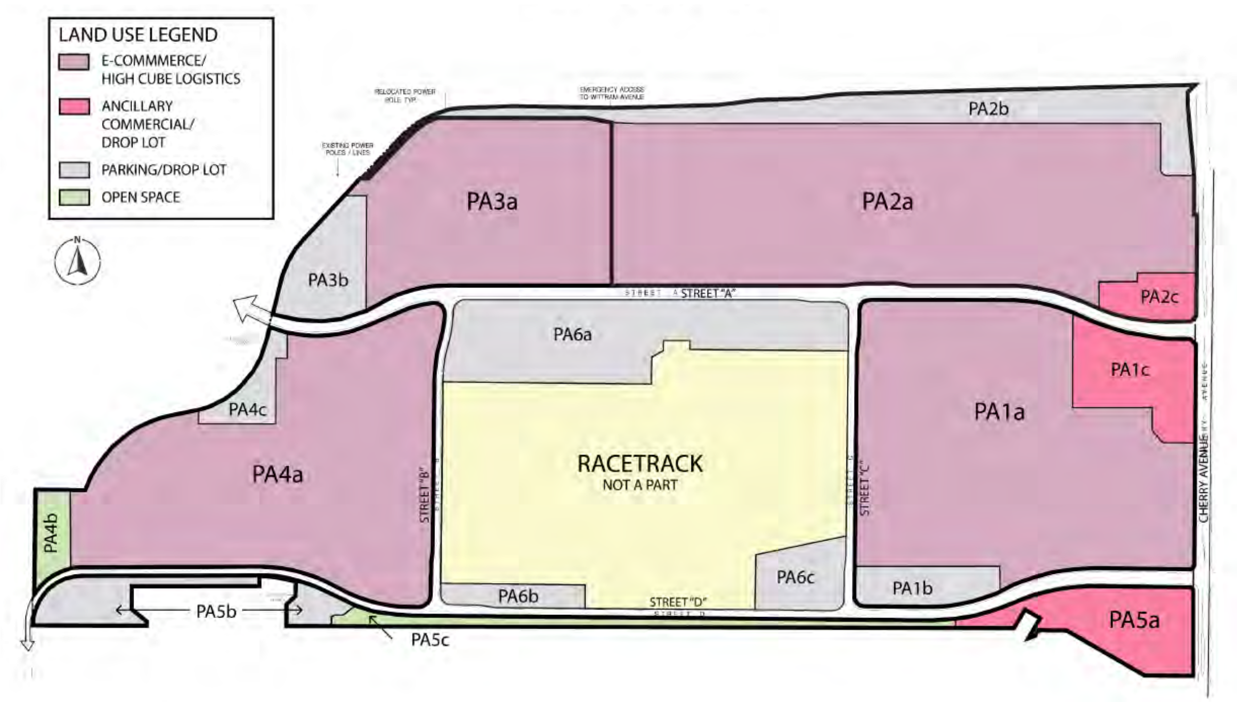


Figure 2-8 Speedway Commerce Center II Specific Plan

2.4.7 Accessory Dwelling Units

Accessory Dwelling Units (ADUs) are also known as "granny flats," second units, or in-law units. ADUs are being encouraged by the State to increase residential infill and help meet the increasing statewide demand for affordable housing. City staff were consulted as part of this Sewer Master Plan about the potential future influx of ADUs. Fontana Municipal Code Section 30-467 addresses ADUs and the City provided the following statistics on ADUs:

- City land use categories that allow ADUs: R-E, R-PC, R-SF, and R-M.
- As of 2022, permitted ADUs are located in the City as follows:
  1. Eleven R-SF parcels on 40.7 acres;
  2. Sixteen R-PC parcels on 11.6 acres;
  3. Five WMXU-1 parcels on 10.5 acres; and
  4. Five R-M parcels on 1.7 acres.

Several laws regarding ADUs have been signed by the Governor and more are being considered by the state legislators. Therefore, the reader is directed to the current version of Gov. Code Section 65852.2 for the latest information related to sewer service.

An increase in ADUs in existing residential areas may densify them more than what had been planned for previously by the City. Particularly in areas that are considered currently "built-out" with infrastructure that is already sized at "ultimate" design capacity, an increase in ADUs may trigger capital projects to upsize existing pipes or replace degrading infrastructure earlier than expected.

This master plan includes a 20% increase in population and sewage generation for the residential land uses that allow ADU's, which is based on an assumption that each unit has five persons and half of the residential properties where ADU's are allowed may ultimately develop an ADU and each ADU would have two persons, which results in a 20% population increase.

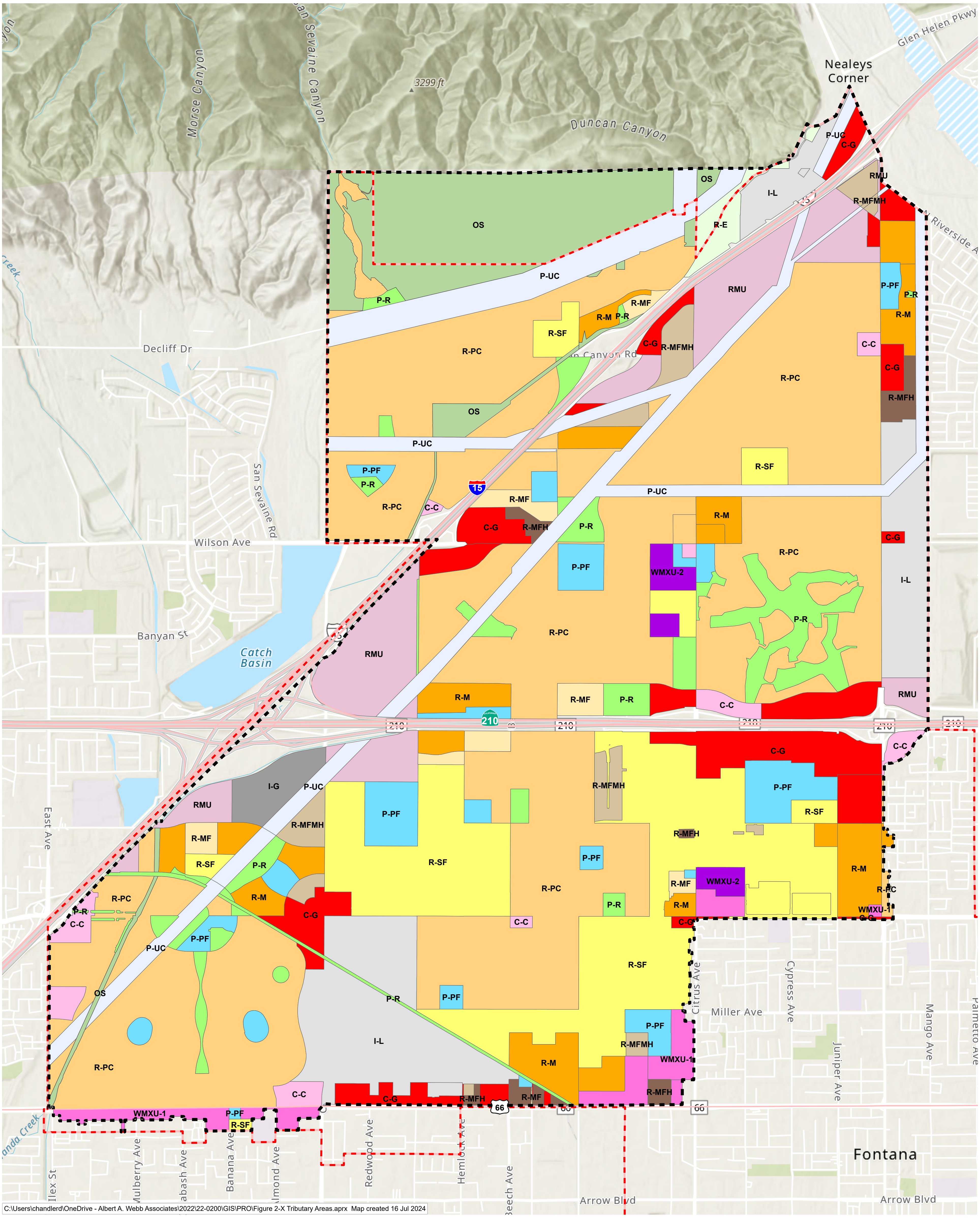
2.4.8 Development Projections

Since sewer system planning is done at the tributary area, future land uses within each tributary area were projected based on the current General Plan Land Use Plan (October 2022). The General Plan Land Use Designations for each tributary area are shown on **Figure 2-9 – IEUA 1 Tributary Area, Figure 2-10 - IEUA 2 Tributary Area, Figure 2-11 - IEUA 3 Tributary Area, Figure 2-12 - IEUA Tributary Area,** and **Figure 2-13 – Rialto Tributary Area.**

To forecast the number of dwelling units (DUs) and square feet (SF) of non-residential land uses within each tributary area, the number of acres of the various General Plan Land Use designations shown on **Figure 2-3** were multiplied by the applicable density or floor area ranges (FAR) as appropriate; and a maximum and mid-range project buildout in dwelling units or square feet (SF) for each land use designation. The maximum and mid-point buildout for each land use designation was determined by multiplying the number of acres of each designation by such designation's maximum, and mid-point density or intensity (in floor area ratio or FAR) for residential and non-residential (i.e., commercial and industrial land uses), respectively. For master planning purposes, these projections were done for each tributary area. Detailed tables showing the land use and buildout projections are included in Appendices A.1 through A.3 and summarized by major land use type in **Table 2-5** through **Table 2-9**.

FIGURE 2-9

IEUA 1 TRIBUTARY AREA



LEGEND

- Fontana City Limits
- IEUA 1 Tributary Area

General Plan Land Use

- R-E Residential Estates
- R-PC Residential Planned Community
- R-SF Single Family Residential
- R-M Medium Density Residential
- R-MF Multi-Family Residential
- R-MFMH Multi-Family Medium/High Residential
- R-MFH Multi-Family High Residential
- WMXU-1 Walkable Mixed Use Corridor Downtown
- WMXU-2 Walkable Mixed Use Urban Village
- C-C Community Commercial
- C-G General Commercial
- RMU Regional Mixed Use
- I-L Light Industrial
- I-G General Industrial
- P-PF Public Facilities
- P-R Recreation Facilities
- P-UC Public Utility Corridors
- OS Open Space

0 1,500 3,000 Feet

Sources: City of Fontana 2022; ESRI; 2023.

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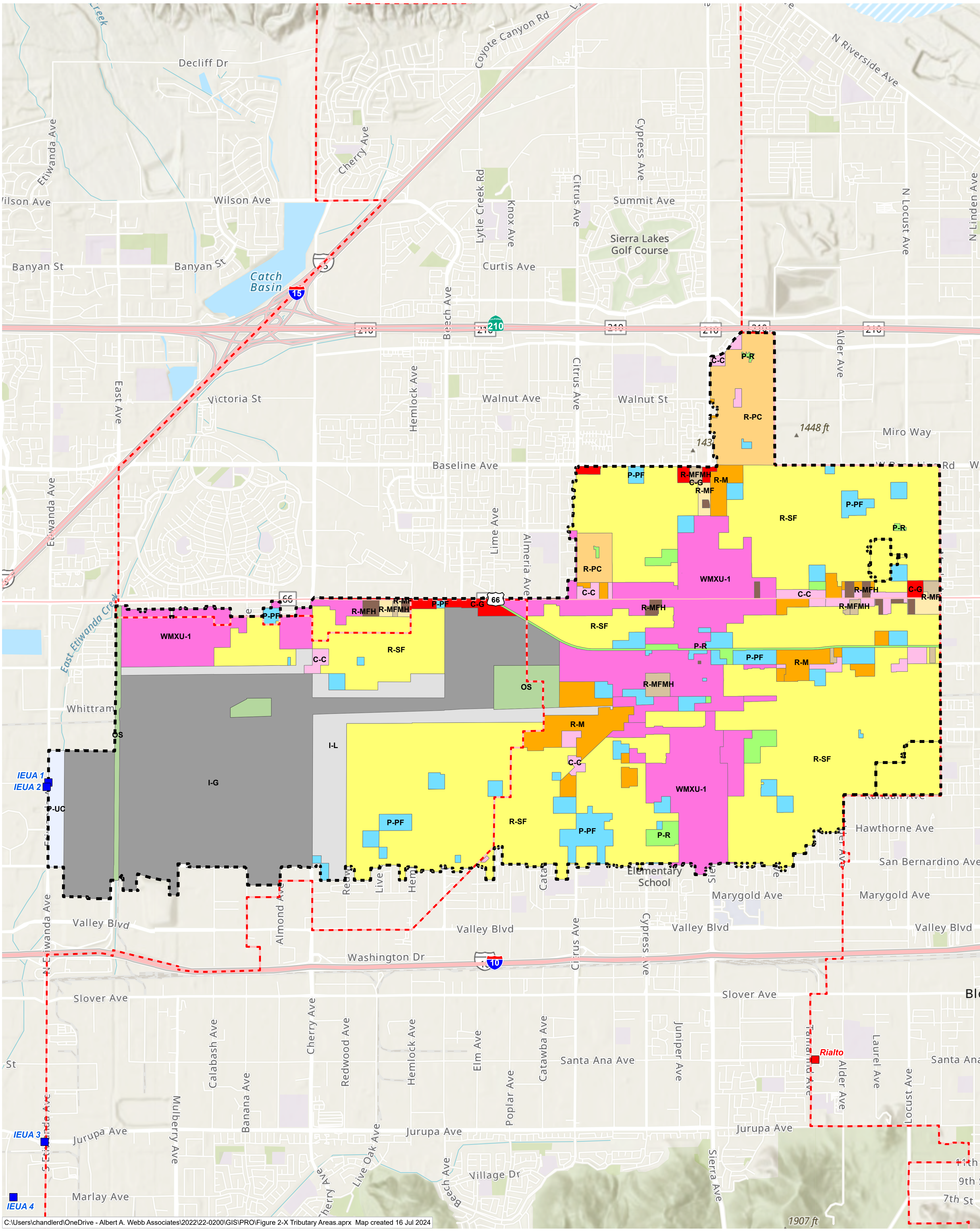
FIGURE 2-10 IEUA 2 TRIBUTARY AREA



LEGEND

- Fontana City Limits
- IEUA 2 Tributary Area
- IEUA Discharge Point
- Rialto Discharge Point

General Plan Land Use

- R-PC Residential Planned Community
- R-SF Single Family Residential
- R-M Medium Density Residential
- R-MF Multi-Family Residential
- R-MFMH Multi-Family Medium/High Residential
- R-MFH Multi-Family High Residential
- WMXU-1 Walkable Mixed Use Corridor Downtown
- C-C Community Commercial
- C-G General Commercial
- I-L Light Industrial
- I-G General Industrial
- P-PF Public Facilities
- P-R Recreation Facilities
- P-UC Public Utility Corridors
- OS Open Space

0 2,500 5,000 Feet

Sources: City of Fontana 2022; ESRI; 2023.

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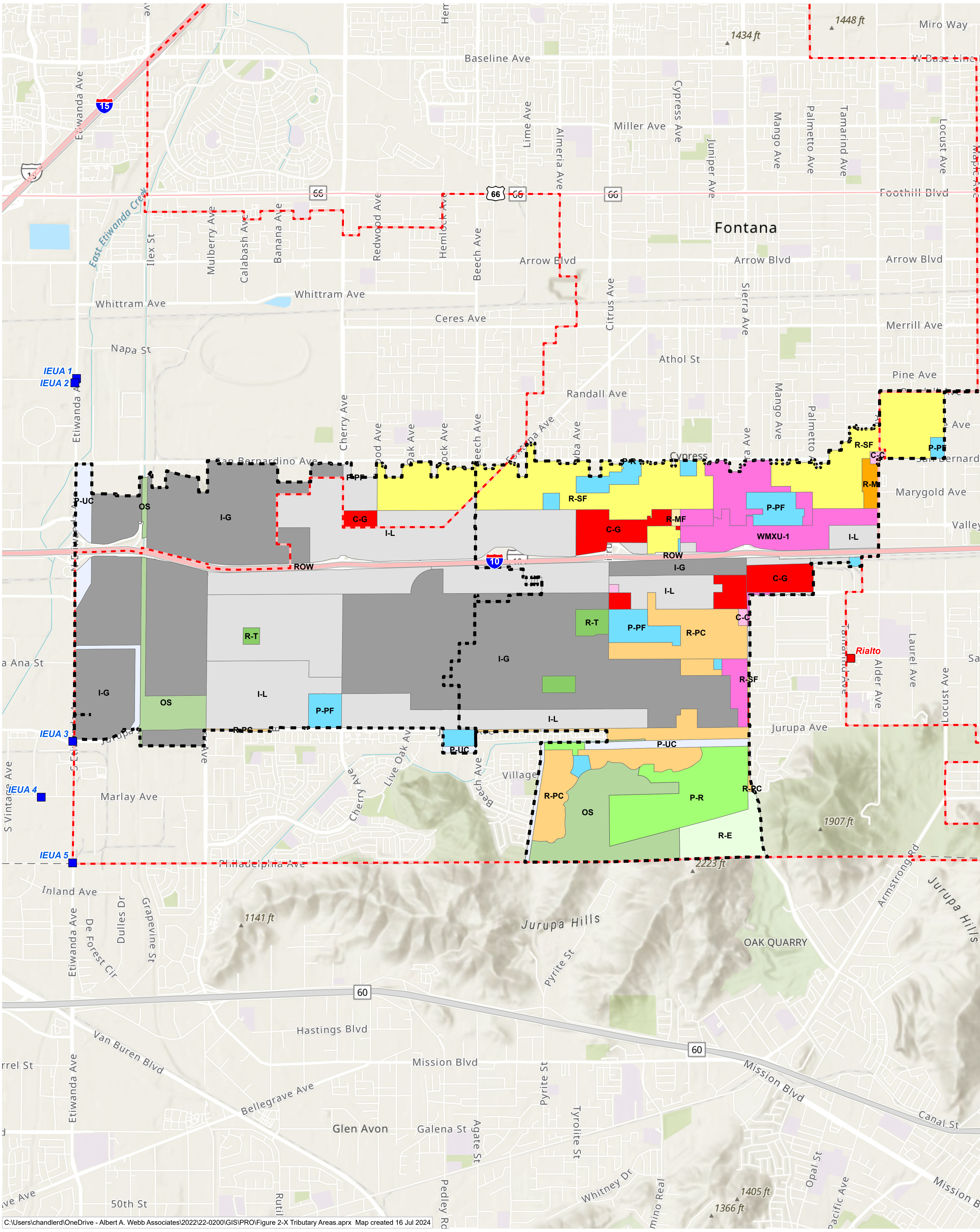
FIGURE 2-11 IEUA 3 TRIBUTARY AREA



LEGEND

- Fontana City Limits
- IEUA 3 Tributary Area
- IEUA Discharge Point
- Rialto Discharge Point

General Plan Land Use

- R-E Residential Estates
- R-PC Residential Planned Community
- R-SF Single Family Residential
- R-M Medium Density Residential
- R-MF Multi-Family Residential
- R-T Residential Trucking
- WMXU-1 Walkable Mixed Use Corridor Downtown
- C-C Community Commercial
- C-G General Commercial
- I-L Light Industrial
- I-G General Industrial
- P-PF Public Facilities
- P-R Recreation Facilities
- P-UC Public Utility Corridors
- OS Open Space

0 2,500 5,000 Feet

Sources: City of Fontana 2022; ESRI; 2023.

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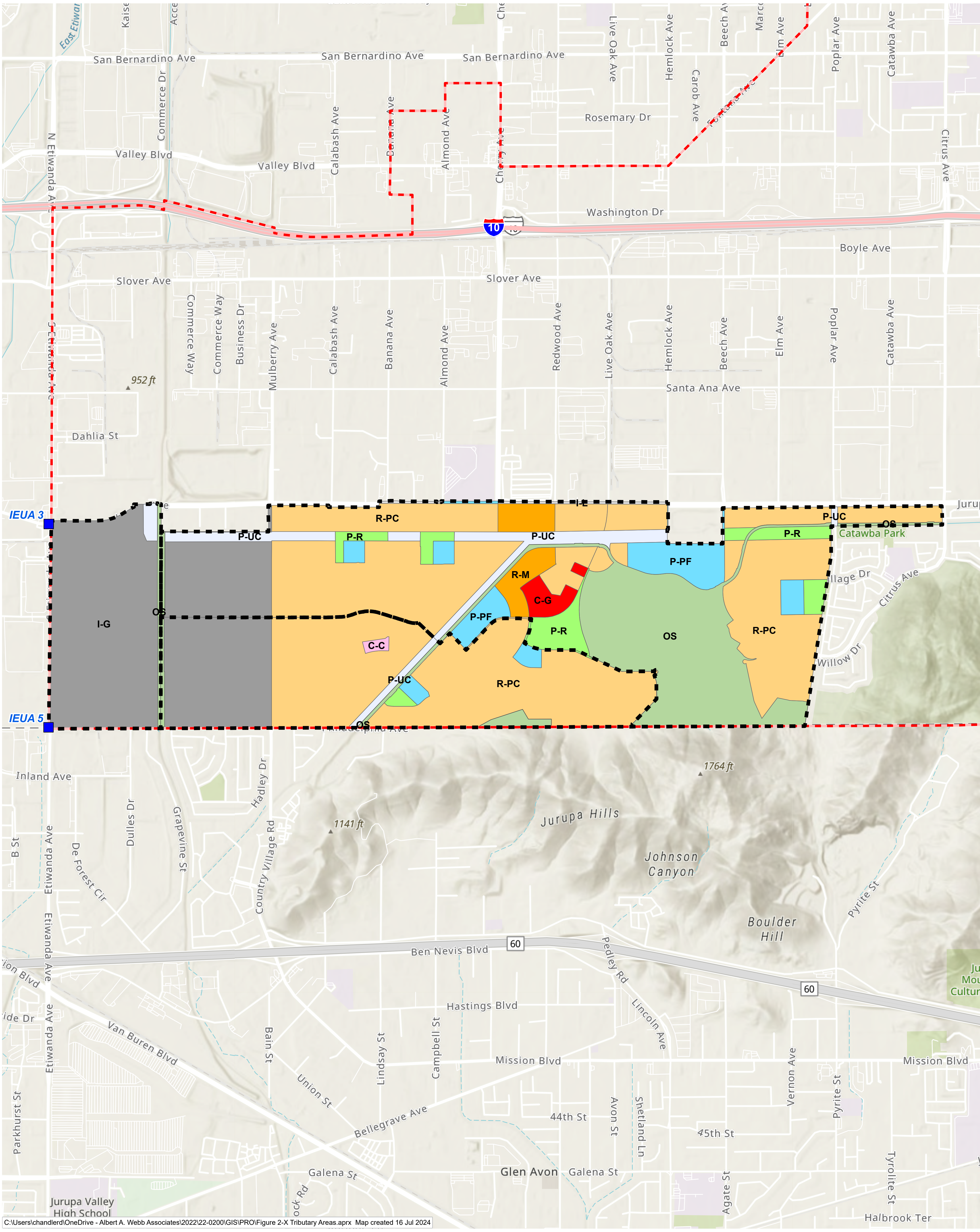
FIGURE 2-12 IEUA 4 TRIBUTARY AREA



LEGEND

- IEUA Discharge Point
- IEUA 4 Tributary Area
- Fontana City Limits

General Plan Land Use

- R-PC Residential Planned Community
- R-M Medium Density Residential
- C-C Community Commercial
- C-G General Commercial
- I-L Light Industrial
- I-G General Industrial
- P-PF Public Facilities
- P-R Recreation Facilities
- P-UC Public Utility Corridors
- OS Open Space

0 1,510 3,020 Feet

Sources: City of Fontana 2022; ESRI; 2023.

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FIGURE 2-13 RIALTO TRIBUTARY AREA

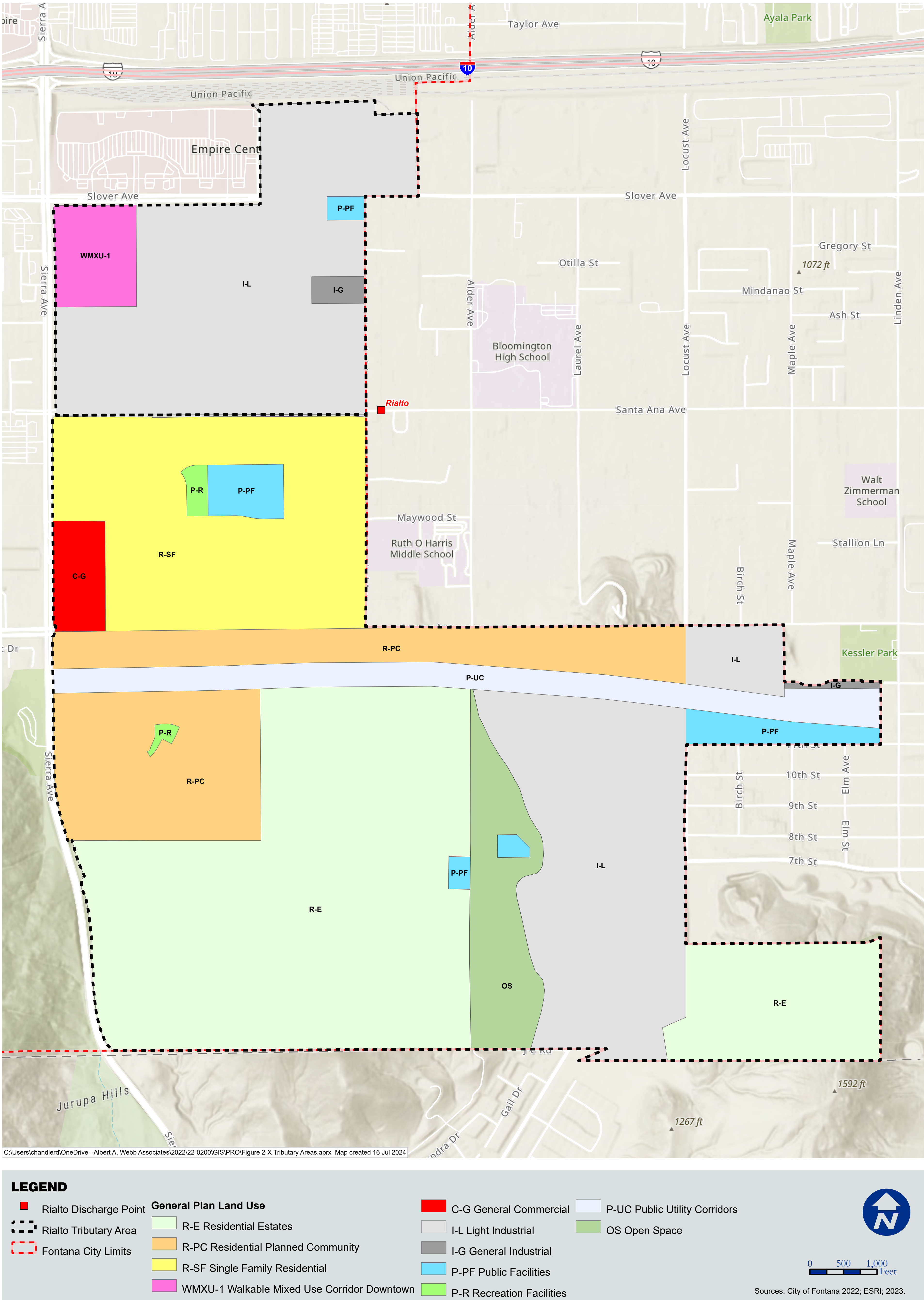

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Table 2-4 IEUA 1 Projected Buildout by Land Use

Tributary Area /Land Use Type	Acres [(1)]	Maximum Projected DUs or SF of Non-Residential Uses	Mid-Point Projected DUs or SF of Non-Residential Uses
IEUA 1 Tributary Area			
Residential	5,025	48,690 DUs	36,323 DUs
Commercial (rounded to the nearest 1,000 SF)	666	30,579,000 SF	18,189,000 SF
Industrial (rounded to the nearest 1,000 SF)	580	15,159,000 SF	10,106,000 SF
Public Facilities	1,155	N/A	N/A
Open Space	516	N/A	N/A
Subtotal IEUA 1 System	**7,942**	-	-

Notes: DU = dwelling unit, SF = square feet
(1) Acres reflect a 25% reduction to remove road ROW. Also, 60% of R-M is "attached" units and 40% is "detached" units. Also, 70% of WMXU-1, WMXU-2, and RMU is "residential" and 30% is "commercial".

Table 2-5 IEUA 2 Projected Buildout by Land Use

Tributary Area /Land Use Type	Acres [(1)]	Maximum Projected DUs or SF of Non-Residential Uses	Mid-Point Projected DUs or SF of Non-Residential Uses
IEUA 2 Tributary Area			
Residential	4,786	55,147 DUs	34,897 DUs
Commercial (rounded to the nearest 1,000 SF)	490	35,589,000 SF	19,929,000 SF
Industrial (rounded to the nearest 1,000 SF)	1,861	48,639,000 SF	32,426,000 SF
Public Facilities	470	N/A	N/A
Open Space	136	N/A	N/A
Subtotal IEUA 2 System	**7,743**	-	-

Notes: DU = dwelling unit, SF = square feet
(1) Acres reflect a 25% reduction to remove road ROW. Also, 60% of R-M is "attached" units and 40% is "detached" units. Also, 70% of WMXU-1, WMXU-2, and RMU is "residential" and 30% is "commercial".

Table 2-6 IEUA 3 Projected Buildout by Land Use

Tributary Area /Land Use Type	Acres [(1)]	Maximum Projected DUs or SF of Non-Residential Uses	Mid-Point Projected DUs or SF of Non-Residential Uses
IEUA 3 Tributary Area			
Residential	1,352	13,544 DUs	8,501 DUs
Commercial (rounded to the nearest 1,000 SF)	272	15,438,000 SF	8,905,000 SF
Industrial (rounded to the nearest 1,000 SF)	3,489	91,189,000 SF	60,792,000 SF
Public Facilities	556	N/A	N/A
Open Space	300	N/A	N/A
Subtotal IEUA 3 System	**5,969**	-	-

Notes: DU = dwelling unit, SF = square feet
(1) Acres reflect a 25% reduction to remove road ROW. Also, 60% of R-M is “attached” units and 40% is “detached” units. Also, 70% of WMXU-1, WMXU-2, and RMU is “residential” and 30% is “commercial”.

Table 2-7 IEUA 4 Projected Buildout by Land Use

Tributary Area /Land Use Type	Acres [(1)]	Maximum Projected DUs or SF of Non-Residential Uses	Mid-Point Projected DUs or SF of Non-Residential Uses
IEUA 4 Tributary Area			
Residential	762	5,009 DUs	3,710 DUs
Commercial (rounded to the nearest 1,000 SF)	18	784,000 SF	470,000 SF
Industrial (rounded to the nearest 1,000 SF)	418	10,925,000 SF	7,283,000 SF
Public Facilities	198	N/A	N/A
Open Space	242	N/A	N/A
Subtotal IEUA 4 System	**1,638**	-	-

Notes: DU = dwelling unit, SF = square feet.
(1) Acres reflect a 25% reduction to remove road ROW. Also, 60% of R-M is “attached” units and 40% is “detached” units. Also, 70% of WMXU-1, WMXU-2, and RMU is “residential” and 30% is “commercial”.

Table 2-8 Rialto Projected Buildout by Land Use

Tributary Area /Land Use Type	Acres [(1)]	Maximum Projected DUs or SF of Non-Residential Uses	Mid-Point Projected DUs or SF of Non-Residential Uses
Rialto Tributary Area			
Residential	659	2,964 DUs	2,229 DUs
Commercial (rounded to the nearest 1,000 SF)	22	1,228,000 SF	708,000 SF
Industrial (rounded to the nearest 1,000 SF)	359	9,383,000 SF	6,255,000 SF
Public Facilities	89	N/A	N/A
Open Space	46	N/A	N/A
Subtotal Rialto System	**1,175**	-	-

Notes: DU = dwelling unit, SF = square feet.
(1) Acres reflect a 25% reduction to remove road ROW. Also, 60% of R-M is “attached” units and 40% is “detached” units. Also, 70% of WMXU-1, WMXU-2, and RMU is “residential” and 30% is “commercial”.

2.5 Population

Understanding the current and future potential populations of the City’s sewer service area is useful to estimate when future improvements proposed by this master plan may be needed. The most recent population estimate from the United States Census Bureau is as follows:

- U.S. Census Bureau
    - As of July 1, 2021, the annual estimate for the City is 210,761 persons[1] and 3.83 persons per household.[2]

Although the estimates above are limited to the City limits and do not include the unincorporated San Bernardino County areas tributary to the City’s sewer system, they include properties that use septic tanks and are not currently connected to the system; therefore, additional population is not added herein for the unincorporated population contributing wastewater to the system.

[1] U.S. Census Bureau, *City and Town Population Totals: 2020-2021 (SUB-IP-EST2021-ANNRNK)* (https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-cities-and-towns.html)
[2] U.S. Census Bureau, *American Community Survey (ACS) Data – Social Characteristics* (https://data.census.gov/cedsci/table?q=selected%20social%20characteristics%20in%20fontana%20ca)

2.5.1 Future Population

The City General Plan refers to the population projections produced by the Southern California Association of Governments (SCAG). The current SCAG projection is 286,700 persons by 2045.[1] This is an increase of roughly 35% from the 2021 estimates of population cited previously.

Regarding buildout of the City, a buildout year is not estimated in the Fontana General Plan but rather the following is stated: "Growth will continue despite the buildout of vacant land. There are many opportunities for infill development and even redevelopment in Fontana's older neighborhoods" (p. 2.9). Therefore, this sewer master plan will not estimate a buildout or "ultimate" year.

Based on the City's current land use plan, WEBB calculated buildout population estimates using the mid-range and maximum residential densities for each residential land use type. The results shown in **Table 2-8** suggest a potential mid-range buildout population of 468,100 and maximum density buildout population of 673,100 using the aforementioned persons-per-household ratio of 3.8 for land uses that do not allow ADUs, and 20% more (4.6) people per household for land uses that do allow ADUs.

Table 2-8 Estimated Population Projections of Sewer Service Area

Fontana Sewer Service Area	Mid-Range Projected Population	Maximum Projected Population
Incorporated City	443,400	639,800
Shere of Influence	44,200	58,600
Sum	487,600	698,500

Source: Refer to Appendix B. Based on 3.8 persons per dwelling unit for non-ADU land uses; and 4.6 people per unit for ADU-permitting land uses.

Based on California Department of Finance Population Estimates from 1970 to 2022, the average annual growth rate for the City has been 4.6 percent (DOF Table E-4). Using a growth rate of 4.6 percent and a starting population of 210,761 persons in year 2022, the City of Fontana's population is projected to achieve a mid-range buildout of 487,557 persons by approximately year 2040.

[1] Southern California Association of Governments. *Demographics and Growth Forecast Technical Report* in the *2020 Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS)*, adopted Sept. 3, 2020 (https://scag.ca.gov/sites/main/files/file-attachments/0903fconnectsocal_demographics-and-growth-forecast.pdf?1606001579)

To maintain a useful capital improvement plan (CIP) (refer to Section 7), it is recommended that the City verify population growth and growth projections routinely every 5 years to track that the infrastructure can meet the demands of the system.

SECTION 3 - Design Criteria

The design criteria for the City's wastewater system generally fall into one of two types: (1) transport facilities; and (2) sewage pump stations. The following discusses each one of these components. The design criteria described herein for the City's transport facilities was developed by reviewing the City's prior master sewer plan[1] as well as other agencies standards.

Development of standards for the design, construction, inspection, testing and acceptance of new, rehabilitated, or repaired portions for the wastewater collection system is key to ensuring a safe, and reliable collection system. The purpose of this is to prevent inconsistencies in the system that can lead to hydraulic deficiencies.

The City of Fontana Engineering Department maintains standard details and specifications for the design and construction of the wastewater collection system in a document named City of Fontana Design Standards. City standards are to be used and prioritized for projects in the City and SOI. These details and specifications are based on the American Public Works Association's "Greenbook" Standard Specifications for Public Works Construction and are supplemented by information specific to the City. The Greenbook is allowable where standards are not covered by the City of Fontana Design Standards. City standards are to take priority. Included with the standard details and specifications are pipe material requirements, backfilling and compaction requirements, and slope and deflection requirements.

The City keeps a current copy of the design and construction standards on the website: https://www.fontanaca.gov/3483/Design-and-Construction-Standards. Section 2000 of the Construction Standards pertains to sewer construction.

3.1 Transport Facilities

As a general practice, the pipelines should be designed to flow by gravity; any other alternatives other than gravity flow will need to be reviewed and approved by the City engineer. Gravity flow pipeline can be categorized into two different groups; collection pipelines or trunk and interceptor sewers.

3.1.1 Collection Pipelines

In this report, collection sewers are considered to be sewer pipes 12 inches in diameter and less. These pipes should be designed under peak conditions to be flowing at one-half full. Collection sewers are typically designed to flow one-half full for maintenance purposes and since collection pipelines serve smaller areas, they can experience high peak factors. Collection sewer diameters are determined by means of Manning's formula, using a roughness coefficient (n) of 0.013.

3.1.2 Trunk and Interceptor Sewers

Trunk sewers in this report are considered to be pipes 15 inches and larger in diameter. The capacity to be provided in each section of a trunk sewer is based on the peak rate of flow

[1] City of Fontana Sanitary Sewer System Master Plan, May 2013

calculated for the area tributary to that section. For each tributary area this rate is the summation of peak domestic, commercial, and industrial flows plus incidental storm water inflow, which is known as the “peak wet weather flow” or “design flow.”

The design criteria for gravity flow sewer pipelines that is assumed in this plan is as follows: sewer lines are sized on the principle of conveying wastewater at a minimum velocity of 2 feet per second (fps) when flowing at the maximum depth to diameter ratio (d/D), and are sized to carry peak flows without exceeding the maximum d/D ratio. For the purposes of this study, all pipes, existing and proposed, and any material type, the mean roughness coefficient (n) will remain at 0.013. A safety factor should be included in the design of all gravity flow pipelines to account for errors due to the variability of the initial approximation of flow and partial clogging of the sewer. A factor of safety is incorporated in the peaking equation, which calculates peak flows higher than the peak flows observed in the City, as later described in Section 5. Another method to account for the inherent variables is to define safe maximum d/D ratios. **Table 3-1** – **Maximum Depth of Flow to Pipeline Diameter Ratio** shows the maximum d/D ratios flow ratios considered in this study.

Table 3-1 Maximum Depth of Flow to Pipeline Diameter Ratio

Pipe Diameter (inches)	Maximum Ration of Depth of Sewage Flow to Diameter of Pipe (d/D)
Peak Conditions	
≤ 12-inch diameter	0.50
≥ 15-inch diameter	0.75

Source: Evaluated the City’s prior master sewer plan (City of Fontana Sanitary Sewer System Master Plan, May 2013) and nearby agencies standards.

Since low velocities in the sewers will cause deposition of solids and result in sulfide generation problems, minimum slopes should be set to maintain a flow velocity of not less than 2 fps during maximum flows. **Table 3-2 – Minimum Pipeline Slope Criteria** provides the minimum allowable slopes to be utilized for this study.

VCP or PVC material, unless otherwise indicated, are assumed to be used in future pipeline construction for purposes of comparative cost evaluation.

Table 3-2 Minimum Gravity Pipeline Slope Criteria

Pipe Diameter (inches)	Minimum Slope (feet/100 feet)
8	0.0040
10	0.0030
12	0.0024
15	0.0017
18	0.0014
21 through 36(1)	0.0011

Source: Evaluated the City's prior master sewer plan (City of Fontana Sanitary Sewer System Master Plan, May 2013) and nearby agencies standards.
(1) For 24-inch diameter and larger other than minimum cleansing velocity (such as construction tolerances and potential ground subsidence) may govern the minimum slope selection.

3.1.3 Manholes

Manholes shall be located at all junctions, all changes in grade, all changes in direction, and all changes in pipe size. Where the distance between manholes required for the foregoing reasons exceeds 300 feet, good judgment should be used in placing intermediate manholes at points of probable sewer intersections, or lacking other criteria, at approximately equal intervals. In general, the maximum of 300 feet[1] should be observed. Manhole diameters are determined based upon pipeline diameters as shown in **Table 3-3** – **Minimum Manhole Diameter Criteria**.

Table 3-3 Minimum Manhole Diameter Criteria

Pipe Diameter (inches)	Min. Manhole Diameter (Sewers 0-15' Deep)	Min. Manhole Diameter (Sewers 16-20' Deep)	Min. Manhole Diameter (Sewers 20-25' Deep)
8 – 15	4 feet	5 feet	6 feet
18 – 24	5 feet	5 feet	6 feet
27 – 42	6 feet	6 feet	6 feet
48 – 72			Los Angeles County Sanitation District Standard Manhole, Type "B"(1)

Source: Evaluated the City's prior master sewer plan (City of Fontana Sewer System Master Plan, September 2000) and nearby agencies standards
(1) https://www.lbiw.com/media/yjbpwnnd/s-a-202-standard-manhole-type-b.pdf

[1] County of San Bernardino Special Districts Department, Standards for Sanitary Sewer, November 2012.

It is noted that 72-inch diameter manholes will be the minimum used at all junction locations.

3.1.4 Inverted Siphons

The purpose of an inverted siphon is to carry the flow under an obstruction such as a stream or depressed highway and to regain as much elevation as possible after the obstruction has been passed. Self-cleaning velocities (2 to 3 fps) should be obtained at least once a day, even during the early years of operation. To ensure adequate minimum velocities, it may be necessary to use multiple diameter pipelines. Flow in these lines can be regulated by control structures such as overflow weirs. Inverted siphons may require cleaning more frequently than gravity sewers.

A conservative Hazen-Williams roughness coefficient (C) of 120 should be used to calculate head loss for inverted siphons. Material that would be considered for siphons include VCP, HDPE, and PVC. Final selection of pipe materials would be made during the detailed design phase. The City discourages the design of inverted siphons due to additional head loss to the sewer system, high probability of blockage, and maintenance requirements. All inverted siphons are to be approved by the City engineer.

3.1.5 Force Mains

Force mains convey wastewaters under pressure from the discharge side of a lift station pump to a discharge point. Force mains are designed to flow full with minimum velocities required to prevent deposition of suspended solids. Velocities normally fall within a range of from 3 to 5 fps. A minimum velocity of 2 fps is considered to be sufficient to prevent settling of solids, but velocities of between 2.5 and 3 fps are required to re-suspend those which already have accumulated in the force main. If flushing velocities are attained once or twice a day, excessive deposits are not likely to occur. **Table 3-4** summarizes the design criteria for force mains.

Table 3-4 Force Main Design Criteria

Design Criteria	Flow Rate (fps)
Minimum Velocity	3.5
Maximum Velocity (new pipes)	6
Maximum Velocity (existing pipes)	8
Hazen-Williams Roughness Constant, "C"	120

fps = feet per second
Source: Evaluated the City's prior master sewer plan (City of Fontana Sanitary Sewer System Master Plan, May 2013) and nearby agencies standards.

Materials that could be considered for force mains are PVC and HDPE. Final selection of pipe material would be made during the detailed design phase. Diameters are calculated using the Hazen-Williams formula with a roughness coefficient (C) of 120.

3.2 Sewage Lift Stations

Sewage lift stations should be installed only when existing topography prevents gravity flow. Efforts should be made to avoid the implementation of lift stations if possible.

Conforming to industry standards and surrounding agencies, sewage lift stations can be categorized into three different groups, which are:

- Small Lift Stations: Up to 750 gallons per minute (gpm), 1 million gallons per day (MGD), 10-inch diameter force main (FM);
- Medium Lift Stations: Up to 2,800 gpm, 4 MGD, 18-inch diameter FM; and
- Large Lift Stations: Up to 3,500 gpm, 5 MGD, 20-inch diameter FM.

Small sewage pump stations should have two pumping units, with each unit sized to pump the peak design flow. One pumping unit operates during each pumping cycle with the other acting as standby. These units alternate in operation so that equal wear can occur. Typically, the pumping units are a submersible design with the units placed in a manhole or precast vault structure.

Intermediate-sized sewage pump stations should be planned to have three pumping units of usually equal size. One or two units can operate during a pumping cycle with the third unit acting as a standby in case one of the primary units fails. Two pumping units operating at the same time should be sized to handle the peak design flow. Intermediate-sized sewage lift stations can have submersible pumping units or be of a wet well / dry well design.

Large sewage pump stations should be designed so that expansion can occur when necessary. Thus, mechanical equipment may be installed at various stages of development. Large sewage pump stations typically provide for complete separation of wet and dry wells with easy access to both. In all cases, standby drives or power units should be provided in cases where bypassing cannot be allowed around the sewage pump station.

Typically, lift stations are to be sized for firm capacity (ultimate peak wet weather capacity) with the largest pump out of service. Also, a standby generator is required for emergency situations such as power outages.

SECTION 4 - Existing Facilities Description

4.1 Data Request

In order to create a sewer model to analyze the City's sewer system, the City provided the following data per WEBB's request for this report, which reflects the "current" scenario of the sewer system as of 2022:

- Current sewer master plan;
- Existing sewer system model;
- Past monitoring data;
- GIS files of land use plan, sewer facilities, sewer accounts, and topography;
- Population projections;
- Repair records
- As-built plans;
- Latest developments map;
- SCADA flow information; and
- Existing design criteria and standards.

4.2 Tributary Areas

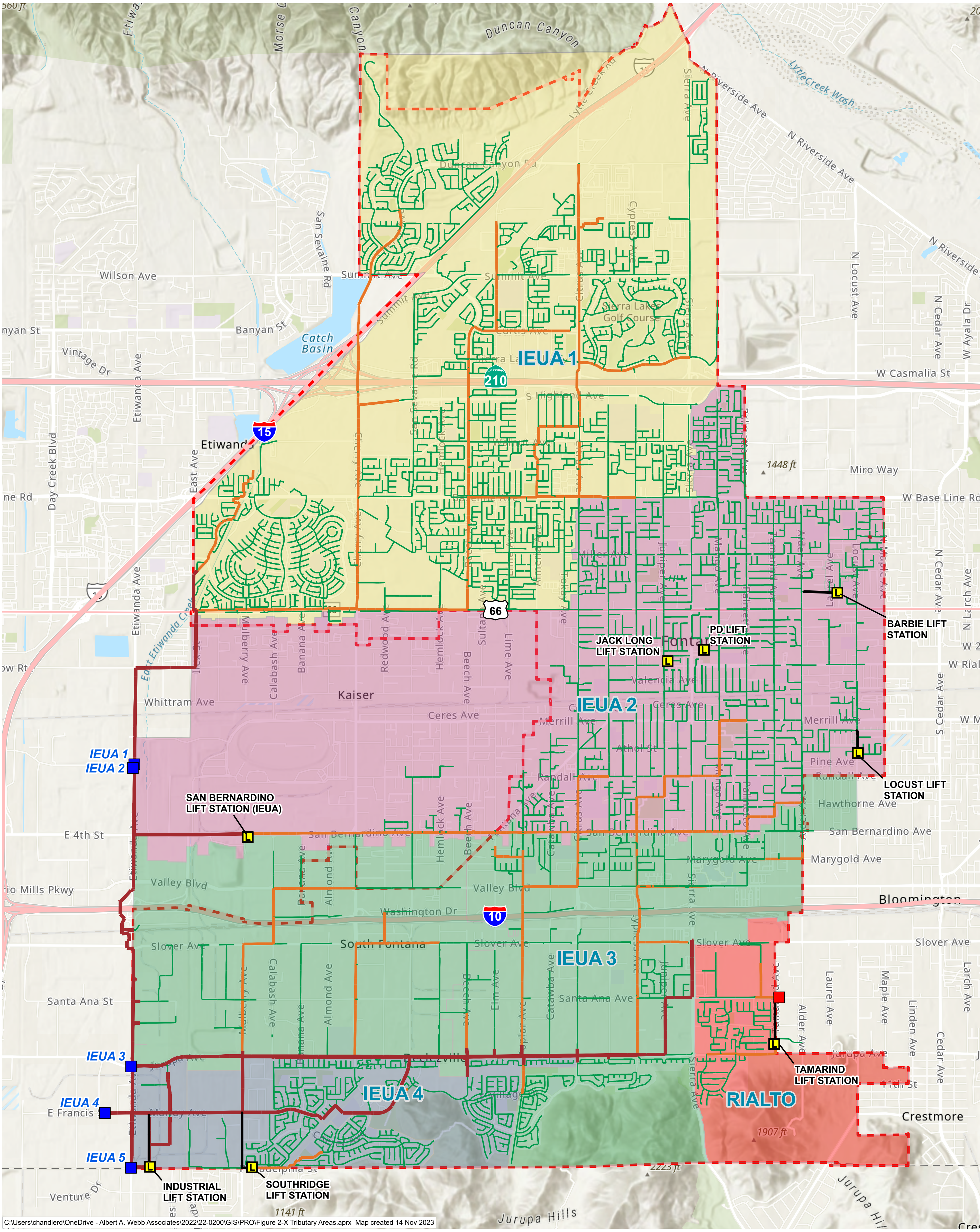
The City's sewer system consists of five hydraulically distinct collection systems, as shown in **Table 4-1 – Sewer Tributary Areas** and on **Figure 4-1 – Sewer Tributary Areas**. Each tributary area correlates to an interagency discharge point located either to the west of the City with IEUA or to the east with City of Rialto.

Table 4-1 Sewer Tributary Areas

Tributary Area	Acres	Percent of Area	Sub Tributary Area	Acres
IEUA 1	11,087	33%	-	-
IEUA 2	10,326	31%	Barbie Lift Station Locust Lift Station	34 105
IEUA 3	8,241	25%	-	-
IEUA 4	2,188	6.5%	Industrial Lift Station Southridge Lift Station-	308 618
Rialto	1,567	4.5%	Tamarind Lift Station	1,286
Sum	**33,409**	**100%**	**-**	**2,351**

Tributary areas "IEUA 2" and "IEUA 4" each have two smaller sub-tributary areas, and "Rialto" has one sub-tributary area corresponding to City lift stations that pump to an interagency discharge point.

FIGURE 4-1 SEWER TRIBUTARY AREAS



LEGEND

Existing Sewerlines

Diameter (in)

- 12-inch or less
- 15-inch or greater
- Force Mains
- IEUA Sewerlines
- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations

Tributary Areas

- IEUA 1
- IEUA 2
- IEUA 3
- IEUA 4
- RIALTO
- Fontana City Limits

0 3,000 6,000 Feet

Sources: City of Fontana 2022; ESRI; 2023.

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Approximately 95 percent of the City's sewer service area contributes wastewater to the IEUA regional sewer system. Connections are made at five points along Fontana's western boundary for treatment at IEUA Regional Water Recycling Plant No. 1 (RP-1) on Walnut Street in the City of Ontario and IEUA Regional Water Recycling Plant No. 4 (RP-4) located on 6th Street in the City of Rancho Cucamonga (Figure 4-1).

The Tamarind Lift Station collects approximately 5 percent of the City's sewer service area and discharges into the City of Rialto's sewer system at the southeast corner of the City for treatment at Rialto's wastewater treatment plant on Richmond Avenue (Figure 4-1).

This Master Plan addresses sewerage service to the existing tributary areas. Future developments served by the City that are not within the existing tributary areas will need to coordinate with the City to determine the feasibility of providing sewage service.

4.3 City Facilities

As of October 2022, the City owns approximately 457 miles of active sewer pipelines within its jurisdiction, of which approximately 453 miles are gravity lines, 3.7 miles are force main, and 0.13 mile are inverted siphon lines. Fontana also maintains 8 lift stations, 9 inverted siphons, and 16 diversion structures[1].

4.3.1 Trunk and Collection System Pipelines

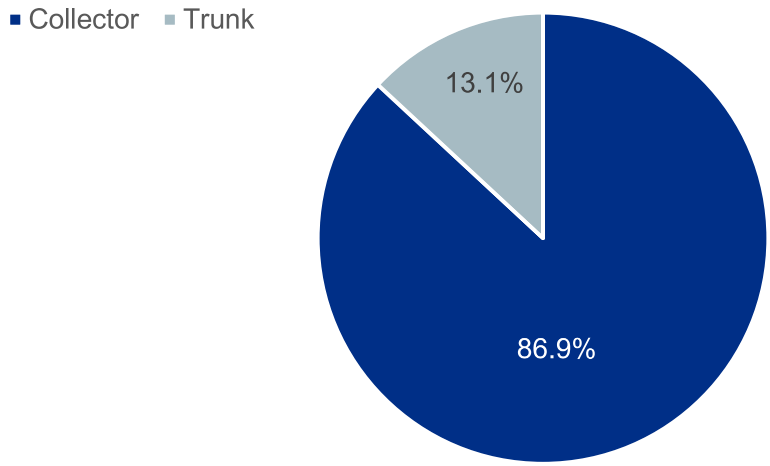
There are two main categories of gravity sewer pipelines in a sewer system; collector and trunk lines:

a. Collector Lines (≤ 12-inch diameter): These lines collect sewage by direct lateral connections to the properties for which they serve.

b. Trunk Lines (≥ 15-inch diameter): These lines serve as a collection point for collector lines and for multiple tributary areas.

The percentage of gravity mains within the City are summarized in **Figure 4-2 – Types of Gravity Pipelines within Fontana**. A majority (87%) of the gravity sewer pipelines are collector lines, and the remaining 13% are trunk lines.

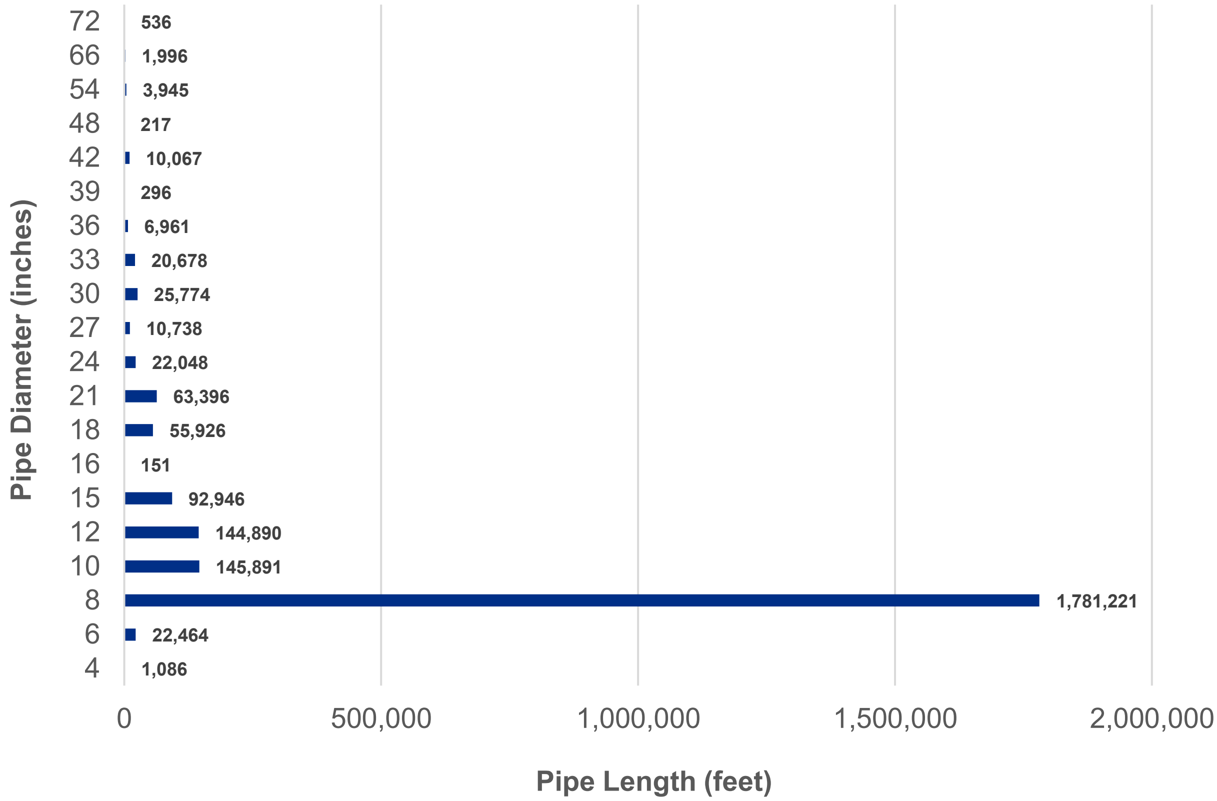
[1] 6 with gate control and 10 uncontrolled.



Source: City of Fontana

Figure 4-2 Types of Gravity Pipelines Within Fontana

The City's sewer system includes sewer pipelines ranging from 4-inches to 72-inches in diameter. A breakdown of the City's sewer pipe diameter size distribution is shown in **Figure 4-3 – Distribution of Fontana Sewer Pipe Diameters**.



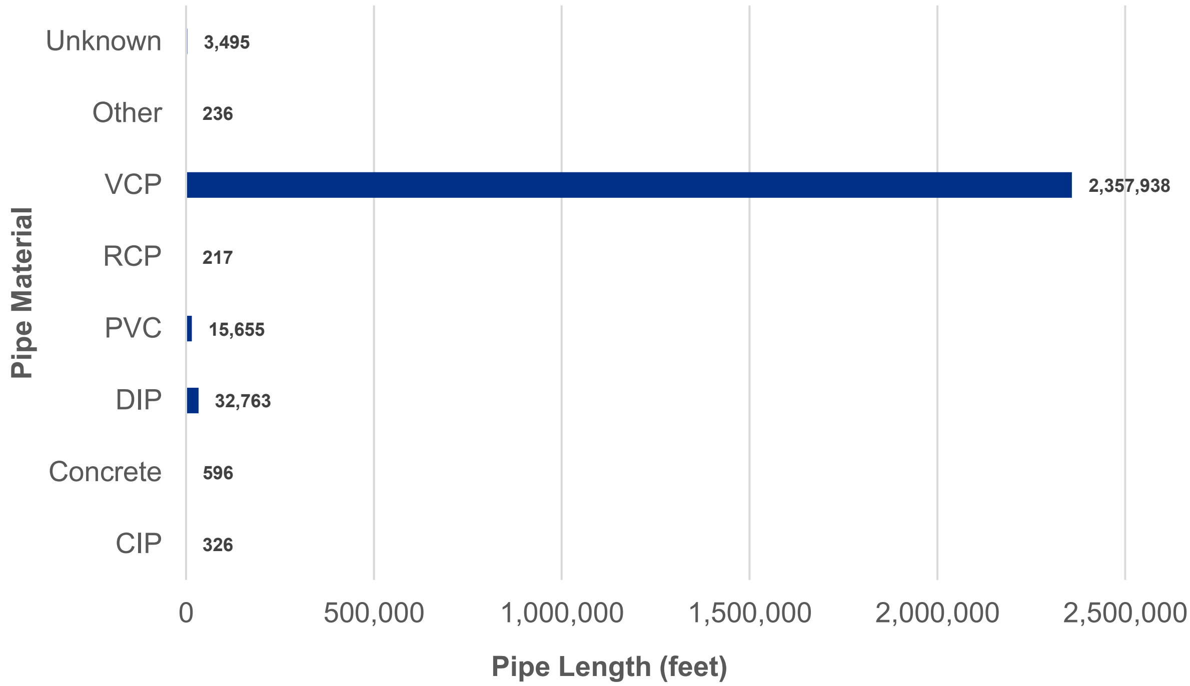
Source: City of Fontana GIS (2022)

Figure 4-3 Distribution of Fontana Sewer Pipe Diameters

The majority of the sewer pipelines are made of vitrified clay pipe (VCP), as summarized in **Figure 4-4 –Distribution of Fontana Sewer Pipe Material**. The City sewage transmission network is a mixture of pipe materials, as follows:

CIP	Cast iron pipe	PVC	Polyvinyl chloride
Concrete	Concrete	RCP	Reinforced concrete pipe
DIP	Ductile Iron Pipe	VCP	Vitrified clay pipe
Other	Other	Unknown	Unknown

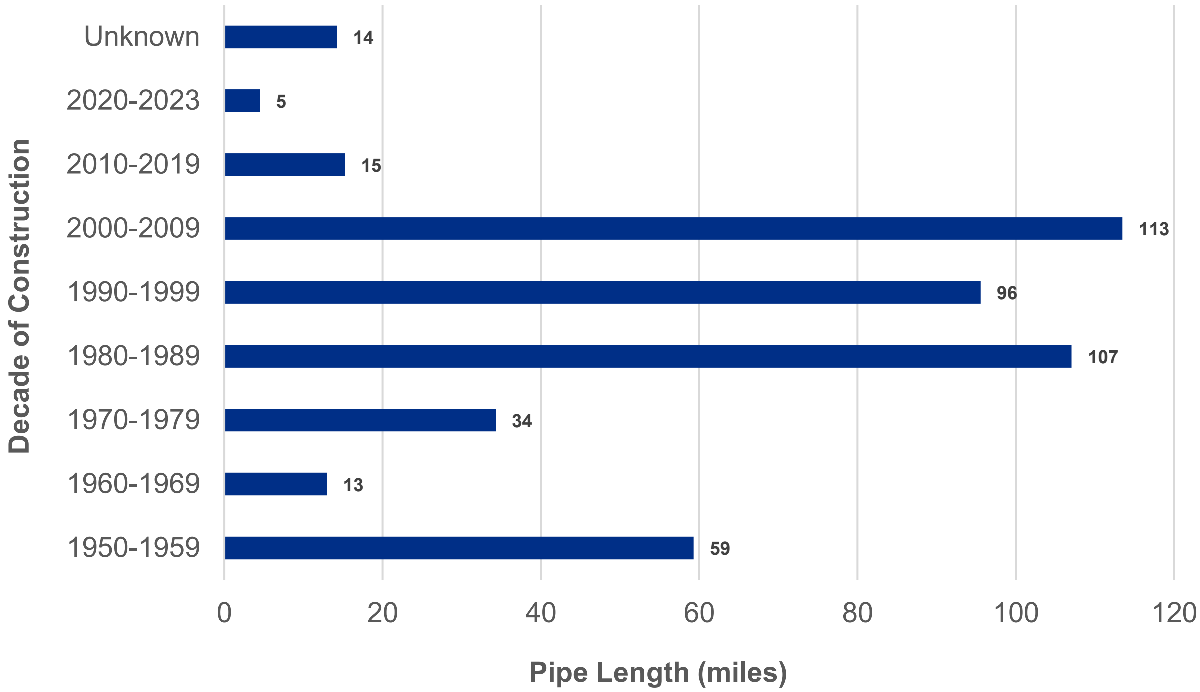
"Other" and "Unknown" materials may be attributed to instances of old pipelines and lost records.



Source: City of Fontana GIS (2022)

Figure 4-4 Distribution of Fontana Sewer Pipe Material

The majority of sewer pipes within Fontana are less than 40 years in age. A breakdown of the City's sewer pipe age is shown in **Figure 4-5 – Distribution of Fontana Sewer Pipe Age**.



Source: City of Fontana GIS (2022)

Figure 4-5 Distribution of Fontana Sewer Pipe Age

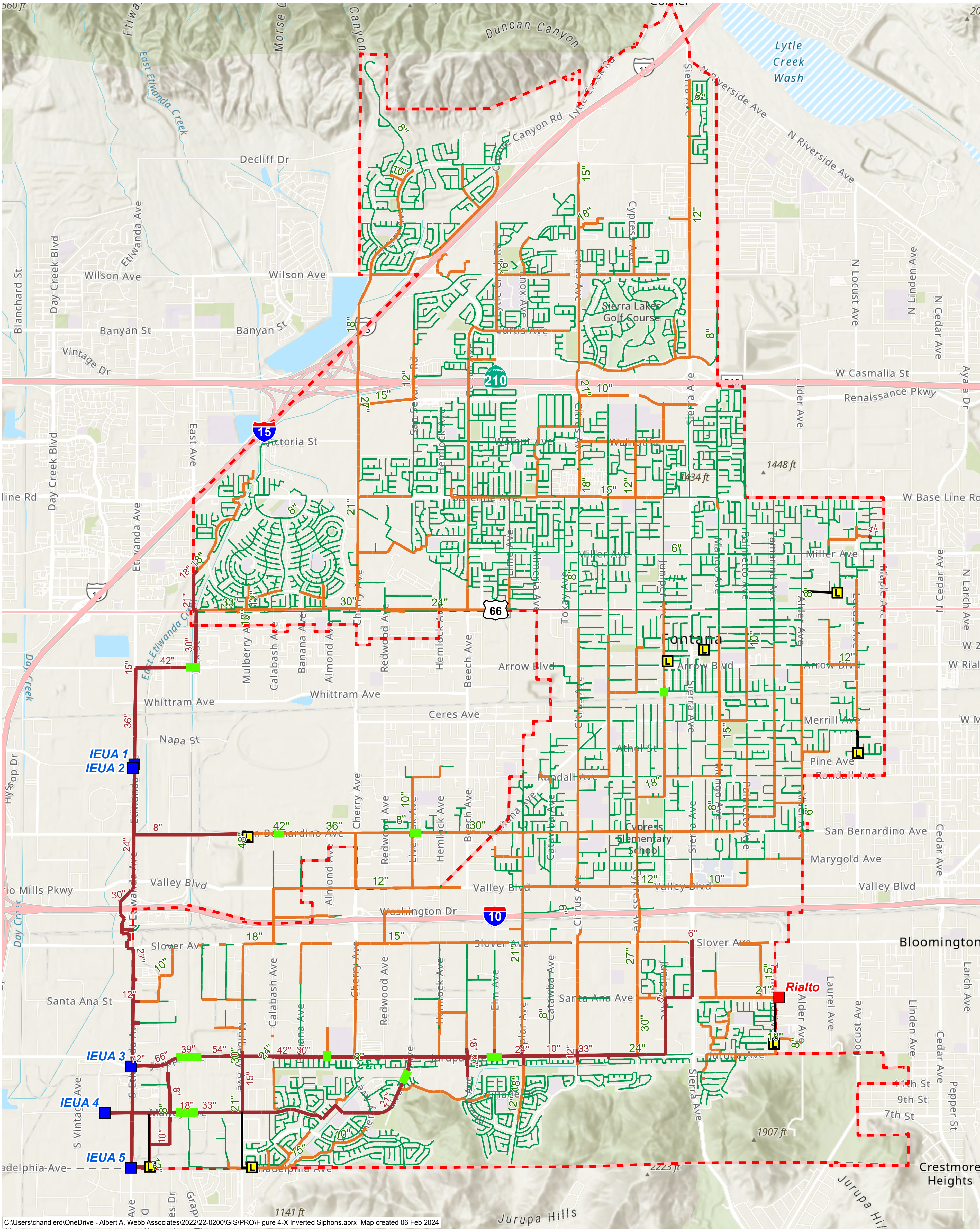
4.3.2 Inverted Siphons

Inverted siphons are used to transport sewage or wastewater in situations where gravity alone is insufficient to ensure the flow of sewage through a sewer system. It is designed to overcome natural obstacles such as hills, valleys, or bodies of water that would otherwise impede the flow of sewage. Upon inspection, the City has nine (9) inverted siphons as shown in **Figure 4-6 – Location of Inverted Siphons**.

CITY OF FONTANA SEWER MASTER PLAN 2023

FIGURE 4-6

LOCATION OF INVERTED SIPHONS



LEGEND

Existing Sewerlines

Diameter (in)

- 8-inch or less
- 10-inch or greater
- Force Mains
- IEUA Sewerlines
- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations
- Fontana City Limits
- Siphons (9)

0 3,000 6,000 Feet

Sources: City of Fontana 2022; ESRI; 2023.

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4.3.3 Diversion Structures

A wastewater diversion structure is a specialized component or facility designed to manage the flow of wastewater within a sewer system. Its primary purpose is to divert, control, or regulate the flow of water for various purposes, such as preventing flooding, directing flows to treatment facilities, or separating different types of wastewater. Typical designs can consist of a designated sluice gates within manholes or a constructed split of sewer lines from a shared manhole where flow is diverted based on downstream gravity control. These structures are essential for ensuring the efficient and safe operation of sewer systems.

Sewer diversion structures are utilized by the City to divert its wastewater at critical trunk line junctions throughout the sewer system. The City has identified 6 diversion structures in the form of sluice gates that can redirect flow from one direction to another downstream. Currently, there is no standard in place for the operations staff and no existing means to operate the sluice gates other than manually closing or opening at the City's discretion. In addition, 10 more diversion manholes were identified on trunk lines where no control gates were constructed, allowing flow to split based on volume and gravity. A majority of diversion structures are located on San Bernardino Ave and direct flow either westward or southward towards the IEUA wastewater outlets. Minor split manholes on distribution lines can be found throughout the entire sewer service area with no infrastructure to regulate flow. Refer to **Figure 4-7 – Locations of Diversion Structures**.

FIGURE 4-7 DIVERSION STRUCTURES

LEGEND

- Diversion Gate Manholes (6)
- Diversion Split Manholes (10)

0 2,000 4,000 Feet

Sources: City of Fontana Model 2023; ESRI 2023

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4.3.4 Lift Stations and Force Mains

As described previously, nearly all of the City's sewerage is collected and transmitted by gravity flow; however, in situations where gravity flow is unattainable, pressure systems are utilized. Currently, 3.7 miles of pipelines are pressurized. Pressure systems consist of pumping facilities which collect and pump wastewater flows (lift station) to a gravity manhole through a pressurized pipeline (force main). Refer to **Table 4-2 – Fontana Lift Station and Force Main Facilities**[1] for a summary the Fontana Lift Stations and force main facilities and **Figure 4-8 – Locations of Lift Stations and Force Mains**. Based on sizing categories established in Section 3, the City owns and operates three small lift stations and three intermediate lift stations. Currently, the City does not anticipate a need for a large lift station in the future.

Table 4-2 Fontana Lift Station and Force Main Facilities

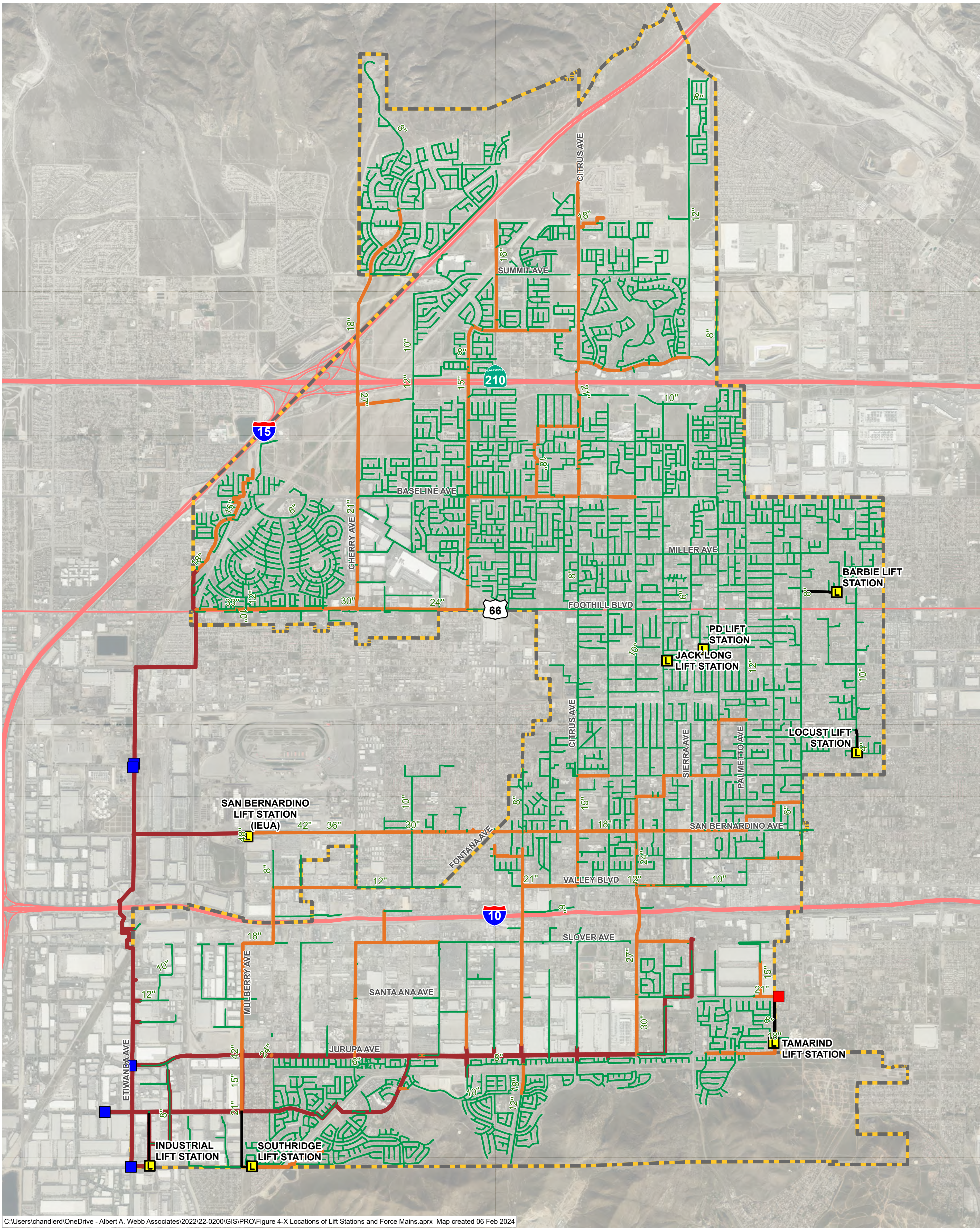
Sewer Lift Station	Pumps	Overall Pump Capacity (gpm)	Horsepower (HP)	Force Main Diameter	Backup Generator	Install Year
Barbee (1)	2	500	10	4, 8	Yes	1979-
Industrial Park	3	960	30	8	Yes	1988
Locust	2	680	20	4	Yes	1977
PD (2)	2	600	20	10	-	-
Southridge (Philadelphia)	3	1,440	90	10	Yes	1985
San Bernardino Avenue (3)	4	-	-	24, 30	-	2007
Tamarind	2	920	60	12	Yes	1984
Jack Long(4)	-	-	-	-	-	-

Source: Fontana Record Drawings, Various Dates; City of Fontana Sanitary Sewer Pump Station Evaluation, August 2011.
(1) Can be served by a portable generator
(2) Only serves the Police Department building. Onsite generator maintained by others.
(3) Owned and operated by IEUA
(4) Jack Long LS has no record data made available per City of Fontana

[1] SCADA information is limited such as flow and runs times.

FIGURE 4-8

LOCATIONS OF LIFT STATIONS AND FORCE MAINS



LEGEND

Existing Sewerlines

Diameter (in)

- 12-inch or less
- 15-inch or greater
- Force Mains
- IEUA Sewerlines
- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations
- Fontana City Limits

0 0.5 1 Mi

Sources: City of Fontana 2022; San Bernardino Co. Aerial 2022.

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4.4 Contracted Wastewater Treatment Locations

Fontana does not own or operate a wastewater treatment facility. Each tributary area in the City correlates to an interagency discharge point located either to the west of the City with IEUA or to the east with City of Rialto.

- Inland Empire Utilities Agency

  The City of Fontana entered into a Regional Sewerage Service Contract with IEUA on August 14, 1972 for wastewater treatment services. Currently, approximately 95% of the City's sewer service area contributes wastewater to the IEUA regional sewer system. Connections are made at five points along Fontana's western boundary for treatment at IEUA Regional Water Recycling Plant No. 1 (RP-1) on Walnut Street in the City of Ontario and IEUA Regional Water Recycling Plant No. 4 (RP-4) located on 6th Street in the City of Rancho Cucamonga (Figure 4-1).

  The City is one of the Contracting Agencies to the Regional Sewerage System that IEUA operates. According to the Chino Basin Regional Sewerage Service Contract (As amended October 19, 1994), "The Contracting Agencies shall have the right to deliver all sewage collected by their respective Community Sewer Systems to the Regional Sewerage System and IEUA shall have the obligation to receive into the Regional Sewerage System all sewage so delivered by the Contracting Agencies" (p. 10).

- City of Rialto

  The City's Tamarind Lift Station collects approximately 5% of the City's sewer service area and discharges into the City of Rialto's sewer system at the southeast corner of the City for treatment at Rialto's wastewater treatment plant on Richmond Avenue (Figure 4-1).
  According to the City's Extraterritorial Sewer Services Agreement (July 16, 1991), "[Fontana] shall have the right (but not the obligation) to deliver to the Rialto Disposal System up to the number of gallons per day (on an annual average-per-day basis…of Service Area Sewage…and Rialto shall have the obligation to receive all such sewage into the Rialto Disposal System and to convey, treat, and dispose of such sewage" beginning November 1, 1994 and thereafter 1,600,000 gallons per day (p. 2).

4.4.1 Current Flows

As of 2022, the City's wastewater flows to each treatment plant from each tributary area is summarized in **Table 4-4 –Wastewater Generation for Fontana Tributary Areas**. Refer to **Figure 4-1 – Location of Tributary Areas, Treatment Plants, Rialto, and IEUA Connections** which includes areas within and adjacent to the City that are unsewered.

Table 4-3 Wastewater Generation for Tributary Areas

Sewer Tributary Areas	Average Tributary Flow (MGD)[(1)]
IEUA Outlet 1[(2)]	6.63
IEUA Outlet 2	3.50
IEUA Outlet 3	2.50
IEUA Outlet 4	1.62
Rialto	0.37
Total	**14.62**

Notes:
(1) Based on metered recorded flow value from 12-month running average from September 2021 to September 2022.
(2) Includes 0.2 MGD of additional estimated flow from tributary area not captured by meter.

4.5 Existing System Deficiencies

4.5.1 Capacity Based

Approximately 22,500 feet of the City's gravity sewer pipelines are 6-inches in diameter and 1,100 feet are 4-inch diameter (**Figure 4-9**). There is a larger concentration of 6-inch diameter gravity sewer pipes in the eastern central area of the City (**Figure 4-9)** Pipe capacity deficiencies for 4-inch and 6-inch diameter pipelines as well as larger sizes has been evaluated as part of the model runs in Section 6 to identify locations.

4.5.2 Sewer Facilities Condition Review

The City has assessed existing sewer line conditions and operational problems and has compiled a list which will serve as the basis for a sewer line replacement/rehabilitation program.

City staff reviewed their sewage system for typical defects such as grease, sediment, roots, slow flows, sags, cracks, joint separations and off sets. This effort was performed by the City Operations staff, utilizing their Closed Circuit Television (CCTV) inspection equipment as well as manual inspection. Refer to **Figure 4-10 – Sewer Hot Spots** for locations of the pipes identified by the City to have structural defects. **Table 4-4** summarizes the general sizes and quantities of pipes with structural defects.

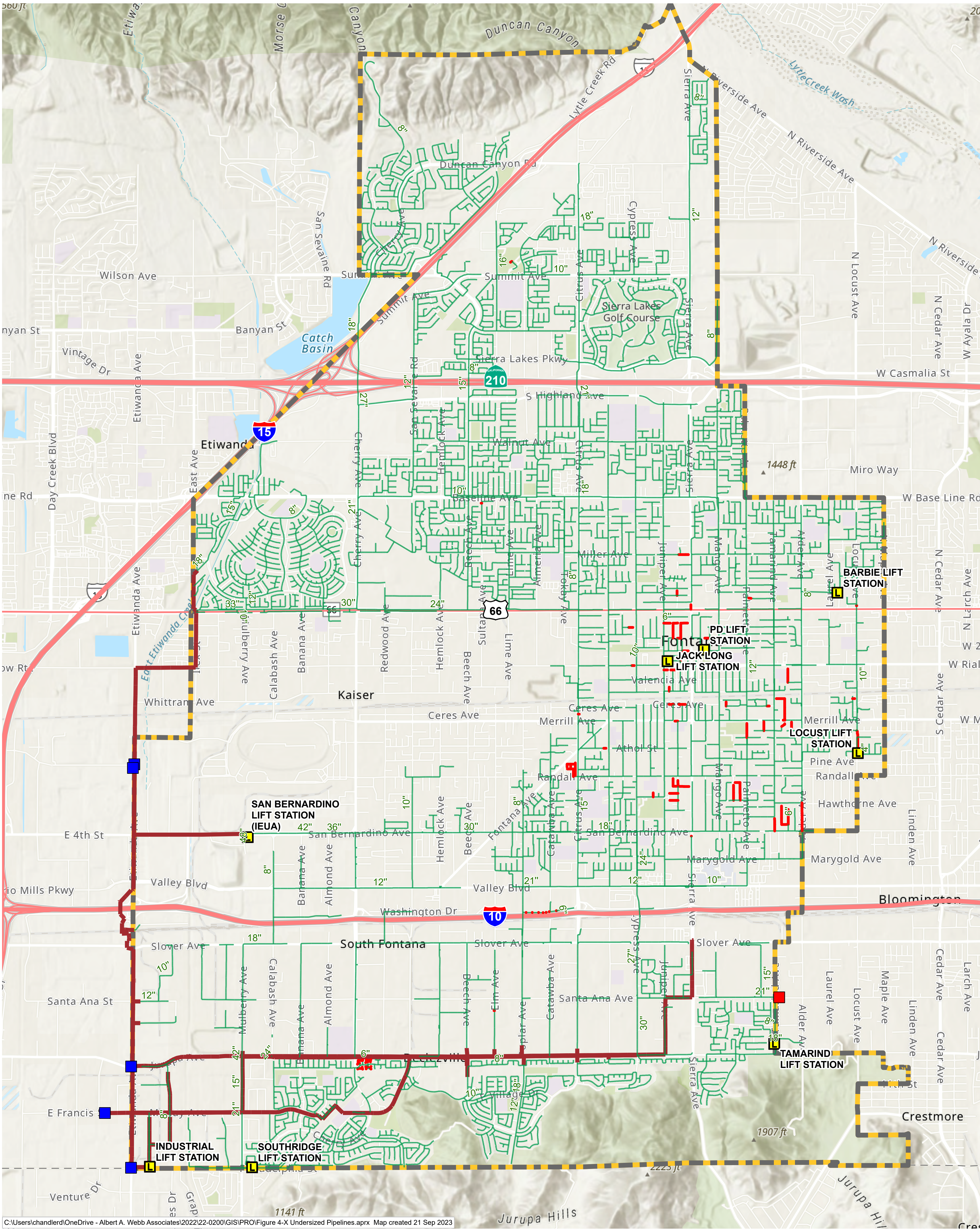
Table 4-4 Fontana Sewer Pipes with Structural Defects

Pipe Diameter	Approximate Pipe Length (feet)
6-inch	665
8-inch	27,125
10-inch	1,990
12-inch	45
21-inch	320
30-inch	145

Source: City of Fontana Sewer Mainline Hotspots (Aug, 2023).

FIGURE 4-9

UNDERSIZED PIPELINES



LEGEND

Existing Sewerlines

Diameter (in)

- 6-inch or less
- 8-inch or greater

- IEUA Sewerlines
- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations
- Service Area Boundary

0 3,000 6,000 Feet

Sources: City of Fontana 2022; ESRI 2023.

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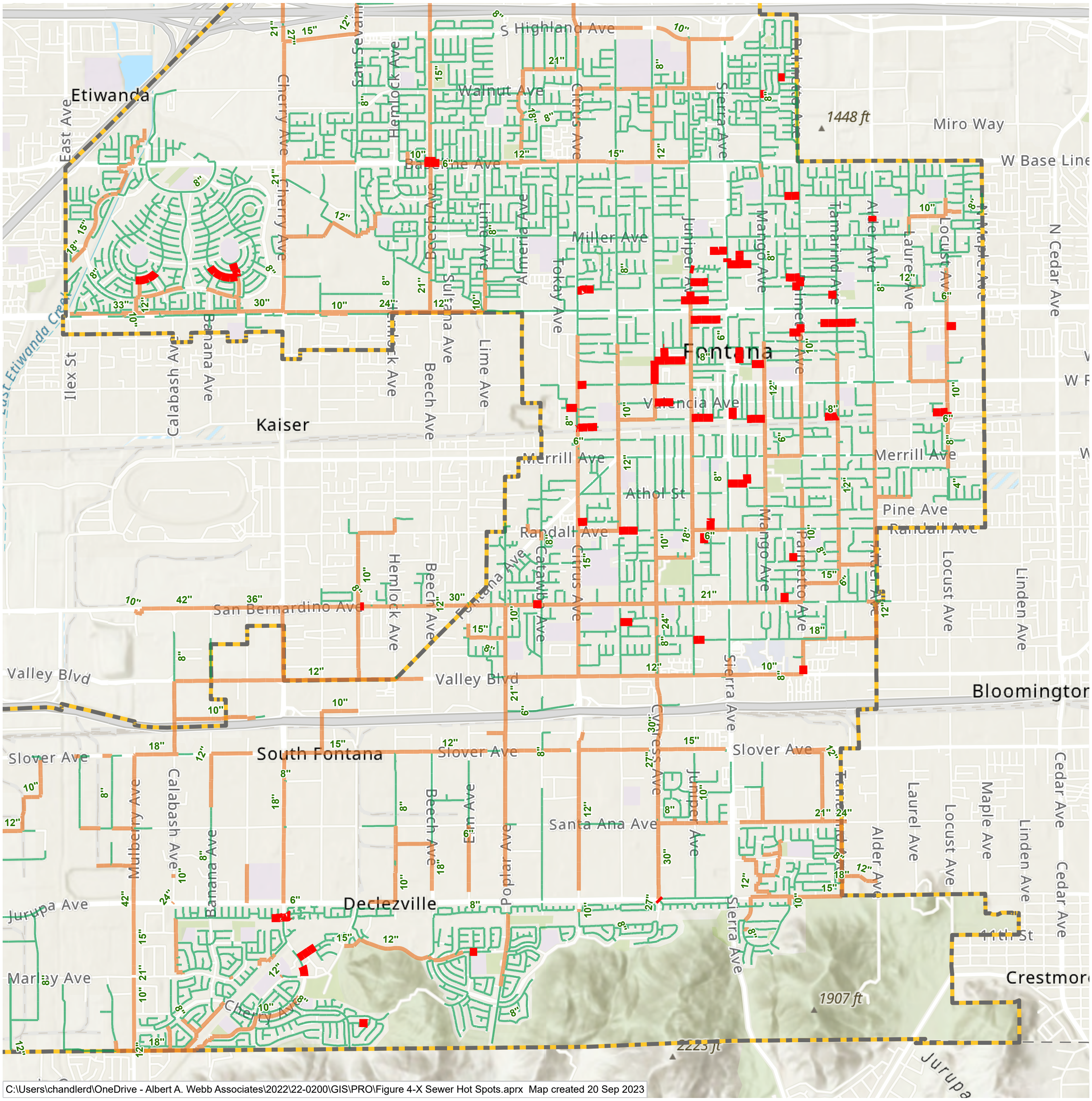
CITY OF FONTANA WASTEWATER MASTER PLAN 2023

FIGURE 4-10

SEWER HOT SPOTS



LEGEND

Diameter (in)

- 8-inch or less
- 10-inch or greater
- Mainline Hot Spots (115)
- City of Fontana

0 2,500 5,000 Feet

Sources: City of Fontana 2023; ESRI 2023

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SECTION 5 - Projected Wastewater Flows

This section describes the process of calculating wastewater generation factors for the different land use types within the City sewer service area.

5.1 Targeted Flow Monitoring

The City contracted with ADS Environmental Services (ADS) to conduct flow metering tests in order to quantify existing sewer flows. Twenty-four (24) sewer manhole locations were selected throughout the sewer service area, as shown in **Figure 5-1 – Flow Monitoring Locations**. Manholes were selected on the basis of having adequate hydraulic conditions in order to isolate specific land use types within the upstream tributary area to determine existing sewer flows. Data on depth and velocity was collected daily by ADS over a 14-day period from March 10 to March 26, 2023 in order to quantify flows to support this master plan. The selected locations are listed in **Table 5-1 – Sewer Flow Monitoring Locations**.

The targeted flow monitors collected nominal data (small sample size) for the following land uses: community commercial (C-C), general industrial (I-G), and public facilities (P-PF). Flow monitors at manholes that captured general industrial (I-G) designated properties produced a significantly lower amount of flow than anticipated during the monitoring period. This could be due to split piping at intersections where tributary sewage was diverted, property/warehouse type, or industrial developments with a majority of land provisioned for parking lots. Any of these factors could have contributed to minimal reported flows.

The targeted flow monitors did not collect results for the following residential land-use types: residential estates (R-E), multi-family medium/high (R-MFMH), multi-family high (R-MFH), trucking residential (R-T), regional mixed use (RMU), walkable mixed use 2 (WMXU-2), and public utility corridors (P-UC). Such zoned areas were observed as either vacant or undeveloped and will therefore be analyzed solely for the ultimate scenario.

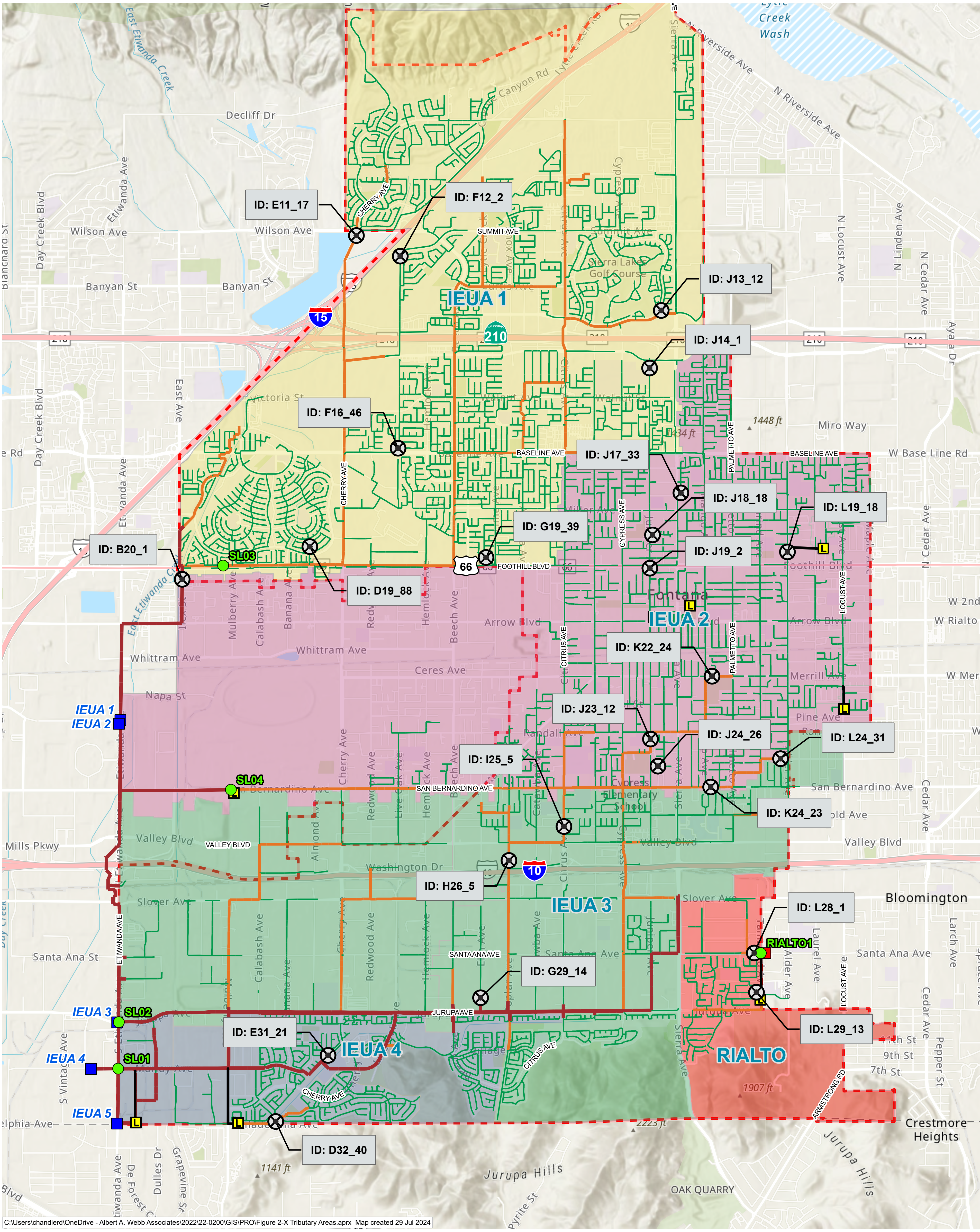
The flow monitoring results provide insight on inflow and infiltration as well as determining a standardized diurnal pattern for daily average flows and formulating a peaking factor, as discussed in the next sections.

Table 5-1 Sewer Flow Monitoring Locations

Location I.D.	Manhole No.	Pipe	Street(s)	Tributary Area
Fon01-E11_17	E11_17	Elliptical (18 in. H x 18 in. W)	5761 Cherry Ave.	IEUA 1
Fon02-D19_88	D19_88	Elliptical (10.25 in. H x 10.12 in. W)	North of 7799 Santa Maria Dr.	IEUA 1
Fon03-F16_46	F16_46	Round (8 in. H)	7251 San Sevaine Rd.	IEUA 1
Fon04-G19_39	G19_39	Round (8 in. H)	15590 Sesame Seed Ave.	IEUA 1
Fon05-L19_18	L19_18	Round (8 in. H)	8008 Alder Ave.	IEUA 2
Fon06-K24_23	K24_23	Round (21 in. H)	17136 San Bernardino Ave.	IEUA 2
Fon07-J24_26	J24_26	Elliptical (8 in. H x 8 in. W)	16762 Holly Dr.	IEUA 2
Fon08-J17_33	J17_33	Round (8 in. H)	7584 Sleepy Ck.	IEUA 2
Fon09-D32_40	D32_40	Round (15 in. H)	14059 Weeping Willow Ln.	IEUA 4
Fon10-B20_1	B20_1	Round (35.63 in. H)	13360 Chestnut Ave.	IEUA 1
Fon11-I25_5	I25-5	Elliptical (21.25 in. H x 21 in. W)	9978 Citrus Ave.	IEUA 3
Fon12-H26_5	H26-5	Round (21 in. H)	10229 Poplar Ave.	IEUA 3
Fon13-L29_13	L29_13	Round (8 in. H)	11174 Daylilly St.	RIALTO
Fon14-L28_1	L28-1	Elliptical (20 in. H x 22.25 in. W)	10760 Tamarind Ave.	RIALTO
Fon15-J18_18	J18_18	Round (8 in. H)	16741 Village Ln.	IEUA 2
Fon16-J14_1	J14_1	Round (10.13 in. H)	6706 Juniper Ave.	IEUA 1
Fon17-L24_31	L24_31	Elliptical (15 in. H x 15 in. W)	17647 Hawthorne Ave.	IEUA 2
Fon18-F12_2	F12_2	Round (7.88 in. H)	5778 San Sevaine Rd.	IEUA 1
Fon19-G29_14	G29_14	Elliptical (12.5 in. H x 11.5 in. W)	11213 Elm Ave.	IEUA 3
Fon20-J13_12	J13_12	Elliptical (9.88 in. H x 10 in. W)	South of Silver Lake Ln. & Augusta Dr.	IEUA 2
Fon21-E31_21	E31_21	Elliptical (10 in. H x 10.13 in. W)	14436 Figwood Dr.	IEUA 4
Fon22-J19_2	J19_2	Round (10 in. H)	8147 Juniper Ave.	IEUA 2
Fon23-K22_24	K22_24	Round (15 in. H)	17169 Merrill Ave.	IEUA 2
Fon24-J23_12	J23_12	Elliptical (18.13 in. H x 18.13 in. W)	9353 Juniper Ave.	IEUA 2

Source: ADS Report, 2023. 5-min flow depth, velocity, and quantity data observed during Friday, 10 March 2023 to Sunday, 26 March 2023, along with observed minimum and maximum data.

FIGURE 5-1 FLOW MONITORING LOCATIONS



LEGEND

Existing Sewerlines
Diameter (in)
- 12-inch or less
- 15-inch or greater
- Force Mains

- IEUA Sewerlines
- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations

Tributary Areas
- IEUA 1
- IEUA 2
- IEUA 3
- IEUA 4
- RIALTO

- Flow Monitoring Manholes
- Fontana City Limits
- City Master Meters

0 3,000 6,000 Feet

Sources: City of Fontana 2022; ESRI; 2023.

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5.1.1 Model Inflow and Infiltration Generation Rates

The model's dry weather sewage flows are those that occur when it is not raining. Since most of the existing and proposed pipelines lie above the groundwater table, infiltration due to ground water into the sewer pipelines during dry weather periods is assumed to be negligible.

The model's wet weather sewage flows include dry weather flows and inflow and infiltration flows. Inflow and infiltration flows are external sources of water such as groundwater and storm events. Groundwater infiltration flows were determined to be negligible for the modeling of this Master Plan. External flows can impact pipe capacities and increase pumping and treatment requirements. Infiltration problems can be controlled to a certain extent with new developments in pipe jointing techniques. However, proper inspection during the construction phase is a key element in reducing infiltration. Infiltration rates are generally in the range of 25 – 200 gallons per inch diameter per mile (gal/in-dia/mile) of sewer pipe per day pursuant to the Gravity Sanitary Sewer Design and Construction, American Society of Civil Engineers, Manual and Reports of Engineering Practice No. 60 (2007). Storm inflow can also be controlled with proper storm drainage around sewered areas. Additionally, a continuous program for detecting and eliminating sources of inflow such as flooded manhole covers and roof drain or catch basin connections is highly recommended.

Inflow and infiltration within the City of Fontana and the City's SOI were determined by evaluating available master meter flow data[1] from (a) Master Meter SL01, (b) Master Meter SL02, and (c) Master Meter SL04. Flow data was compared to available rainfall data[2] resulting in a correlation between storm events and high peaks in the flow data. As a result of our analysis, an inflow and infiltration factor of 90 gpd/acre is utilized in this analysis, which falls within the acceptable range established per the aforementioned ASCE Manual and Reports of Engineering Practice No. 60 (2007). The model applies this factor evenly for all parcels within its sewer service area.

5.1.2 Diurnal Loading Patterns

The flow monitoring data collected from March 10, 2023 to March 26, 2023 provides much insight to the flow characteristics of the City's service area and has been utilized for model calibration. Additionally, a review of the diurnal loading patterns for base wastewater flows was conducted (**Figure 5-2 – Diurnal Loading Patterns**). **Table 5-2 – Observed Diurnal Loading Pattern** summarizes the average and peak flows as well as review of the peak factors (PF). **Appendix C** contains individual manhole loading pattern exhibits.

[1] Per City of Fontana Operations September 2021 – September 2022

[2] AgACIS Station Name: Ontario Intl AP September 2021 – September 2022

Table 5-2 Observed Diurnal Loading Pattern

Location I.D.	Manhole No.	Average Daily Flow (MGD)[1]	Recorded Peak Flow (MGD)[1]	Peak Factor
Fon01-E11_17	E11_17	0.67	2.45	3.64
Fon02-D19_88	D19_88	0.21	0.35	1.67
Fon03-F16_46	F16_46	0.13	0.36	2.71
Fon04-G19_39	G19_39	0.06	0.14	2.22
Fon05-L19_18	L19_18	0.26	0.51	2.01
Fon06-K24_23	K24_23	1.07	2.16	2.02
Fon07-J24_26	J24_26	0.07	0.17	2.25
Fon08-J17_33	J17_33	0.06	0.15	2.43
Fon09-D32_40	D32_40	0.25	0.48	1.89
Fon10-B20_1	B20_1	6.06	11.94	1.97
Fon11-I25_5	I25-5	2.99	5.41	1.81
Fon12-H26_5	H26-5	3.06	6.02	1.97
Fon13-L29_13	L29_13	0.04	0.12	2.75
Fon14-L28_1	L28-1	0.09	0.2	2.21
Fon15-J18_18	J18_18	0.02	0.07	3.32
Fon16-J14_1	J14_1	0.08	0.22	2.68
Fon17-L24_31	L24_31	0.62	1.23	1.99
Fon18-F12_2	F12_2	0.06	0.14	2.22
Fon19-G29_14	G29_14	0.01	0.05	7.08
Fon20-J13_12	J13_12	0.23	0.37	1.64
Fon21-E31_21	E31_21	0.15	0.26	1.73
Fon22-J19_2	J19_2	0.24	0.56	2.31
Fon23-K22_24	K22_24	0.32	0.63	1.96
Fon24-J23_12	J23_12	1.36	2.45	1.8

(1) Source ADS Flow Monitoring Results (March 10, 2023 – March 26, 2023)

PF = Peak Factor; MGD = million gallons per day

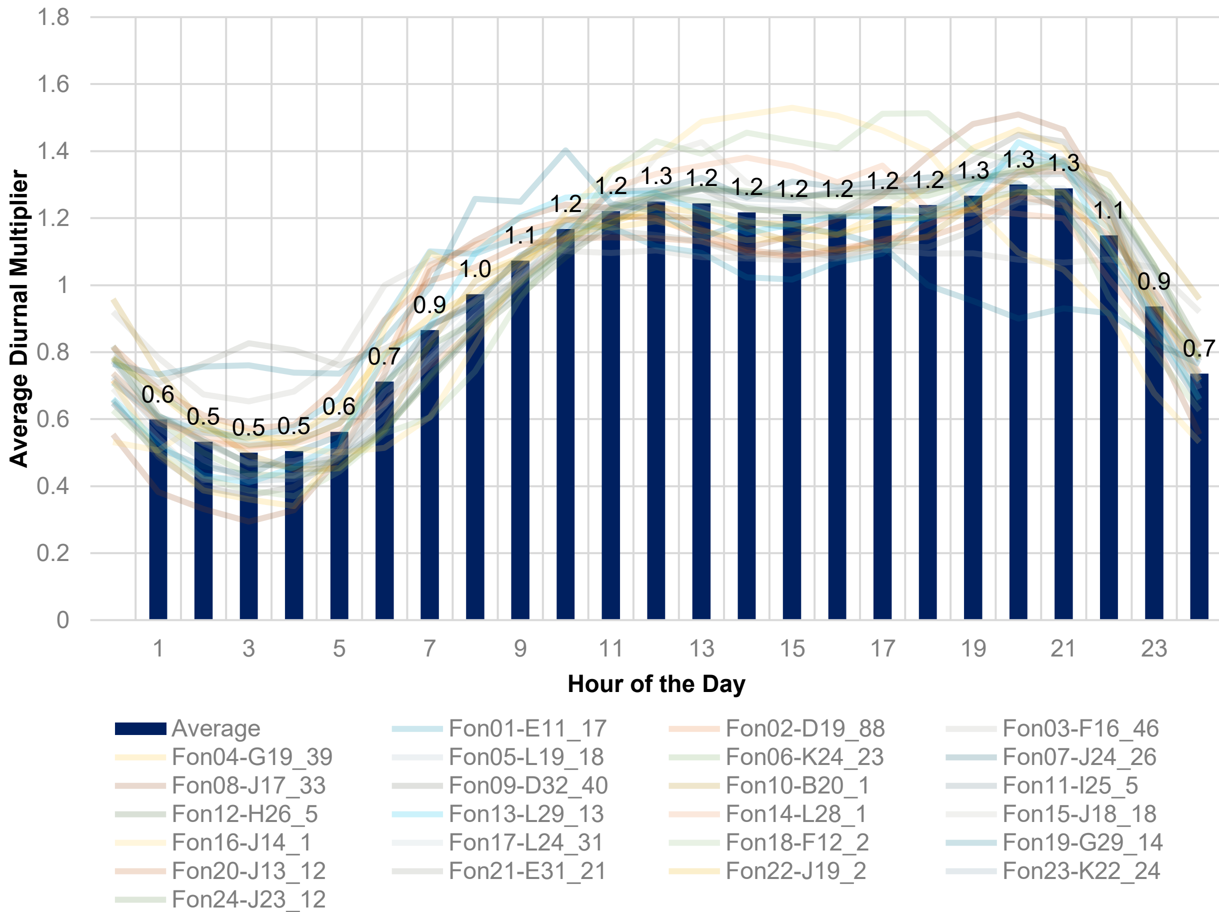


Figure 5-2 Diurnal Loading Patterns

Based on our review of flow monitoring data, a best fit curve was developed (**Figure 5-3**) resulting in the following wastewater peak flow formula:

$$Q_{Peak} = 2.1Q_{Ave}^{\ 0.91}$$

$$Q_{Ave} = \text{Observed Average Daily Flow (MGD)}$$

$$Q_{Peak} = \text{Peak Flow (MGD)}$$

As shown in **Table 5-2**, the peak factors based on field recorded data ranged from 1.64 to 3.64[1]. The calculated peak factors provided in Table 5-3 ranges of 1.79 to 3.18 which correlates well to the field recorded peaking factors, therefore validating the proposed peak formula used for this study. The peaking factor along with inflow/infiltration rates are integral to pipeline sizing and capacities.

[1] The observed peaking factor of 7.08 at MH No. G29_14 appeared out of range and was not used in this analysis.

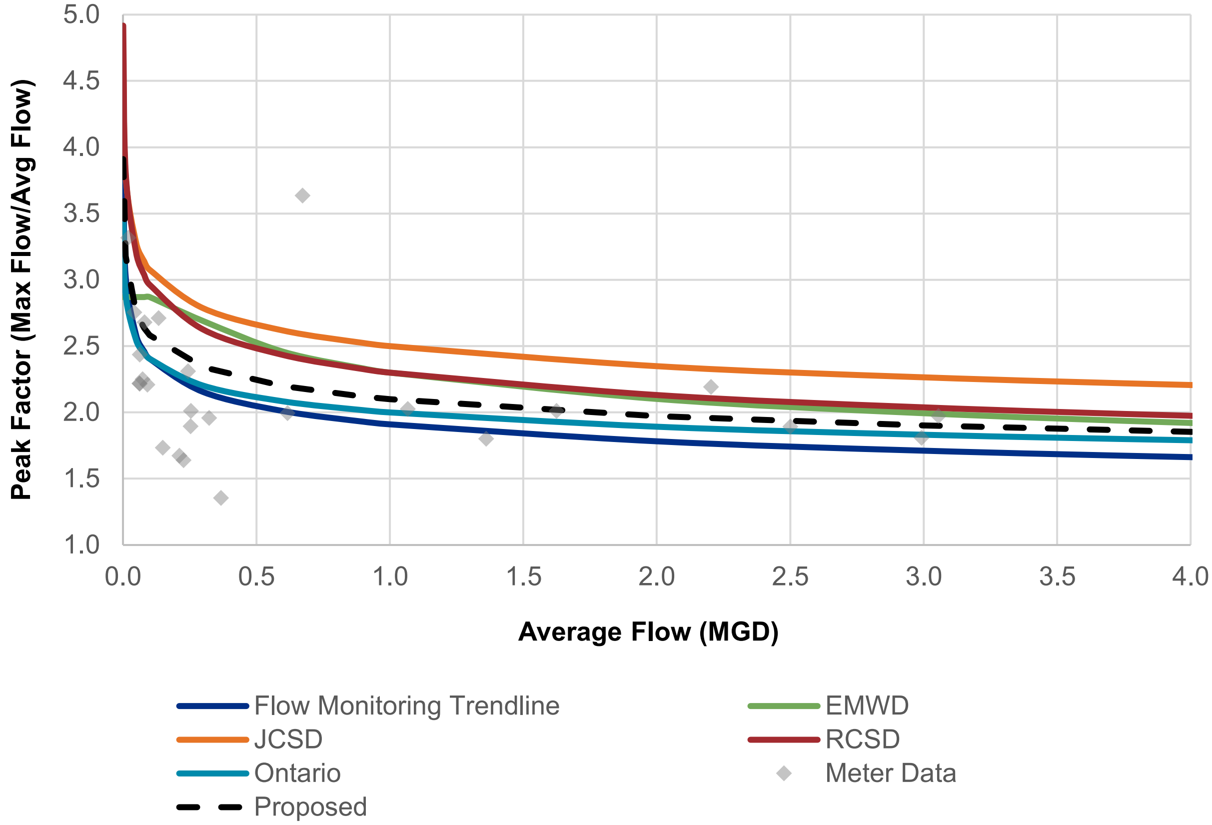


Figure 5-3 Comparison of Peaking Relationships from Different Agencies

5.2 Wastewater Generation Factors

5.2.1 Factor Calibration Process

The flow monitoring data results informed the development of preliminary generation factors (i.e., observed flows), which were then calibrated with data from surrounding agencies and the City's previous 2013 master plan results (i.e., predicted flows). Projected average flows were then adjusted to be comparable if not slightly conservative to the observed flows. An example of observed and projected flows is shown in **Table 5-3 – Example of Calibration Process**.

Table 5-3 Example of Calibration Process

Manhole ID	Area (ac)	Land-Use	Observed Flow (MGD)	Sewer Gen. Factor (gpd/ac)	Projected Flow (MGD)
L19_18	203	R-SF	**0.255**	1,025	**0.268**
D32_40	170	R-PC	**0.254**	1,550	**0.278**
L28_1	205	I-L	**0.091**	400	**0.096**

Notes: MGD = million gallons per day; gpd/ac = gallons per day per acre

5.2.2 Proposed Sewer Generation Factors

The results of the calibration process described above are summarized in **Table 5-4 – Calibrated Wastewater Factors.**

Table 5-4 Calibrated Wastewater Generation Factors by Land Use Type

Land Use Code	Land Use Category	Density (DU/acre) or Intensity (FAR)	Generation Factor (gpd/ac)*
Residential Categories			
R-E (1)	Residential Estate	0.1-2.0	265**
R-PC (2)	Residential Planned Community	3.0-6.5	1,550**
R-SF	Single-Family Residential	2.1-5.0	1,025**
R-M	Medium-Density Residential	5.1-12.0	2,900**
R-MF	Multi-Family Residential	12.1-24.0	4,200
R-MFMH (1)	Multi-Family Medium/High Residential	24.1-39.0	5,200
R-MFH (1)	Multi-Family High Residential	39.1-50.0	5,200
R-T (1)	Trucking Residential	2.0	265
Mixed Use Categories(3)			
RMU (1)	Regional Mixed-Use	12.0-24.0 0.1-1.0 FAR	Varies(3)
WMXU-1	Walkable Mixed-Use 1	3.0-39.0	Varies(3)
WMXU-2 (1)	Walkable Mixed-Use 2	2.10-24.0	Varies(3)
Commercial & Industrial Categories			
C-C (4)	Community Commercial	0.1-1.0 FAR	1,200
C-G (4)	General Commercial	0.1-1.0 FAR	1,200
I-L	Light Industrial	0.1-0.6 FAR	400
I-G (1)	General Industrial	0.1-0.6 FAR	500
Other Categories			
P-PF (4)	Public Facilities	-	1,500
P-R	Recreation Facilities	-	0
P-UC (1)	Public Utility Corridors	-	100
OS	Open Space	-	0

Notes: FAR = floor to area ratio; DU/acre = dwelling unit per acre; gpd/ac = gallons per day per acre.

* Factors assume typical density of land use categories not the maximum.
** Factors include a 20% increase to account for potential future accessory dwelling units (ADU), see discussion below.
(1) These factors are not based on observed flow monitoring data.
(2) This factor represents all Specific Plans within the City and therefore includes a range of densities and non-residential intensities.
(3) Generation factors for Mixed Use Categories vary and are to be determined based on specific project's residential and commercial land use densities to estimate projected wastewater. For purposes of this study RMU = 3,000, WMXU-1 = 2,600, WMXU-2 = 2,000.
(4) Nominal sample size of observed flow was collected; therefore, these factors are from the previous master plan and/or surrounding agencies.

Because flow data could not be collected for R-E, R-MFMH, and R-MFH land uses because those properties were vacant/undeveloped at the time the monitors were in-place, the City has elected to use a factor from its previous master plan (2013) of 5,200 gallons per day per acre for R-MFMH and R-MFH properties. The factor for R-T was selected to match R-E based on similarities in density and the factor for RMU was selected based on the previous master plan and surrounding agencies. Likewise, factors from neighboring agencies were used to generate a factor for R-E of 265 gpd/ac, which is the lowest density residential land use (0.1 to 2.0 units per acre). The factor for WMXU-2 is a comparable reduction based on density from WMXU-1. Furthermore, a conservative factor of 500 gpd/acre for I-G properties was selected, instead of using the observed flow rates, which is a rate consistent with the City's previous master plan and nearby agencies.

5.2.3 Equivalent Dwelling Unit

An equivalent dwelling unit (EDU) refers to one single-family residential unit and is utilized as a unit of measurement for wastewater generation. The single family residential (R-SF) land use were analyzed as the EDU benchmark considering that over one-third of the City service area consists of this land use type. With a density range of 2.1 to 5.0 dwelling units per acre for R-SF, this study assumes four dwelling units per acre is a reasonable definition for the City's proposed EDU factor. This would equate one EDU to four dwelling units/acre with a flow factor of 1,025 gpd/ac totaling a defined **240 gpd/EDU**.

Fontana is continuously working to refine this definition using multiple references including the latest IEUA Study titled, "Sewer Return Flow Estimation" dated November 30th, 2020. In the aforementioned study, an EDU was defined as 270 gpd/EDU using a wealth of criteria for commercial and residential types. EDU data has been provided by the City in shapefile format and has been examined to assist in a verified EDU generation rate to use for regional planning. As the state enforces water conservation regulations, certain agencies are considering utilizing a lower EDU rate as more efficient water fixtures are being implemented.

5.2.4 Accessory Dwelling Unit

As discussed in Section 2.4.7, an estimate has been made assuming each dwelling unit has five persons, and half of the residential properties where ADUs are allowed (which are, R-E, R-PC, R-SF, and R-M) may ultimately develop an ADU and each ADU would have two persons, which results in a 20% population increase. Therefore, the potential future impact of ADU's in residential areas is accounted for in two ways: (1) the number of people per dwelling unit was increased by 20%, from 5.0 to 6.0, but only for those residential land uses with densities up to and including medium-density residential; and (2) the ultimate wastewater generation projections in this report are increased 20% for the same residential land uses. The City has overlooked a handful of multi-family project use ADU's, but due to the limited space available the increased wastewater flow rate was assumed nominal in terms of overall sewer generation. The 20% increase in population for the land use types that allow ADUs (i.e., R-E, R-PC, R-SF, and R-M) is embedded in the projections.

Because of the evolving regulations around ADUs, the City should maintain consistency with the State regulations, including when a separate connection is required and to correctly assess and collect appropriate fees.

The additional ultimate flow increase that results from considering potential ADU's is calculated in **Table 5-5 – ADU Additional Average Wastewater Generation (Ultimate Condition).**

Table 5-5 ADU Additional Wastewater Generation (Ultimate Condition)

LU Code	LU Category	Density (DU/ac)	Buildout Area (ac)	Wastewater Generation Factor (gpd/ac)	Total Wastewater Projection (MGD)	Ult. Wastewater Projection(1) (MGD)
R-E	Residential Estate	0.1-2.0	634	265	0.17	0.03
R-PC	Residential Planned Community	3.0-6.5	5,978	1,550	9.27	1.85
R-SF	Single-Family Residential	2.1-5.0	5,401	1,025	5.54	1.11
R-M	Medium-Density Residential	5.1-12.0	890	2,900	2.58	0.52
					Total Increase=	**3.51**

(1) 20% increase accounted for ADU projection

5.3 Projected Ultimate Wastewater Flow

Wastewater flow projections have been determined by reviewing recorded flow data at metered wastewater connections, lift stations, treatment plants, and targeted sewer pipeline flow monitoring. This information was used to develop wastewater generation and peaking factors for the City of Fontana's areas of similar land use. The ultimate scenario, which is considered the same as "buildout" for this study is based on the City's land use plans provided for this study. The buildout wastewater flow projections have been separated into the five connections point tributary areas (refer to **Table 4-1** and **Figure 4-1**).

To design a sewage system for the City of Fontana under buildout conditions, sewage flow was calculated from each tributary area based on the current City and County Land Use Plan, as discussed in Section 2. Appropriate wastewater generation factors, developed herein Section 5, were applied to calculate projected flows for each land use for each tributary sewage area within the City prior to the modeling discussed in Section 6. In order to calculate future residential and nonresidential sewage generation, the corresponding generation factors are applied to their respective area per tributary area were determined.

The summation of the total flows from each tributary area was used to calculate the total design flow for the City's service area. **Table 5-6 – Preliminary Fontana Average Daily Flows at Buildout** summarizes the average daily flows at projected buildout within the City, including the City's wastewater discharge capacity rights. The total projected average daily flow for the City is about 25.2 MGD. Ultimate flow values will be utilized in the modeling process for the design of a trunk sewer system to convey the buildout flow conditions.

Table 5-6 Preliminary Average Daily Flow at Buildout

Tributary Area	Residential (gpd)(1)	Commercial/ Industrial (gpd)(1)	Public Use/ Mixed Use (gpd)(1)	Total Average Daily Flow (gpd)	Discharge Capacity Rights (gpd)(3)
IEUA 1	8,031,703	802,132	2,124,630	10,958,465	-
IEUA 2	5,133,215	406,545	3,328,227	8,867,986	-
IEUA 3	1,319,469	923,596	1,039,231	3,282,296	-
IEUA 4	1,228,819	44,077	121,164	1,394,060	-
Rialto	466,338	159,756	105,524	731,627	1,600,000(2)
Total	**16,179,544**	**2,336,106**	**6,718,776**	**25,234,434**	**-**

(1) A wastewater generation factors for all land use types based on Table 5-5.

(2) The delivery and receipt of sewage is per the July 16, 1991, Extraterritorial Sewer Services Agreement between the City of Fontana and the City of Rialto from a period of November 1, 1994 and thereafter, for the amount of 1,600,000 average gallons per day.

(3) IEUA allotted treatment capacity for Fontana relies on number of EDUs within the City. The total capacity of IEUA is 58,000 ac-ft with the City currently consuming approximately 25%, per City of Fontana email communication (06/12/24). Buildout projections indicate the City to reach nearly 50% of IEUA's treatment capacity.

Note: A 75% factor was applied to the gross acreage for ultimate buildout to determine the net acreage not including streets or ROW

SECTION 6 - System Hydraulic Model

This section describes the computer modeling performed to analyze the hydraulics of the Fontana sewer system. Model inputs and data cleanup methods are discussed. The model was calibrated with observed flow data including peak flows. The model results were refined to achieve City-wide generation factors that would result in flows greater than, and therefore more conservative than field measurements. Model results focus on sewer line segments with hydraulic deficiency and/or full flow failures in an existing wet model scenario and/or an ultimate wet model scenario.

6.1 Software Selection

A detailed model of Fontana's entire sewer system was developed as part of this Wastewater Master Plan. The model is built on a Geographical Information System (GIS) platform to interface with the City's existing GIS database and atlas maps. The model has the ability to manage and maintain the database that stores the sewer analysis input and output results. Manning's Equation is used for depth of flow calculations in the gravity sewer pipes.

Fontana's sewer system is modeled by entering pipe diameters, lengths, inverts, and roughness coefficients, as well as land use designations. The sewer model includes all the City's existing manholes, sewer pipes (excluding laterals, private sewers, and sewers belonging to other agencies), pump stations, large point source flows, and tributary area boundaries. Points of connection to IEUA facilities were also identified during model development.

Average dry-weather and wet-weather flows were established as model scenarios, while peak flows were determined based on the City's peaking equation. Pumped flows and measured flows can be entered at any manhole as a fixed flow. At the completion of a modeling run, output data for pipes include average and peak flow rate, velocity, pipe capacity, and ratio of flow depth to pipe diameter (d/D).

The model meets the City's requirements for modeling, as follows:

- Selected model shall be updatable as the City's sewer system continues to grow and change; and
- Selected model shall be user-friendly so that a variety of City staff in various departments can use the model with minimal to no training.

The available software options that can perform the tasks listed above were researched. Innovyze's® InfoSewer® program was found to be the most appropriate modeling software that fits the City's needs and intended uses. Innovyze has an office in Monrovia and InfoSewer is the primary modeling tool used in Southern California. InfoSewer was selected for the following reasons:

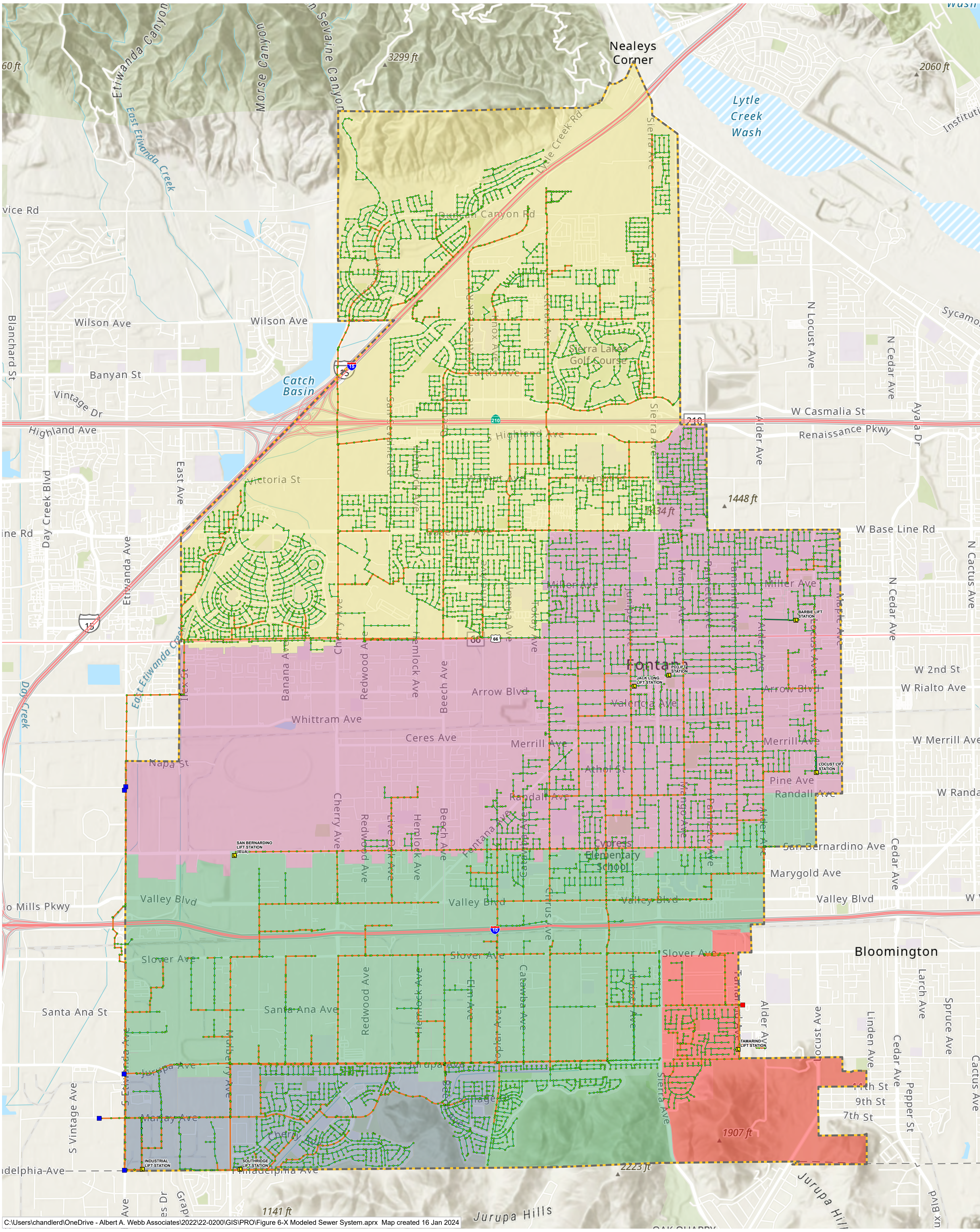
- InfoSewer is an Esri Extension, and it permits full use of ArcGIS elements. Additionally, Innovyze is an Esri Gold Business Partner. Hence, the software will allow the user to have an easy one-to-one relationship between the existing GIS database and the model.
- InfoSewer adopted successful features of InfoWater like domain, facility, DB, Reports, Utilities, Scenario and Run Managers, all which has a long reputable history.

- InfoSewer has peaking factors for Dry Weather Flow, and has both Steady State and EPS Runs, making it efficient for large networks.
- InfoSewer uses Manning's equations, making it efficient for Western USA conditions which are characterized by minimal inflow and infiltration (I&I) influence.

Furthermore, WEBB has a history of successfully using Innovyze's InfoWater, which is programmed similarly to InfoSewer. Webb's experience with the Innovyze support staff has always been favorable, and we experienced the same during our preparation of a Fontana sewer model. Based on the aforementioned reasons, Innovyze's InfoSewer was selected for preparation of the City's Wastewater Master Plan and for the City's long-term system model maintenance.

The modeled sewer system for each tributary area is shown in **Figure 6-1 – Modeled Sewer System**. Refer to **Appendix D** for a more detailed summary of modeled elements organized by tributary areas.

FIGURE 6-1 MODELED SEWER SYSTEM



LEGEND

Model Pipes
Diameter (in)
- 8-inch or less
- 10-inch or greater
- Force Mains

- Model Manholes
- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations

Tributary Areas
- IEUA 1
- IEUA 2
- IEUA 3
- IEUA 4
- RIALTO

- Service Area Boundary

0 0.5 1 Mi

Sources: City of Fontana 2022; ESRI, 2023.

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6.2 Model Calibration

To compare and calibrate the model flows, WEBB used targeted flow monitoring data collected from March 10, 2023 to March 26, 2023 (see Section 5), along with other available field flow data, in order to have a model that accurately represents Fontana's sewer system.

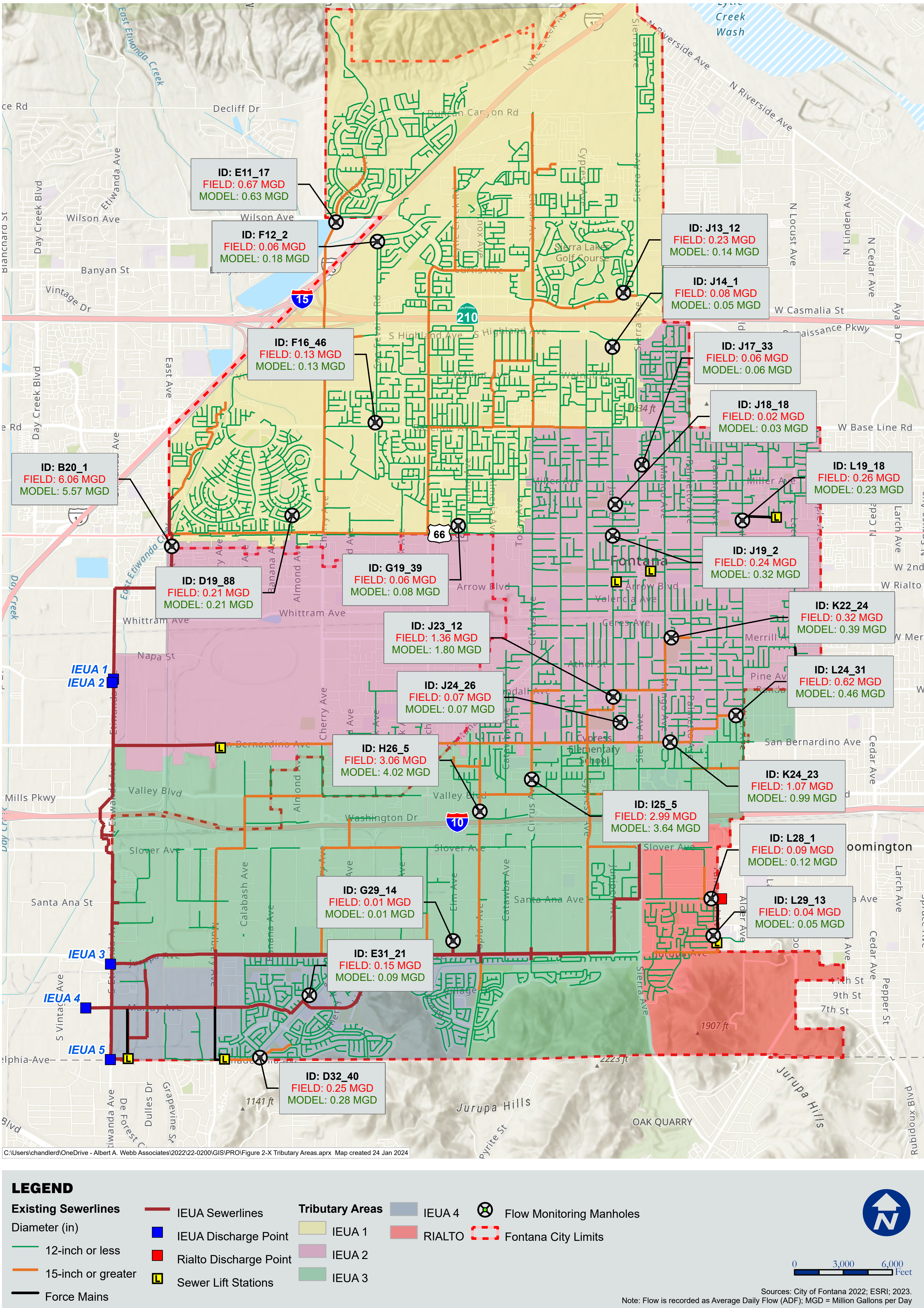
To understand the calibration approach, a quick summary of the model's wastewater loading process is helpful. The model allows for wastewater loading at every manhole. To determine the wastewater load at each manhole, a spatial analysis using ArcMap tools was run to tie the parcel shapefiles to a system manhole. Manual corrections and verifications were performed throughout the system to re-create more accurate tributary areas for the system's manholes. Each parcel has a specific land use and acreage assigned to it, which allows for individual wastewater generation calculations for each parcel using land use generation factors. Parcels that are known to the City as having a registered sewer account for billing purposes were assumed to generate wastewater for modeling purposes. This allows for the study of existing sewer accounts only.

Given the GIS data, land use, and parcel acreage, the only variable for calibration is the land use wastewater generation factors. To calibrate the model, the wastewater generation factors for each land use type calculated in Section 5 were applied across the City, which gave flow rates in some areas of the City that were too high or too low as compared to field measurements. In these areas, the land use generation factors were iteratively adjusted to align the model results with observed field measurements. Sometimes field data did not match model data during the calibration process. Reasons why field data and model data did not closely match during the calibration process can include incorrect field data (i.e., faulty measuring device, faulty measuring method, faulty calculations), incorrect GIS data (i.e., wrong elevations, wrong pipe diameters, wrong pipe orientation), or unknown field conditions (i.e., pipe blockages, pipe leaks, I/I flows). Where inconsistencies remained between field measurements and model results, unit wastewater generation factors were chosen such that the modeled flows in general were more conservative than the field measurements. This criterion gives a conservative generation factor that can be applied City-wide and avoids the creation or need for parcel-specific factors. Notably, model results and field measurements were consistent at the most downstream points of the system.

The model was also calibrated for the "ultimate" modeling scenarios at buildout of the City. All parcels that were previously excluded because they had no sewer account and were considered undeveloped were included in the ultimate model.

The model calibration points utilized for comparing field flow to model flow are provided on **Figure 6-2 – Model Calibration Points.**

FIGURE 6-2 MODEL CALIBRATION POINTS



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Once the calibration process was completed, the results are shown in **Table 6-1 – Calibrated Wastewater Generation Factors by Land Use Category**. The generation factors for individual residential categories are the product of the residential generation factor (265 gpd/DU)(1) and the assumed residential density (DU/acre) for each category.

Table 6-1 Calibrated Wastewater Generation Factors by Land Use Category

Land Use	Land Use Description	Density (DU/ac)	Generation Factor (gpd/ac)*
Residential Categories			
R-E	Residential Estate	0.1-2.0	265
R-PC	Residential Planned Community	3.0-6.5	1,550
R-SF	Single-Family Residential	2.1-5.0	1,025
R-M	Medium-Density Residential	5.1-12.0	2,900
R-MF	Multi-Family Residential	12.1-24.0	4,200
R-MFMH	Multi-Family Medium/High Residential	24.1-39.0	5,200
R-MFH	Multi-Family High Residential	39.1-50.0	5,200
R-T	Trucking Residential	2.0	265
Mixed-Use Categories			
RMU	Regional Mixed-Use	12.0-24.0	Varies(1)
WMXU-1	Walkable Mixed-Use 1	3.0-39.0	Varies(1)
WMXU-2	Walkable Mixed-Use 2	2.10-24.0	Varies(1)
Commercial & Industrial Categories			
C-C	Community Commercial		1,200
C-G	General Commercial		1,200
I-L	Light Industrial		400
I-G	General Industrial		500
Other Categories			
P-PF	Public Facilities		1,500
P-R	Recreation Facilities		0
P-UC	Public Utility Corridors		100
OS	Open Space		0

* Factors assume the typical density of land use categories not the maximum.
(1) Generation factors for Mixed Use Categories vary and are to be determined based on specific project's residential and commercial land use densities to estimate projected wastewater. For purposes of this study RMU = 3,000, WMXU-1 = 2,600, WMXU-2 = 2,000.

The model calibration was considered complete once consistent generation factors for the entire system were recommended and agreed upon by the City. Some comparison locations are not an exact match, but changes to their tributary area's wastewater generation factors upset the comparisons in other regions of the City. Therefore, attempts were made to keep the system as balanced as possible, with refined field flow vs model flow comparisons while using the same wastewater generation factors. It was decided that as a general rule, sewerlines within mostly industrial and commercial tributary areas were to be modeled with more flow than with less flow, given the more volatile nature of industrial and commercial flows. The accuracy of the calibration results is captured in **Figure 6-2 – Model Calibration Points**.

It is important to note that part of the calibration process is matching the same conditions in the model as in the field. There are multiple diversion structures located at various trunk lines throughout the service area that divert all or most of the flow in a manhole one of multiple directions when there is more than one downstream pipe. The City provided information on what direction the diversion structures they have within their system flow in Section 5. These were programmed as specified by the City.

6.2.1 Model Peaking

The model includes a feature that allows for peaking using the City's sewer peaking equation, which was determined based on the peaking flows monitored from the Flow Monitoring Report provided by ADS. The calculated peaking factor is defined below.

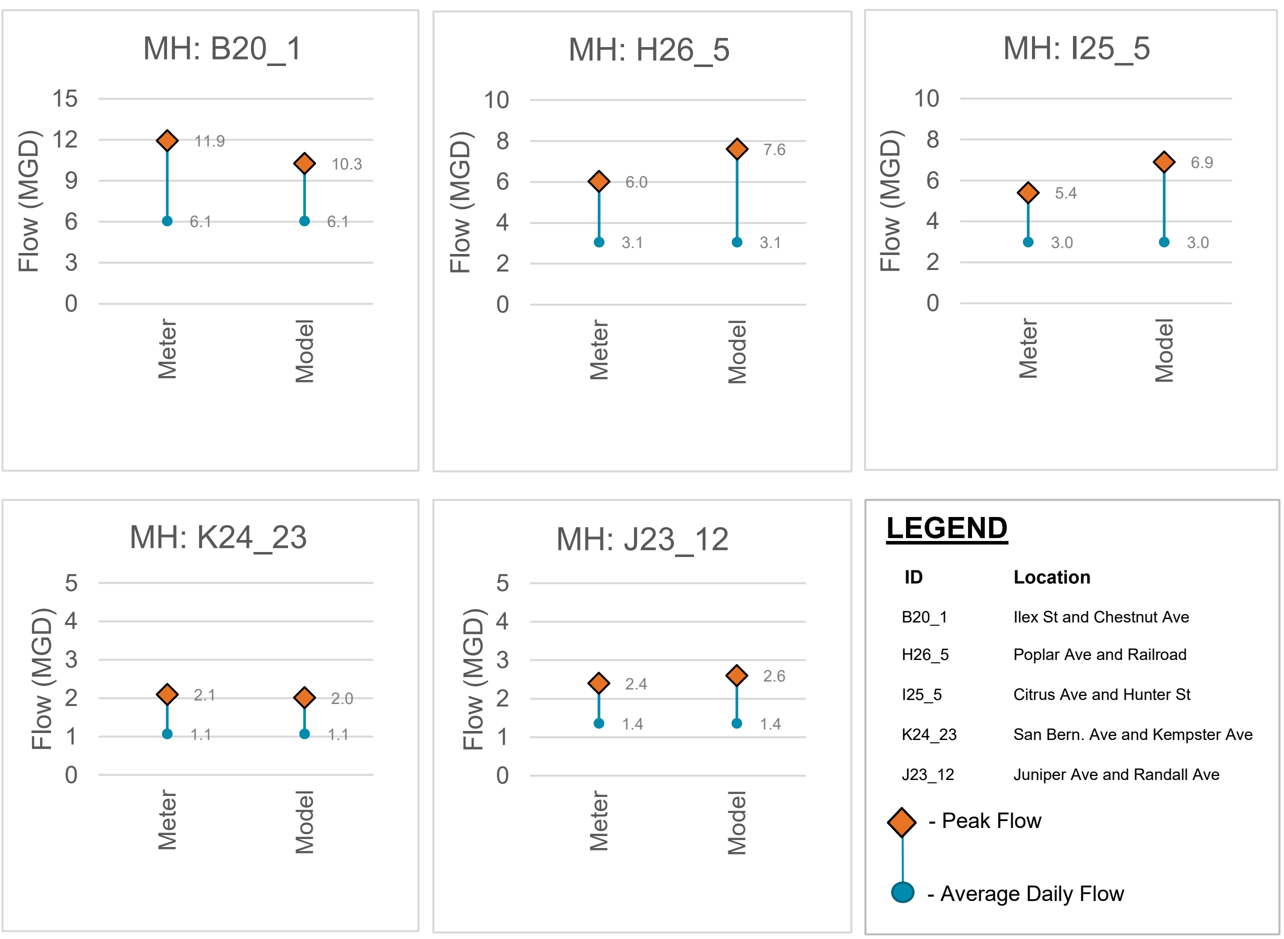
$$Q_{pk} = 2.1\ Q_{ADF}^{0.91}, \text{ where}$$

$$Q_{pk} = \text{peak flow, in MGD}$$

$$Q_{ADF} = \text{average daily flow, in MGD}$$

The peaking equation calculates peak flows that are generally higher than the field-observed peak flows, therefore calculated peaks for planning purposes are considered more conservative. A comparison of the flow monitoring observed peak flows and equation-calculated peak flows, for manholes observed with a minimum of 1.0 MGD of average daily flow, is summarized in **Figure 6-3 – Observed and Calculated Peak Flow Comparison**. As shown in Figure 6-3, the City's peaking equation typically provides higher, more conservative flow values for pipe sizing and design. Lift stations are designed to pump peak flow.

Figure 6-3 Observed and Calculated Peak Flow Comparisons



6.2.2 Modeled Lift Station Flow

The model considered the effects of five City lift stations: Industrial, Southridge, Tamarind, Locust, and Barbie. These stations were essential for effective model execution. However, three other lift stations, namely Police Department (PD), Jack Long, and San Bernardino, were not included in the analysis. For PD and Jack Long, their pumping contributions were factored into the calculations for the respective manholes' loads. As for the San Bernardino lift station, it was modeled as an outlet since it exclusively pumped into IEUA's system. The five lift stations flow was modeled based on pump curves provided by the City. The modeled lift stations are summarized in **Table 6-2 – Lift Station Model Flow Inputs**.

Table 6-2 Lift Station Model Flow Inputs

Lift Station	Existing Peak Flow Tributary to Lift Station (MGD)	Lift Station Firm Capacity (MGD)
Industrial	0.02	0.92
Southridge	1.28	1.38
Tamarind	0.63	0.66
Locust	0.07	0.49
Barbie	0.04	0.36

6.3 Model Scenarios

Four scenarios were created in the model identified as:

- Existing Dry Weather
- Existing Wet Weather
- Ultimate Dry Weather
- Ultimate Wet Weather

All scenarios in the model include the same land use-based wastewater generation and peaking factors. To differentiate scenarios used for analysis in the model, model loading was changed for each scenario. A summary of each scenario's manhole loading follows.

6.3.1 Existing Dry Scenario

The existing dry scenario included the sewer manhole loading that were finalized for the calibration process. It includes flow from active sewer generating parcels and excludes parcels with no water use and parcels with only water accounts only. This scenario also excludes inflow/infiltration flows. This scenario is considered the minimum impact scenario because each of the other scenarios increase either inflow/infiltration due to wet weather and/or increase the developed parcel area.

6.3.2 Existing Wet Scenario

The existing wet scenario includes the sewer loading for the existing dry scenario and the wet-weather inflow/infiltration loading. The inflow/infiltration loading is determined with the use of a 90 gpd/acre inflow/infiltration rate for the area within the City's service boundary. The inflow/infiltration flows were added as "Unpeakable Flow" in the model, meaning that the flows were constant and without a peaking factor.

6.3.3 Ultimate Dry Scenario

The ultimate dry scenario included the sewer manhole loading determined from every parcel tributary to each manhole, using model-generated wastewater generation factors calculated during the model calibration process. This includes every developable parcel in the City according to its ultimate land use. It includes flow from active sewer generating parcels and includes parcels with no current sewer connections. This scenario excludes inflow/infiltration flows.

6.3.4 Ultimate Wet Scenario

The ultimate wet scenario includes the sewer loading for the ultimate dry scenario with the wet-weather inflow/infiltration loading. The additional inflow/infiltration flows are the same in both the existing wet scenario and the ultimate wet scenario because the flows are only dependent on existing surface area. This scenario is considered the maximum impact scenario.

The "existing" wet and dry scenarios will help identify near term replacement recommendations, and the "ultimate" wet and dry scenarios will help identify long term replacement recommendations.

It is important to note the existing scenarios were run assuming the CIP Project No. 1 in section 7.1 of this report has already been finished. The current flow path through diversion structures in the system generates many more deficiencies in the system than what the new flow conditions from modifying the flow directions in the existing diversion structures create. This assumption was made to minimize future projects and project cost.

6.4 Analysis Results

Results from the InfoSewer model runs provided vital insight to the characteristics of the City's sewer system. The ultimate goal of this study is to determine and locate areas of deficiencies and provide cost effective and timely solutions.

6.4.1 Hydraulic Deficiencies

The City's Standard defines hydraulic deficiencies as the depth of wastewater flow exceeding the diameter of the pipe (d/D) ratio by more than 0.50 for pipes smaller than and equal to 12-inches in diameter and 0.75 for pipes larger than 12-inches in diameter.

6.4.2 Results of Existing Wet Scenario

Once all inputs and parameters were established into the model, it was run in the Existing Wet scenario yielding significant results. A substantial amount of potential hydraulic deficiencies in this scenario are present due to various existing diversion manholes in San Bernardino Avenue and Baseline Avenue, where existing flows are directed away from larger transmission lines and feed into adjacent smaller distribution pipelines flowing south.

Table 6-3 – Existing Wet Scenario Hydraulic Deficiencies summarizes the modeled hydraulic deficiencies during the Peak Day Generation scenario. Again, hydraulic deficiency has been defined as: 0.50<d/D<1.0 for 12-inch pipes and smaller, and 0.75<d/D<1.0 for pipes larger than 12-inches.

Table 6-3 Existing Wet Scenario Hydraulic Deficiencies

Type	Pipe Diameters (inches)					
	<12-in	12-in	15-in	18-in	21-in	>21-in
Pipe Lengths (ft) (1)	27,000	10,400	400	1,350	0	0
Percent of System	1.1%	0.43%	0.02%	0.06%	0%	0%

Notes:
(1) Length is rounded to nearest 50.
Hydraulic deficiency defined as 0.50<d/D<1.0 for 8-inch pipes and smaller, and 0.75<d/D<1.0 for 10-inch pipes and larger.
For inventory of pipes that experience hydraulic deficiencies under existing conditions, see Appendix E, Table B-1.

Similarly, **Table 6-4 – Existing Wet Scenario Potential Surcharge** summarizes pipe failures based on Full Flow Failure, which is defined as d/D ratio = 1.0. Results suggest that 33,550 linear feet of sewer pipe are currently showing potential surcharge in the existing wet weather scenario. Please note that these pipes would have no remaining capacity at full flow surcharge. This table separates the lengths of hydraulic issues where CIP projects are recommended, and hydraulic issues that are not significant enough to prompt CIP project recommendations.

It is important to note that many of the potential surcharges that are not identified as a CIP project are due to one or more of three main factors.

1. The sewer segment is part of an inverted siphon and full flow conditions are by design.
2. The full flow pipe is part of the IEUA interceptor line that runs North to South on the West side of the City boundary.
3. The full flow pipe is a local smaller diameter collector line rather than the interceptor line. These lines were not considered for the CIP project but will be shown and provided to the City for their information and use.

Table 6-4 Existing Wet Scenario Potential Surcharge

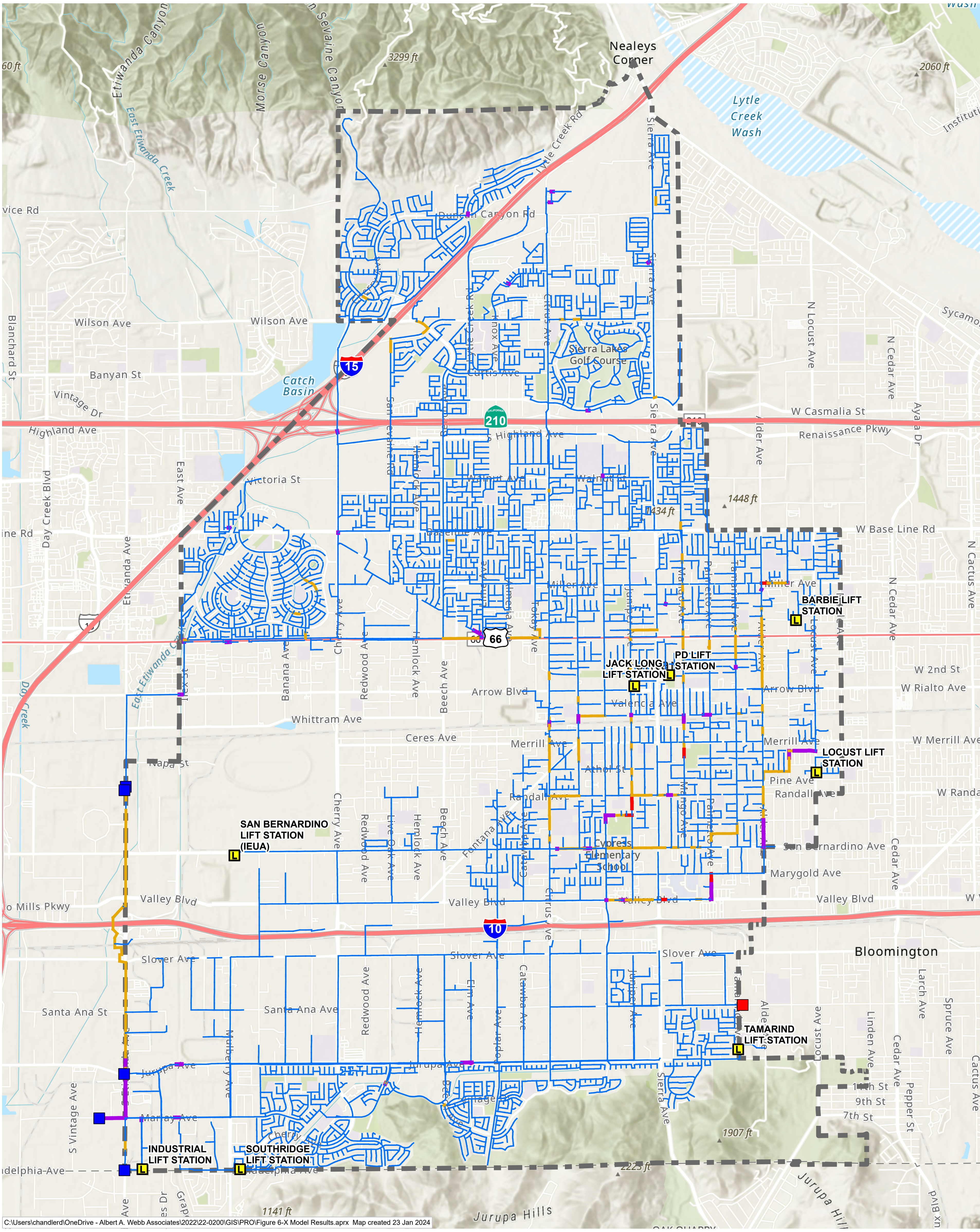
Type	Pipe Diameters (inches)					
	<12-in	12-in	15-in	18-in	21-in	>21-in
Pipe Lengths (ft) [(1)]	5,700	1,550	2,350	1,000	300	1,950
Percent of System	0.24%	0.06%	0.10%	0.04%	0.01%	0.08%

Notes:
(1) Length is rounded to nearest 50.
Hydraulic deficiency defined as 0.50<d/D<1.0 for 8-inch pipes and smaller, and 0.75<d/D<1.0 for 10-inch pipes and larger.
For inventory of pipes that experience hydraulic deficiencies under existing conditions, see Appendix E, Table B-1.

See **Figure 6-4 – Existing Wet Scenario Depth/Diameter Ratio Results** for the locations of modeled pipes falling under the definitions of hydraulic deficiencies and potential surcharge in the Existing Wet Scenario.

FIGURE 6-4

EXIST. WET WEATHER SCENARIO d/D RATIO RESULTS



LEGEND

d/D Ratio

- less than 0.5
- 0.5 ~ 0.75
- 0.75 ~ 0.99
- Potential Surcharge

- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations
- Service Area Boundary

0 0.5 1 Mi

Sources: City of Fontana 2022; ESRI, 2023.

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6.4.3 Ultimate Wet Scenario Analysis

Table 6-5 – Ultimate Wet Scenario Hydraulic Deficiencies summarizes the modeled hydraulic deficiencies in the ultimate wet scenario. The table excludes lengths for pipes with hydraulic deficiencies and potential surcharge in the existing wet scenario. Hydraulic deficiencies are defined as: 0.50<d/D<1.0 for 12-inch pipes and smaller, and 0.75<d/D<1.0 for 15-inch pipes and larger. Refer to **Appendix E** for the pipe inventory list and **Figure 6-6** for the locations of modeled pipes that meet this definition. Pipelines represented hereon, that surpass City hydraulic design criteria, were evaluated and helped establish CIP project recommendations. Proposed recommendations, further described in Section 7, focus on reducing these hydraulic deficiencies at critical parts of the City's sewer system and address downstream impacts.

Table 6-5 Ultimate Wet Scenario Hydraulic Deficiencies

Type	Pipe Diameters (inches)					
	<12-in	**12-in**	**15-in**	**18-in**	**21-in**	**>21-in**
Pipe Lengths (ft) (1)	58,850	27,100	1,050	0	100	2,700
Percent of System	2.4%	1.1%	0.04%	0%	<0%	0.11%

Notes:
(1) Length is rounded to nearest 50.
Hydraulic deficiency defined as 0.50<d/D<1.0 for 8-inch pipes and smaller, and 0.75<d/D<1.0 for 10-inch pipes and larger.
For inventory of pipes that experience hydraulic deficiencies under existing conditions, see Appendix E, Table B-1.

Table 6-6 – Ultimate Wet Scenario Potential Surcharge summarizes potential flow surcharge in the ultimate wet weather scenario. It is noted that these pipes would have no remaining capacity. Refer to **Appendix E** for the pipe inventory list and **Figure 6-6 – Ultimate Wet Scenario Depth/Diameter Ratio Results** for the locations of modeled pipes falling under this definition.

It is important to note that many of the potential surcharges that are not identified as a CIP project are due to one or more of three main factors.

1. The sewer segment is part of an inverted siphon and full flow conditions are by design.
2. The full flow pipe is part of the IEUA interceptor line that runs North to South on the West side of the City boundary.
3. The full flow pipe is a local smaller diameter collector line rather than the interceptor line. These lines were not considered for the CIP project but will be shown and provided to the City for their information and use.

Table 6-6 Ultimate Wet Scenario Potential Surcharge (d/D Ratio = 1.0)

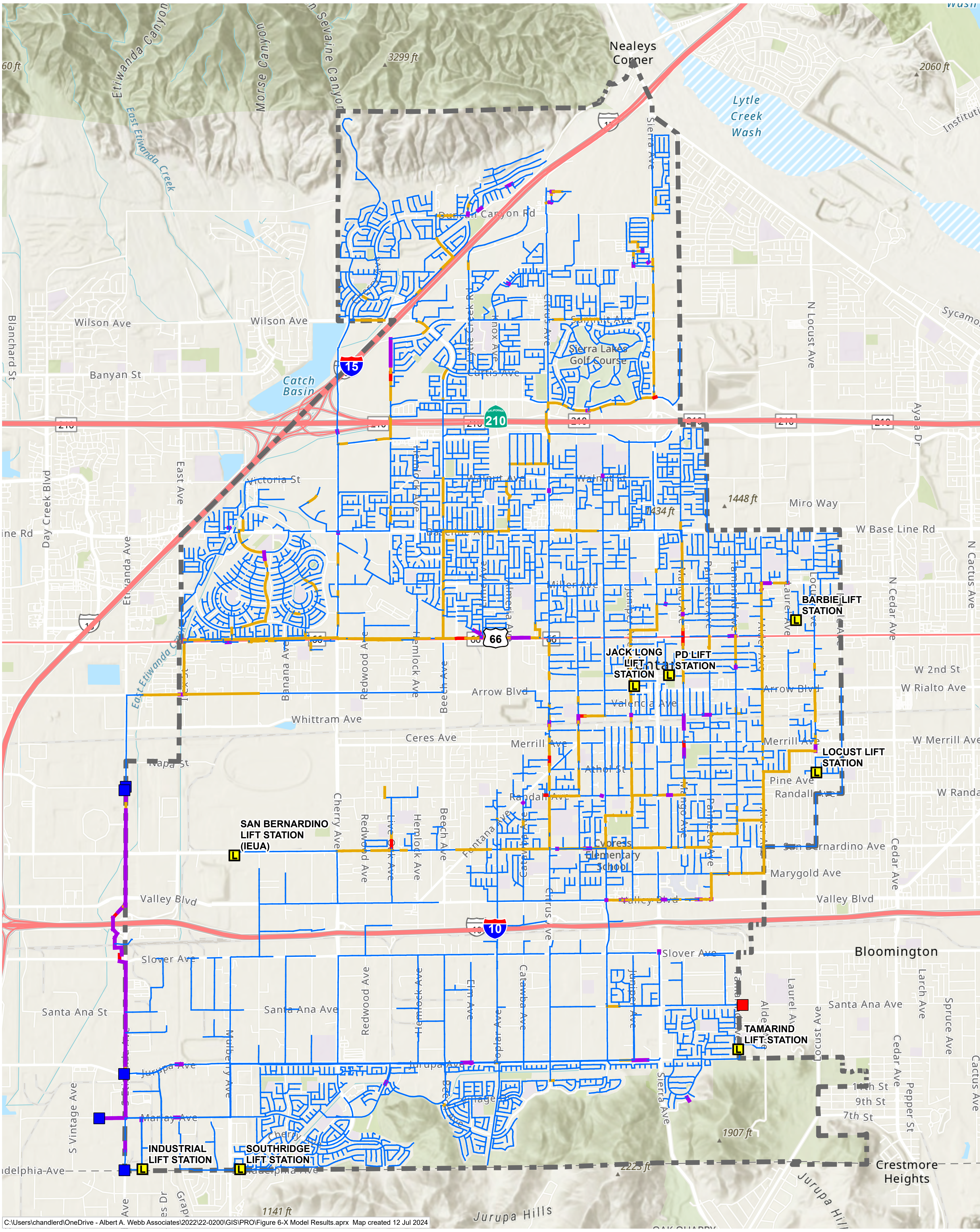
Type	Pipe Diameters (inches)					
	<12-in	12-in	15-in	18-in	21-in	>21-in
Pipe Lengths (ft) [(1)]	13,850	2,850	4,550	2,650	300	15,500
Percent of System	0.57%	0.12%	0.19%	0.11%	0.01%	0.64%

Notes:
(1) Length is rounded to nearest 50.
Hydraulic deficiency defined as 0.50<d/D<1.0 for 8-inch pipes and smaller, and 0.75<d/D<1.0 for 10-inch pipes and larger.
For inventory of pipes that experience hydraulic deficiencies under existing conditions, see Appendix E, Table B-1.

See **Figure 6-5** for the locations of modeled pipes falling under the definitions of hydraulic deficiencies and full flow failures in the Ultimate Wet Scenario.

FIGURE 6-5

ULT. WET WEATHER SCENARIO d/D RATIO RESULTS



LEGEND

d/D Ratio
- less than 0.5
- 0.5 ~ 0.75
- 0.75 ~ 0.99
- Potential Surcharge

- IEUA Discharge Point
- Rialto Discharge Point
- Sewer Lift Stations
- Service Area Boundary

0 0.5 1 Mi

Sources: City of Fontana 2022; ESRI, 2023.

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6.4.4 Ultimate Wet-Weather Lift Station Peak Flows

Table 6-7 – Ultimate Lift Station Peak Flows summarizes the modeled ultimate wet-weather peak flows that are tributary to the City's existing lift stations. Ultimate buildout flow is based on the service area being fully developed as shown in the City land use plans and the lift stations functioning at peak flow. These model results were used to determine how much ultimate flow the lift stations will undertake. As previously stated in Section 3, lift stations are to be sized for firm capacity with the largest pump out of service.

Table 6-7 Ultimate Lift Station Peak Flows

Lift Station	Ultimate Peak Flow Tributary to Lift Station (MGD)	Lift Station Firm Capacity (MGD)
Industrial	0.02	0.92
Southridge	1.35	1.38
Tamarind	1.29	0.66
Locust	0.26	0.49
Barbie	0.17	0.36

6.4.5 System Summary

The total length of pipes that were modeled in InfoSewer was approximately 2,452,650 feet. This consists of all existing pipes. Approximately 39,100 feet or 1.6 percent of the total length of pipes met the definition of hydraulic deficiencies. As previously stated, pipes that fall under this definition have some remaining capacity to convey ultimate wastewater flows. Approximately 12,700 feet or 0.5% of the total length of pipes met the definition of potential surcharge. Pipes that fall under this definition have no available capacity; therefore, would require upgrade, replacement, or parallel pipe. In total, approximately 51,800 feet or 2.1% of the total length of pipes meets the definition of hydraulic deficiencies or potential surcharge.

The locations where the model identified pipes that meet both criteria of potential surcharge was conducted. It appears that some pipes that meet the hydraulic deficiencies definition are located either adjacent or between pipes that meet the potential surcharge definition. Repair of these pipes may be combined depending on their close proximity.

Model results of hydraulic deficiencies and potential surcharges have been organized as follows by tributary area and model scenario. Refer to **Appendix E** for a pipe inventory list. The hydraulic deficiencies noted whether the d/D ratio is significantly higher than the design standard, or slightly higher than the design standard and therefore considered acceptable given the factors noted herein.

6.4.6 Tributary Area

IEUA 1 Tributary Area

In the IEUA 1 tributary area, model results suggest multiple small diameter sewer segments meet the criteria for both hydraulic deficiency and potential surcharge for both existing and ultimate scenarios. These segments are considered collectors and are not a part of this evaluation.

IEUA 2 Tributary Area

In the IEUA 2 tributary area, model results suggest multiple sewer segments meet the criteria for both hydraulic deficiency and potential surcharge for both existing and ultimate scenarios. These sewer segments and City areas present issues in the City's sewer model and require short-term or long-term attention:

1. Interceptor sewer line between Base Line Road to San Bernadino Avenue, Segments of Cypress Avenue, Orange Way, Oleander Avenue and Citrus Avenue
    a. **Existing Wet Scenario.** Six (6) 10-inch diameter and three (3) 12-inch sewer segments are categorized as hydraulic deficiencies with one 10-inch and one 12-inch sewer segments are full-flow failures in this area using the model's existing wet scenario.
    b. **Ultimate Wet Scenario.** An additional six (6) 12-inch sewer segments are categorized as hydraulic deficient in the ultimate wet scenario.
2. Interceptor sewer line between Alder Avenue to Cypress Avenue, segments on Hawthorne Avenue, Grevillea Street and San Bernardino Avenue.
    a. **Existing Wet Scenario.** All sewer segments are not considered hydraulically deficient however multiple are near the threshold.
    b. **Ultimate Wet Scenario.** Three (3) 15-inch sewer segments are categorized as hydraulically deficient with four (4) 15-inch segments categorized as potential surcharge.
3. Collector sewer line in Alder Avenue between Hawthorne Avenue to San Bernardino Avenue
    a. **Existing Wet Scenario.** According to the model, Four (4) 6-inch diameter sewer segments are full-flow failures in Felspar Street in the existing wet scenario.

    Ultimate Wet Scenario. Same results as Existing Wet Scenario.
4. Interceptor sewer line between Locust Avenue to Alder Avenue, segments on Alder Avenue, Athol Street Laurel Avenue and Granada Avenue.
    a. **Existing Wet Scenario.** Five (5) 8-inch sewer segments are categorized as full flow, three (3) 8-inch and six (6) 10-inch sewer segments are categorized as hydraulic deficiencies according to the model's existing wet scenario.
    b. **Ultimate Wet Scenario.** All sewer segments categorized as hydraulically deficient are categorized as a potential surcharge in the ultimate wet scenario.

5. Interceptor sewer line in Mango Drive between Baseline Road to Randall Avenue
    a. **Existing Wet Scenario.** Seven (7) 8-inch, two (2) 12-inch and one (1) 15-inch diameter sewer segments are categorized as hydraulic deficiencies with one 12-inch diameter sewer segment categorized as full flow.
    b. **Ultimate Wet Scenario.** An additional nine (9) 8-inch, one (1) 10-inch diameter sewer segments is categorized as a hydraulic deficiency with an additional 12-inch and 15-inch segment categorized as full flow.
6. Collector sewer line in Miller Avenue between Laurel Avenue to Alder Avenue and connecting on Fairfax Street and Alder Avenue
    a. **Existing Wet Scenario.** Five (5) 8-inch sewer segments are hydraulically deficient according to the model's existing wet scenario.
    b. **Ultimate Wet Scenario.** Two (2) of the 8-inch sewer segments are now categorized as full flow.
7. Interceptor sewer line in Alder Ave. between McWethy Drive and Arrow Boulevard
    a. **Existing Wet Scenario.** Thirteen 8-inch sewer segments are categorized as hydraulic deficiencies in the model's existing wet scenario.
    b. **Ultimate Wet Scenario.** Four (4) of the thirteen 8-inch sewer segments are now categorized as full flow.
8. Interceptor sewer line segments in Juniper Avenue, Filbert Street, and Cypress Avenue between Athol Street and San Bernardino Avenue
    a. **Existing Wet Scenario.** Three (3) 12-inch and three (3) 18-inch diameter sewer segments are categorized as hydraulic deficiencies with two (2) 18-inch segments categorized as full flow in the model's existing wet scenario.
    b. **Ultimate Wet Scenario.** An additional 12-inch diameter segment is categorized as hydraulically deficient. An additional five (5) 18-inch diameter sewer segments are categorized as full flow.

IEUA 3 Tributary Area

In the IEUA 3 tributary area, Model results show that a few sewer segments are meet the criteria for hydraulic deficiency and potential surcharge for both existing and ultimate conditions. These sewer segments and City areas present issues in the City's sewer model and require short-term and long-term attention:

1. Interceptor sewer line segments in Palmetto Avenue between Marygold Avenue to Valley Boulevard
    a. **Existing Wet Scenario.** One (1) 10-inch diameter sewer segments is categorized as hydraulic deficient with three (3) 10-inch segments categorized as full flow in the model's existing wet scenario.

   b. **Ultimate Wet Scenario.** An additional one (1) 10-inch diameter sewer segments are categorized as full flow.

2. Interceptor sewer line segments in Valley Boulevard between Palmetto Avenue and Cypress Avenue

   a. **Existing Wet Scenario.** Six (6) 12-inch and One (1) 10-inch diameter sewer segments are categorized as having hydraulic deficiencies with one (1) 12-inch segments categorized as full flow in the model's existing wet scenario.

   b. **Ultimate Wet Scenario.** An additional (3) 12-inch diameter segment are categorized as hydraulically deficient. An additional one (1) 12inch and one (1) 15-inch diameter sewer segments are categorized as full flow.

IEUA 4 Tributary Area

In the IEUA 4 tributary area, model results suggest no sewer segments meet the criteria for both hydraulic deficiency and potential surcharge in either existing or ultimate scenarios. It is important to note that the model shows locations of full flow pipe for sewer segments that are inverse siphons. These are not considered surcharge points.

RIALTO Tributary Area

In the RIALTO tributary area, model results suggest no sewer segments meet the criteria for both hydraulic deficiency and potential surcharge in either existing or ultimate scenarios. It is important to note that the model shows locations of full flow pipe for sewer segments that are inverse siphons. These are not considered surcharge points.

SECTION 7 - Capital Improvement Program

The Capital Improvement Program (CIP) outlined in this section is recommended to mitigate existing and forecasted hydraulic deficiencies. The recommended improvement projects are organized by priority. In addition, some pipeline improvements are recommended due to incompatibilities with City standards as well as structural defects.

When reviewing the cost estimates presented herein, it is essential to remember these are estimates that would be refined during final design which will alter the totals to some degree. Furthermore, future changes in the cost of material, labor, and equipment certainly will cause comparable changes in the costs summarized herein.

Analysis and planning for this section has been divided into two "phased" improvement categories:

Near-Term Improvements
1 to 5 years

Long-Term Improvements
6 to 25 years

7.1 Components of Construction and Project Costs

The Association for the Advancement of Cost Engineering (AACE) Class 4 level of cost estimating was used to determine estimated costs for the proposed facilities of this Master Plan. As defined by AACE International Recommended Practice No. 18R-97, "Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges."

Construction costs for all projects were based upon preliminary layouts of proposed facilities. For estimating purposes, the prices of comparative work were obtained from a variety of available sources of current information such as recent project bid data, literature publications, telephone and personal contacts with manufacturers and suppliers of equipment. It should be noted that the unit prices applied to sewer facilities estimates take into account the costs of asphalt pavement removal, disposal, replacement, and cap where these lines occur in paved roads. Where these sewer lines occur outside of paved streets, the cost estimates take into account clearing and grubbing a 12-foot wide access road.

The estimated construction costs apply to preliminary design and layout of major facilities that are required for the proposed facilities. In such layouts, detailed construction drawings and specifications are not required. Instead, reasonably close approximations of the size, location, route and cost of the various facilities were developed in sufficient detail to permit cost estimates to be made. Estimated construction costs were based upon what one might expect of a "low bid" price to construct the required improvements.
The total project cost in this report has been determined to be 1.4 times the estimated construction cost. This additional 40% consists of 15% for contingencies, 15% for engineering fees, and 10% for "other" costs (i.e., legal, administrative, and environmental). It should be noted that the total

project cost includes working within public right-of-way (ROW) portions only (i.e., sewer main to ROW line).

The cost estimates herein do not include land acquisition costs for land outside public ROW and they do not include extraordinary construction items such as bore casings, dewatering, or rock removal. Further, the cost estimates herein do not include more than basic environmental documentation, nor do they include mitigation costs.

Construction costs can be expected to undergo long-term changes in keeping with corresponding changes in the national economy. The best available barometer of these changes is the Engineering News-Record Construction Cost Index (ENR-CCI), which is computed from prices of construction materials and labor. For purposes of this report, cost data are based on an ENR-CCI Los Angeles of 15,257 (December, 2023). By referring to the ENR-CCI at any future date, the estimated construction costs included herein can be adjusted to match the current costs at that future date. This allows the estimated costs to be updated to the time when actual construction is undertaken.

7.1.1 Construction Contingencies

A contingency allowance is made for uncertainties associated with preliminary design. Such factors as differences in final lengths and exact topography associated with the pipelines, unknown underground substructures, and changes made during construction, are a few of the many items which may increase contract costs and for which some allowance must be made in preliminary design estimates.

7.1.2 Engineering Costs

The cost of engineering services for major construction projects may include special investigations, pre-design reports, surveys, foundation explorations, location of interfering utilities, detailed design, preparation of contract drawings and specifications, construction inspection, materials testing, and final inspection of the completed work. Depending on the size and type of the project, the total engineering costs may range from 7 to 20 percent of the contract cost. The lower percentage applies to large projects and to those which do not require a large amount of preliminary investigation. The higher percentage applies to smaller projects or to those which require a relatively large amount of preliminary work.

7.1.3 Legal, Administrative, and Basic Environmental Costs

Legal costs would include items such as assistance in ROW acquisition, specification review, construction contract review and approval, coordination during construction, etc. Administrative costs would be those associated with contract administration, progress payments to the Contractor, change orders, notice of completion, etc. Finally, it should be noted that assessment engineering and financing costs are not included in these costs. Assessment engineering and financing costs are those associated with securing funds to pay for the proposed improvements and determination of equitable method(s) of sharing the costs (i.e., costs and benefits). Legal and administrative cost includes environmental documentation, which includes those basic services necessary to obtain environmental clearance to perform the construction. However, extensive environmental services such as those that would be necessary for an environmental impact report and/or environmental impact statement, or the cost of mitigation for project impacts are not included.

7.2 Economic Assumptions

7.2.1 Unit Cost of Construction

The components used to develop unit construction costs for the trunk sewer lines include pipeline material and installation costs, manhole costs, and asphalt concrete (AC) removal, disposal, and replacement costs. Construction costs were determined by reviewing historical bids of similar projects and through a cost study where a “generic bid” was sent to three prominent contractors in the area. The generic bid was based on the assumptions that an average project for the City would consist of 2,500 linear feet of pipe, and that asphalt concrete roads would be removed, disposed of, and replaced. Road reconstruction was assumed to be 25 feet wide with 4 inches of AC pavement over 8 inches of Class II base. The average depth of the pipe was assumed to be 20 feet and would require B-2 bedding. It was assumed nine, 5-foot diameter manholes would be installed for each project. These costs were then updated to correlate with recent bid results that are about 25% higher than the “generic bid” results. Not included in the unit cost estimates are extraordinary construction items such as bore casings, dewatering, rock removal, etc.

The construction and project unit costs by sewer pipeline diameter are shown in **Table 7-1 – Estimated Unit Cost of Sewer Pipelines**.

Table 7-1 Estimated Unit Cost of Sewer Pipelines

Sewer Line Diameter (inch)	Construction Cost per Linear Foot*	Project Cost per Linear Foot**
10	$354.00	$495.00
12	$403.00	$565.00
15	$428.00	$600.00
18	$477.00	$670.00
21	$504.00	$705.00
24	$575.00	$805.00
27	$648.00	$905.00
30	$719.00	$1,005.00
36	$863.00	$1,210.00
39	$935.00	$1,310.00
42	$1,007.00	$1,410.00
48	$1,150.00	$1,610.00

* Costs based on a generic bid of 2,500 ft of pipe. Assumed asphalt concrete roads would be removed, disposed of, and replaced. Road construction was assumed to be 25 feet wide with 4 inches of AC pavement over 8 inches of Class II base. The average depth of the pipe was assumed to be 20 ft and would require B-2 bedding. It was assumed nine, 5 ft diameter manholes would be installed for each project. These costs were then updated to correlate with recent bid results. Construction cost estimates are complete in place costs for the project. Not included in the unit cost estimates are extraordinary construction items such as bore casings, dewatering, rock removal, etc.
** Project cost is 1.4 times construction cost rounded up to nearest $5. Project cost includes construction cost, construction contingencies, design engineering including plans and specifications; design and construction surveying and mapping; geotechnical evaluation and report; engineering contract administration; field inspection and basic environmental documentation. Costs are based on ENR-CCI for the Los Angeles Areas for November 2023. This value is 15,301.44. Escalation, financing, interest during construction, legal, land, R.O.W. agent, and environmental mitigation costs are not included in construction costs. Additionally, not included in the unit cost estimates are extraordinary construction items such as bore casings, dewatering, rock removal etc.

7.3 Summary of Recommended Improvements

Based on our evaluation of the existing and ultimate system and facilities, presented herein is a summary of recommendations; including further evaluations and studies; capital improvements; and other recommendations that would benefit the future sustainability of Fontana's sewer system and associated facilities. As previously stated, the recommendations have been divided based upon Near-Term and Long-Term timeframes to better assist the City in phasing and implementation of the recommendations and improvements. Shown on **Figure 7-1** are the proposed CIP facilities and individual summary sheets are provided in **Appendix F**.

7.3.1 Near-Term Recommendations

Based on the modeling of the City's sewer system in Section 6 and the hydraulic concerns found therein, the following are the proposed CIP near-term improvements to meet ultimate wastewater flows as presented in **Table 7-2 – Proposed CIP Near-Term Improvements**. The following improvements were identified as near-term based on existing hydraulic deficiencies and/or failing to meet City design criteria.

Table 7-2 Proposed CIP Near-Term Improvements

Facility Name	Project ID	Description of Improvement	Estimated Project Cost
Diversion Structures			
San Bernardino Ave and Citrus Ave(1)	-	Change diversion of splitter box. Reconfigure flow direction westerly (MH ID: I24_70)	-
San Bernardino Ave and Poplar Ave(1)	-	Change diversion of splitter box. Reconfigure flow direction westerly (MH ID: H24_88)	-
Cypress Ave and Baseline Ave(1)	-	Change diversion of splitter box. Reconfigure flow direction westerly (MH ID: I26_28)	-
Palmetto Ave and Valley Blvd	H-1	Install diversion stop plate to divert flow into southerly parallel line	$128,000
Alder Ave and Hawthorne Ave	H-3	Install diversion structure to split half flow into Hawthorne Ave and half into Alder Ave	$128,000
		Subtotal Diversion Structures:	$256,000
Pipelines			
Alder Ave. and Hawthorne Ave	H-2	Replace ±1,350 LF of 6" dia. pipe with 10" dia. pipe	$669,000
Granada Ave. and Alder Ave.	H-4	Replace ±2,400 LF of 8"-12" dia. pipe with 12" and 15" dia. pipe	$2,436,000
Marygold Ave. and Palmetto Ave.	H-5	Replace ±1,300 LF of 10" dia. pipe with 15" dia. pipe	$780,000
Juniper Ave. and Randall Ave.	H-6	Replace ±2,650 LF of 18" dia. pipe with 24" dia. pipe	$2,134,000
Oleander Ave. and Orange Way	H-7	Lower invert elevation of manhole L21_22 to increase slope and maximize pipe capacity prior to RR crossing. Replace ±1,000 LF of 12" dia. pipe and ±300 LF of 10" dia. pipe.	$714,000
Arrow Blvd Interceptor	S-1	Proposed ±7,700 LF of 15" dia. pipe, ±5,300 LF of 12" dia. pipe, and 2,350± of 8" dia. pipe.	$8,907,000
Downtown Core	-	Refer to Appendix A	$7,871,000
		Subtotal Pipelines:	$23,511,000
		Grand Total:	**$23,767,000**

Notes:
(1) Existing structure present. No cost associated with reconfiguration of existing infrastructure.

As seen in **Table 7-2**, there are currently three manholes that include a sluice gate and/or splitter box that are seldom maintained or operated by City staff. Recommendations currently include manually adjusting the gate to divert wastewater west, but due to the deteriorating condition of the structure, the City may consider a full stainless-steel replacement with costs matching

Project's H-1 and H-3. All diversion structure related improvements are recommended to be completed first based on minimal required effort and downstream mainline effects.

7.3.2 Long-Term Recommendations

Proposed CIP long-term improvements that are listed in **Table 7-3 – Proposed CIP Long-Term Improvements** do not require immediate attention but are recommended to satisfy ultimate buildout requirements. As presented previously in **Table 6-8**, the only capacity shortfall is the Tamarind Lift Station. Ultimate tributary peak flows exceed the existing lift station firm capacity by roughly 0.60 MGD. Based on the age and condition of the lift station, a full replacement is recommended with a firm pumping capacity of 1.3 MGD. Final sizing details to be determined during a preliminary design report.

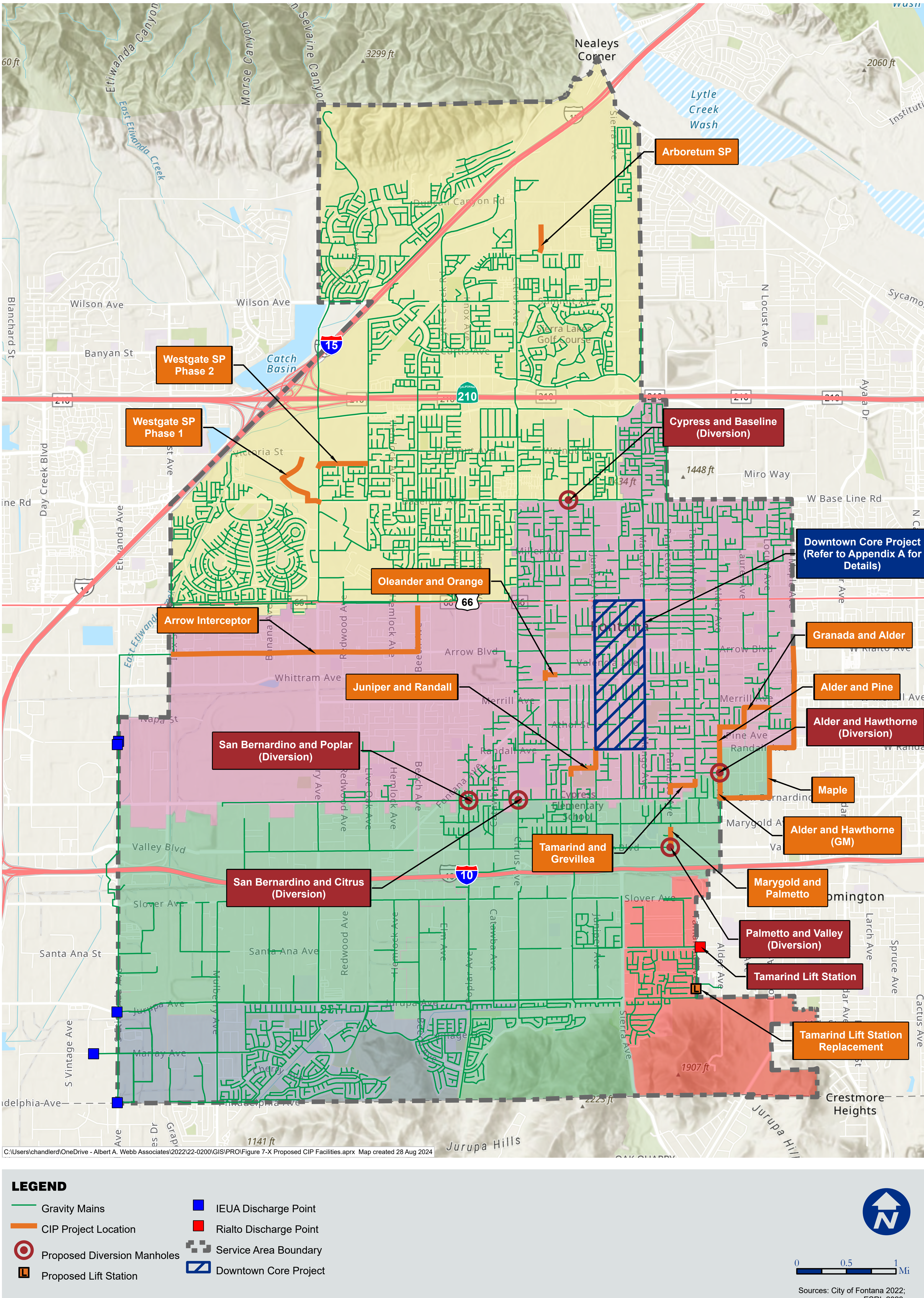
Lift Stations

Lift station cost estimates are prepared on a case-by-case basis; therefore, generic unit costs of a lift station upgrade are not available. WEBB maintains a database of past lift station projects based on capacity which is updated to current costs. These lift stations typically include the pumps and motors, structures, piping, building, electrical, site grading, and other appurtenances for a complete-in-place pump station. Estimating the costs of the proposed lift station upgrades started with the completely new lift station cost and, if applicable, the cost of specific items are removed to reduce the cost down based on site specific information about the existing facilities.

Table 7-3 Proposed CIP Long-Term Improvements

Facility Name	Project ID	Description of Improvement	Estimated Project Cost
Pipelines			
Westgate SP Phase 1	H-8	Proposed ±2,520 of 10" dia. and 1,600± of 12" dia. backbone piping for Westgate SP	$2,152,000
Westgate SP Phase 2	H-9	Proposed ±3,000 of 12" dia. backbone piping for Westgate SP	$1,695,000
Arboretum SP	H-10	Proposed ±1,310 of 10" dia. backbone piping for Arboretum Specific Plan	$649,000
Tamarind Ave. and Grevillea St.	H-11	Replace ±1,900 LF of 15" dia. pipe with 18" dia. pipe	$1,273,000
Alder Ave. and Pine Ave.	H-12	Replace ±2,150 LF of 12" dia. pipe with 15" dia. pipe	$1,290,000
Maple Ave	S-2	Proposed ±2,650 LF of 15" dia. pipe, ±2,650 LF of 12" dia. pipe, and ±6,600 of 10" dia. pipe.	$6,355,000
		Subtotal Pipelines:	$13,414,000
Lift Stations			
Tamarind	L-1	Proposed 1.7 MGD LS (1.3 MGD firm capacity)	$3,000,000
		Subtotal Lift Stations:	$3,000,000
		Grand Total:	**$16,414,000**

FIGURE 7-1 PROPOSED CIP FACILITIES



ALBERT A. WEBB ASSOCIATES

References

-	*Chino Basin Regional Sewage Service Contract*, as amended April 12, 1984, and October 19, 1994.
-	*Extraterritorial Sewer Services Agreement* between the City of Fontana and the City of Rialto, July 16, 1991.
-	*Memorandum of Understanding – 4600001213 between IEUA and the City of Fontana for the implementation of the emergency assistance protocols in support of the San Bernardino Lift Station.* June 15, 2012.
ADS	ADS Environmental Services. *Flow Monitoring Report for Fontana Sewer Master Plan*. April 27, 2023.
CDMSmith	CDM Smith. *Sanitary Sewer System Master Plan for City of Fontana*. May 2013.
ERSC	Engineering Resources of Southern California, Inc. *City of Fontana Sewer Master Plan.* September 2000.
FGP	City of Fontana. *Fontana Forward General Plan Update 2015-2035.* Adopted November 13, 2018.
FGP DEIR	City of Fontana. *Draft Environmental Impact Report (EIR) for the Fontana Forward General Plan Update 2015-2035. State Clearinghouse No. 2016021099.* June 8, 2018.
WestYost	West Yost. *2020 Urban Water Management Plan for San Gabriel Valley Water Company Fontana Water Company Division.* June 2021.

Appendix A

Downtown Core Project

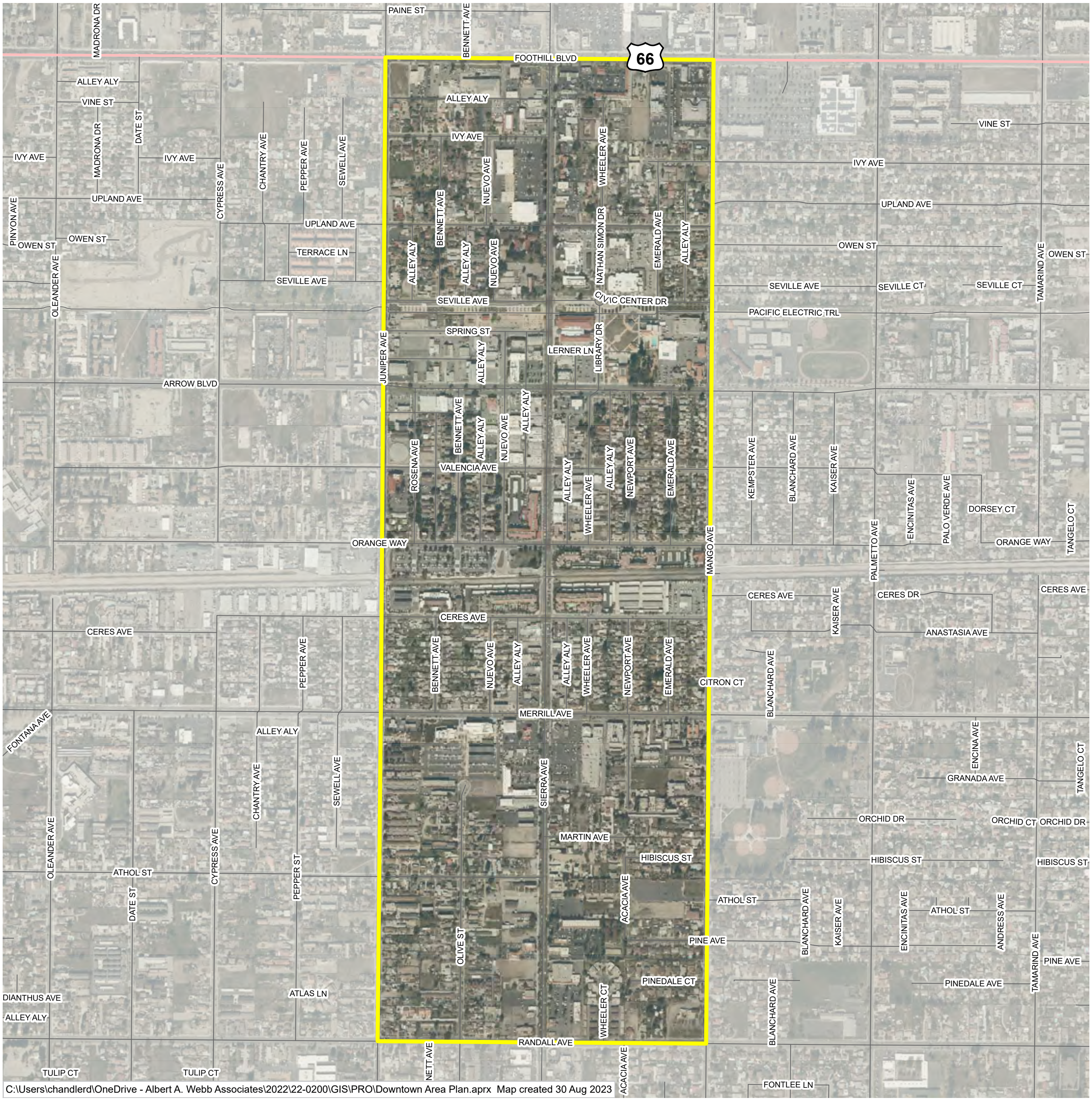
ALBERT A. WEBB ASSOCIATES

Downtown Core Project

The Downtown Core Project proposed amendments to the Fontana General Plan, Community Mobility and Circulation, Downtown Area Plan, Land Use, Zoning, and Urban Design. Amendments are approved to establish and implement new FBC districts within the project area. Modifications made to the general plan have required the City to analyze the project area, see **Figure 1**, for recommended wastewater infrastructure improvements to accommodate the surplus sewer generation.

As shown in **Figure 2**, the existing land use consists primarily of walkable mixed use and single-family residential zoning. Existing sewer facilities, located within and around the project area, are provided in **Figure 3**. An initial model scenario was developed analyzing the existing conditions showing minimal sewer flows within the project area and recording a total flow of 3.58 MGD (see **Figure 4**). After applying proposed land use changes and computing new projected wastewater generation for the project area, an additional model scenario was evaluated. The projected total wastewater flow nearly doubled to 6.31 MGD. Significant capacity concerns can be identified in **Figure 5** within the project boundary and downstream. **Figure 5** also indicates how the existing diversion structure conditions adversely impact trunk line capacity tributary to the Downtown Core Project. After coordination with the City, WEBB was instructed to alter the diversion manholes downstream on San Bernardino Ave. to redirect flows westbound. This alteration did reduce capacity constraints south of San Bernardino Ave. but did not resolve potential hydraulic deficiencies upstream directly adjacent to the project area (see **Figure 5.1**). Using the design criteria established in Section 3, recommended sewerline improvements were developed and implemented into the hydraulic model that would satisfy the City’s pipeline d/D capacity requirements in conjunction with the Juniper and Randall CIP project and diversion manhole modifications within and downstream of the Downtown Core Project area. **Figure 5.2** summarizes the findings and proposed facilities needed to withstand the considerable influx of projected wastewater generated from the Downtown Core amendment change.

FIGURE 1 DOWNTOWN CORE PROJECT AREA



LEGEND

Project Area

0 500 1,000 Feet

Sources: City of Fontana 2023; Aerial 2020

ALBERT A. WEBB ASSOCIATES

FIGURE 2

GENERAL PLAN LAND USE

LEGEND

Project Area

Land Use

P-PF Public Facilities

P-R Recreation Facilities

R-SF Single Family Residential

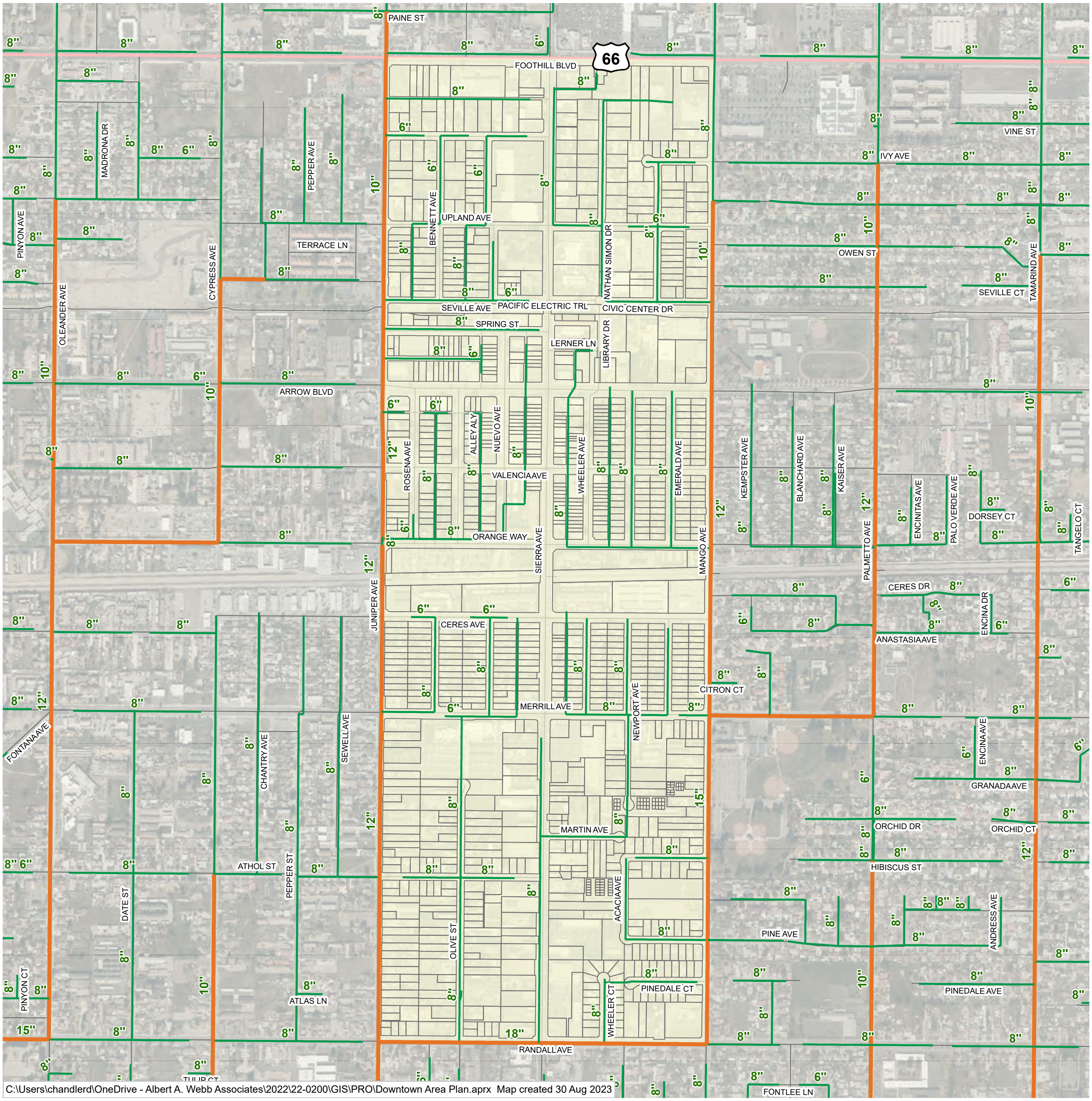
WMXU-1 Walkable Mixed Use Corridor Downtown

0 500 1,000 Feet

Sources: City of Fontana 2023; Aerial 2020

ALBERT A. WEBB ASSOCIATES

FIGURE 3 EXISTING SEWER FACILITIES



LEGEND

Project Area

Diameter (in)

- 8-inch or less
- 10-inch or greater

0 500 1,000 Feet

Sources: City of Fontana 2023; Aerial 2020

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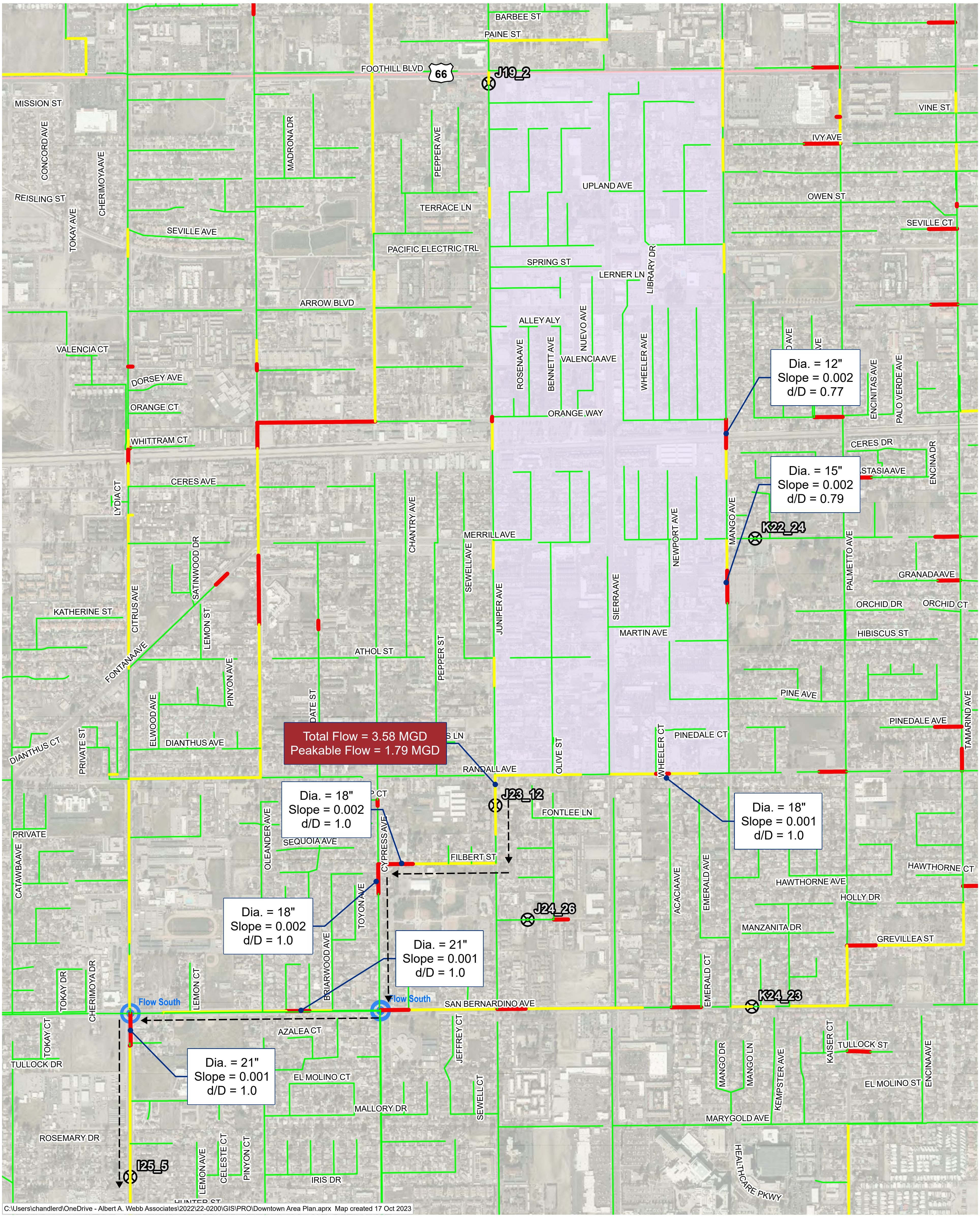
FIGURE 4

EXIST. DRY PEAK RESULTS



LEGEND

- Project Area
- Flow Monitoring Locations
- Diversion Manholes
- Tributary Flow Path

Sewerlines

d/D

- less than 0.5
- 0.5 ~ 0.75
- greater than 0.75

0 500 1,000 Feet

Sources: City of Fontana 2023, Aerial 2022

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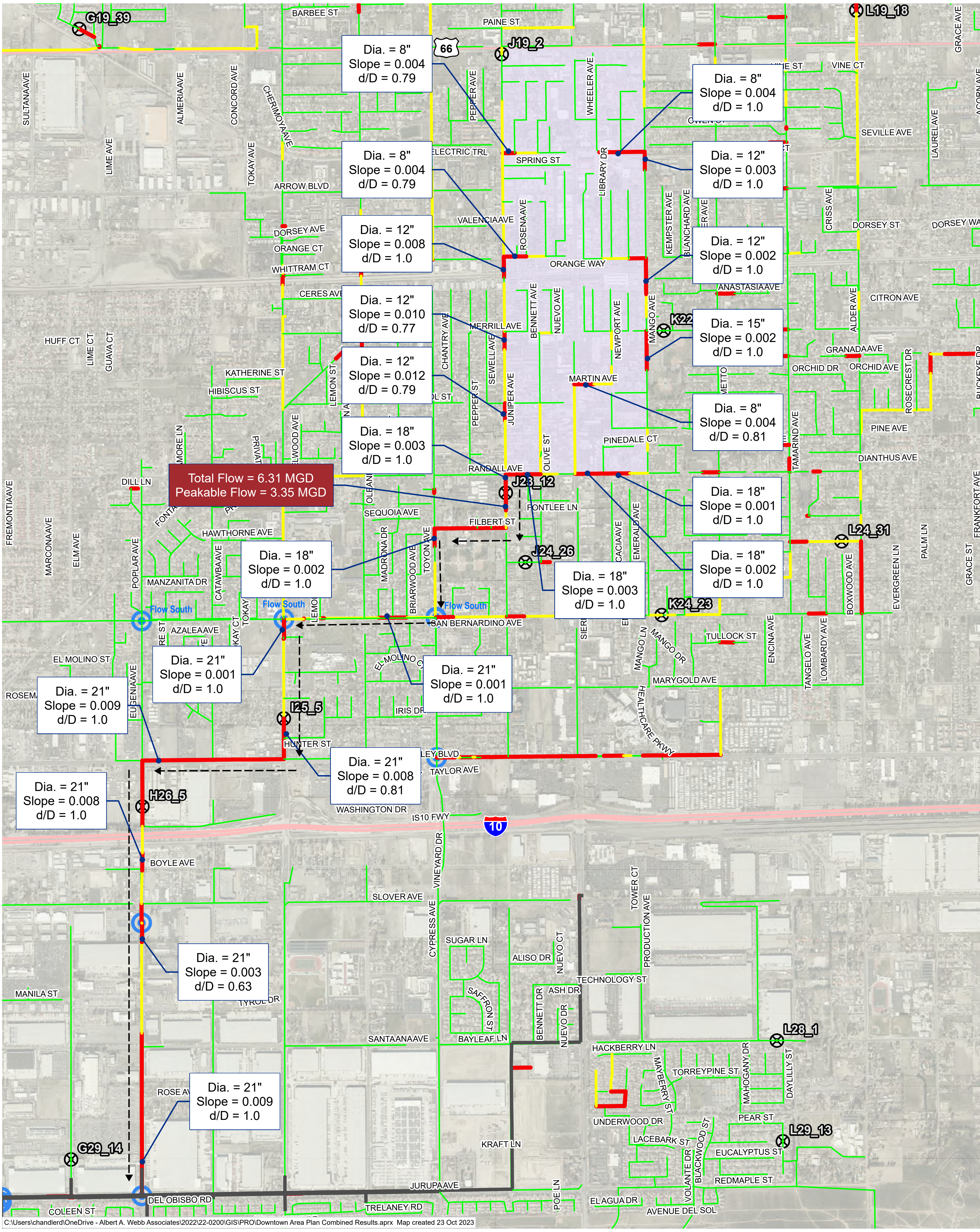
FIGURE 5

PROP. LAND USE RESULTS



LEGEND

- Project Area
- Flow Monitoring Locations
- IEUA Sewerlines
- Diversion Manholes

Sewerlines

d/D

- less than 0.5
- 0.5 ~ 0.75
- greater than 0.75

Tributary Flow Path

0 975 1,950 Feet

***NOTE: Assume combined commercial and residential max. development in mixed-use districts.**

Sources: City of Fontana 2023, Aerial 2022

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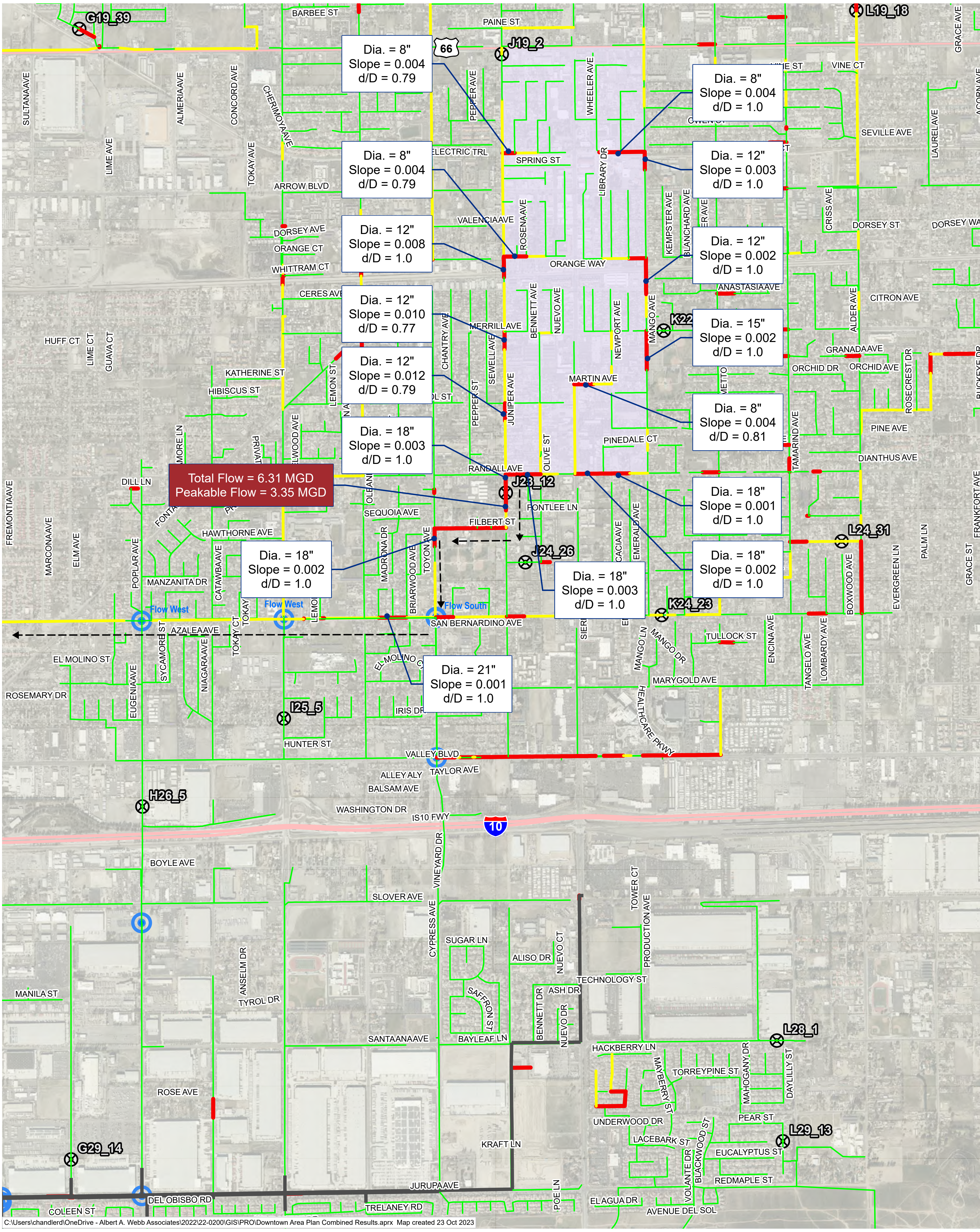
FIGURE 5.1

PROP. LAND USE RESULTS - MODIFIED DIVERSION STRUCTURES



LEGEND

- Project Area
- Flow Monitoring Locations
- IEUA Sewerlines
- Diversion Manholes

Sewerlines

d/D

- less than 0.5
- 0.5 ~ 0.75
- greater than 0.75

←– Tributary Flow Path

0 975 1,950 Feet

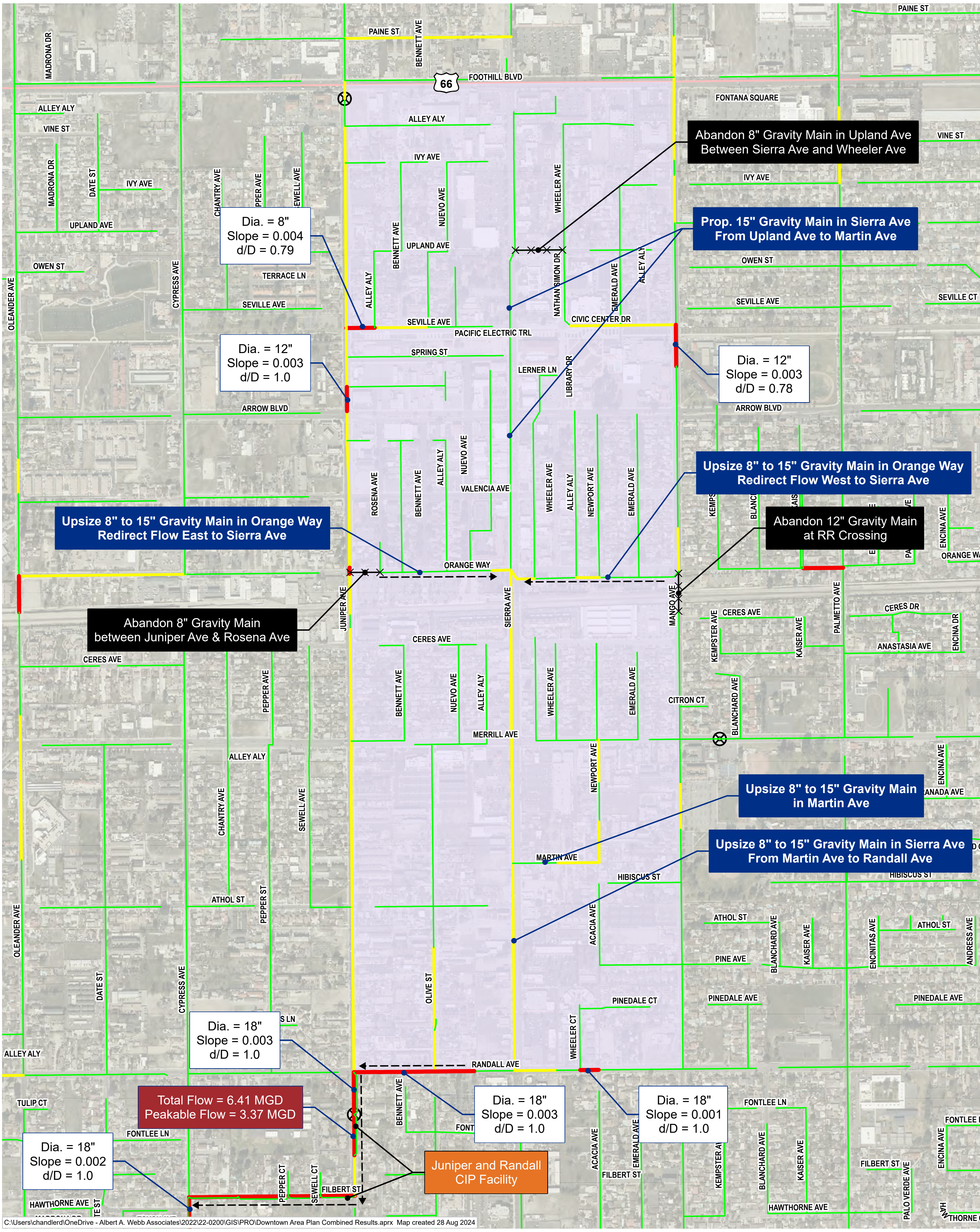
***NOTE:** Assume combined commercial and residential max. development in mixed-use districts.*

Sources: City of Fontana 2023, Aerial 2022

ALBERT A. WEBB ASSOCIATES

FIGURE 5.2

PROP. LAND USE RESULTS - MODIFIED DIVERSION STRUCTURES



LEGEND

Project Area

Flow Monitoring Locations

Sewerlines

d/D

less than 0.5

0.5 ~ 0.75

greater than 0.75

Tributary Flow Path

0 420 840 Feet

***NOTE: Assume combined commercial and residential max. development in mixed-use districts.**

Sources: City of Fontana 2023, Aerial 2022

ALBERT A. WEBB ASSOCIATES

Appendix B

Population Projections

ALBERT A.
WEBB
ASSOCIATES

Incorporated City Only General Plan Land Use Designation[a]		General Plan Residential Density (DU/ac) or Non-Residential Intensity (FAR)	Acres within Sewer Service Area	Residential Density / Non-Residential Intensity: Maximum Density (DU/ac) or Intensity (FAR)	Residential Density / Non-Residential Intensity: Calculated Mid-Range Density (DU/ac) or Intensity (FAR)[b]	Projected Development: Maximum DUs or SF of Non-Residential Uses	Projected Development: Mid-Range DUs or SF of Non-Residential Uses[c]	Population Projections[d]: Maximum Projected Population	Population Projections[d]: Mid-Range Projected Population
Residential									
R-E	Residential Estates*	2 du/ac	633	2.0	2.0	1,266	1,266	5,773	5,773
R-T	Residential Trucking	2 du/ac	60	2.0	2.0	120	120	456	456
R-PC	Residential Planned Community*	3.0 - 6.4 du/ac	5,978	6.4	4.7	38,260	28,097	174,466	128,123
R-SF	Single Family Residential, detached*	2.1 - 5 du/ac	5,401	5.0	3.6	27,005	19,174	123,143	87,434
R-M	Medium Density Residential, single-family detached product type[e]*	5.1 - 7.6 du/ac	356	7.6	6.4	2,706	2,261	12,340	10,311
R-M	Medium Density Residential, single-family attached or multiple family product type[e]*	7.7 - 12 du/ac	534	12.0	9.9	6,408	5,260	29,221	23,986
R-MF	Multi Family Residential	12.1 - 24 du/ac	174	24.0	18.1	4,176	3,141	15,869	11,936
R-MFMH	Multi Family Medium / High Residential	24.1 - 39 du/ac	225	39.0	31.6	8,775	7,099	33,345	26,977
R-MFH	Multi Family High Residential	39.1 - 50 du/ac	121	50.0	44.6	6,050	5,391	22,990	20,486
WMXU-1	Walkable Mixed-Use Downtown, residential[f]	3 - 39 du/ac	1,236	39.0	21.0	48,212	25,961	183,206	98,652
WMXU-2	Walkable Mixed-Use Village, residential[f]	12 - 24 du/ac	46	24.0	18.0	1,109	832	4,215	3,162
RMU	Regional Mixed Use, residential[f]	12 - 24 du/ac	382	24.0	18.0	9,156	6,867	34,793	26,095
		Subtotal Residential	15,146	-	-	153,243	105,469	**639,817**	**443,391**
Commercial									
C-C	Community Commercial	0.1 - 1.0 FAR	271	1.00	0.60	11,804,760	7,082,856		
C-G	General Commercial	0.1 - 1.0 FAR	830	1.00	0.60	36,154,800	21,692,880		
WMXU-1	Walkable Mixed-Use Downtown, non-residential[f]	0.1 - 2.0 FAR	530	2.00	1.10	46,156,176	25,385,897		
WMXU-2	Walkable Mixed-Use Village, non-residential[f]	0.1 - 1.0 FAR	20	1.00	0.60	862,488	517,493		
RMU	Regional Mixed Use, non-residential[f]	0.1 - 1.0 FAR	164	1.00	0.60	7,122,060	4,273,236		
		Subtotal Commercial	1,814	-	-	102,100,284	58,952,362		
Industrial									
I-L	Light Industrial	0.1 - 0.6 FAR	3,087	0.60	0.40	80,681,832	53,787,888		
I-G	General Industrial	0.1 - 0.6 FAR	2,795	0.60	0.40	73,050,120	48,700,080		
		Subtotal Industrial	5,882	-	-	153,731,952	102,487,968		
Public									
P-PF	Public Facilities	N/A	1,150	-	-	N/A	N/A		
P-R	Recreational Facilities	N/A	927	-	-	N/A	N/A		
P-UC	Public Utility Corridors	N/A	979	-	-	N/A	N/A		
		Subtotal Public	3,056	-	-	0	0		
Open Space									
OS	Open Space	N/A	1,042	-	-	N/A	N/A		
Right-of-Way									
ROW	Right-of-way	N/A	805	-	-	N/A	N/A		
		Acreage rounding error correction	5						
		Grand Total[g]	**27,750**		**Dwelling Units**	**153,240**	**105,470**	**(rounded)**	
					SF of Non Residential Uses	**255,832,240**	**161,440,330**	**(rounded)**	

Persons/DU:	3.8	*Persons/DU for land uses that allow ADUs:	4.6

Notes: DU/ac: dwelling unit per acre; FAR: floor-to-area ratio; SF: square feet. Asterisk* indicates residential types that allow ADUs.

[a] City of Fontana General Plan Land Use data, as of October 3, 2022.

[b] The mid-point range of dwelling units per acre for each residential land use designation (and FAR for non-residential designations) are used to forecast EDUs and SF, respectively

[c] Projected dwelling units are the product of the acres of each residential use and the DU/Acre used for projected buildout rounded up to the nearest whole number. Projected non-residential square footage is the product of the FAR and acreage.

[d] Population projections are based on 3.8 people per DU multiplied by the number of dwelling units.

[e] Based on discussion with City staff for this analysis, it is assumed that 60% of the R-M acreage is "attached" units and 40% is "detached" units.

[f] Based on input from City staff for this analysis, it is assumed that 70% of the acreage of WMXU-1, WMXU-2, and RMU is "residential" and 30% of the acreage is "non-residential".

[g] The grand total area reflects the total area in the City limits, which includes currently unsewered parcels (those that are on septic). The total area of parcels with sewer service in City of SOI is 12,760 acres.

Sphere of Influence General Plan Land Use Designation[(a)]		General Plan Residential Density (DU/ac) or Non-Residential Intensity (FAR)	Acres within Sewer Service Area	Residential Density / Non-Residential Intensity		Projected Development		Population Projections[(d)]	
				Maximum Density (DU/ac) or Intensity (FAR)	Calculated Mid-Range Density (DU/ac) or Intensity (FAR)[(b)]	Maximum DUs or SF of Non-Residential Uses	Mid-Range DUs or SF of Non-Residential Uses[(c)]	Maximum Projected Population	Mid-Range Projected Population
Residential									
R-E	Residential Estates*	2 du/ac	21	2.00	2.0	42	42	192	192
R-T	Residential Trucking	2 du/ac	0	2.0	2.0	0	0	0	0
R-PC	Residential Planned Community*	3.0 - 6.4 du/ac	0	6.4	4.7	0	0	0	0
R-SF	Single Family Residential, detached	2.1 - 5 du/ac	1,453	5.0	3.6	7,265	5,159	33,129	23,526
R-M	Medium Density Residential, single-family detached product type[(e)]*	5.1 - 7.6 du/ac	0	7.6	6.4	0	0	0	0
R-M	Medium Density Residential, single-family attached or multiple family product type[(e)]*	7.7 - 12 du/ac	0	12.0	9.9	0	0	0	0
R-MF	Multi Family Residential	12.1 - 24 du/ac	0	24.0	18.1	0	0	0	0
R-MFMH	Multi Family Medium / High Residential	24.1 - 39 du/ac	0	39.0	31.6	0	0	0	0
R-MFH	Multi Family High Residential	39.1 - 50 du/ac	0	50.0	44.6	0	0	0	0
WMXU-1	Walkable Mixed-Use Downtown, residential[(f)]	24 - 39 du/ac	171	39.0	31.5	6,662	5,381	25,316	20,448
WMXU-2	Walkable Mixed-Use Village, residential[(f)]	12 - 24 du/ac	0	24.0	18.0	0	0	0	0
RMU	Regional Mixed Use, residential[(f)]	12 - 24 du/ac	0	24.0	18.0	0	0	0	0
		Subtotal Residential	1,645	-	-	13,969	10,582	58,637	44,166
Commercial									
C-C	Community Commercial	0.1 - 1.0 FAR	15	1.00	0.60	653,400	392,040		
C-G	General Commercial	0.1 - 1.0 FAR	55	1.00	0.60	2,395,800	1,437,480		
WMXU-1	Walkable Mixed-Use Downtown, non-residential[(f)]	0.1 - 2.0 FAR	73	2.00	1.10	6,377,184	3,507,451		
WMXU-2	Walkable Mixed-Use Village, non-residential[(f)]	0.1 - 1.0 FAR	0	1.00	0.60	0	0		
RMU	Regional Mixed Use, non-residential[(f)]	0.1 - 1.0 FAR	0	1.00	0.60	0	0		
		Subtotal Commercial	143	-	-	9,426,384	5,336,971		
Industrial									
I-L	Light Industrial	0.1 - 0.6 FAR	523	0.60	0.40	13,669,128	9,112,752		
I-G	General Industrial	0.1 - 0.6 FAR	2,538	0.60	0.40	66,333,168	44,222,112		
		Subtotal Industrial	3,061	-	-	80,002,296	53,334,864		
Public									
P-PF	Public Facilities	N/A	87	-	-	N/A	N/A		
P-R	Recreational Facilities	N/A	3	-	-	N/A	N/A		
P-UC	Public Utility Corridors	N/A	146	-	-	N/A	N/A		
		Subtotal Public	236	-	-	0	0		
Open Space									
OS	Open Space	N/A	612	-	-	N/A	N/A		
Right-of-Way									
ROW	Right-of-way	N/A	47	-	-	N/A	N/A		
		Acreage rounding error correction	5						
		Grand Total[(g)]	**5,749**		**Dwelling Units**	**13,970**	**10,580**	**(rounded)**	
					SF of Non Residential Uses	**89,428,680**	**58,671,840**	**(rounded)**	

Persons/DU:	**3.8**	***Persons/DU for land uses that allow ADUs:**	**4.56**

Notes: DU/ac: dwelling unit per acre; FAR: floor-to-area ratio; SF: square feet. Asterisk * indicates residential types that allow ADUs.

(a) City of Fontana General Plan Land Use data, as of October 3, 2022

(b) The mid-point range of dwelling units per acre for each residential land use designation (and FAR for non-residential designations) are used to forecast EDUs and SF, respectively

(c) Projected dwelling units are the product of the acres of each residential use and the DU/Acre used for projected buildout rounded up to the nearest whole number. Projected non-residential square footage is the product of the FAR and acreage.

(d) Population projections are based on 3.8 people per DU multiplied by the number of dwelling units.

(e) Based on discussion with City staff for this analysis, it is assumed that 60% of the R-M acreage is "attached" units and 40% is "detached" units.

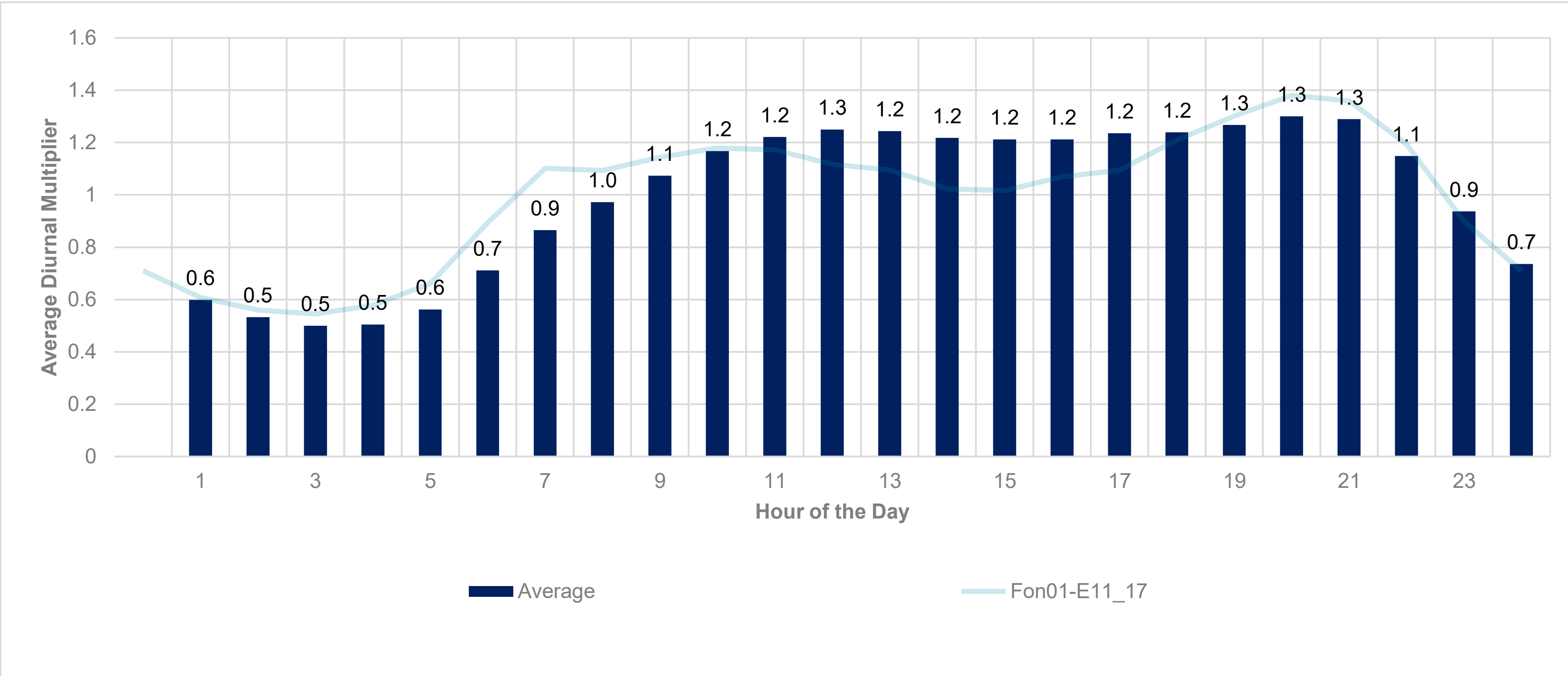
(f) Based on input from City staff for this analysis, it is assumed that 70% of the acreage of WMXU-1, WMXU-2, and RMU is "residential" and 30% of the acreage is "non-residential".

(g) The grand total area reflects the total area in the City's Sphere of Influence limits, which includes currently unsewered parcels (those that are on septic). The total area of parcels in City plus SOI with sewer service is 12,760 acres.

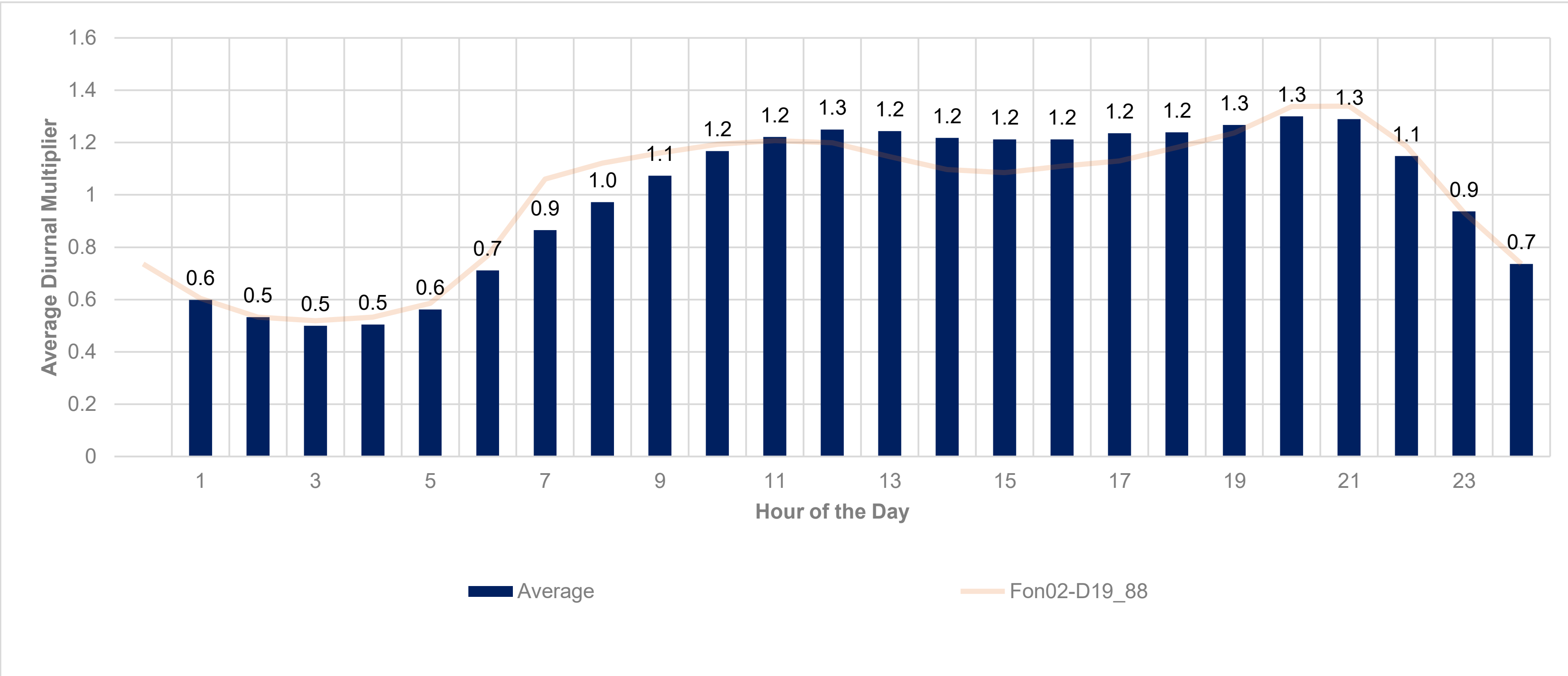
Appendix C

Diurnal Loading Patterns

Calibration Manhole ID: FON01-E11_17



Calibration Manhole ID: FON02-D19_88



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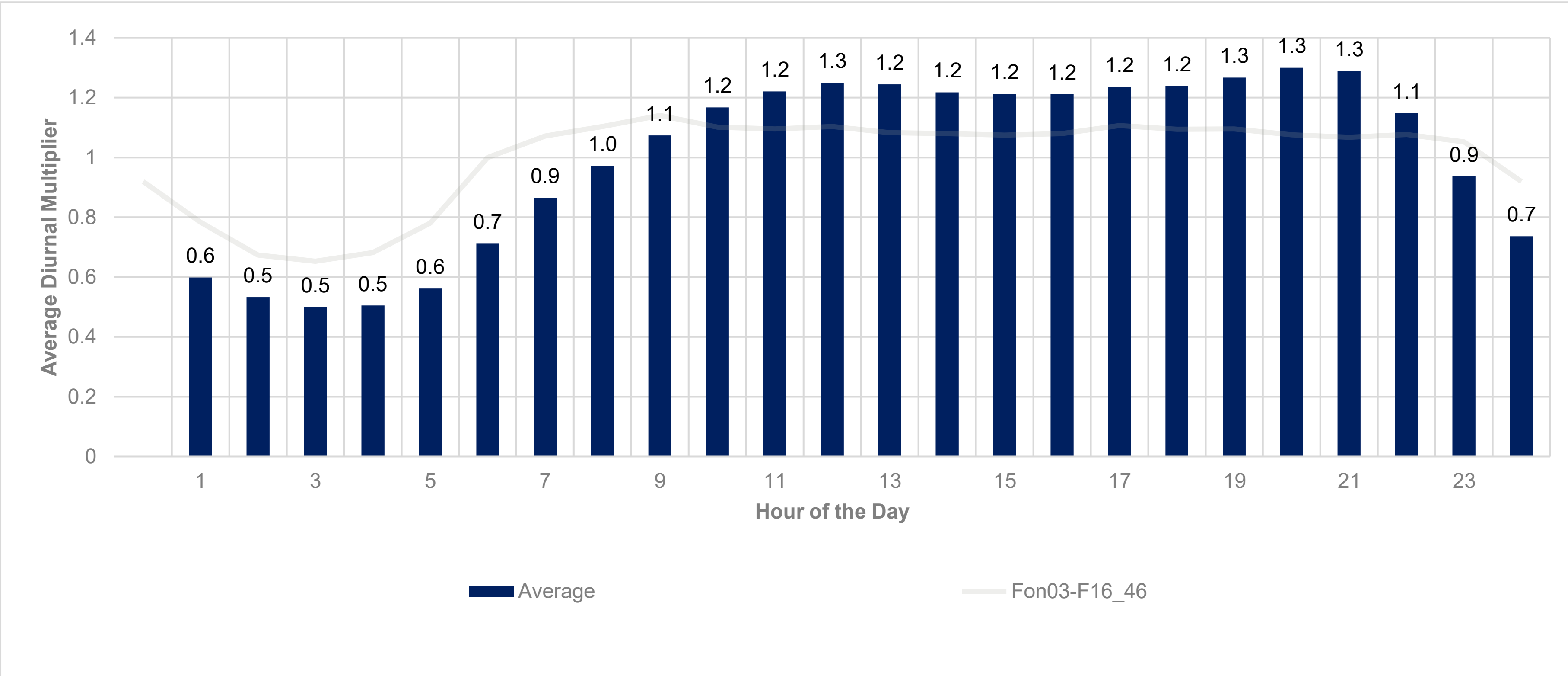
Calibration Manhole ID: FON03-F16_46



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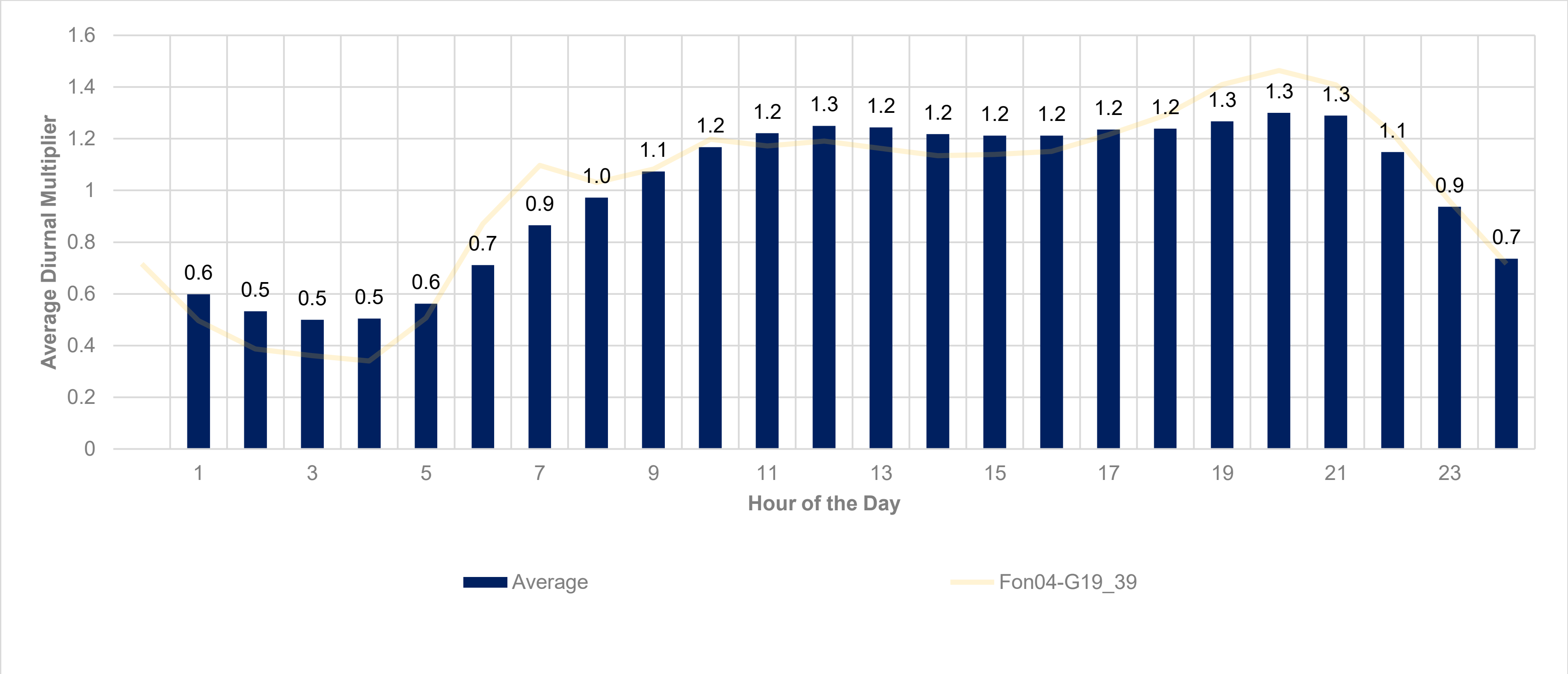
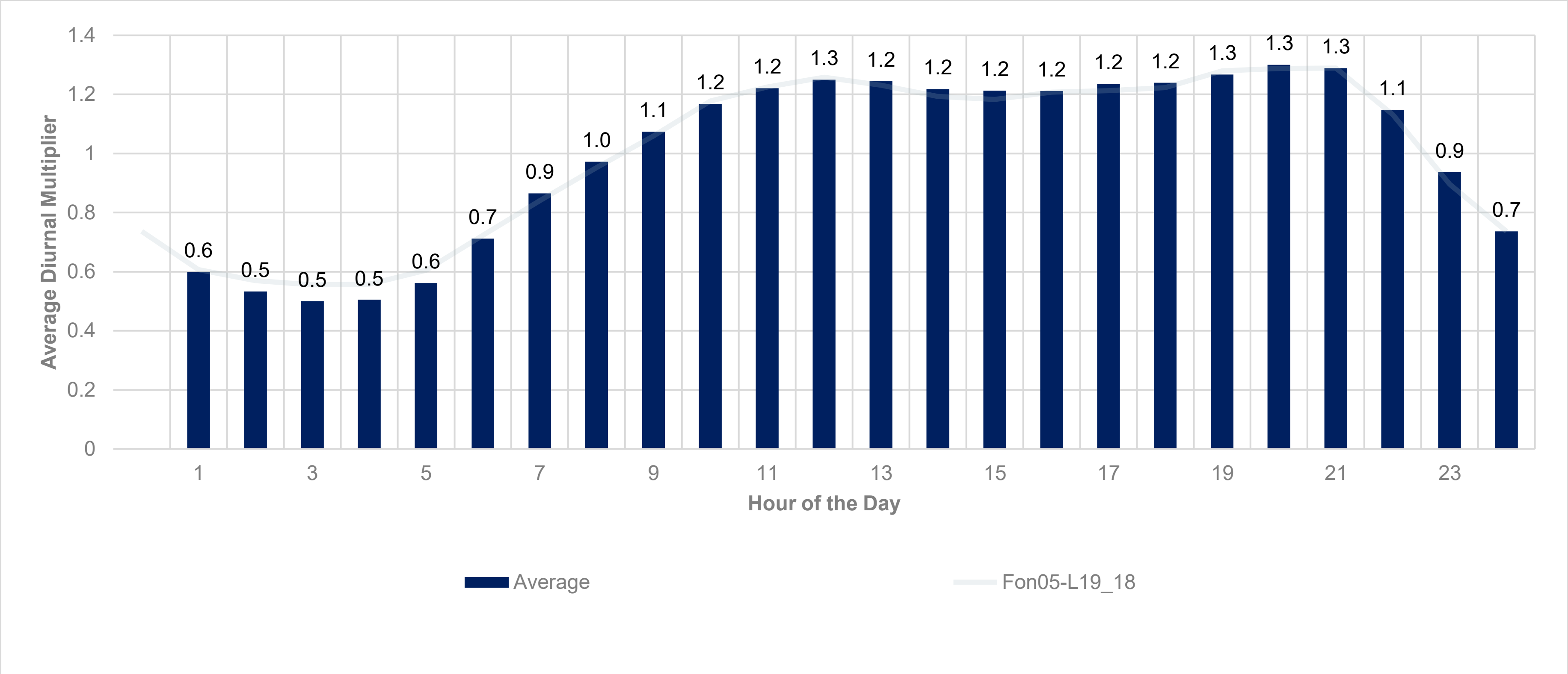
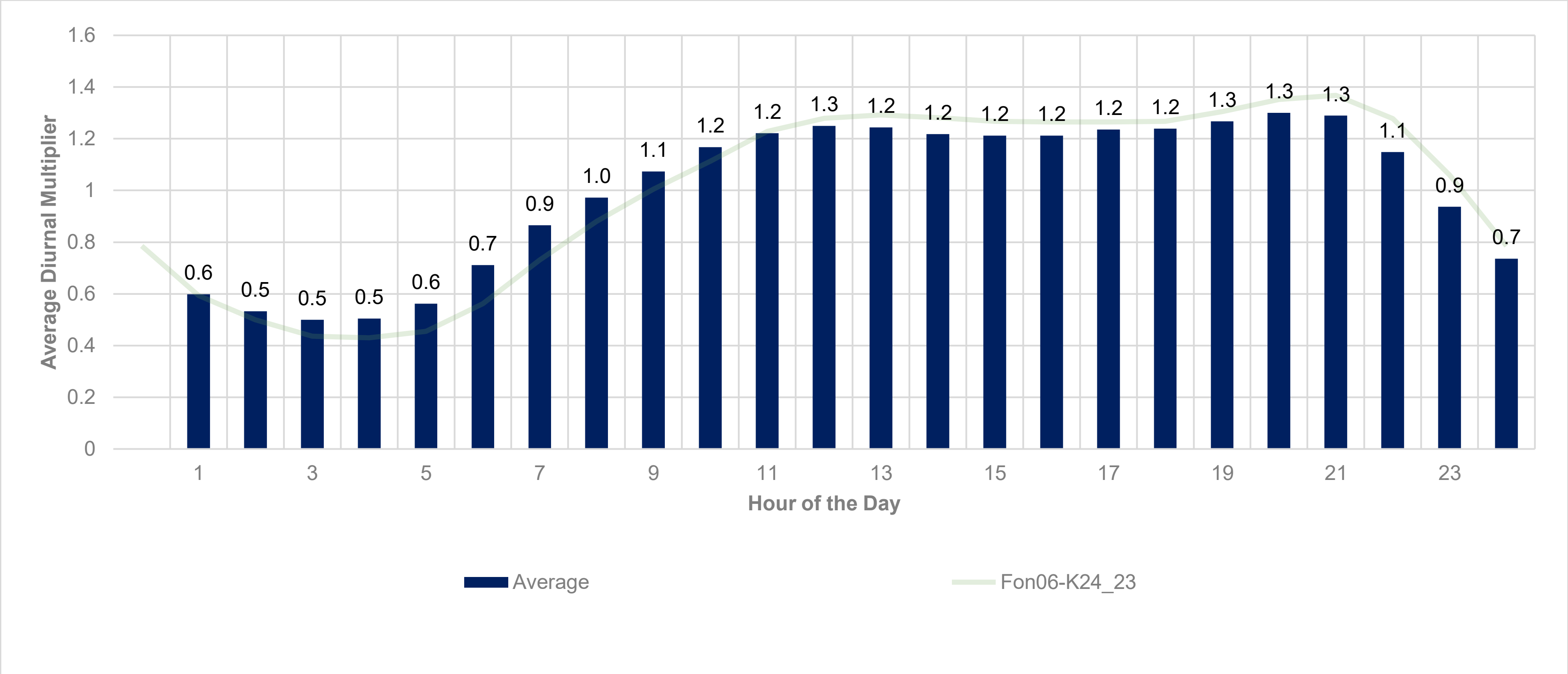
Calibration Manhole ID: FON04-G19_39



Calibration Manhole ID: FON05-L19_18



Calibration Manhole ID: **FON06-K24_23**



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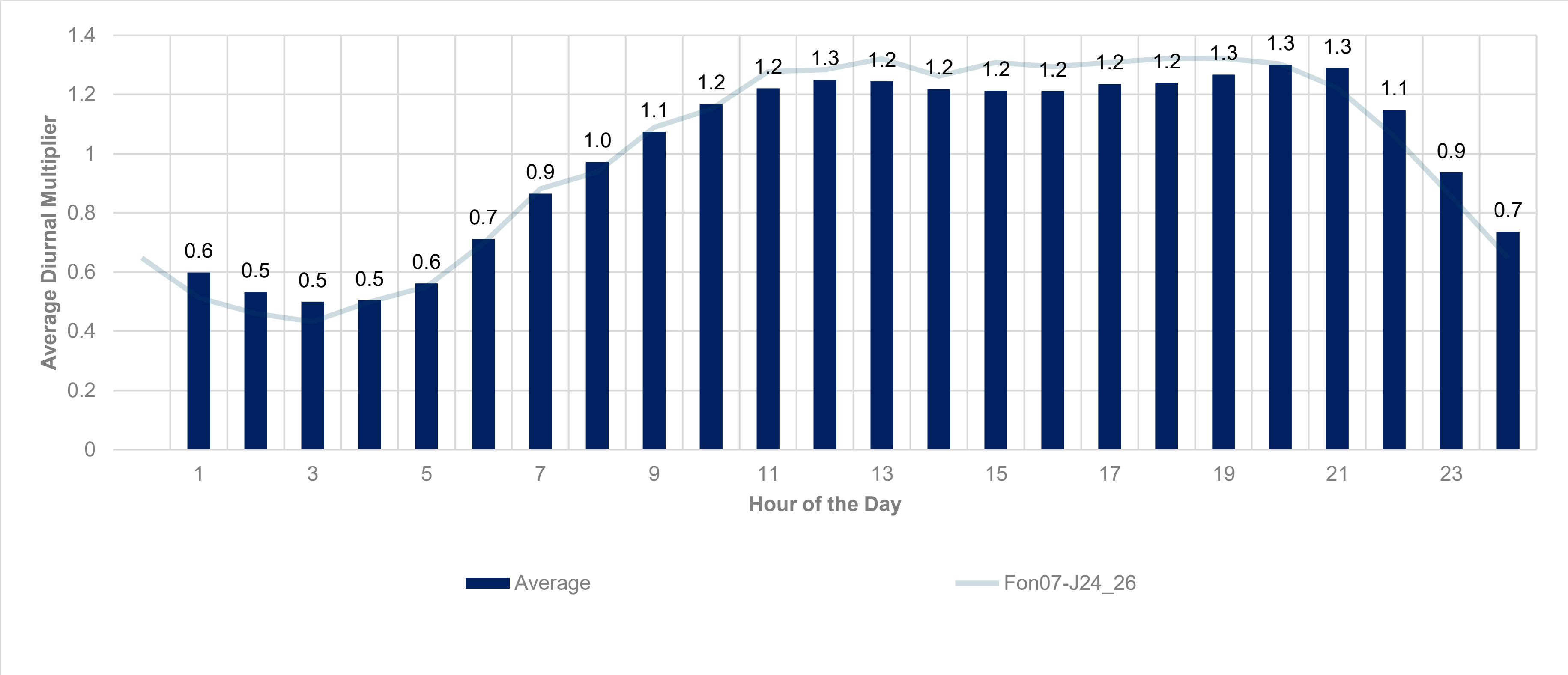
Calibration Manhole ID: FON07-J24_26



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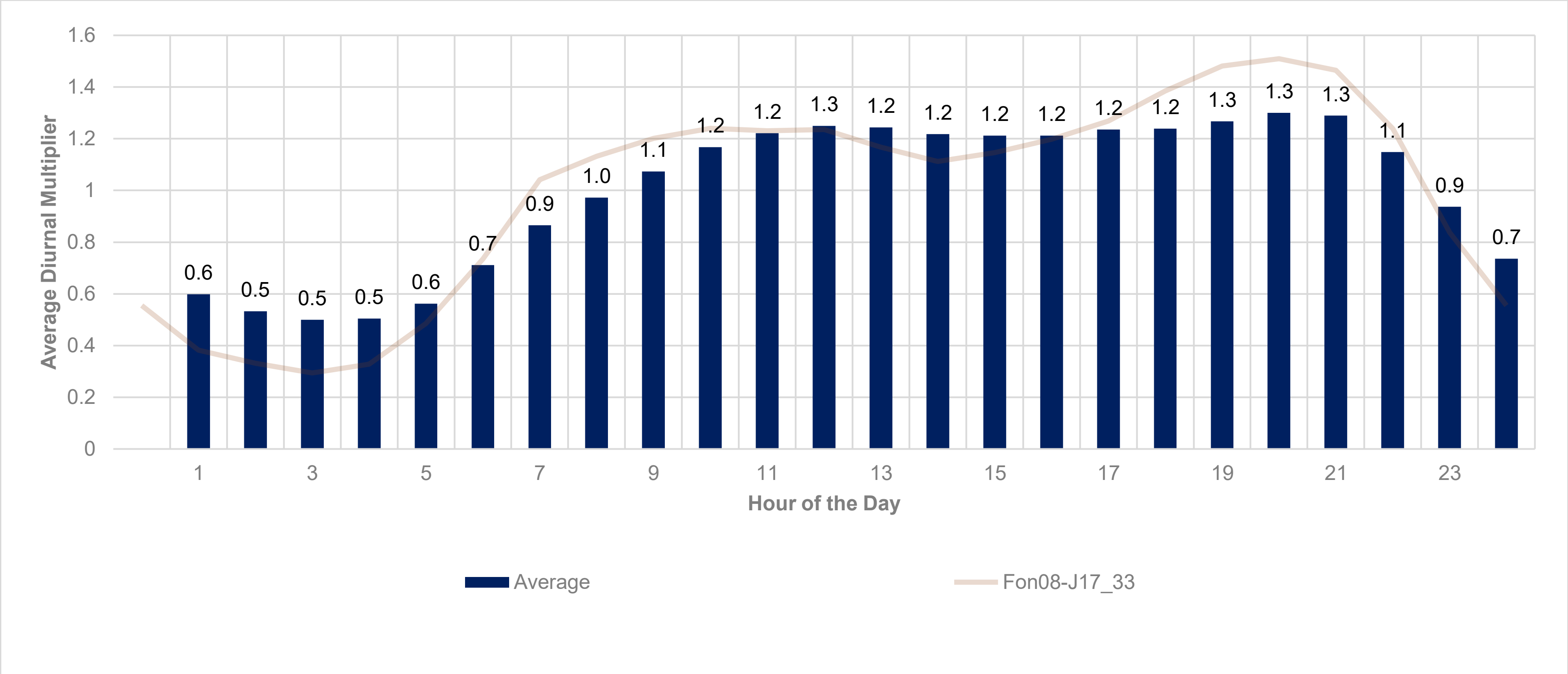
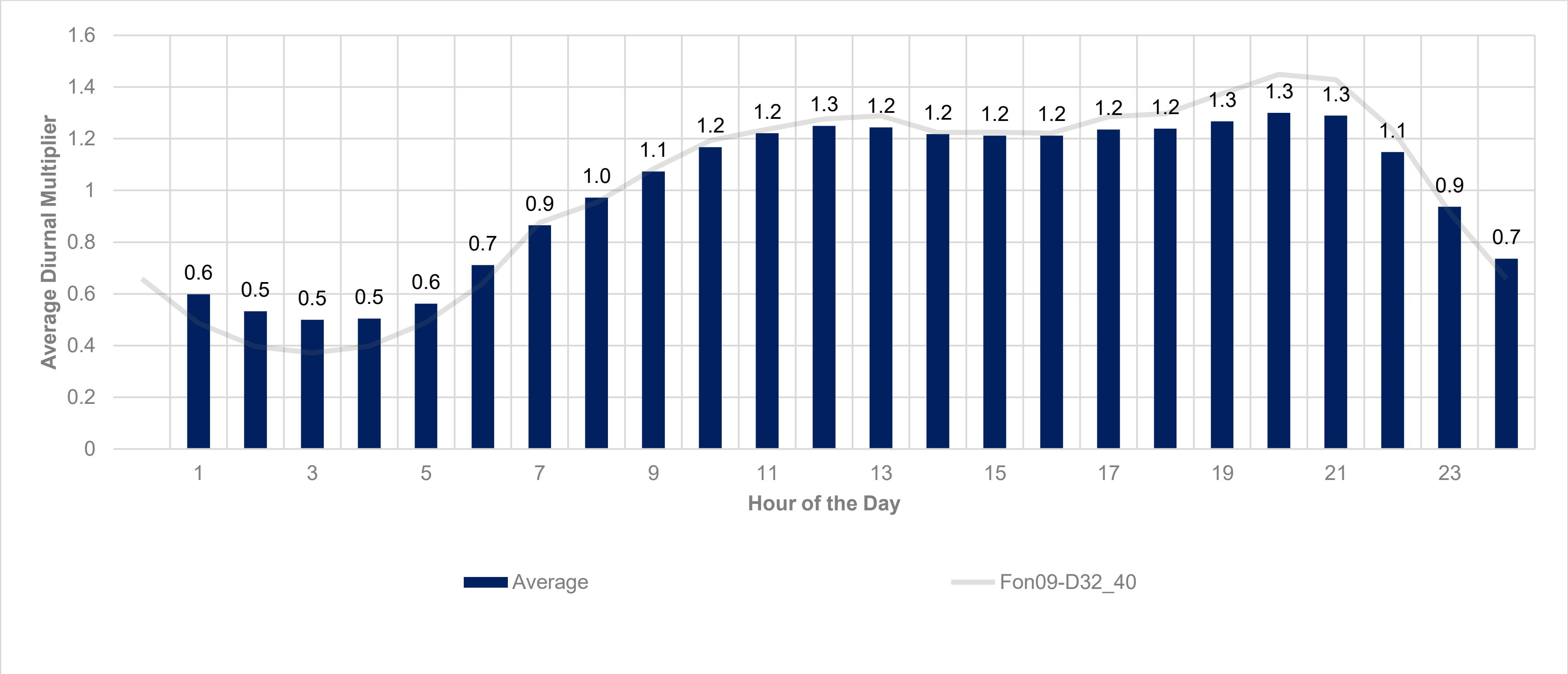
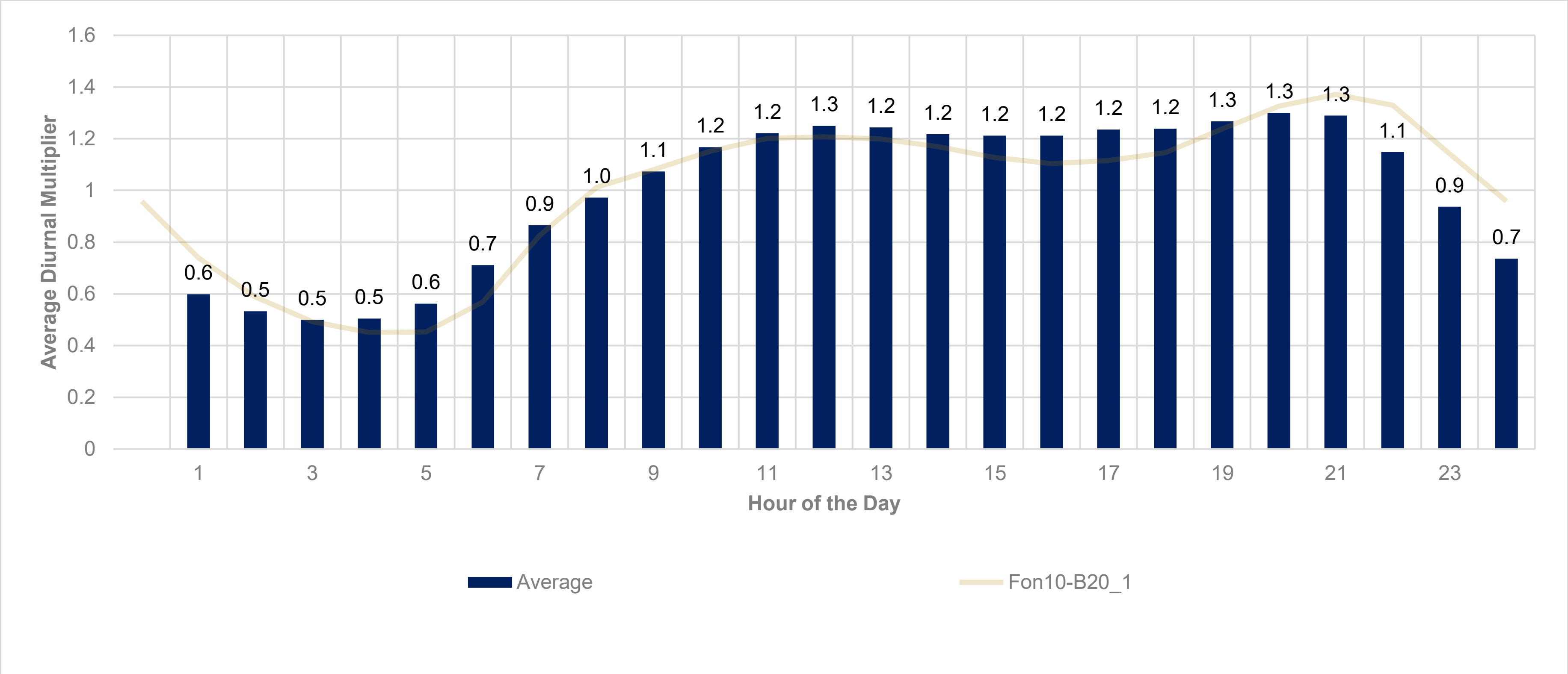
Calibration Manhole ID: FON08-J17_33



Calibration Manhole ID: FON09-D32_40



Calibration Manhole ID: FON10-B20_1



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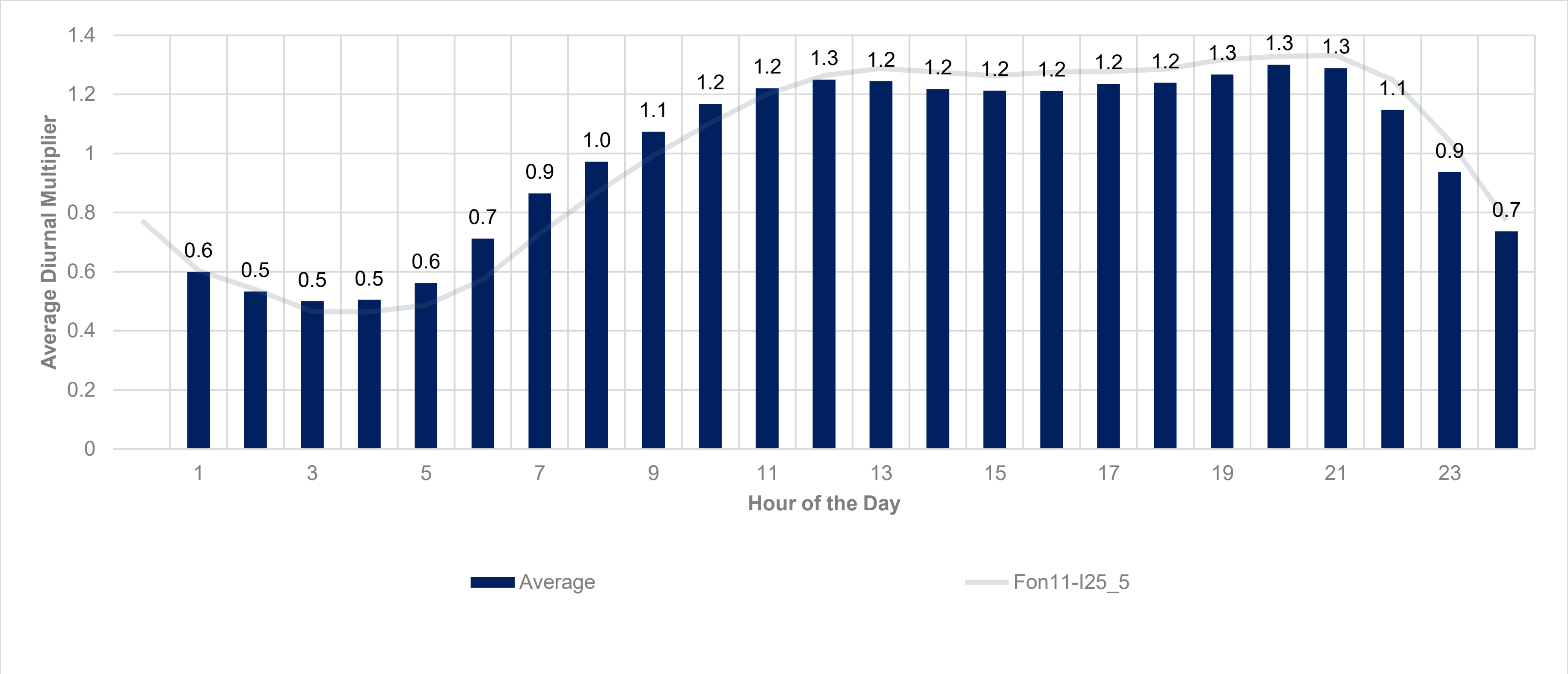
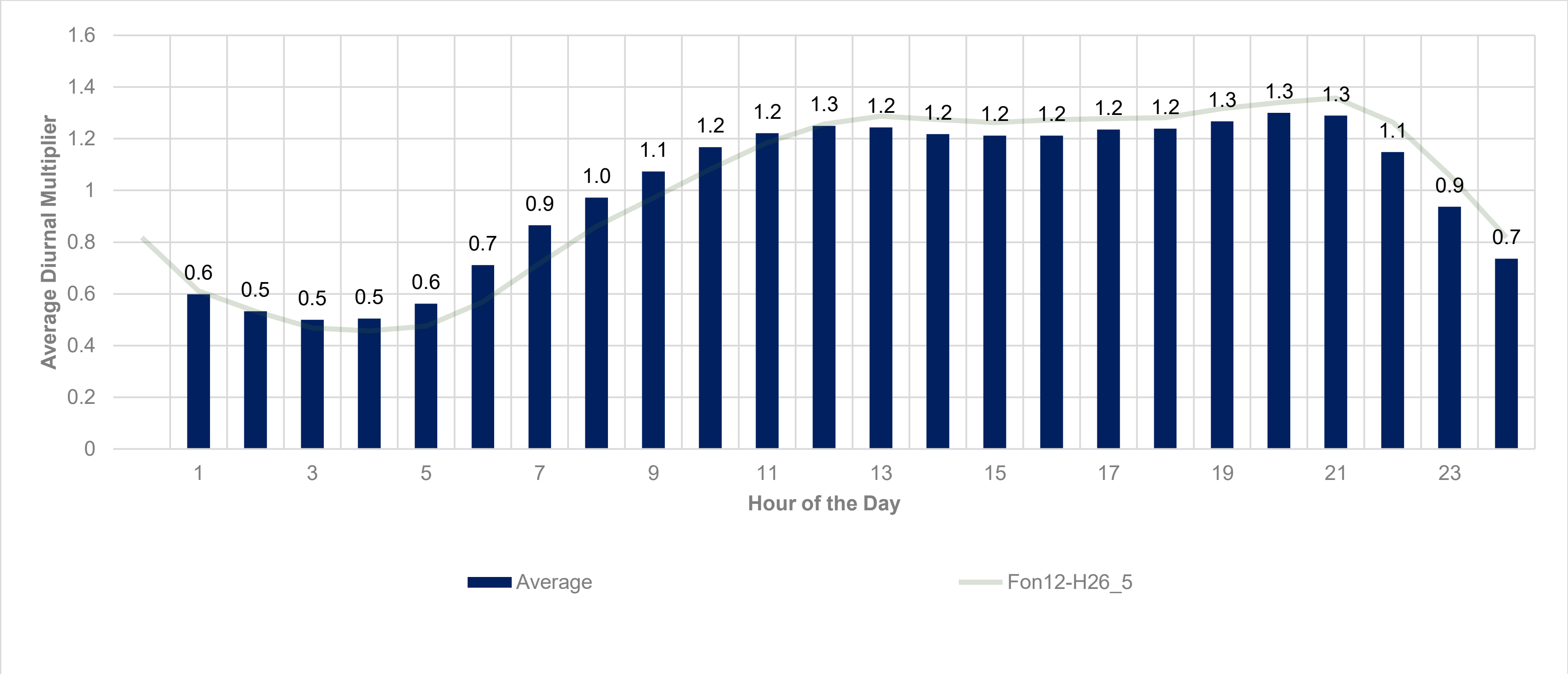
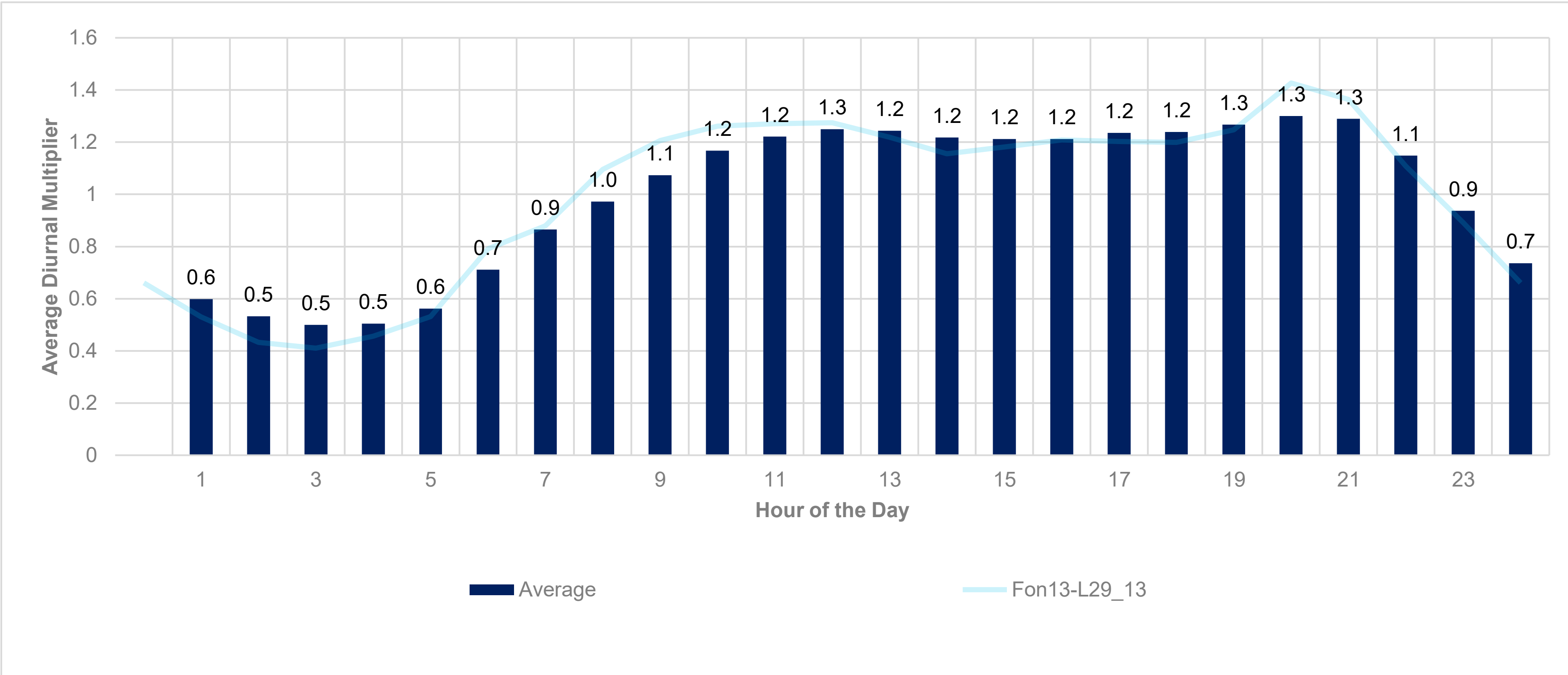
Calibration Manhole ID: FON11-I25_5



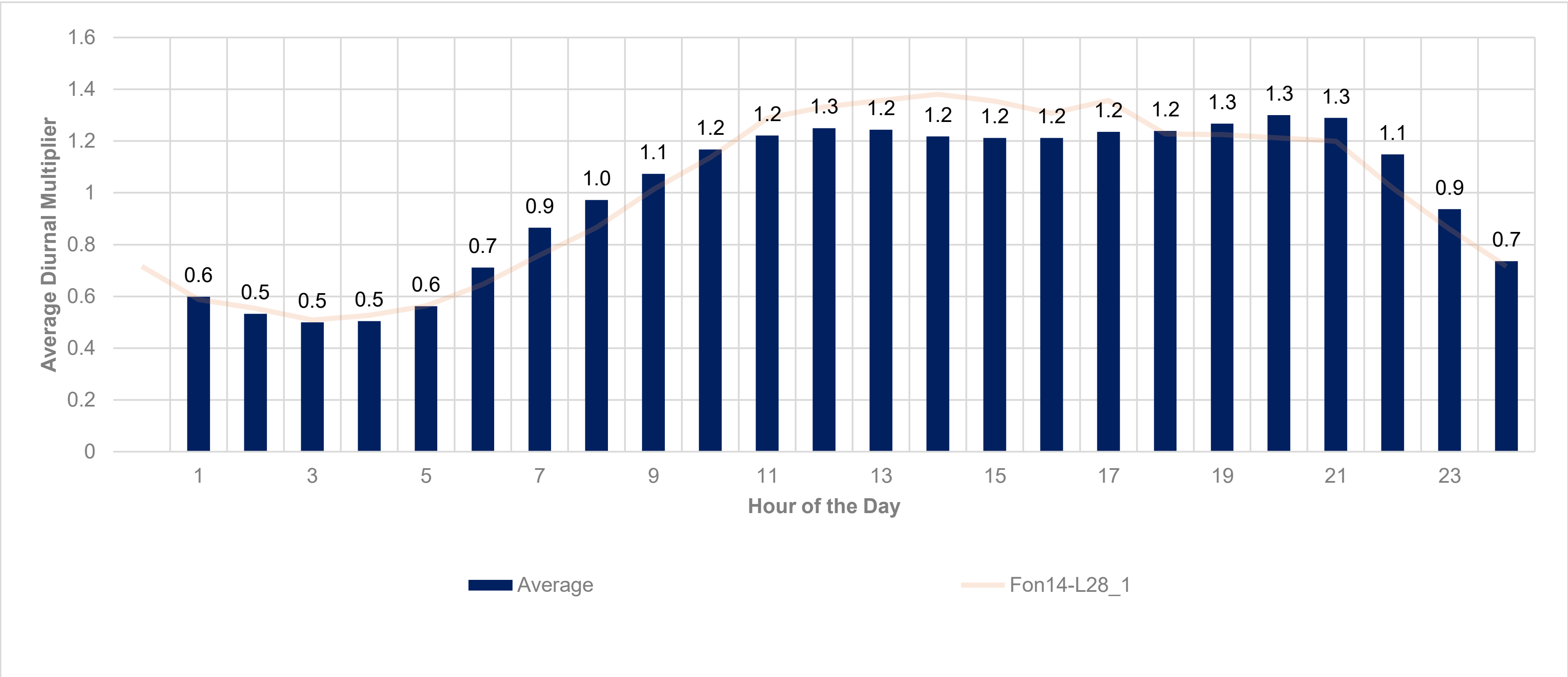
Calibration Manhole ID: FON12-H26_5



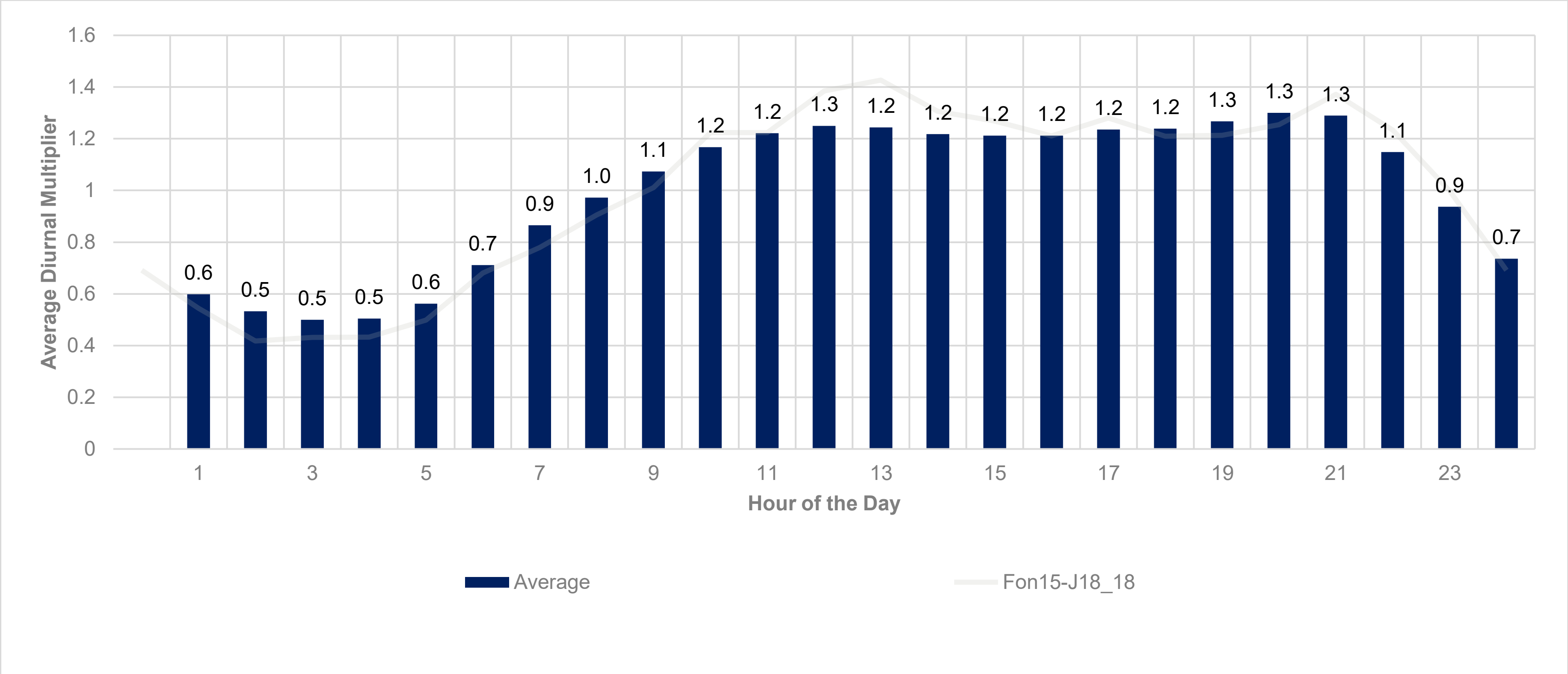
Calibration Manhole ID: FON13-L29_13



Calibration Manhole ID: FON14-L28_1



Calibration Manhole ID: FON15-J18_18



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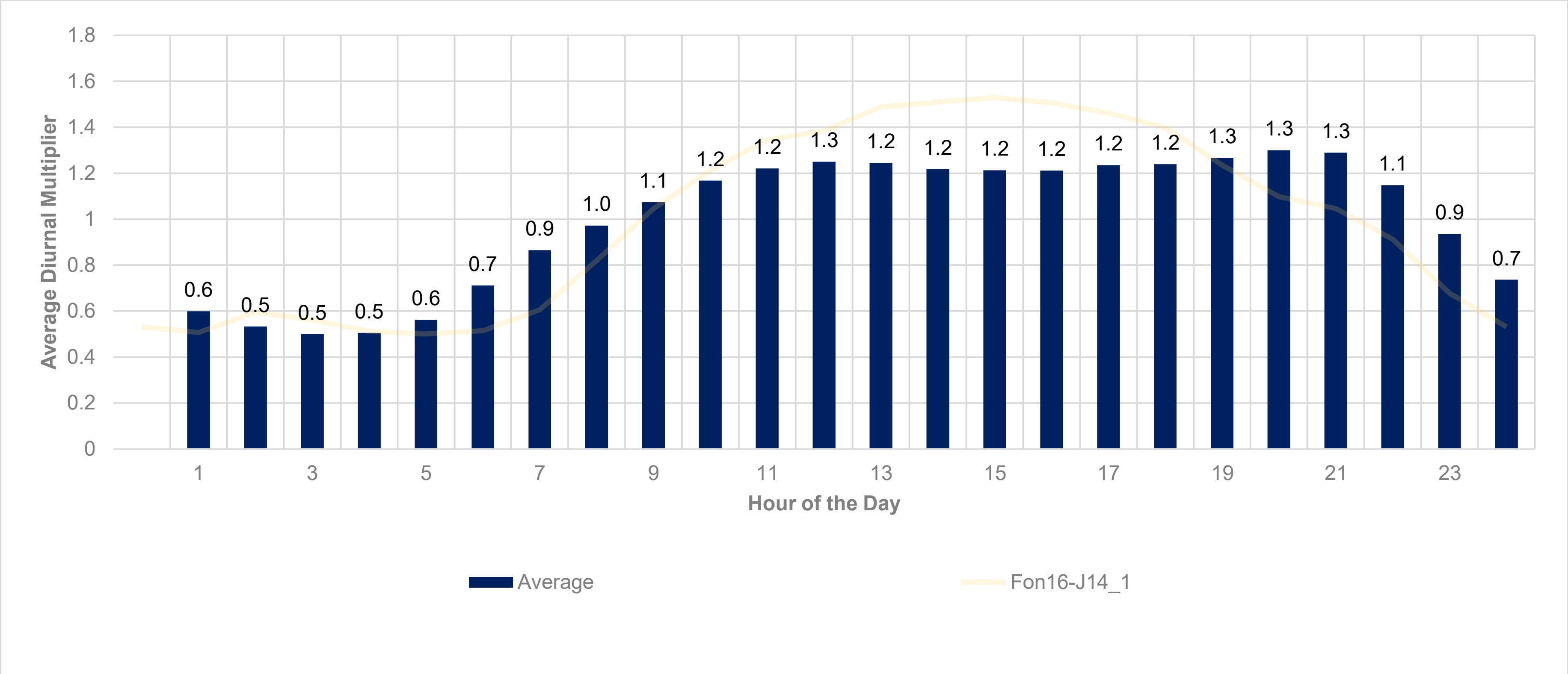
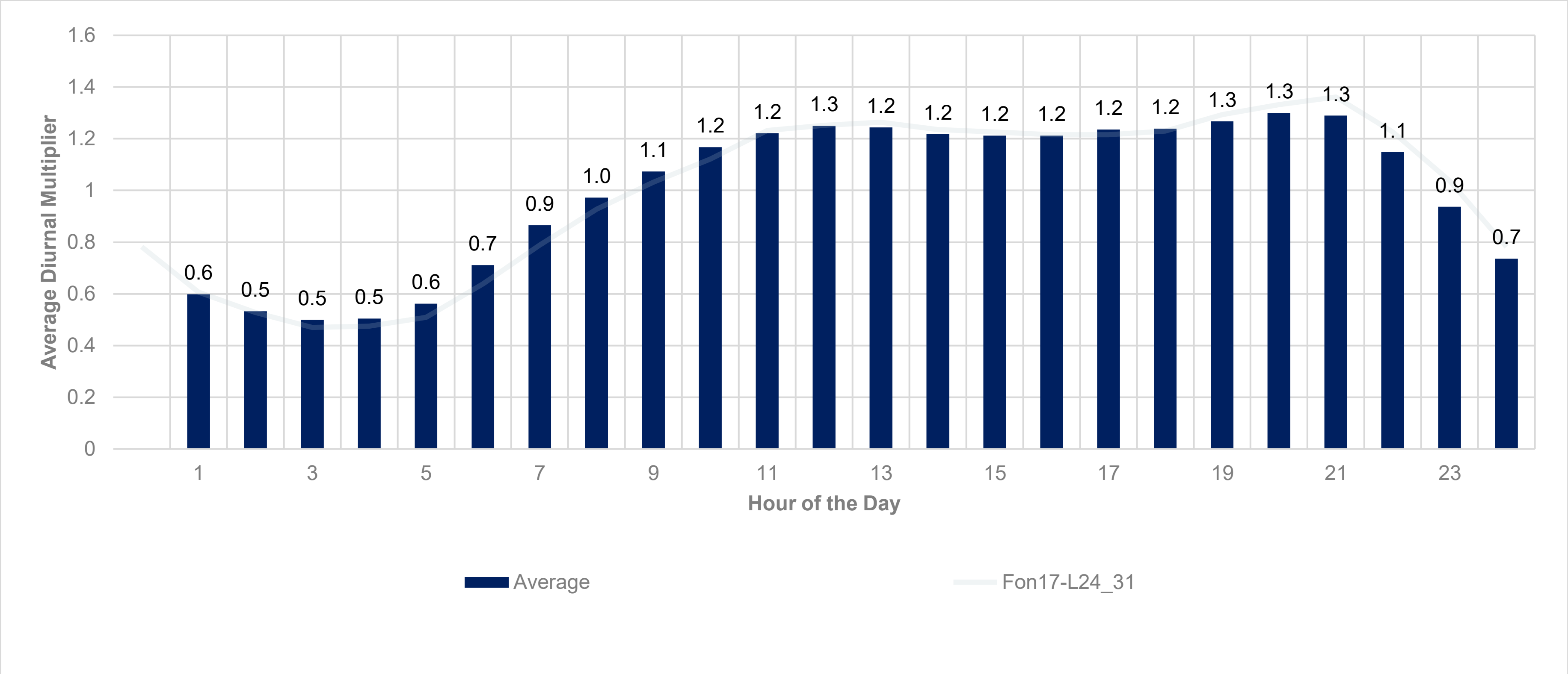
Calibration Manhole ID: FON16-J14_1

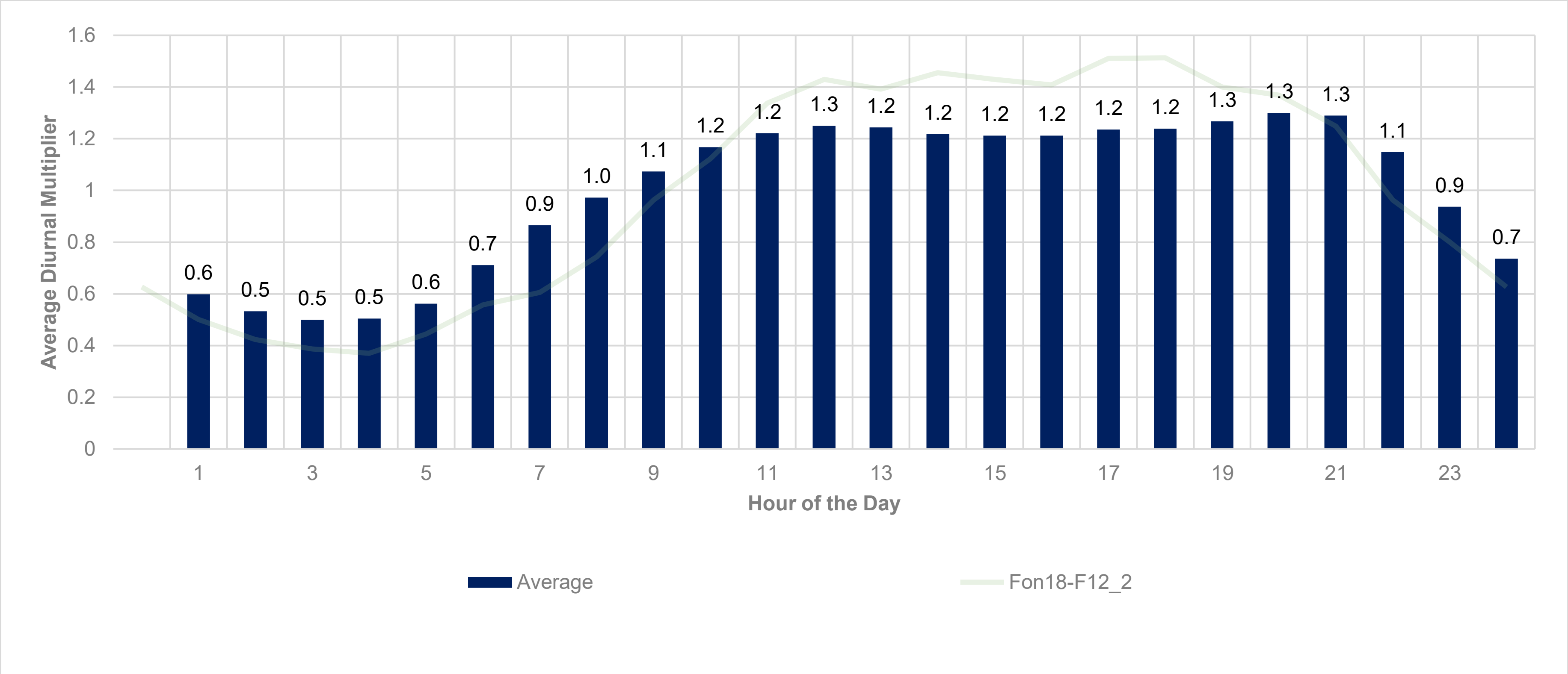


ALBERT A. WEBB ASSOCIATES

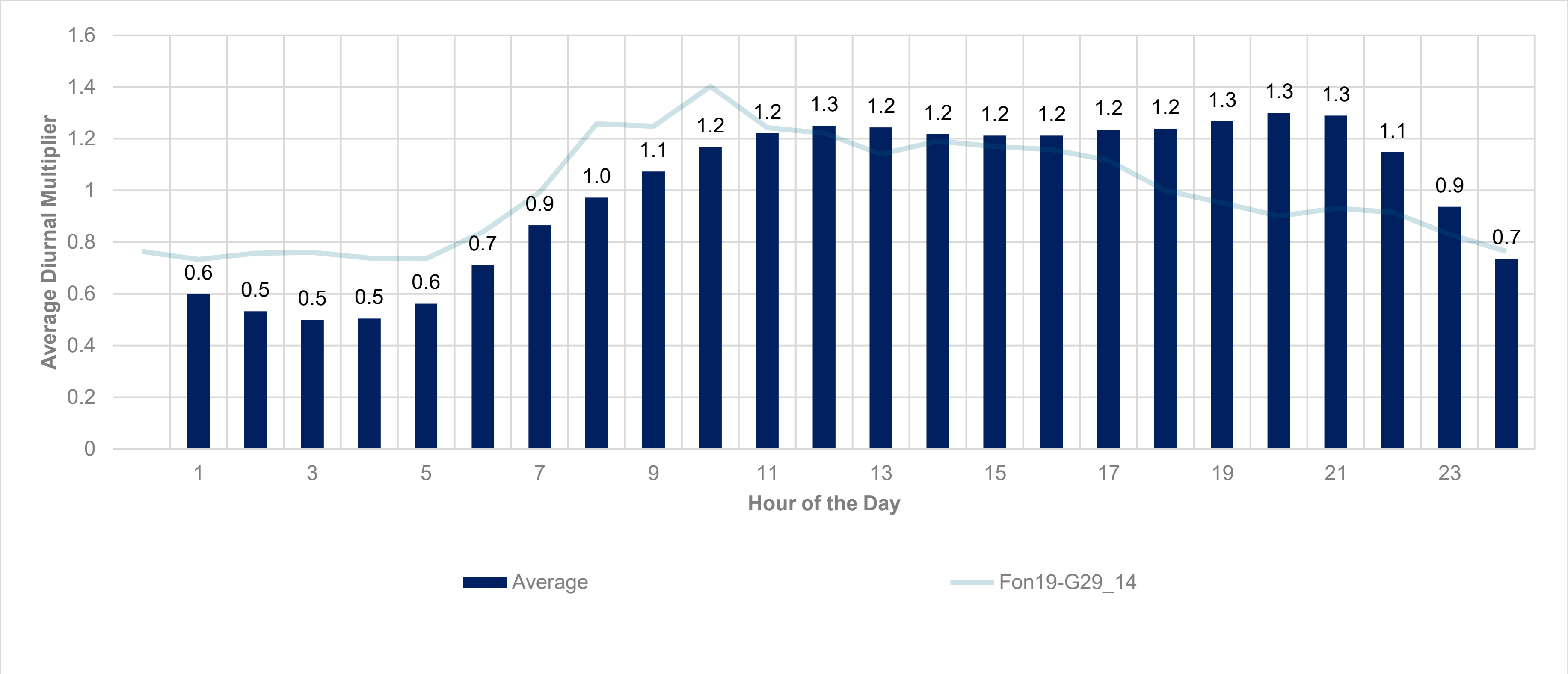
Calibration Manhole ID: FON17-L24_31



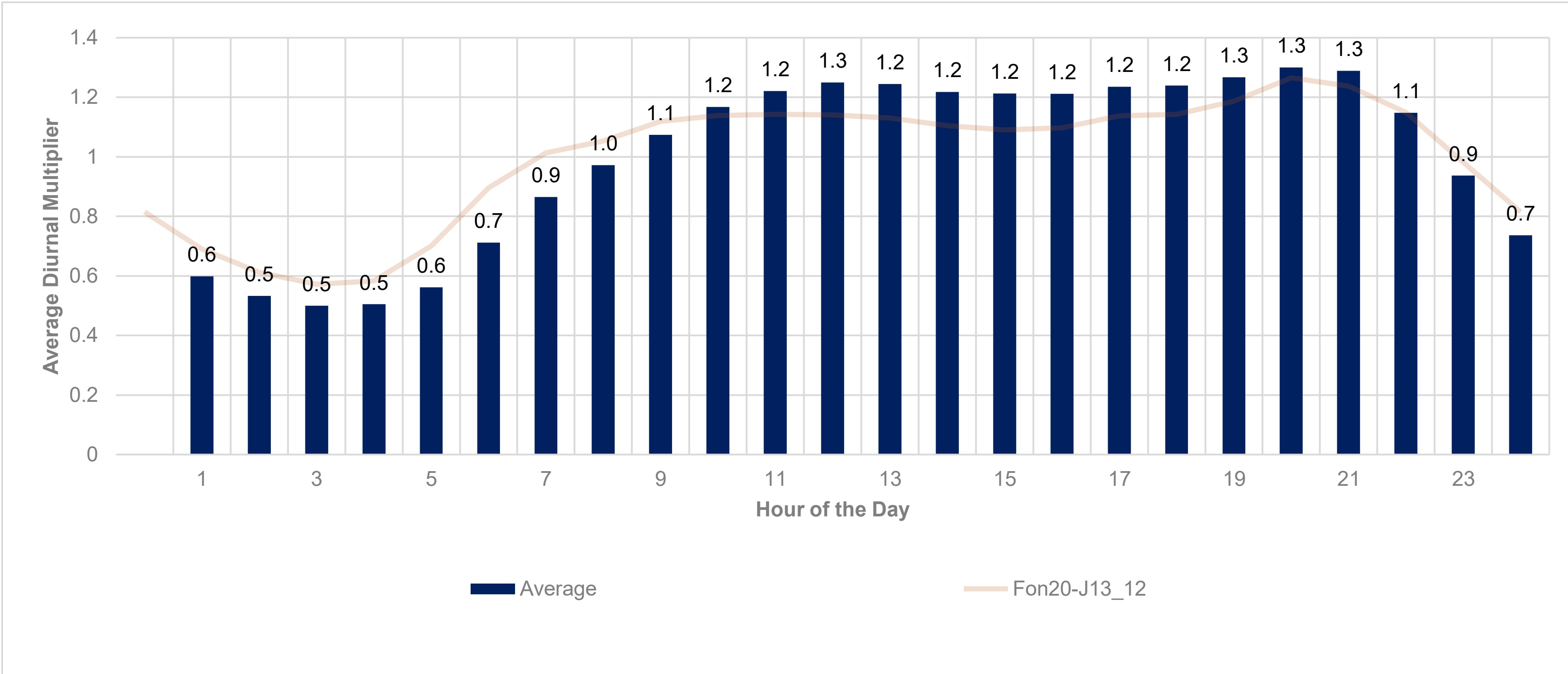
Calibration Manhole ID: FON18-F12_2



Calibration Manhole ID: FON19-G29_14

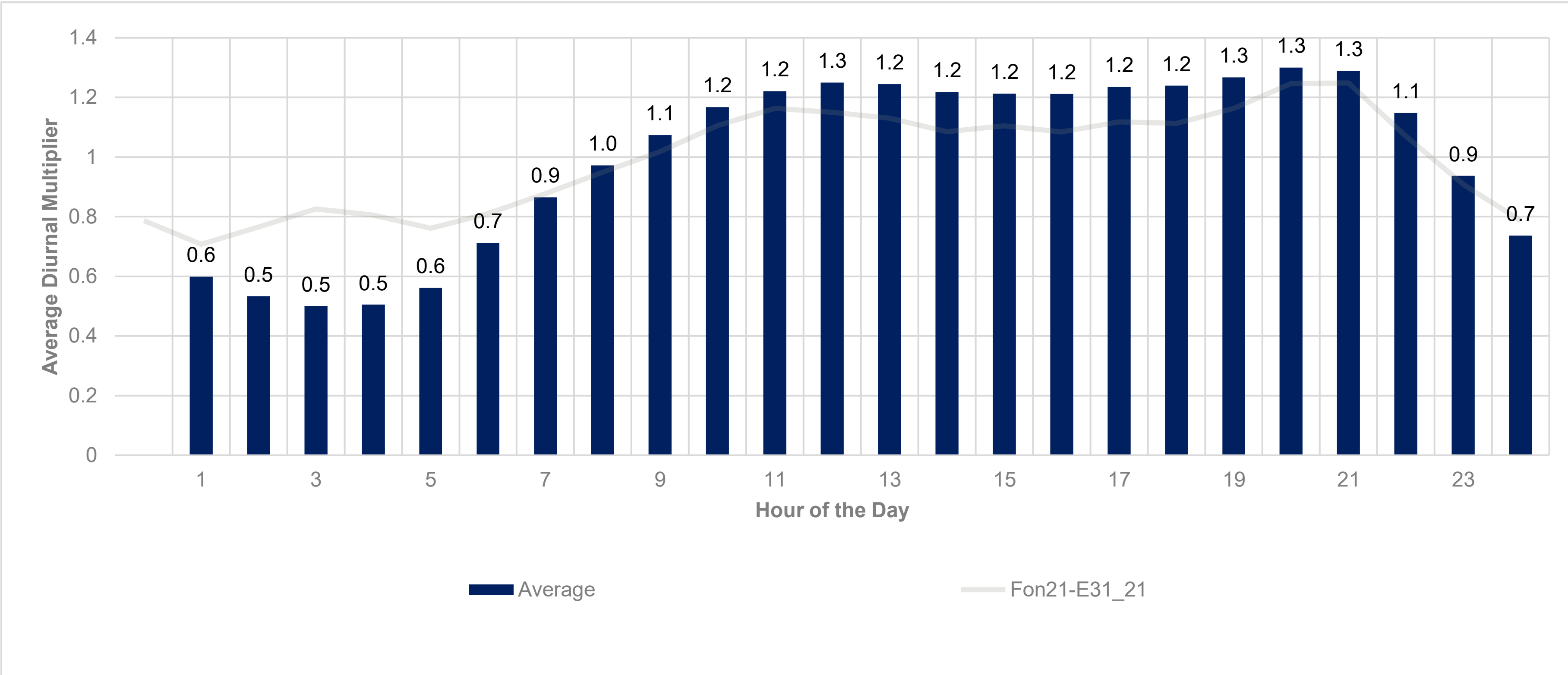


Calibration Manhole ID: FON20-J13_12

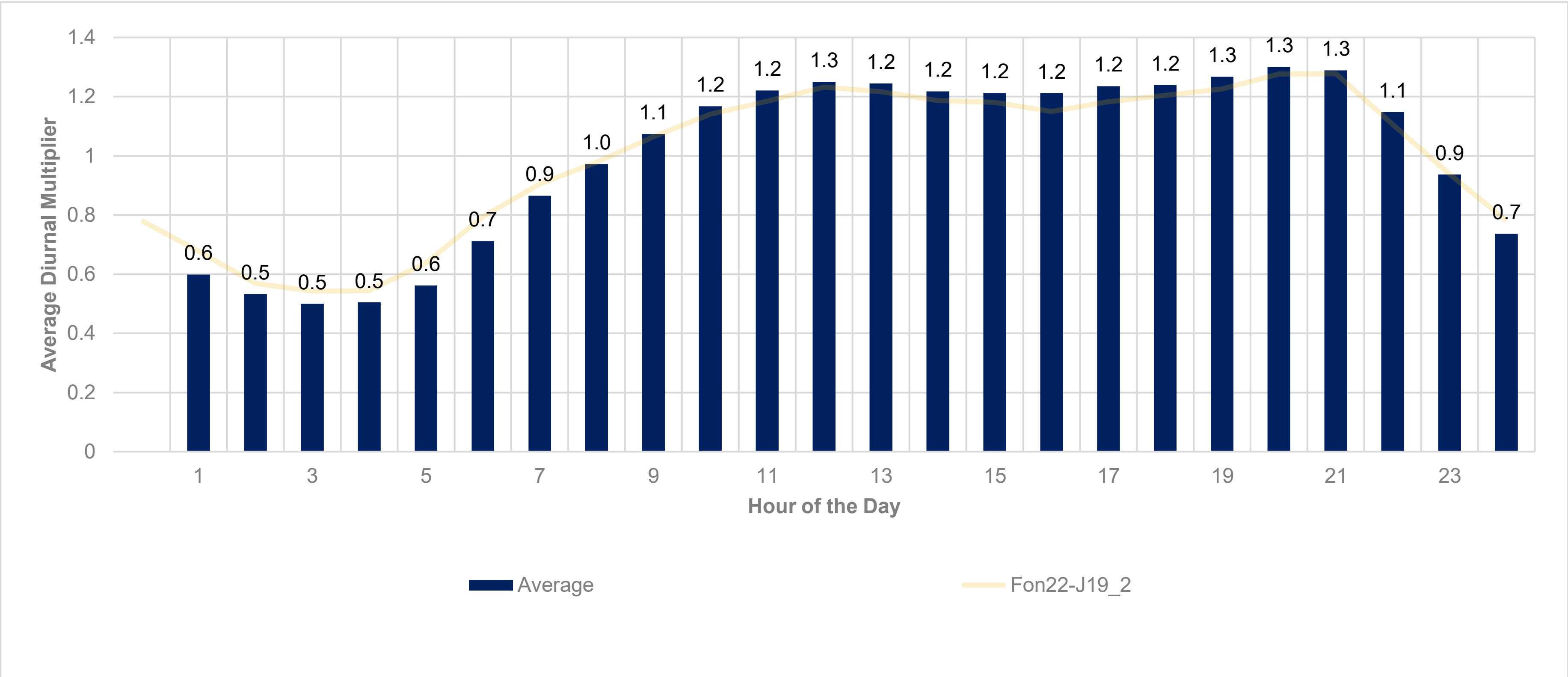


ALBERT A. WEBB ASSOCIATES

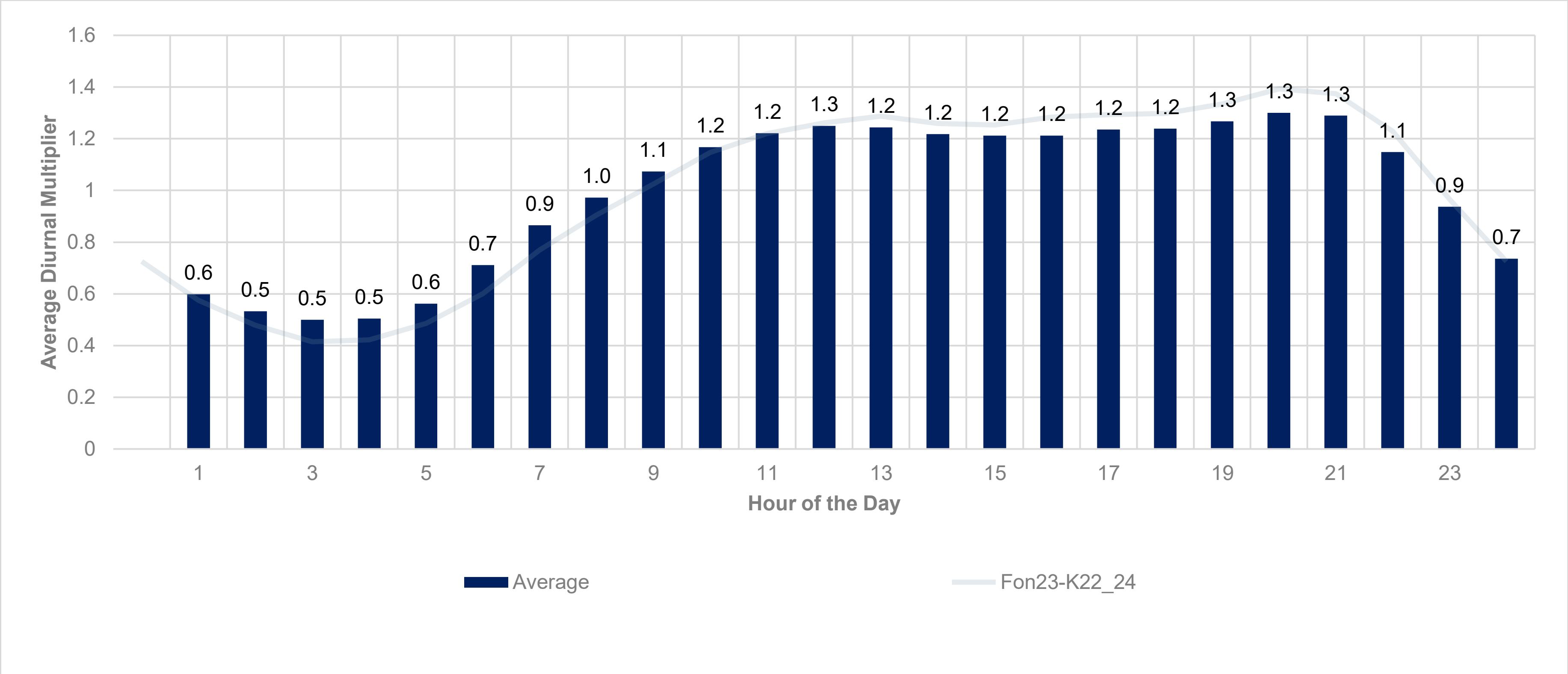
Calibration Manhole ID: FON21-E31_21



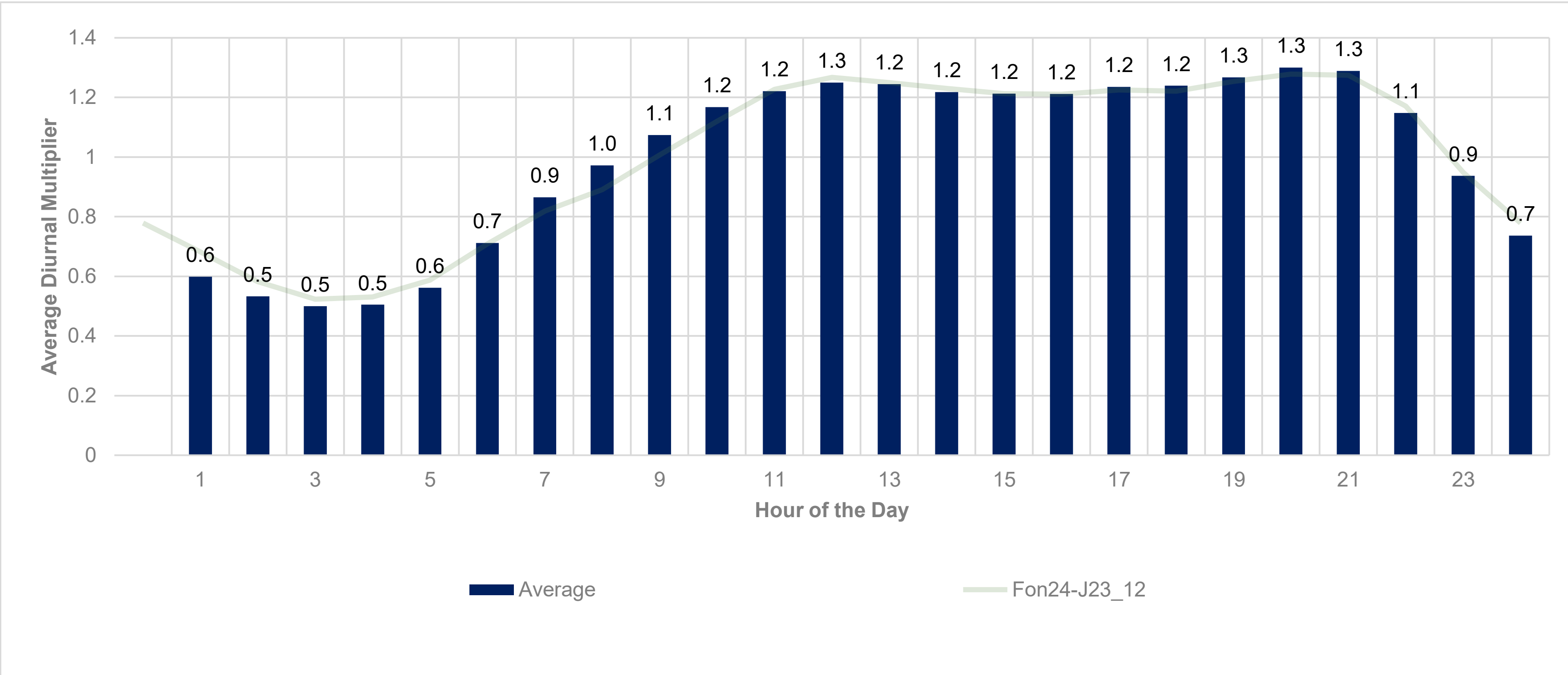
Calibration Manhole ID: FON22-J19_2



Calibration Manhole ID: FON23-K22_24



Calibration Manhole ID: FON24-J23_12



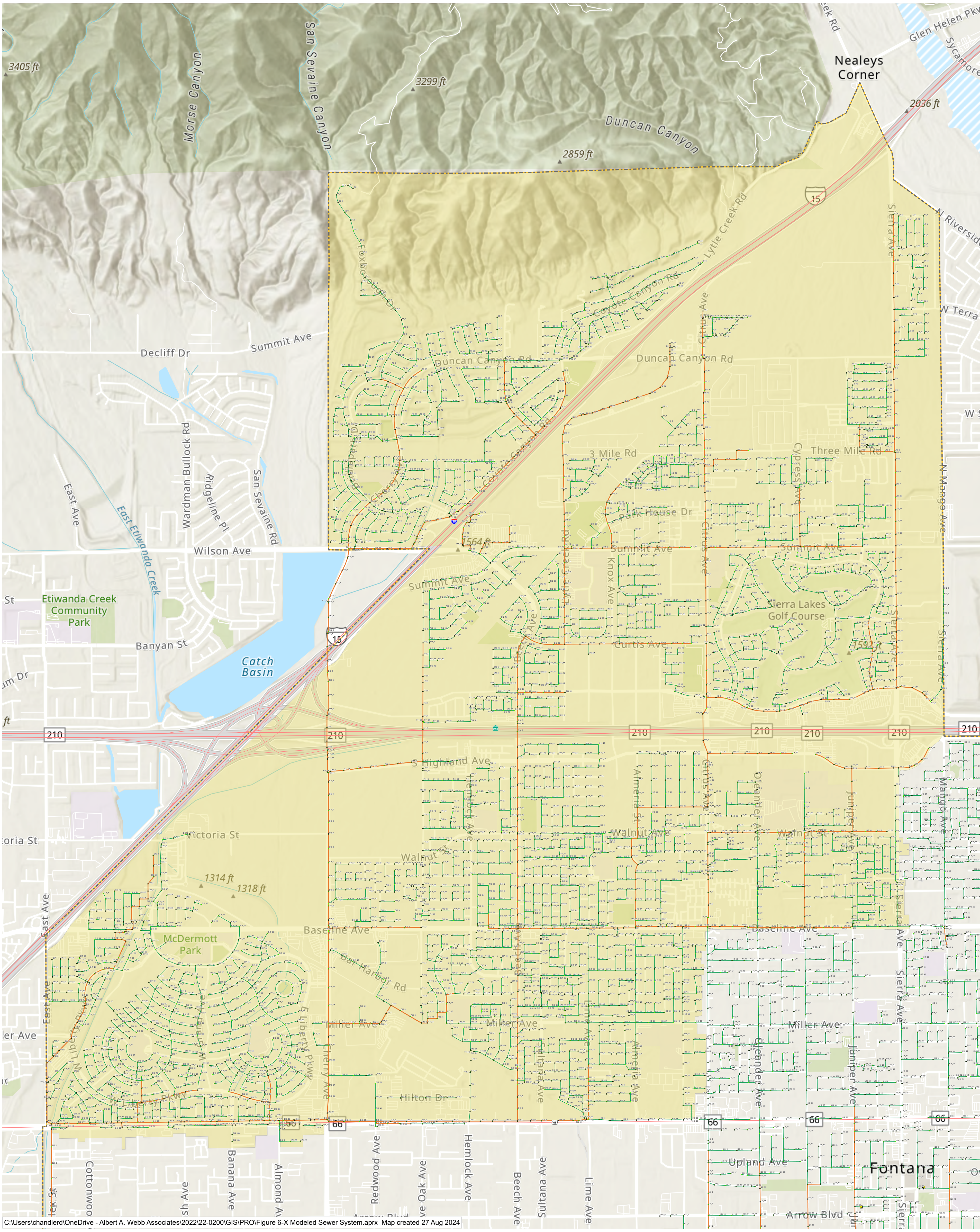
Appendix D

Model Elements by Tributary Area

ALBERT A.
WEBB
ASSOCIATES

APPENDIX D-1

IEUA 1 MODEL SYSTEM MANHOLE ID



LEGEND

Model Pipes

Diameter (in)

8-inch or less

10-inch or greater

Model Manholes

Service Area Boundary

Tributary Areas

IEUA 1

0 1,250 2,500 Feet

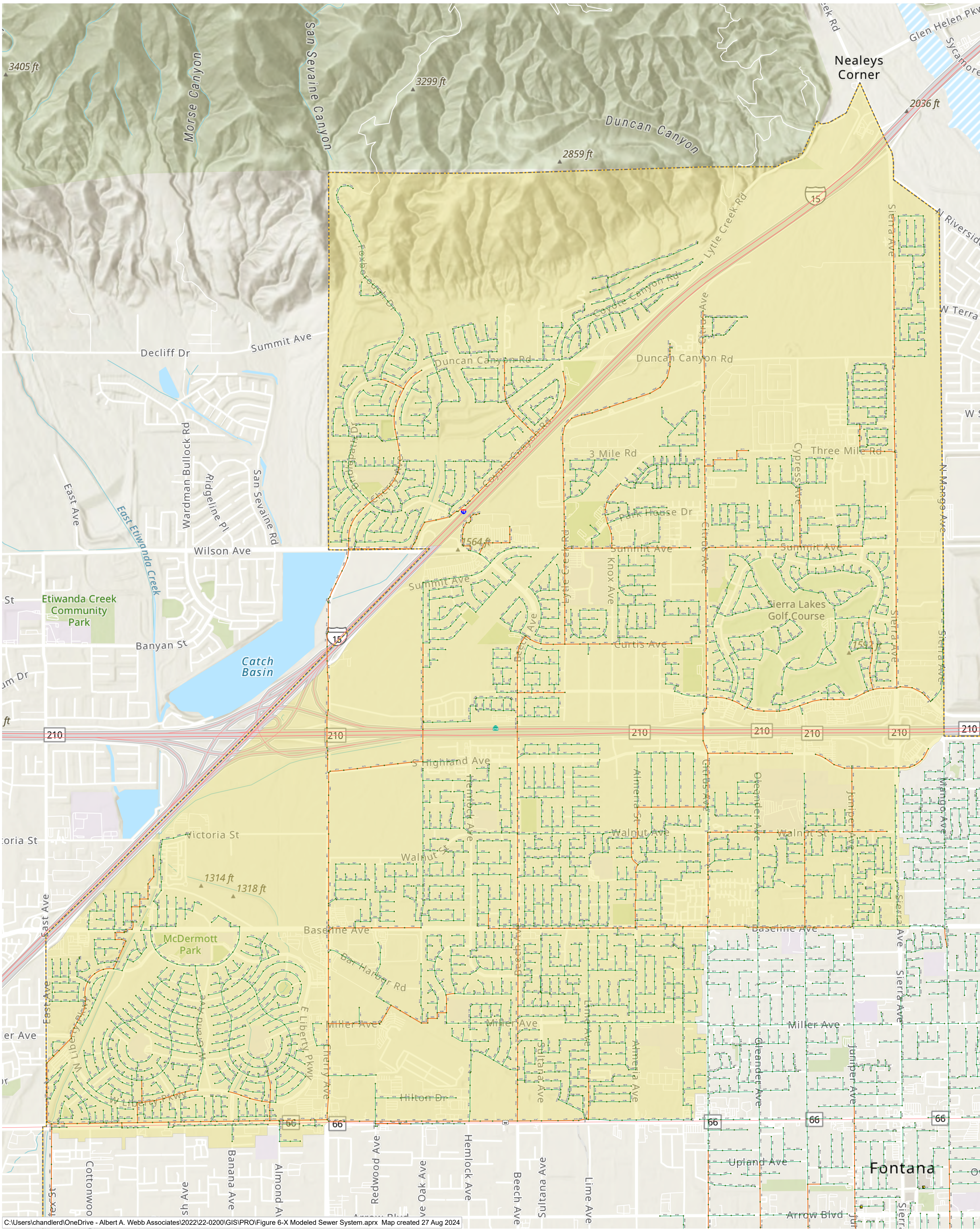
Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

CITY OF FONTANA SEWER MASTER PLAN 2023

APPENDIX D-2

IEUA 1 MODEL SYSTEM PIPE ID



LEGEND

Model Pipes

Diameter (in)

- 8-inch or less
- 10-inch or greater

Model Manholes

Service Area Boundary

Tributary Areas

- IEUA 1

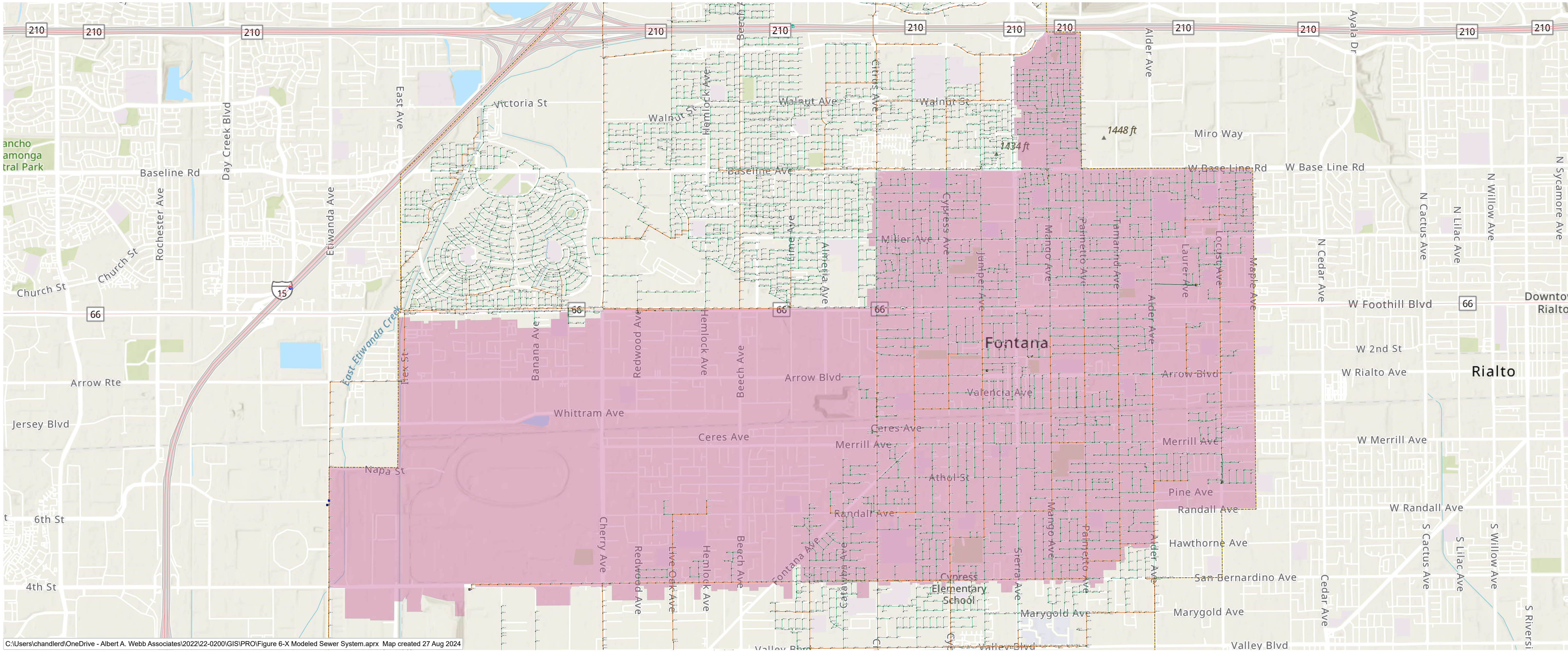
0 1,250 2,500 Feet

Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

APPENDIX D-3

IEUA 2 MODEL SYSTEM MANHOLE ID



LEGEND

Model Pipes

Diameter (in)

- 8-inch or less
- 10-inch or greater

Model Manholes

Service Area Boundary

Tributary Areas

IEUA 2

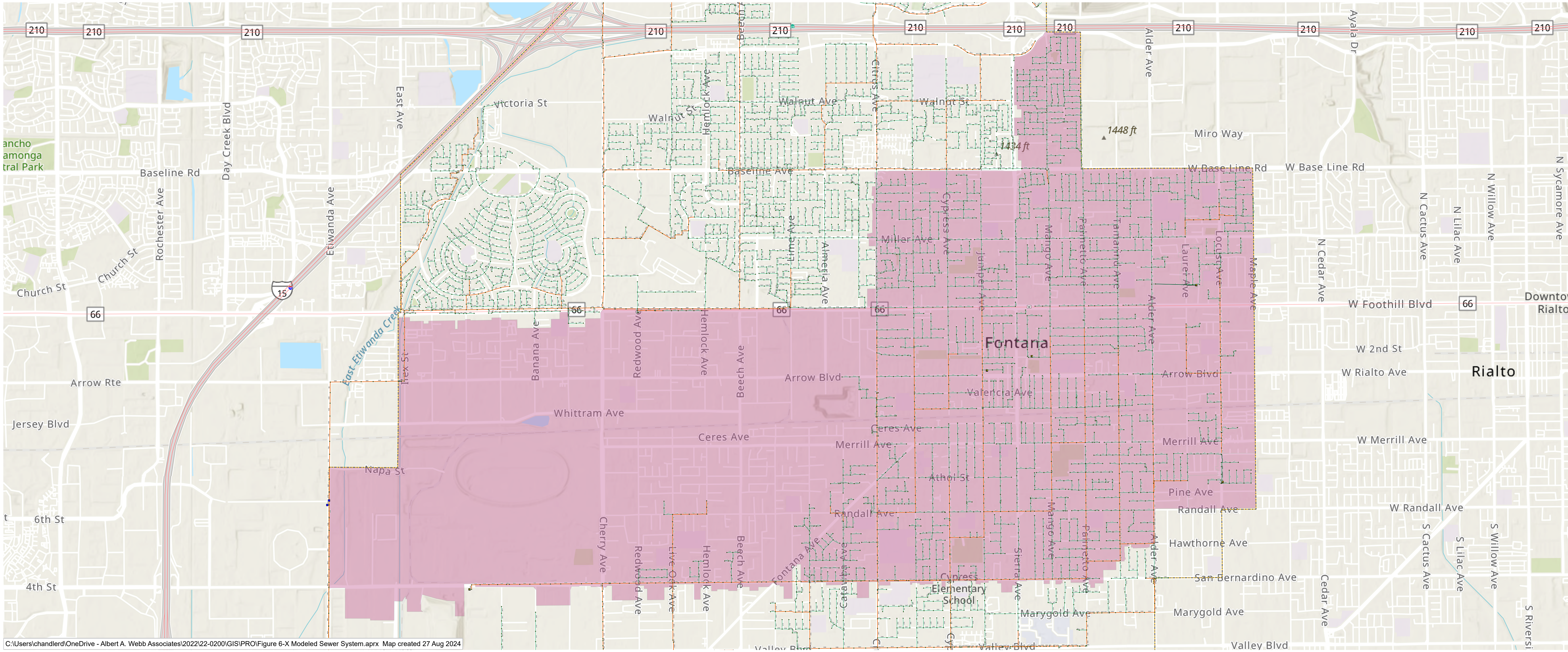
0 2,000 4,000 Feet

Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

APPENDIX D-4

IEUA 2 MODEL SYSTEM PIPE ID



LEGEND

Model Pipes

Diameter (in)

- 8-inch or less
- 10-inch or greater

Model Manholes

Service Area Boundary

Tributary Areas

IEUA 2

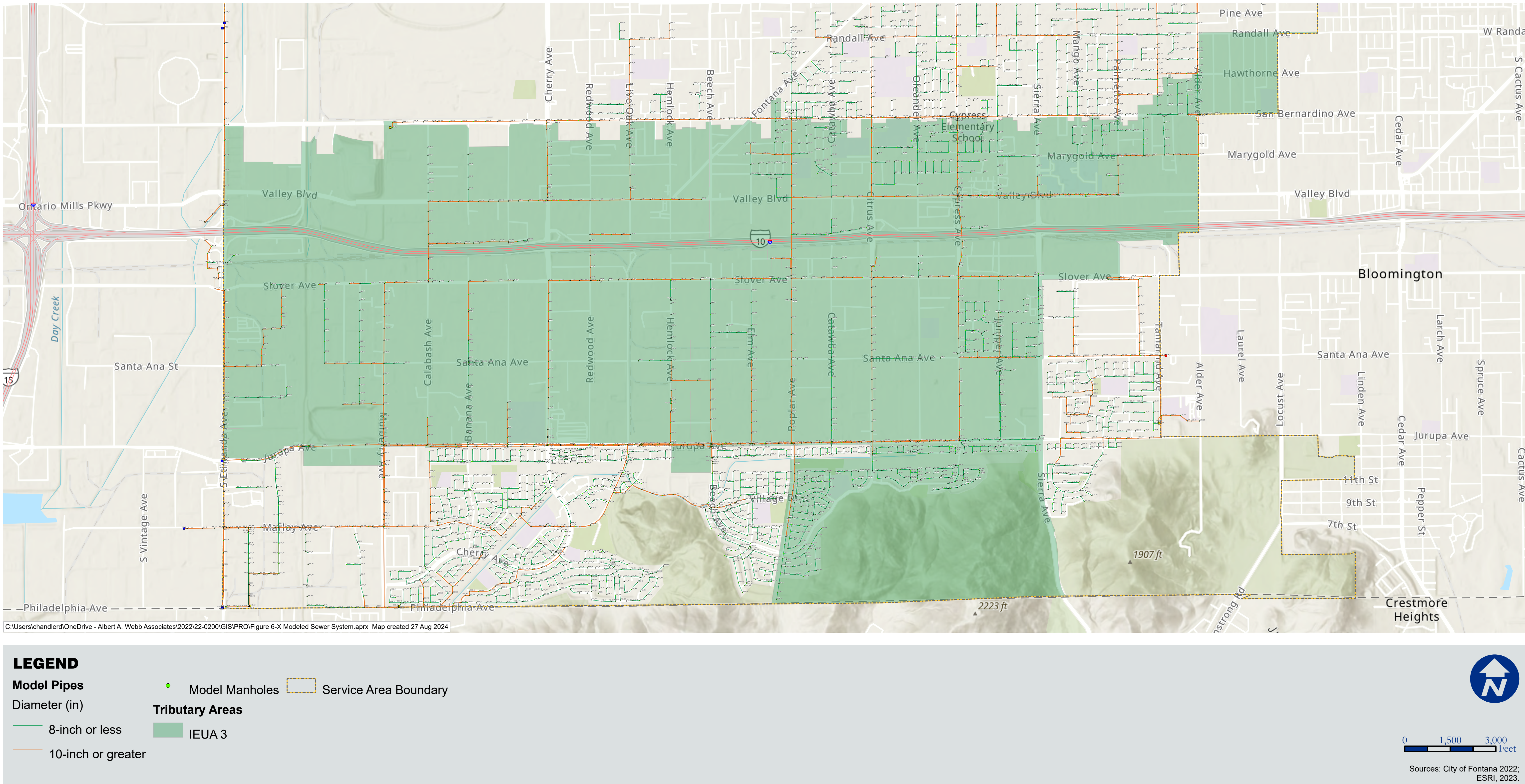
0 2,000 4,000 Feet

Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

APPENDIX D-5

IEUA 3 MODEL SYSTEM MANHOLE ID

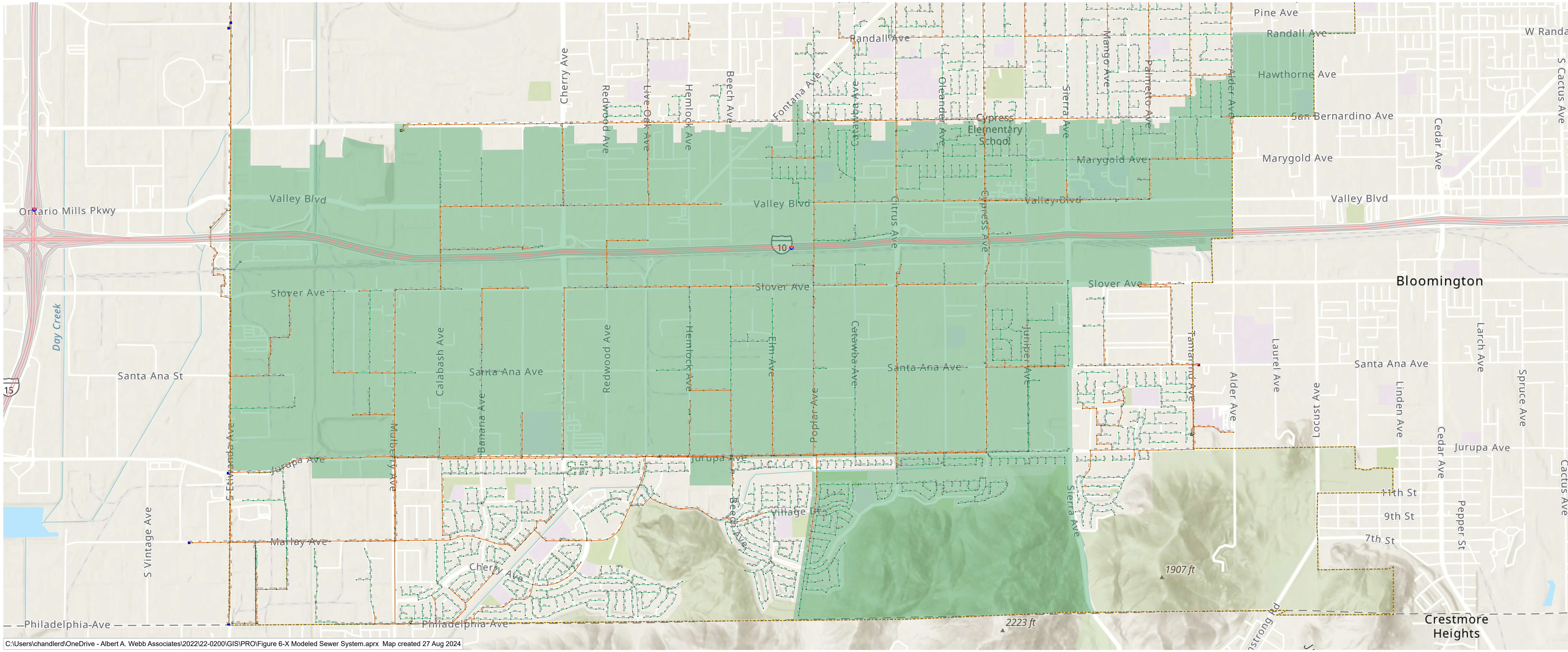


Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

APPENDIX D-6

IEUA 3 MODEL SYSTEM PIPE ID



LEGEND

Model Pipes

Diameter (in)

- 8-inch or less
- 10-inch or greater

Model Manholes

Service Area Boundary

Tributary Areas

IEUA 3

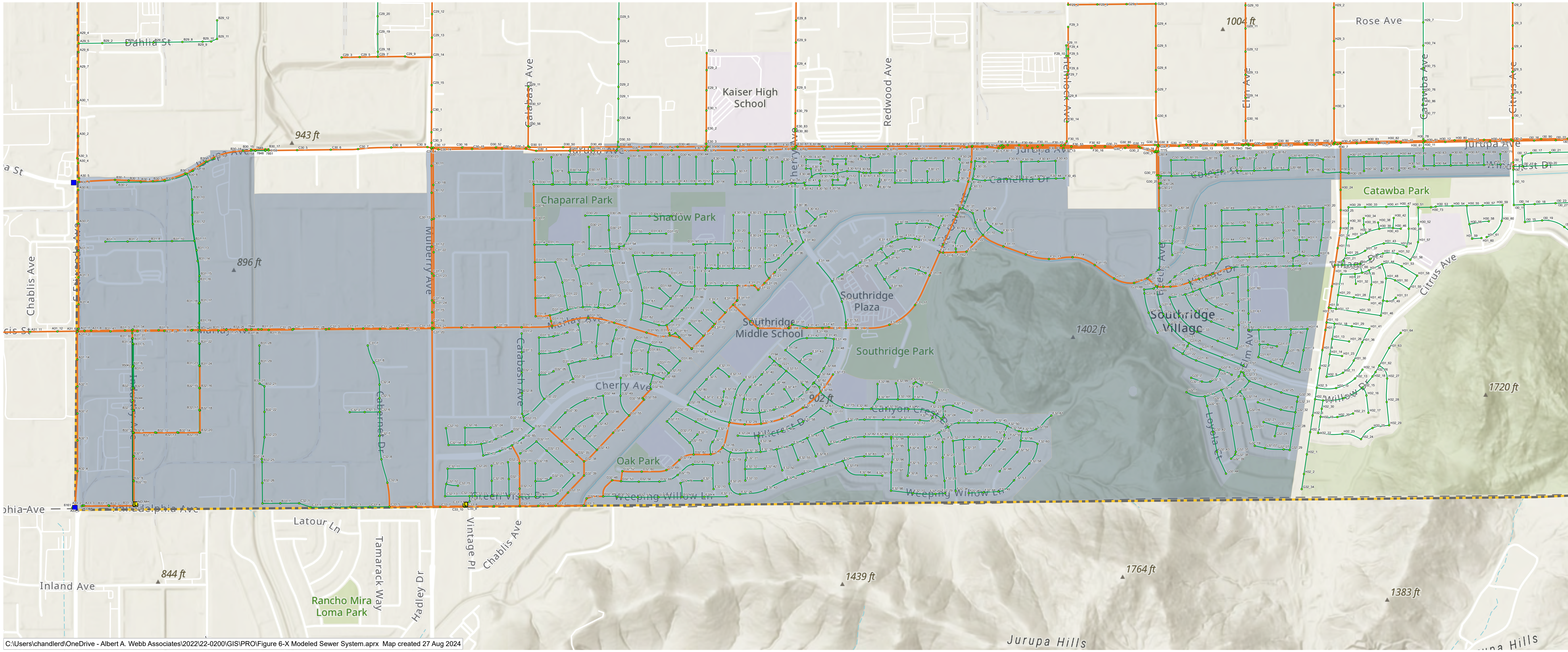
0 1,500 3,000 Feet

Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

APPENDIX D-7

IEUA 4 MODEL SYSTEM MANHOLE ID



LEGEND

Model Pipes

Diameter (in)

- 8-inch or less
- 10-inch or greater

Model Manholes

Service Area Boundary

Tributary Areas

IEUA 4

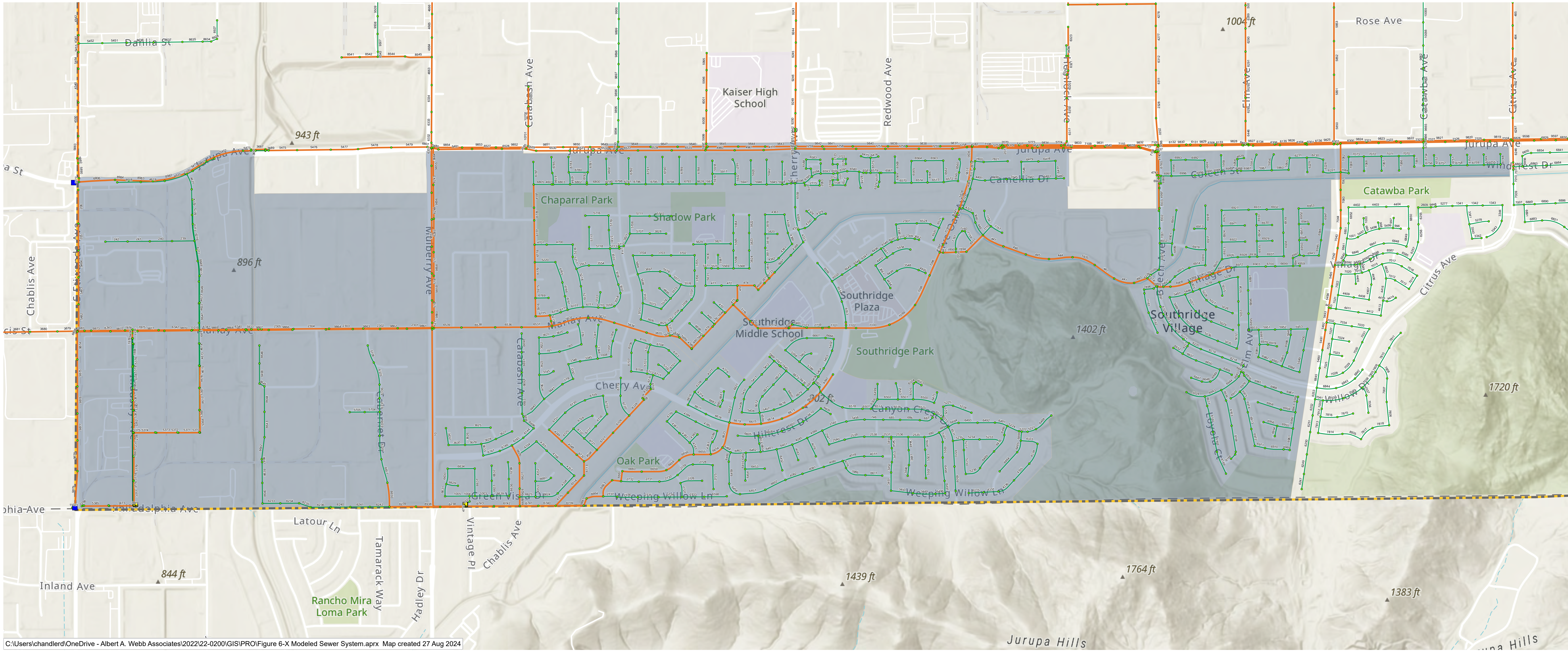
0 500 1,000 Feet

Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

APPENDIX D-8

IEUA 4 MODEL SYSTEM PIPE ID



LEGEND

Model Pipes

Diameter (in)

- 8-inch or less
- 10-inch or greater

Model Manholes

Service Area Boundary

Tributary Areas

IEUA 4

0 500 1,000 Feet

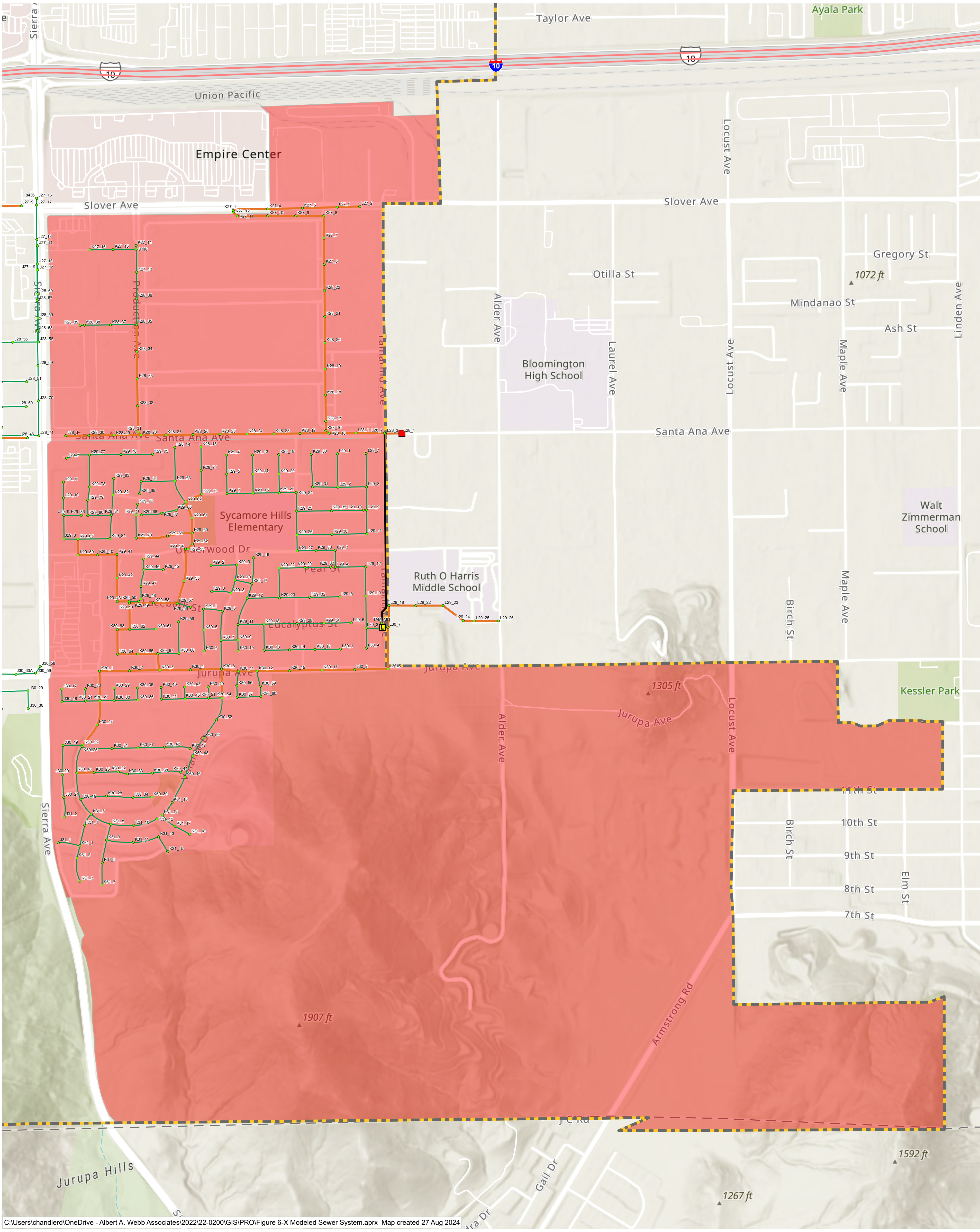
Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

CITY OF FONTANA SEWER MASTER PLAN 2023

APPENDIX D-9

RIALTO MODEL SYSTEM MANHOLE ID



LEGEND

Model Pipes
Diameter (in)
- 8-inch or less
- 10-inch or greater
- Force Mains

- Model Manholes
- Rialto Discharge Point

Tributary Areas
- RIALTO

- Service Area Boundary

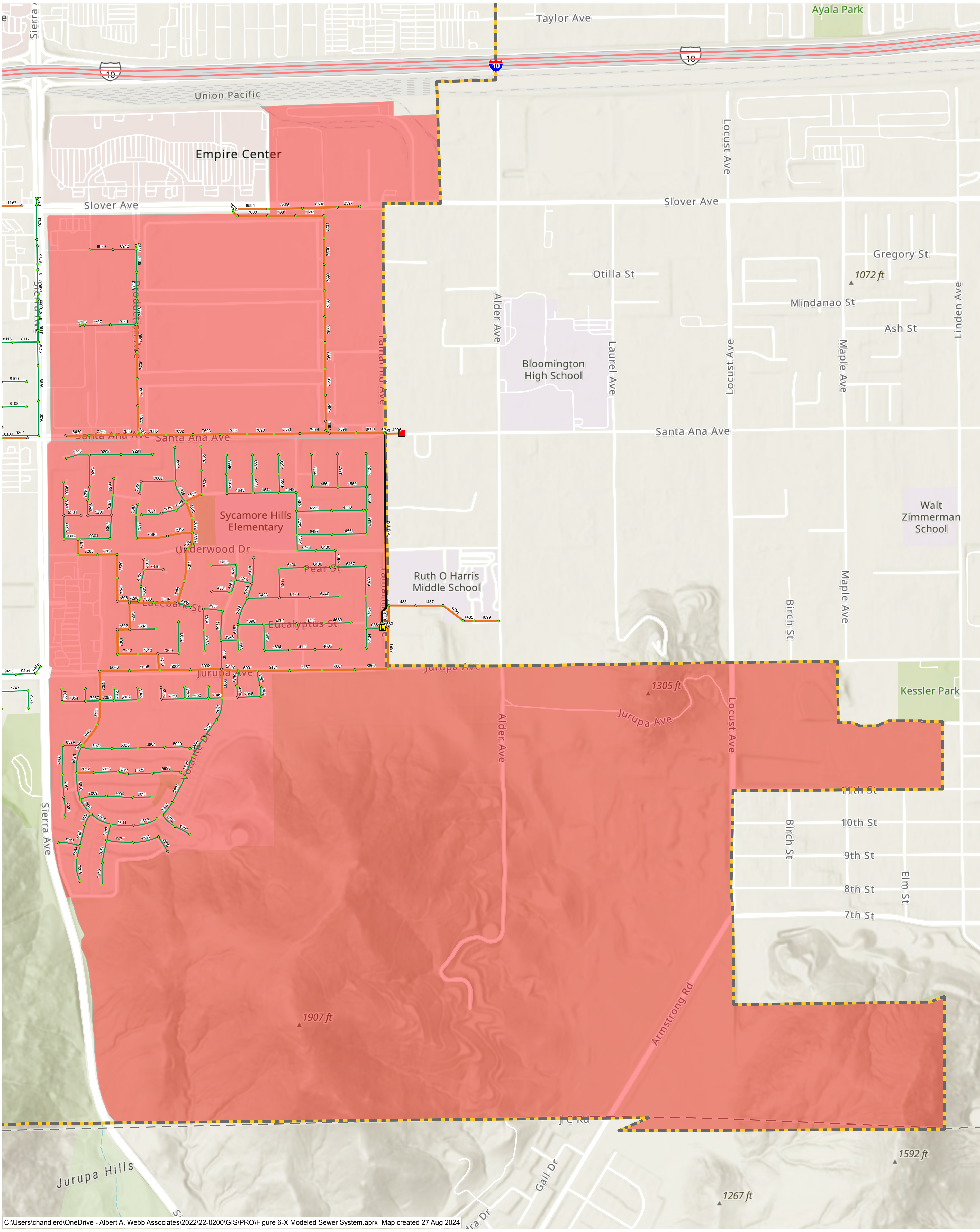
0 500 1,000 Feet

Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

APPENDIX D-10

RIALTO MODEL SYSTEM PIPE ID



LEGEND

Model Pipes

Diameter (in)

- 8-inch or less
- 10-inch or greater
- Force Mains

Model Manholes

Rialto Discharge Point

Tributary Areas

RIALTO

Service Area Boundary

0 500 1,000 Feet

Sources: City of Fontana 2022; ESRI, 2023.

ALBERT A. WEBB ASSOCIATES

Appendix E

Pipe Inventory Results

ALBERT A. WEBB ASSOCIATES

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
Existing Wet Weather Scenario - Potential Surcharge																
5135	6	390	0.014	0.477	0.012	0.191	3.758	1	1.105	0.5	0.414	0.937	0.432	Yes	0.5	3.758
5136	6	390	0.014	0.481	0.012	0.193	3.788	1	1.113	0.5	0.414	0.944	0.432	Yes	0.5	3.788
5137	6	390	0.013	0.487	0.012	0.195	3.835	1	1.183	0.5	0.405	0.956	0.411	No	0.5	3.835
8911	6	166.4	0.013	0.417	0.011	0.186	3.287	1	1	0.5	0.407	0.819	0.417	Yes	0.5	3.287
10000	8	92.39	0	11.563	0.318	6.321	51.253	1	466.947	0.667	0.088	11.062	0.025	Yes	0.667	51.253
10063	8	24.7	-0.023	0.206	0.001	0.078	0.913	1		0.667	0	0.197		No	0.667	0.913
10069	8	316.846	0	0.182	0.001	0.068	0.809	1	7.368	0.667	0.088	0.175	0.025	No	0.667	0.809
10287	8	60.891	-0.004	0.048	0.001	0.016	0.215	1		0.667	0	0.046		No	0.667	0.215
10364	8	80.5	0	0.064	0.001	0.021	0.284	1	2.591	0.667	0.088	0.061	0.025	No	0.667	0.284
10377	8	78.4	-0.118	0.035	0.001	0.011	0.155	1		0.667	0	0.034		No	0.667	0.155
10641	8	55.4	-0.005	0.004	0	0.001	0.017	1		0.667	0	0.004		No	0.667	0.017
1101	8	358.226	0.014	0.913	0.016	0.393	4.048	1	1.002	0.667	0.558	0.874	0.911	No	0.667	4.048
111	8	89.195	0.012	1.437	0.061	0.629	6.371	1	1.645	0.667	0.548	1.375	0.874	No	0.667	6.371
1958	8	47.997	0	10.065	0.284	5.423	44.613	1	406.459	0.667	0.088	9.629	0.025	Yes	0.667	44.613
1959	8	16.566	0.362	10.065	0.284	5.423	44.613	1	2.136	0.667	0.666	9.629	4.713	Yes	0.667	44.613
2196	8	14.19	0.001	0.3	0.006	0.115	1.332	1	1.445	0.667	0.263	0.287	0.208	No	0.667	1.332
2390	8	263	0.004	0.509	0.01	0.206	2.258	1	1.03	0.667	0.414	0.487	0.495	No	0.667	2.258
2401	8	17.708	-0.06	0.066	0.001	0.022	0.291	1		0.667	0	0.063		No	0.667	0.291
3303	8	266.907	0.004	0.504	0.01	0.204	2.234	1	1.016	0.667	0.414	0.482	0.496	Yes	0.667	2.234
3304	8	262.513	0.004	0.505	0.01	0.204	2.239	1	1.02	0.667	0.414	0.483	0.495	Yes	0.667	2.239
3305	8	262.8	0.004	0.509	0.01	0.206	2.256	1	1.028	0.667	0.414	0.487	0.495	Yes	0.667	2.256
43	8	353.965	0.004	0.517	0.011	0.21	2.292	1	1.057	0.667	0.411	0.495	0.489	No	0.667	2.292
6086	8	7.878	-0.762	10.065	0.284	5.423	44.613	1		0.667	0	9.629		Yes	0.667	44.613
6087	8	34.254	-0.073	10.065	0.284	5.423	44.613	1		0.667	0	9.629		Yes	0.667	44.613
6088	8	10.262	0.43	10.064	0.284	5.423	44.609	1	1.96	0.667	0.666	9.628	5.134	Yes	0.667	44.609
6447	8	12.801	0.625	11.563	0.318	6.321	51.253	1	1.868	0.667	0.667	11.062	6.19	Yes	0.667	51.253
6467	8	15.134	-0.437	11.563	0.318	6.321	51.253	1		0.667	0	11.062		Yes	0.667	51.253
804	8	4.942	-0.047	0.164	0.003	0.059	0.726	1		0.667	0	0.157		No	0.667	0.726
932	8	21.002	-0.082	0.008	0	0.002	0.037	1		0.667	0	0.008		No	0.667	0.037
9539	8	70.536	-0.01	0.059	0.001	0.019	0.26	1		0.667	0	0.056		No	0.667	0.26
10311	10	28.8	-0.257	0.529	0.014	0.213	1.501	1		0.833	0	0.29		No	0.833	1.501
11125	10	362	0.001	0.441	0.01	0.187	1.252	1	1	0.833	0.364	0.242	0.441	No	0.833	1.252
3314	10	156	0.003	0.961	0.016	0.415	2.725	1	1.15	0.833	0.508	0.526	0.835	No	0.833	2.725
5208	10	29.483	0.002	0.832	0.02	0.352	2.359	1	1.422	0.833	0.421	0.455	0.585	No	0.833	2.359
5560	10	115.3	0	0.611	0.013	0.252	1.734	1	3.268	0.833	0.233	0.335	0.187	No	0.833	1.734
11015	12	29	0	1.21	0.017	0.538	2.385	1	16.579	1	0.137	0.42	0.073	No	1	2.385
1178	12	331.994	0.002	1.288	0.021	0.574	2.538	1	1.347	1	0.516	0.447	0.957	Yes	1	2.538
3028	12	289.115	0.003	1.784	0.035	0.818	3.514	1	1.469	1	0.584	0.619	1.214	No	1	3.514
3029	12	334.1	0.002	1.262	0.021	0.561	2.486	1	1.169	1	0.549	0.438	1.079	Yes	1	2.486
3030	12	333.002	0.002	1.263	0.021	0.562	2.489	1	1.169	1	0.55	0.439	1.081	Yes	1	2.489
3611	12	333	0.002	1.279	0.021	0.569	2.52	1	1.183	1	0.55	0.444	1.081	Yes	1	2.52
5306	12	324.1	0.002	1.078	0.018	0.472	2.124	1	1.027	1	0.541	0.374	1.05	No	1	2.124
5902	12	288.21	0.001	1.311	0.027	0.583	2.583	1	1.679	1	0.464	0.455	0.781	Yes	1	2.583
5903	12	235.5	0.003	1.311	0.027	0.583	2.583	1	1.027	1	0.6	0.455	1.277	Yes	1	2.583
7878	12	81.675	-0.015	0.024	0.008	0.005	0.047	1		1	0	0.008		No	1	0.047
8996	12	330.9	0.002	1.311	0.027	0.583	2.583	1	1.141	1	0.568	0.455	1.149	Yes	1	2.583
9514	12	8.338	0	1.402	0.029	0.627	2.762	1	19.206	1	0.137	0.487	0.073	Yes	1	2.762
9565	12	26.5	0	1.209	0.017	0.537	2.383	1	2.697	1	0.347	0.42	0.449	Yes	1	2.383
9828	12	474.676	0	0.079	0.006	0.025	0.155	1	1.075	1	0.137	0.027	0.073	No	1	0.155
1219	15	39.975	0	0.163	0.002	0.059	0.205	1	1.23	1.25	0.175	0.032	0.132	No	1.25	0.205
205	15	399.994	0.012	15.299	0.577	8.499	19.289	1	3.354	1.25	1.064	3.04	4.562	Yes	1.25	19.289
206	15	500.003	0.009	15.299	0.577	8.499	19.289	1	3.905	1.25	0.995	3.04	3.918	Yes	1.25	19.289
5482	15	362.794	0.018	15.299	0.577	8.499	19.289	1	2.724	1.25	1.144	3.04	5.616	Yes	1.25	19.289
5483	15	400.003	0.017	15.299	0.577	8.499	19.289	1	2.787	1.25	1.137	3.04	5.49	Yes	1.25	19.289
5484	15	400.002	0.01	15.299	0.577	8.499	19.289	1	3.655	1.25	1.025	3.04	4.186	Yes	1.25	19.289
5931	15	87.595	-0.182	3.42	0.086	1.662	4.312	1		1.25	0	0.68		Yes	1.25	4.312
5933	15	101.87	0	3.42	0.086	1.662	4.312	1	25.835	1.25	0.175	0.68	0.132	Yes	1.25	4.312
6808	15	38.962	0.056	15.299	0.577	8.499	19.289	1	1.545	1.25	1.237	3.04	9.902	Yes	1.25	19.289
2221	18	392.445	0.002	3.727	0.074	1.838	3.263	1	1.143	1.5	0.864	0.47	3.26	Yes	1.5	3.263
2222	18	329.568	0.002	4.014	0.08	1.993	3.514	1	1.499	1.5	0.78	0.506	2.678	No	1.5	3.514
4062	18	147.532	-0.002	1.951	0.042	0.901	1.708	1		1.5	0	0.246		Yes	1.5	1.708
5640	18	53.573	-0.153	1.173	0.04	0.508	1.027	1		1.5	0	0.148		No	1.5	1.027
5641	18	63.253	0	1.173	0.04	0.508	1.027	1	5.451	1.5	0.213	0.148	0.215	Yes	1.5	1.027
2785	21	28.3	-0.013	2.216	0.075	1.021	1.425	1		1.75	0	0.19		No	1.75	1.425
3863	21	263.995	0.001	4.065	0.082	2.02	2.615	1	1.03	1.75	0.911	0.348	3.947	No	1.75	2.615

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
9089	21	13	0	4.145	0.085	2.063	2.666	1	12.764	1.75	0.252	0.355	0.325	Yes	1.75	2.666
9119	21	356.4	0.001	6.902	0.15	3.609	4.44	1	2.209	1.75	0.806	0.591	3.125	Yes	1.75	4.44
9120	21	11.8	0.001	6.902	0.15	3.609	4.44	1	2.309	1.75	0.788	0.591	2.989	No	1.75	4.44
5883	24	329.654	0.004	10.235	0.373	5.472	5.04	1	1.105	2	1.364	0.628	9.263	Yes	2	5.04
3679	33	299.617	0.001	18.004	0.674	10.167	4.69	1	1.856	2.75	1.268	0.498	9.7	Yes	2.75	4.69
3680	33	406.369	0.001	18.004	0.674	10.167	4.69	1	1.765	2.75	1.302	0.498	10.201	Yes	2.75	4.69
3681	33	497.796	0.001	18.004	0.674	10.167	4.69	1	1.747	2.75	1.309	0.498	10.305	No	2.75	4.69
4904	36	97.481	-0.017	10.059	0.284	5.42	2.202	1		3	0	0.224		No	3	2.202
3687	39	213.733	0	5.955	0.203	3.026	1.111	1	3.519	3.25	0.492	0.109	1.692	Yes	3.25	1.111
3691	39	18.001	-0.333	5.955	0.203	3.026	1.111	1		3.25	0	0.109		Yes	3.25	1.111
6468	39	46.27	0	5.954	0.203	3.026	1.11	1	3.519	3.25	0.492	0.109	1.692	Yes	3.25	1.11
Existing Wet Weather Scenario - Hydraulic Deficient Lines																
6371	12	330	0.002	1.066	0.022	0.464	2.405	0.815	0.995	0.815	0.546	0.451	1.071	Yes	1	2.1
6372	12	330	0.002	1.043	0.022	0.453	2.436	0.786	0.961	0.786	0.539	0.478	1.086	Yes	1	2.055
891	8	321	0.002	0.296	0.006	0.113	1.56	0.784	0.958	0.523	0.316	0.376	0.309	No	0.523	1.56
6373	12	330	0.002	1.04	0.022	0.451	2.436	0.784	0.958	0.784	0.539	0.479	1.086	Yes	1	2.049
5209	10	233.276	0.003	0.787	0.017	0.332	2.683	0.775	0.946	0.646	0.492	0.586	0.831	Yes	0.833	2.232
9513	12	193.1	0.004	1.332	0.027	0.592	3.179	0.769	0.938	0.769	0.613	0.639	1.42	Yes	1	2.623
8392	10	311.4	0.004	0.832	0.02	0.352	2.865	0.767	0.936	0.639	0.507	0.632	0.889	Yes	0.652	2.81
10066	8	66.168	0	0.023	0	0.007	0.125	0.762	0.929	0.508	0.085	0.031	0.025	No	0.508	0.125
3551	10	331.401	0.004	0.782	0.019	0.329	2.717	0.76	0.926	0.634	0.491	0.605	0.844	No	0.634	2.717
4295	8	371.001	0.017	0.936	0.016	0.404	5.149	0.751	0.914	0.501	0.565	1.298	1.024	No	0.501	5.149
4293	8	364.998	0.017	0.927	0.016	0.399	5.111	0.75	0.911	0.5	0.562	1.292	1.017	No	0.5	5.111
1102	8	365.001	0.017	0.924	0.016	0.398	5.108	0.747	0.908	0.498	0.561	1.296	1.017	Yes	0.499	5.1
1918	8	404	0.015	0.881	0.015	0.377	4.878	0.746	0.906	0.497	0.55	1.239	0.972	Yes	0.602	4.106
7995	8	368.6	0.008	0.633	0.009	0.264	3.511	0.746	0.906	0.497	0.47	0.892	0.699	No	0.497	3.511
898	8	339.005	0.004	0.44	0.005	0.177	2.475	0.735	0.891	0.49	0.389	0.638	0.494	No	0.49	2.475
5305	12	342	0.003	1.081	0.018	0.474	2.709	0.734	0.889	0.734	0.55	0.571	1.217	No	0.734	2.709
5284	12	386	0.008	1.866	0.036	0.86	4.679	0.733	0.888	0.733	0.729	0.987	2.102	No	0.733	4.679
5285	12	390.485	0.008	1.855	0.036	0.854	4.651	0.733	0.888	0.733	0.726	0.981	2.09	No	0.733	4.651
1917	8	395.658	0.016	0.873	0.015	0.374	4.934	0.732	0.885	0.488	0.548	1.278	0.986	Yes	0.493	4.884
8391	10	302.5	0.004	0.793	0.019	0.334	2.886	0.728	0.88	0.606	0.494	0.672	0.902	Yes	0.623	2.806
5205	10	362	0.002	0.565	0.012	0.231	2.078	0.72	0.868	0.6	0.414	0.489	0.651	Yes	0.684	1.824
897	8	322	0.004	0.429	0.005	0.172	2.473	0.718	0.865	0.479	0.384	0.652	0.496	Yes	0.484	2.441
5511	8	105	0.002	0.295	0.006	0.113	1.704	0.717	0.863	0.478	0.316	0.45	0.342	No	0.478	1.704
4224	8	329.897	0.006	0.522	0.011	0.212	3.024	0.715	0.861	0.477	0.425	0.8	0.607	Yes	0.492	2.928
4120	8	357.577	0.004	0.418	0.005	0.168	2.432	0.713	0.857	0.475	0.379	0.645	0.488	Yes	0.477	2.423
4526	8	254.279	0	0.139	0.002	0.05	0.811	0.711	0.854	0.474	0.213	0.216	0.163	No	0.474	0.811
2493	8	329.997	0.01	0.675	0.016	0.28	3.954	0.708	0.849	0.472	0.485	1.056	0.795	No	0.472	3.954
6370	12	296.09	0.003	0.996	0.021	0.43	2.643	0.695	0.83	0.695	0.527	0.585	1.2	Yes	1	1.962
7392	8	303.81	0	0.02	0	0.006	0.122	0.689	0.819	0.459	0.08	0.033	0.025	No	0.459	0.122
1171	8	297.4	0.014	0.747	0.012	0.315	4.558	0.682	0.808	0.455	0.51	1.257	0.924	No	0.455	4.558
10017	8	33	0.007	0.515	0.007	0.21	3.152	0.68	0.805	0.453	0.422	0.872	0.639	No	0.453	3.152
2766	8	300.004	0.014	0.744	0.012	0.314	4.583	0.676	0.799	0.451	0.509	1.274	0.931	Yes	0.453	4.56
3247	12	194.895	0.003	1.049	0.015	0.459	2.873	0.676	0.799	0.676	0.541	0.651	1.313	No	0.676	2.873
4294	8	364.993	0.022	0.933	0.016	0.402	5.757	0.675	0.798	0.45	0.564	1.6	1.169	Yes	0.476	5.42
281	8	331.97	0.013	0.72	0.01	0.304	4.463	0.673	0.793	0.448	0.501	1.245	0.908	No	0.448	4.463
2526	8	371.831	0.018	0.83	0.014	0.354	5.152	0.672	0.792	0.448	0.536	1.439	1.048	Yes	0.468	4.909
2661	8	392.573	0.014	0.744	0.011	0.315	4.621	0.672	0.792	0.448	0.509	1.291	0.94	No	0.448	4.621
5904	12	137	0.005	1.332	0.027	0.592	3.68	0.671	0.79	0.671	0.613	0.84	1.685	No	0.671	3.68
2006	12	59.944	0.006	1.429	0.038	0.636	4.002	0.663	0.778	0.663	0.636	0.922	1.838	No	0.663	4.002
1759	8	266.018	0.007	0.513	0.01	0.208	3.233	0.663	0.777	0.442	0.422	0.913	0.66	Yes	0.639	2.308
5886	8	346	0.005	0.429	0.006	0.172	2.711	0.661	0.775	0.441	0.384	0.767	0.554	No	0.441	2.711
3512	10	351	0.01	1.095	0.019	0.48	4.445	0.659	0.771	0.549	0.584	1.128	1.42	No	0.549	4.445
8533	8	340.1	0.004	0.396	0.005	0.157	2.517	0.658	0.769	0.438	0.368	0.715	0.515	No	0.438	2.517
899	8	319	0.006	0.447	0.005	0.18	2.844	0.658	0.769	0.438	0.393	0.808	0.582	No	0.438	2.844
3380	12	325	0.003	0.939	0.014	0.406	2.654	0.658	0.769	0.658	0.511	0.616	1.222	No	0.658	2.654
5211	10	357.73	0.003	0.576	0.012	0.236	2.357	0.654	0.763	0.545	0.418	0.601	0.754	No	0.545	2.357
1534	8	260.586	0.018	0.804	0.013	0.342	5.153	0.653	0.761	0.435	0.528	1.472	1.056	No	0.435	5.153
3161	8	362	0.018	0.805	0.013	0.342	5.178	0.651	0.758	0.434	0.528	1.483	1.062	Yes	0.441	5.084
8814	10	307.9	0.003	0.571	0.011	0.234	2.354	0.65	0.756	0.541	0.416	0.604	0.755	No	0.541	2.354
4132	8	239	0.018	0.79	0.013	0.335	5.122	0.646	0.751	0.431	0.524	1.475	1.053	No	0.431	5.122
4142	8	287.742	0.005	0.425	0.006	0.17	2.767	0.645	0.748	0.43	0.382	0.798	0.569	Yes	0.435	2.726
2491	8	288.861	0.012	0.641	0.015	0.264	4.172	0.644	0.747	0.43	0.473	1.205	0.858	No	0.43	4.172
351	10	246.999	0.003	0.565	0.012	0.231	2.365	0.642	0.743	0.535	0.414	0.613	0.761	No	0.535	2.365
8532	8	360.9	0.004	0.378	0.005	0.15	2.475	0.641	0.741	0.427	0.359	0.717	0.51	No	0.427	2.475
4952	12	275	0.007	1.416	0.037	0.63	4.161	0.635	0.732	0.635	0.633	0.992	1.934	No	0.635	4.161

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
2343	8	384.141	0.017	0.75	0.011	0.317	4.97	0.634	0.73	0.423	0.511	1.453	1.027	No	0.423	4.97
350	10	255.999	0.003	0.558	0.012	0.227	2.377	0.632	0.726	0.526	0.411	0.623	0.769	Yes	0.531	2.355
225	10	451.255	0.003	0.571	0.013	0.233	2.436	0.631	0.725	0.526	0.416	0.639	0.788	No	0.526	2.436
29	8	332.3	0.008	0.508	0.013	0.204	3.39	0.63	0.724	0.42	0.419	0.995	0.702	No	0.42	3.39
348	10	262.526	0.003	0.552	0.012	0.225	2.361	0.63	0.723	0.525	0.409	0.62	0.764	Yes	0.526	2.357
2866	12	215.059	0.007	1.417	0.037	0.63	4.206	0.63	0.723	0.63	0.633	1.009	1.96	Yes	0.646	4.082
3163	8	128.8	0.018	0.767	0.013	0.325	5.128	0.63	0.722	0.42	0.516	1.507	1.062	Yes	0.425	5.049
902	8	240.21	0.017	0.736	0.012	0.31	4.92	0.629	0.722	0.42	0.506	1.446	1.019	Yes	0.435	4.718
3164	8	350.003	0.018	0.762	0.013	0.322	5.108	0.628	0.72	0.419	0.515	1.504	1.059	Yes	0.419	5.101
7563	8	40	0.005	0.378	0.005	0.15	2.534	0.628	0.719	0.419	0.359	0.746	0.525	No	0.419	2.534
2637	12	386	0.013	1.851	0.036	0.852	5.546	0.625	0.715	0.625	0.726	1.338	2.591	Yes	0.679	5.044
3315	10	168	0.009	0.962	0.016	0.416	4.182	0.621	0.707	0.517	0.546	1.111	1.359	No	0.517	4.182
3517	10	263.012	0.003	0.537	0.011	0.218	2.345	0.619	0.704	0.515	0.403	0.625	0.763	Yes	0.52	2.32
3162	8	101.4	0.021	0.792	0.013	0.336	5.44	0.615	0.698	0.41	0.524	1.626	1.135	Yes	0.528	4.137
6168	12	461.3	0.005	1.092	0.018	0.478	3.334	0.615	0.697	0.615	0.552	0.814	1.565	No	0.615	3.334
3049	10	302.999	0.015	1.223	0.02	0.542	5.386	0.614	0.696	0.512	0.617	1.443	1.757	Yes	0.833	3.469
1172	8	250	0.012	0.596	0.014	0.244	4.107	0.614	0.695	0.409	0.455	1.231	0.858	Yes	0.5	3.282
1357	10	425.667	0.012	1.09	0.019	0.477	4.838	0.61	0.689	0.509	0.583	1.302	1.581	No	0.509	4.838
2291	10	101.5	0	0.137	0.005	0.048	0.609	0.609	0.686	0.507	0.199	0.164	0.199	No	0.507	0.609
3516	10	264.495	0.003	0.525	0.011	0.213	2.341	0.608	0.685	0.506	0.398	0.632	0.766	Yes	0.511	2.316
5207	10	362	0.003	0.489	0.011	0.197	2.185	0.607	0.683	0.505	0.384	0.591	0.716	No	0.505	2.185
3513	10	352	0.013	1.097	0.019	0.481	4.906	0.606	0.683	0.505	0.584	1.327	1.607	Yes	0.833	3.112
3048	10	309.281	0.016	1.218	0.02	0.54	5.45	0.606	0.682	0.505	0.616	1.474	1.785	Yes	0.508	5.407
4761	8	338.63	0.004	0.348	0.006	0.136	2.467	0.599	0.67	0.399	0.344	0.753	0.519	No	0.399	2.467
335	8	237.074	0	0.017	0	0.005	0.118	0.599	0.669	0.399	0.072	0.036	0.025	No	0.399	0.118
9146	10	270.1	0.003	0.52	0.012	0.21	2.366	0.597	0.667	0.498	0.396	0.647	0.779	No	0.498	2.366
5206	10	362.006	0.003	0.489	0.011	0.197	2.231	0.596	0.665	0.497	0.384	0.611	0.735	Yes	0.548	1.987
5171	10	120.5	0.005	0.665	0.01	0.278	3.04	0.595	0.664	0.496	0.451	0.833	1.002	No	0.496	3.04
4757	8	350	0.004	0.344	0.006	0.134	2.461	0.594	0.662	0.396	0.342	0.755	0.519	No	0.396	2.461
4758	8	275	0.004	0.344	0.006	0.134	2.461	0.594	0.662	0.396	0.342	0.755	0.519	No	0.396	2.461
1173	8	316.8	0.013	0.591	0.014	0.242	4.235	0.594	0.661	0.396	0.453	1.3	0.894	Yes	0.402	4.152
4759	8	351.4	0.004	0.344	0.006	0.134	2.463	0.594	0.661	0.396	0.342	0.756	0.52	No	0.396	2.463
4780	8	340	0.016	0.658	0.009	0.275	4.721	0.593	0.661	0.396	0.479	1.449	0.997	Yes	0.408	4.556
3743	10	325.976	0.006	0.722	0.018	0.301	3.312	0.594	0.661	0.495	0.471	0.909	1.092	Yes	0.564	2.843
5172	10	156	0.005	0.663	0.01	0.277	3.043	0.594	0.661	0.495	0.45	0.835	1.004	No	0.495	3.043
333	10	355	0.014	1.09	0.019	0.477	5.011	0.592	0.659	0.494	0.583	1.378	1.654	No	0.494	5.011
708	10	91.867	0.011	0.971	0.017	0.42	4.464	0.592	0.659	0.494	0.549	1.227	1.474	No	0.494	4.464
9134	8	336.01	0.016	0.657	0.009	0.274	4.73	0.591	0.657	0.394	0.478	1.456	1	No	0.394	4.73
7565	8	259.8	0.005	0.36	0.005	0.142	2.597	0.59	0.654	0.393	0.35	0.801	0.55	Yes	0.396	2.576
4762	8	302.06	0.005	0.357	0.006	0.14	2.588	0.588	0.652	0.392	0.349	0.799	0.548	No	0.392	2.588
2882	10	351.002	0.014	1.095	0.019	0.48	5.075	0.588	0.652	0.49	0.584	1.402	1.679	Yes	0.52	4.735
3609	10	338	0.016	1.159	0.02	0.511	5.373	0.588	0.652	0.49	0.601	1.484	1.778	No	0.49	5.373
9512	12	94.5	0.008	1.311	0.027	0.583	4.227	0.588	0.651	0.588	0.608	1.067	2.015	Yes	0.678	3.577
1829	8	341.485	0.004	0.338	0.006	0.131	2.449	0.587	0.65	0.392	0.339	0.757	0.519	Yes	0.394	2.433
3610	10	333	0.016	1.163	0.02	0.513	5.478	0.581	0.638	0.484	0.602	1.528	1.821	Yes	0.524	4.976
3835	10	321.984	0.013	1.043	0.018	0.455	4.912	0.581	0.638	0.484	0.57	1.37	1.633	No	0.484	4.912
7343	10	221.9	0.005	0.602	0.01	0.248	2.859	0.576	0.631	0.48	0.428	0.801	0.953	No	0.48	2.859
9460	8	54.3	0	0.015	0	0.005	0.116	0.573	0.625	0.382	0.07	0.036	0.025	Yes	0.667	0.069
9927	8	40.531	0	0.015	0	0.004	0.116	0.573	0.625	0.382	0.07	0.036	0.025	Yes	0.667	0.069
3284	12	386	0.017	1.849	0.036	0.851	6.161	0.572	0.623	0.572	0.725	1.585	2.966	Yes	0.598	5.832
2431	8	220.708	0.017	0.633	0.009	0.264	4.775	0.569	0.619	0.379	0.47	1.51	1.023	No	0.379	4.775
2927	12	330	0.017	1.881	0.037	0.867	6.325	0.568	0.616	0.568	0.731	1.636	3.053	No	0.568	6.325
670	12	356	0.018	1.871	0.036	0.862	6.32	0.566	0.613	0.566	0.73	1.638	3.054	No	0.566	6.32
2489	8	296.004	0.016	0.605	0.014	0.248	4.606	0.565	0.611	0.377	0.459	1.464	0.99	No	0.377	4.606
2924	12	325.2	0.018	1.876	0.037	0.865	6.357	0.564	0.61	0.564	0.73	1.651	3.075	Yes	0.566	6.333
11127	10	19.608	0.002	0.39	0.009	0.165	1.908	0.563	0.608	0.469	0.341	0.543	0.641	No	0.469	1.908
1828	8	226.726	0.004	0.303	0.006	0.117	2.328	0.561	0.605	0.374	0.32	0.743	0.502	No	0.374	2.328
3383	8	273.6	0.025	0.744	0.011	0.315	5.714	0.561	0.605	0.374	0.509	1.824	1.231	Yes	0.667	3.3
924	8	329.997	0.016	0.602	0.014	0.247	4.62	0.561	0.605	0.374	0.458	1.475	0.995	Yes	0.375	4.601
3313	10	217	0.008	0.79	0.014	0.335	3.882	0.561	0.604	0.467	0.493	1.109	1.307	Yes	0.739	2.389
9492	12	46.3	0.009	1.311	0.027	0.583	4.522	0.556	0.596	0.556	0.608	1.186	2.199	Yes	1	2.583
1272	8	330	0.003	0.27	0.006	0.102	2.099	0.555	0.594	0.37	0.301	0.675	0.454	No	0.37	2.099
3153	12	330.085	0.008	1.236	0.017	0.55	4.28	0.554	0.593	0.554	0.59	1.125	2.084	Yes	0.646	3.565
3300	12	133.004	0.018	1.806	0.035	0.829	6.291	0.552	0.588	0.552	0.717	1.659	3.069	No	0.552	6.291
2919	10	145.793	0.009	0.799	0.011	0.341	4.015	0.551	0.587	0.459	0.496	1.161	1.361	No	0.459	4.015
5509	8	324.6	0.003	0.267	0.006	0.101	2.1	0.55	0.586	0.367	0.3	0.679	0.456	No	0.367	2.1
2868	12	224.925	0.012	1.466	0.039	0.654	5.13	0.55	0.585	0.55	0.644	1.356	2.506	Yes	1	2.888

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
9125	8	349.7	0.013	0.517	0.011	0.21	4.079	0.549	0.583	0.366	0.423	1.322	0.886	Yes	0.421	3.441
6167	12	302	0.007	1.092	0.018	0.479	3.833	0.548	0.583	0.548	0.553	1.015	1.874	No	0.548	3.833
8426	8	320.3	0.02	0.645	0.009	0.269	5.095	0.548	0.582	0.365	0.474	1.653	1.108	No	0.365	5.095
2492	8	250.002	0.02	0.643	0.015	0.265	5.091	0.547	0.58	0.365	0.473	1.654	1.107	Yes	0.418	4.314
8335	10	350.8	0.004	0.518	0.01	0.21	2.629	0.547	0.58	0.455	0.396	0.764	0.894	No	0.455	2.629
6169	12	421.5	0.007	1.092	0.018	0.478	3.849	0.546	0.579	0.546	0.552	1.022	1.885	Yes	0.581	3.572
4118	8	206	0.015	0.55	0.013	0.223	4.379	0.544	0.576	0.363	0.437	1.427	0.954	No	0.363	4.379
6170	12	148	0.007	1.092	0.018	0.478	3.869	0.544	0.575	0.544	0.552	1.03	1.898	Yes	0.545	3.859
1830	8	217.977	0.005	0.313	0.006	0.121	2.503	0.543	0.574	0.362	0.326	0.817	0.546	Yes	0.377	2.382
4946	8	299.868	0.011	0.47	0.009	0.189	3.759	0.543	0.573	0.362	0.403	1.227	0.82	No	0.362	3.759
943	8	286.078	0.018	0.6	0.014	0.246	4.8	0.542	0.573	0.362	0.457	1.568	1.048	Yes	0.368	4.7
4174	8	283.06	0.005	0.316	0.007	0.122	2.532	0.542	0.572	0.361	0.327	0.827	0.553	No	0.361	2.532
2601	12	366.7	0.007	1.095	0.018	0.48	3.897	0.542	0.572	0.542	0.553	1.04	1.914	No	0.542	3.897
4945	8	305.107	0.011	0.46	0.009	0.184	3.724	0.537	0.564	0.358	0.398	1.224	0.816	Yes	0.36	3.701
1827	8	394.093	0.005	0.303	0.006	0.117	2.466	0.536	0.561	0.357	0.32	0.812	0.541	No	0.357	2.466
9591	8	350	0	0.014	0	0.004	0.113	0.536	0.561	0.357	0.066	0.037	0.025	No	0.357	0.113
2928	12	330.01	0.021	1.89	0.037	0.871	6.824	0.536	0.561	0.536	0.733	1.835	3.367	Yes	0.671	5.216
5881	8	303.17	0.002	0.178	0.001	0.066	1.449	0.535	0.56	0.357	0.243	0.478	0.318	No	0.357	1.449
617	12	332.92	0.01	1.285	0.018	0.574	4.648	0.535	0.56	0.535	0.602	1.251	2.295	No	0.535	4.648
3078	12	330	0.012	1.388	0.02	0.624	5.034	0.534	0.558	0.534	0.626	1.357	2.487	No	0.534	5.034
3506	8	333.2	0.013	0.493	0.006	0.2	4.026	0.533	0.557	0.356	0.413	1.33	0.884	No	0.356	4.026
9516	8	401.4	0.002	0.195	0.002	0.072	1.591	0.533	0.557	0.356	0.254	0.526	0.35	No	0.356	1.591
4175	8	351.305	0.006	0.322	0.007	0.125	2.645	0.532	0.554	0.354	0.331	0.876	0.582	No	0.354	2.645
9135	8	313	0.023	0.653	0.009	0.273	5.358	0.532	0.554	0.354	0.477	1.773	1.179	No	0.354	5.358
3301	12	305.019	0.02	1.806	0.035	0.829	6.585	0.532	0.554	0.532	0.717	1.78	3.26	Yes	0.552	6.288
3614	8	300	0.017	0.56	0.013	0.228	4.594	0.531	0.553	0.354	0.441	1.521	1.011	Yes	0.375	4.281
9542	8	283.3	0.01	0.422	0.011	0.166	3.481	0.529	0.55	0.353	0.381	1.156	0.767	No	0.353	3.481
4117	8	164.8	0.015	0.518	0.012	0.209	4.285	0.528	0.548	0.352	0.424	1.424	0.945	Yes	0.358	4.205
7955	8	48	0.004	0.268	0	0.104	2.229	0.526	0.544	0.35	0.3	0.744	0.493	No	0.35	2.229
9161	8	242.6	0.01	0.424	0.011	0.167	3.542	0.524	0.541	0.349	0.382	1.184	0.784	No	0.349	3.542
9162	8	329.7	0.012	0.461	0.012	0.184	3.854	0.524	0.541	0.349	0.399	1.288	0.853	No	0.349	3.854
5731	10	339.5	0.009	0.737	0.018	0.308	3.952	0.523	0.539	0.436	0.476	1.183	1.368	No	0.436	3.952
4589	12	218.651	0.008	1.092	0.018	0.478	4.063	0.523	0.539	0.523	0.552	1.11	2.024	No	0.523	4.063
9759	8	379.5	0.011	0.436	0.005	0.175	3.656	0.522	0.538	0.348	0.387	1.224	0.81	No	0.348	3.656
1985	10	338	0.01	0.771	0.019	0.324	4.17	0.519	0.533	0.433	0.487	1.254	1.447	No	0.433	4.17
4296	10	413	0.021	1.088	0.019	0.476	5.886	0.519	0.532	0.433	0.582	1.77	2.043	Yes	0.471	5.301
1682	10	330.279	0.013	0.862	0.012	0.37	4.675	0.518	0.531	0.432	0.516	1.408	1.624	No	0.432	4.675
2214	8	196	0.01	0.408	0.004	0.163	3.479	0.515	0.526	0.344	0.374	1.175	0.775	No	0.344	3.479
4173	8	303.661	0.006	0.307	0.007	0.118	2.628	0.514	0.524	0.343	0.322	0.889	0.586	Yes	0.352	2.542
2490	8	298.121	0.022	0.605	0.014	0.248	5.205	0.512	0.521	0.341	0.459	1.765	1.162	Yes	0.385	4.478
8909	12	250	0.015	1.469	0.039	0.656	5.663	0.509	0.515	0.509	0.645	1.575	2.854	Yes	1	2.894
1681	10	327.662	0.014	0.867	0.012	0.372	4.824	0.508	0.513	0.423	0.518	1.472	1.69	No	0.423	4.824
3081	12	331	0.015	1.453	0.022	0.656	5.623	0.507	0.512	0.507	0.641	1.567	2.838	No	0.507	5.623
4951	12	355.046	0.014	1.403	0.037	0.624	5.433	0.507	0.512	0.507	0.63	1.515	2.743	No	0.507	5.433
2958	8	409.563	0.014	0.473	0.006	0.192	4.145	0.504	0.507	0.336	0.404	1.42	0.932	No	0.336	4.145
9462	10	143	0.006	0.576	0.012	0.236	3.24	0.503	0.506	0.419	0.418	0.994	1.139	Yes	0.482	2.723
2368	8	183.985	0.01	0.395	0.004	0.158	3.479	0.503	0.504	0.335	0.368	1.194	0.783	Yes	0.339	3.424
279	8	199.292	0.015	0.484	0.011	0.194	4.26	0.502	0.504	0.335	0.409	1.463	0.959	No	0.335	4.26
3080	12	331	0.015	1.424	0.021	0.642	5.595	0.501	0.502	0.501	0.635	1.572	2.838	Yes	0.504	5.552
3613	8	300	0.02	0.555	0.013	0.226	4.913	0.501	0.501	0.334	0.439	1.69	1.107	Yes	0.344	4.73
4818	8	247.212	0.01	0.395	0.01	0.155	3.5	0.501	0.501	0.334	0.368	1.204	0.789	No	0.334	3.5
168	12	185.223	0.005	0.847	0.022	0.358	3.341	0.5	0.499	0.5	0.484	0.94	1.696	No	0.5	3.341
4067	15	361	0.002	1.825	0.039	0.837	2.686	0.799	0.976	0.999	0.675	0.462	1.87	No	0.999	2.686
9651	21	8.836	0.002	4.602	0.106	2.309	3.573	0.772	0.942	1.351	0.987	0.541	4.885	No	1.351	3.573
3071	18	338.993	0.003	3.68	0.073	1.812	3.927	0.765	0.932	1.147	0.921	0.648	3.948	No	1.147	3.927
3068	18	275.005	0.003	3.697	0.073	1.821	3.976	0.759	0.924	1.138	0.923	0.662	4.001	No	1.138	3.976
3070	18	326.988	0.003	3.687	0.073	1.816	3.992	0.754	0.917	1.131	0.922	0.669	4.019	No	1.131	3.992
5149	21	463.7	0.006	7.105	0.159	3.724	5.653	0.754	0.917	1.319	1.236	0.877	7.748	No	1.319	5.653
2220	18	402.597	0.004	3.725	0.074	1.836	4.054	0.75	0.912	1.125	0.926	0.683	4.085	Yes	1.5	3.261
Ultimate Wet Weather Scenario - Potential Surcharge																
5135	6	390	0.014	1.516	0.047	0.676	11.947	1	3.511	0.5	0.414	2.978	0.432	Yes	0.5	11.947
5136	6	390	0.014	1.527	0.047	0.681	12.03	1	3.536	0.5	0.414	2.998	0.432	Yes	0.5	12.03
5137	6	390	0.013	1.537	0.048	0.686	12.111	1	3.737	0.5	0.405	3.018	0.411	No	0.5	12.111
8911	6	166.4	0.013	1.41	0.046	0.667	11.111	1	3.38	0.5	0.407	2.769	0.417	Yes	0.5	11.111
9791	6	5.42	0	0.032	0.003	0.009	0.252	1	2.781	0.5	0.065	0.063	0.011	Yes	0.5	0.252
10000	8	92.39	0	8.709	0.381	4.544	38.602	1	351.689	0.667	0.088	8.332	0.025	Yes	0.667	38.602
10017	8	33	0.007	0.666	0.011	0.278	2.954	1	1.042	0.667	0.472	0.638	0.639	No	0.667	2.954

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
10063	8	24.7	-0.023	0.228	0.001	0.087	1.012	1		0.667	0	0.219		No	0.667	1.012
10069	8	316.846	0	0.202	0.001	0.076	0.896	1	8.16	0.667	0.088	0.193	0.025	No	0.667	0.896
10118	8	112	0.004	0.537	0.016	0.216	2.38	1	1.07	0.667	0.417	0.514	0.502	No	0.667	2.38
10287	8	60.891	-0.004	0.054	0	0.018	0.241	1		0.667	0	0.052		No	0.667	0.241
1033	8	154.152	0.002	0.394	0.018	0.151	1.745	1	1.224	0.667	0.33	0.377	0.322	No	0.667	1.745
10364	8	80.5	0	0.443	0.011	0.176	1.966	1	17.908	0.667	0.088	0.424	0.025	No	0.667	1.966
10365	8	55.7	0.002	0.443	0.011	0.176	1.966	1	1.337	0.667	0.336	0.424	0.332	Yes	0.667	1.966
10377	8	78.4	-0.118	0.418	0.01	0.165	1.852	1		0.667	0	0.4		No	0.667	1.852
10450	8	190.6	0	0.202	0.003	0.075	0.893	1	1.589	0.667	0.204	0.193	0.127	No	0.667	0.893
10499	8	69.13	0	0.354	0.01	0.137	1.568	1		0.667	0	0.338		No	0.667	1.568
10589	8	275.4	0	0.116	0.001	0.041	0.514	1	4.685	0.667	0.088	0.111	0.025	No	0.667	0.514
10641	8	55.4	-0.005	0.004	0	0.001	0.017	1		0.667	0	0.004		No	0.667	0.017
111	8	89.195	0.012	2.343	0.172	1.037	10.385	1	2.682	0.667	0.548	2.241	0.874	No	0.667	10.385
1172	8	250	0.012	0.92	0.022	0.393	4.076	1	1.072	0.667	0.544	0.88	0.858	Yes	0.667	4.076
1173	8	316.8	0.013	0.904	0.021	0.386	4.009	1	1.012	0.667	0.554	0.865	0.894	Yes	0.667	4.009
1759	8	266.018	0.007	1.379	0.044	0.608	6.114	1	2.09	0.667	0.48	1.32	0.66	Yes	0.667	6.114
1958	8	47.997	0	18.558	0.752	10.475	82.257	1	749.418	0.667	0.088	17.754	0.025	Yes	0.667	82.257
1959	8	16.566	0.362	18.557	0.752	10.475	82.255	1	3.938	0.667	0.666	17.753	4.713	Yes	0.667	82.255
2196	8	14.19	0.001	0.377	0.008	0.148	1.673	1	1.815	0.667	0.263	0.361	0.208	No	0.667	1.673
2390	8	263	0.004	1.373	0.044	0.605	6.086	1	2.775	0.667	0.414	1.314	0.495	Yes	0.667	6.086
2401	8	17.708	-0.06	0.072	0.001	0.024	0.317	1		0.667	0	0.068		No	0.667	0.317
2491	8	288.861	0.012	0.991	0.025	0.426	4.392	1	1.155	0.667	0.544	0.948	0.858	No	0.667	4.392
2493	8	329.997	0.01	1.025	0.026	0.442	4.542	1	1.289	0.667	0.525	0.98	0.795	No	0.667	4.542
3303	8	266.907	0.004	1.36	0.043	0.599	6.03	1	2.744	0.667	0.414	1.301	0.496	Yes	0.667	6.03
3304	8	262.513	0.004	1.365	0.043	0.601	6.048	1	2.755	0.667	0.414	1.305	0.495	Yes	0.667	6.048
3305	8	262.8	0.004	1.371	0.044	0.604	6.076	1	2.769	0.667	0.414	1.311	0.495	Yes	0.667	6.076
4029	8	346	0.016	1.038	0.019	0.452	4.603	1	1.048	0.667	0.577	0.993	0.991	No	0.667	4.603
4120	8	357.577	0.004	0.621	0.007	0.259	2.753	1	1.272	0.667	0.411	0.594	0.488	Yes	0.667	2.753
4142	8	287.742	0.005	1.022	0.019	0.444	4.529	1	1.795	0.667	0.445	0.978	0.569	Yes	0.667	4.529
4224	8	329.897	0.006	1.394	0.044	0.615	6.178	1	2.297	0.667	0.459	1.333	0.607	Yes	0.667	6.178
43	8	353.965	0.004	1.385	0.044	0.611	6.14	1	2.833	0.667	0.411	1.325	0.489	Yes	0.667	6.14
4305	8	199.8	0	0.099	0.005	0.033	0.44	1	1.791	0.667	0.133	0.095	0.055	No	0.667	0.44
4757	8	350	0.004	0.528	0.009	0.215	2.34	1	1.016	0.667	0.424	0.505	0.519	Yes	0.667	2.34
4758	8	275	0.004	0.56	0.01	0.229	2.48	1	1.077	0.667	0.424	0.535	0.519	Yes	0.667	2.48
4759	8	351.4	0.004	0.588	0.011	0.242	2.608	1	1.132	0.667	0.424	0.563	0.52	No	0.667	2.608
4761	8	338.63	0.004	0.661	0.014	0.274	2.928	1	1.272	0.667	0.424	0.632	0.519	Yes	0.667	2.928
4762	8	302.06	0.005	0.697	0.016	0.29	3.089	1	1.271	0.667	0.436	0.667	0.548	No	0.667	3.089
5511	8	105	0.002	0.368	0.008	0.144	1.632	1	1.077	0.667	0.341	0.352	0.342	Yes	0.667	1.632
5885	8	346	0.016	1.034	0.019	0.45	4.585	1	1.044	0.667	0.577	0.99	0.991	Yes	0.667	4.585
5886	8	346	0.005	1.03	0.019	0.448	4.567	1	1.861	0.667	0.438	0.986	0.554	Yes	0.667	4.567
5969	8	353.4	0.004	0.602	0.018	0.245	2.667	1	1.217	0.667	0.414	0.576	0.495	No	0.667	2.667
6086	8	7.878	-0.762	18.558	0.752	10.475	82.257	1		0.667	0	17.754		Yes	0.667	82.257
6087	8	34.254	-0.073	18.558	0.752	10.475	82.257	1		0.667	0	17.754		Yes	0.667	82.257
6088	8	10.262	0.43	18.557	0.752	10.475	82.255	1	3.615	0.667	0.666	17.753	5.134	Yes	0.667	82.255
622	8	299.999	-0.001	0.026	0	0.008	0.116	1		0.667	0	0.025		No	0.667	0.116
6447	8	12.801	0.625	8.709	0.381	4.544	38.602	1	1.407	0.667	0.667	8.332	6.19	Yes	0.667	38.602
6467	8	15.134	-0.437	8.709	0.381	4.544	38.602	1		0.667	0	8.332		Yes	0.667	38.602
804	8	4.942	-0.047	0.194	0.005	0.071	0.859	1		0.667	0	0.185		No	0.667	0.859
891	8	321	0.002	0.373	0.008	0.146	1.652	1	1.206	0.667	0.323	0.357	0.309	No	0.667	1.652
897	8	322	0.004	0.634	0.007	0.265	2.812	1	1.28	0.667	0.414	0.607	0.496	Yes	0.667	2.812
898	8	339.005	0.004	0.645	0.007	0.27	2.86	1	1.306	0.667	0.413	0.617	0.494	Yes	0.667	2.86
899	8	319	0.006	0.652	0.008	0.273	2.889	1	1.121	0.667	0.45	0.624	0.582	No	0.667	2.889
9125	8	349.7	0.013	1.387	0.044	0.612	6.15	1	1.565	0.667	0.552	1.327	0.886	Yes	0.667	6.15
932	8	21.002	-0.082	0.13	0.005	0.045	0.574	1		0.667	0	0.124		No	0.667	0.574
9451	8	351.514	0	0.027	0	0.008	0.119	1	1.083	0.667	0.088	0.026	0.025	Yes	0.667	0.119
9452	8	349.491	0	0.027	0	0.008	0.119	1	1.083	0.667	0.088	0.026	0.025	Yes	0.667	0.119
9539	8	70.536	-0.01	0.45	0.047	0.163	1.993	1		0.667	0	0.43		No	0.667	1.993
9790	8	74.186	0	0.032	0.003	0.009	0.142	1	1.291	0.667	0.088	0.031	0.025	No	0.667	0.142
10311	10	28.8	-0.257	0.582	0.016	0.237	1.652	1		0.833	0	0.319		No	0.833	1.652
11127	10	19.608	0.002	2.237	0.071	1.035	6.346	1	3.489	0.833	0.442	1.225	0.641	No	0.833	6.346
225	10	451.255	0.003	1.504	0.049	0.668	4.266	1	1.908	0.833	0.493	0.823	0.788	No	0.833	4.266
3314	10	156	0.003	1.155	0.033	0.502	3.276	1	1.382	0.833	0.508	0.632	0.835	No	0.833	3.276
3333	10	129.83	0.004	0.951	0.026	0.406	2.697	1	1.048	0.833	0.53	0.521	0.907	No	0.833	2.697
348	10	262.526	0.003	1.481	0.048	0.657	4.202	1	1.939	0.833	0.485	0.811	0.764	Yes	0.833	4.202
350	10	255.999	0.003	1.49	0.049	0.661	4.225	1	1.938	0.833	0.486	0.816	0.769	Yes	0.833	4.225
351	10	246.999	0.003	1.5	0.049	0.666	4.254	1	1.97	0.833	0.484	0.821	0.761	Yes	0.833	4.254
3516	10	264.495	0.003	1.419	0.046	0.627	4.025	1	1.852	0.833	0.486	0.777	0.766	Yes	0.833	4.025

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
3517	10	263.012	0.003	1.442	0.047	0.638	4.09	1	1.889	0.833	0.485	0.789	0.763	Yes	0.833	4.09
3551	10	331.401	0.004	2.165	0.068	0.999	6.141	1	2.566	0.833	0.511	1.185	0.844	Yes	0.833	6.141
3743	10	325.976	0.006	2.111	0.067	0.971	5.987	1	1.932	0.833	0.583	1.156	1.092	Yes	0.833	5.987
5208	10	362	0.002	2.237	0.071	1.035	6.346	1	3.331	0.833	0.453	1.225	0.672	Yes	0.833	6.346
5560	10	115.3	-9.716	0.191	0.006	0.069	0.541	1		0.833	0	0.104		No	0.833	0.541
8391	10	302.5	0.004	2.195	0.07	1.014	6.228	1	2.435	0.833	0.529	1.202	0.902	Yes	0.833	6.228
8392	10	311.4	0.004	2.23	0.07	1.032	6.325	1	2.509	0.833	0.525	1.221	0.889	Yes	0.833	6.325
9136	10	249.8	0.004	1.149	0.034	0.499	3.261	1	1.249	0.833	0.534	0.629	0.921	Yes	0.833	3.261
9640	10	7	0	0.05	0.001	0.016	0.142	1	1.115	0.833	0.113	0.027	0.045	No	0.833	0.142
11015	12	29	0	1.602	0.023	0.731	3.156	1	21.941	1	0.137	0.556	0.073	No	1	3.156
2006	12	59.944	0.006	2.74	0.089	1.292	5.398	1	1.491	1	0.723	0.951	1.838	No	1	5.398
2866	12	215.059	0.007	2.725	0.088	1.284	5.367	1	1.39	1	0.746	0.946	1.96	Yes	1	5.367
2868	12	224.925	0.012	2.795	0.091	1.32	5.505	1	1.115	1	0.836	0.97	2.506	Yes	1	5.505
3028	12	289.115	0.003	1.528	0.036	0.687	3.011	1	1.258	1	0.584	0.531	1.214	No	1	3.011
3247	12	194.895	0.003	1.41	0.021	0.635	2.778	1	1.074	1	0.608	0.49	1.313	No	1	2.778
4952	12	275	0.007	2.711	0.087	1.277	5.34	1	1.402	1	0.742	0.941	1.934	Yes	1	5.34
5305	12	342	0.003	1.295	0.021	0.577	2.55	1	1.064	1	0.585	0.449	1.217	No	1	2.55
5306	12	324.1	0.002	1.29	0.021	0.575	2.542	1	1.229	1	0.541	0.448	1.05	No	1	2.542
5902	12	288.21	0.001	1.002	0.017	0.435	1.973	1	1.282	1	0.464	0.348	0.781	No	1	1.973
7878	12	81.675	-0.015	0.028	0.011	0.005	0.054	1		1	0	0.01		No	1	0.054
9514	12	8.338	0	1.125	0.02	0.494	2.217	1	15.413	1	0.137	0.391	0.073	Yes	1	2.217
9565	12	26.5	0	1.602	0.023	0.731	3.156	1	3.572	1	0.347	0.556	0.449	Yes	1	3.156
9828	12	474.676	0	0.221	0.014	0.078	0.435	1	3.021	1	0.137	0.077	0.073	No	1	0.435
1052	15	213.001	0.003	2.348	0.074	1.092	2.961	1	1.023	1.25	0.761	0.467	2.295	Yes	1.25	2.961
1219	15	39.975	0	0.242	0.003	0.092	0.305	1	1.829	1.25	0.175	0.048	0.132	No	1.25	0.305
1839	15	334.13	0.003	2.352	0.074	1.094	2.965	1	1.022	1.25	0.762	0.467	2.302	Yes	1.25	2.965
205	15	399.994	0.012	23.157	1.238	13.162	29.196	1	5.076	1.25	1.064	4.602	4.562	Yes	1.25	29.196
206	15	500.003	0.009	23.157	1.238	13.162	29.196	1	5.91	1.25	0.995	4.602	3.918	Yes	1.25	29.196
4067	15	361	0.002	2.09	0.045	0.971	2.635	1	1.118	1.25	0.683	0.415	1.87	No	1.25	2.635
456	15	214	0.003	2.262	0.073	1.047	2.852	1	1.066	1.25	0.73	0.45	2.122	No	1.25	2.852
5482	15	362.794	0.018	23.157	1.238	13.162	29.196	1	4.123	1.25	1.144	4.602	5.616	Yes	1.25	29.196
5483	15	400.003	0.017	23.157	1.238	13.162	29.196	1	4.218	1.25	1.137	4.602	5.49	Yes	1.25	29.196
5484	15	400.002	0.01	23.157	1.238	13.162	29.196	1	5.532	1.25	1.025	4.602	4.186	Yes	1.25	29.196
5515	15	335.004	0.003	2.354	0.075	1.095	2.968	1	1.035	1.25	0.757	0.468	2.276	Yes	1.25	2.968
5579	15	325	0.003	2.362	0.075	1.099	2.978	1	1.022	1.25	0.763	0.469	2.31	Yes	1.25	2.978
5931	15	87.595	-0.182	2.951	0.141	1.377	3.721	1		1.25	0	0.587		Yes	1.25	3.721
5933	15	101.87	0	2.951	0.141	1.377	3.721	1	22.296	1.25	0.175	0.587	0.132	Yes	1.25	3.721
6808	15	38.962	0.056	23.157	1.238	13.162	29.196	1	2.339	1.25	1.237	4.602	9.902	Yes	1.25	29.196
9165	15	51	0	0.172	0.005	0.062	0.217	1	1.298	1.25	0.175	0.034	0.132	No	1.25	0.217
9877	15	399.998	0	0.4	0.034	0.147	0.505	1	3.024	1.25	0.175	0.08	0.132	No	1.25	0.505
2220	18	402.597	0.004	4.409	0.088	2.21	3.861	1	1.079	1.5	0.972	0.556	4.085	Yes	1.5	3.861
2221	18	392.445	0.002	4.413	0.089	2.212	3.864	1	1.354	1.5	0.864	0.556	3.26	Yes	1.5	3.864
2222	18	329.568	0.002	4.712	0.096	2.376	4.126	1	1.76	1.5	0.78	0.594	2.678	No	1.5	4.126
299	18	259.995	0.004	4.402	0.088	2.206	3.854	1	1.075	1.5	0.973	0.555	4.093	Yes	1.5	3.854
3068	18	275.005	0.003	4.384	0.087	2.196	3.838	1	1.096	1.5	0.962	0.552	4.001	Yes	1.5	3.838
3070	18	326.988	0.003	4.375	0.087	2.191	3.83	1	1.088	1.5	0.964	0.551	4.019	No	1.5	3.83
3071	18	338.993	0.003	4.367	0.087	2.187	3.824	1	1.106	1.5	0.955	0.55	3.948	Yes	1.5	3.824
4062	18	147.532	-0.002	2.228	0.05	1.041	1.951	1		1.5	0	0.281		Yes	1.5	1.951
5640	18	53.573	-0.153	0.261	0.045	0.082	0.228	1		1.5	0	0.033		No	1.5	0.228
5641	18	63.253	0	0.261	0.045	0.082	0.228	1	1.211	1.5	0.213	0.033	0.215	Yes	1.5	0.228
2785	21	28.3	-0.013	4.35	0.228	2.098	2.798	1		1.75	0	0.373		No	1.75	2.798
3863	21	263.995	0.001	4.761	0.099	2.402	3.062	1	1.206	1.75	0.911	0.408	3.947	No	1.75	3.062
9089	21	13	0	4.875	0.104	2.464	3.136	1	15.013	1.75	0.252	0.418	0.325	Yes	1.75	3.136
11017	24	162.85	0.022	23.156	1.238	13.162	11.404	1	1.061	2	1.909	1.421	21.827	Yes	2	11.404
1443	24	387.546	0.012	18.707	0.829	10.521	9.213	1	1.171	2	1.754	1.148	15.972	Yes	2	9.213
1449	24	500.002	0.016	18.686	0.82	10.514	9.203	1	1.008	2	1.841	1.147	18.544	Yes	2	9.203
1450	24	499.993	0.011	18.681	0.815	10.514	9.2	1	1.226	2	1.723	1.146	15.236	Yes	2	9.2
4340	24	500.001	0.012	18.764	0.861	10.538	9.241	1	1.168	2	1.758	1.152	16.06	Yes	2	9.241
4341	24	252.634	0.013	18.751	0.854	10.534	9.235	1	1.107	2	1.791	1.151	16.932	Yes	2	9.235
4342	24	500.004	0.014	18.751	0.854	10.534	9.235	1	1.081	2	1.805	1.151	17.346	Yes	2	9.235
4343	24	499.996	0.012	18.718	0.835	10.525	9.219	1	1.168	2	1.756	1.149	16.019	Yes	2	9.219
4364	24	500.005	0.012	18.718	0.835	10.525	9.219	1	1.166	2	1.758	1.149	16.059	Yes	2	9.219
4365	24	499.997	0.012	18.718	0.835	10.525	9.219	1	1.166	2	1.758	1.149	16.06	Yes	2	9.219
4366	24	409.436	0.012	18.751	0.854	10.534	9.235	1	1.193	2	1.744	1.151	15.724	Yes	2	9.235
4367	24	90.551	0.012	18.718	0.835	10.525	9.219	1	1.164	2	1.759	1.149	16.085	Yes	2	9.219
4550	24	500.001	0.012	18.764	0.861	10.538	9.241	1	1.168	2	1.758	1.152	16.06	Yes	2	9.241
4647	24	499.997	0.016	18.664	0.809	10.507	9.192	1	1	2	1.844	1.145	18.66	Yes	2	9.192

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
4648	24	500.006	0.015	18.664	0.809	10.507	9.192	1	1.047	2	1.82	1.145	17.835	Yes	2	9.192
4649	24	499.997	0.012	18.676	0.814	10.511	9.198	1	1.161	2	1.759	1.146	16.086	Yes	2	9.198
4650	24	199.994	0.01	18.676	0.814	10.511	9.198	1	1.249	2	1.71	1.146	14.951	Yes	2	9.198
4651	24	100	0.014	18.705	0.828	10.521	9.212	1	1.071	2	1.809	1.148	17.47	Yes	2	9.212
4652	24	499.993	0.014	18.702	0.826	10.52	9.211	1	1.094	2	1.796	1.148	17.097	Yes	2	9.211
4653	24	500.002	0.014	18.7	0.826	10.519	9.21	1	1.094	2	1.796	1.148	17.097	Yes	2	9.21
4654	24	500.002	0.014	18.697	0.823	10.519	9.208	1	1.094	2	1.796	1.147	17.097	Yes	2	9.208
5454	24	247.326	0.014	18.764	0.861	10.538	9.241	1	1.087	2	1.802	1.152	17.265	Yes	2	9.241
5846	24	499.997	0.011	18.659	0.805	10.506	9.19	1	1.225	2	1.723	1.145	15.235	Yes	2	9.19
5883	24	329.654	0.004	18.767	0.863	10.539	9.243	1	2.026	2	1.364	1.152	9.263	Yes	2	9.243
8624	24	296.125	0.014	18.707	0.829	10.521	9.213	1	1.097	2	1.795	1.148	17.06	Yes	2	9.213
8625	24	253.58	0.016	18.707	0.829	10.521	9.213	1	1.008	2	1.841	1.148	18.55	Yes	2	9.213
8978	24	169.994	0.01	18.575	0.76	10.481	9.148	1	1.252	2	1.705	1.14	14.832	Yes	2	9.148
8980	24	500.009	0.015	18.609	0.76	10.503	9.165	1	1.052	2	1.816	1.142	17.69	No	2	9.165
11025	27	1	0.46	18.717	0.833	10.525	7.283	1	1.375	2.25	1.607	0.856	13.612	Yes	2.25	7.283
5735	27	500.02	0.007	18.718	0.835	10.525	7.284	1	1.126	2.25	1.771	0.856	16.623	Yes	2.25	7.284
8618	27	180.459	0.005	18.717	0.833	10.525	7.283	1	1.279	2.25	1.666	0.856	14.639	Yes	2.25	7.283
8619	27	179.875	0.005	18.717	0.833	10.525	7.283	1	1.365	2.25	1.613	0.856	13.715	Yes	2.25	7.283
8620	27	325.152	0.005	18.717	0.833	10.525	7.283	1	1.317	2.25	1.642	0.856	14.21	Yes	2.25	7.283
8621	27	400.493	0.004	18.717	0.834	10.525	7.284	1	1.423	2.25	1.579	0.856	13.153	Yes	2.25	7.284
8622	27	319.867	0.005	18.717	0.833	10.525	7.283	1	1.268	2.25	1.673	0.856	14.76	Yes	2.25	7.283
8623	27	588.148	0.006	18.707	0.829	10.521	7.279	1	1.186	2.25	1.727	0.855	15.767	Yes	2.25	7.279
8626	27	494.25	0.004	18.707	0.829	10.521	7.279	1	1.476	2.25	1.549	0.855	12.671	Yes	2.25	7.279
3679	33	299.617	0.001	25.396	1.391	14.546	6.616	1	2.618	2.75	1.268	0.703	9.7	Yes	2.75	6.616
3680	33	406.369	0.001	25.396	1.391	14.546	6.616	1	2.49	2.75	1.302	0.703	10.201	Yes	2.75	6.616
3681	33	497.796	0.001	25.396	1.391	14.546	6.616	1	2.465	2.75	1.309	0.703	10.305	No	2.75	6.616
4904	36	97.481	-0.017	18.328	0.728	10.342	4.012	1		3	0	0.408		No	3	4.012
3687	39	213.733	0	5.423	0.372	2.623	1.011	1	3.205	3.25	0.492	0.099	1.692	Yes	3.25	1.011
3691	39	18.001	-0.333	5.423	0.372	2.623	1.011	1		3.25	0	0.099		Yes	3.25	1.011
6468	39	46.27	0	5.421	0.372	2.622	1.011	1	3.204	3.25	0.492	0.099	1.692	Yes	3.25	1.011
Ultimate Wet Weather Scenario - Hydraulic Deficient Lines																
6168	12	461.3	0.005	1.559	0.038	0.701	3.515	0.816	0.996	0.816	0.665	0.658	1.565	No	0.816	3.515
8909	12	250	0.015	2.808	0.092	1.327	6.409	0.806	0.984	0.806	0.875	1.22	2.854	Yes	1	5.532
2291	10	101.5	0	0.196	0.007	0.071	0.645	0.804	0.983	0.67	0.239	0.135	0.199	No	0.67	0.645
4951	12	355.046	0.014	2.691	0.087	1.267	6.159	0.803	0.981	0.803	0.861	1.177	2.743	Yes	0.811	6.105
281	8	331.97	0.013	0.878	0.013	0.377	4.584	0.791	0.967	0.528	0.549	1.092	0.908	No	0.528	4.584
2489	8	296.004	0.016	0.948	0.023	0.406	4.996	0.784	0.958	0.523	0.567	1.204	0.99	No	0.523	4.996
2661	8	392.573	0.014	0.901	0.014	0.388	4.746	0.784	0.958	0.523	0.555	1.143	0.94	No	0.523	4.746
7777	10	355.19	0.004	0.857	0.049	0.35	2.899	0.781	0.954	0.651	0.515	0.627	0.898	No	0.651	2.899
924	8	329.997	0.016	0.939	0.023	0.402	5.017	0.773	0.944	0.516	0.565	1.227	0.995	Yes	0.519	4.983
3336	10	270.1	0.005	0.957	0.026	0.409	3.274	0.773	0.943	0.644	0.545	0.717	1.015	No	0.644	3.274
3512	10	351	0.01	1.324	0.037	0.584	4.576	0.765	0.933	0.638	0.642	1.013	1.42	No	0.638	4.576
1178	12	331.994	0.002	0.893	0.018	0.382	2.141	0.765	0.933	0.765	0.497	0.433	0.957	Yes	1	1.758
4027	10	337.892	0.009	1.248	0.023	0.553	4.319	0.764	0.931	0.637	0.623	0.958	1.34	No	0.637	4.319
10066	8	66.168	0	0.023	0	0.007	0.125	0.761	0.928	0.508	0.085	0.031	0.025	No	0.508	0.125
4950	12	328.997	0.016	2.676	0.086	1.259	6.467	0.76	0.925	0.76	0.859	1.317	2.891	Yes	0.781	6.287
9568	6	92.4	0	0.011	0	0.003	0.103	0.759	0.924	0.379	0.062	0.03	0.011	Yes	0.5	0.084
3380	12	325	0.003	1.111	0.018	0.488	2.727	0.748	0.909	0.748	0.558	0.564	1.222	No	0.748	2.727
5467	8	346	0.004	0.448	0.013	0.177	2.482	0.746	0.906	0.497	0.393	0.631	0.495	No	0.497	2.482
5468	8	284.74	0.004	0.447	0.013	0.177	2.487	0.744	0.903	0.496	0.392	0.634	0.495	No	0.496	2.487
2492	8	250.002	0.02	0.994	0.026	0.427	5.553	0.74	0.897	0.493	0.578	1.422	1.107	Yes	0.667	4.405
7473	12	159.61	0.002	1.009	0.078	0.409	2.51	0.739	0.896	0.739	0.53	0.526	1.127	No	0.739	2.51
2867	12	275.07	0.018	2.748	0.089	1.296	6.862	0.736	0.892	0.736	0.868	1.443	3.082	Yes	1	5.414
943	8	286.078	0.018	0.931	0.022	0.398	5.246	0.734	0.888	0.489	0.563	1.355	1.048	Yes	0.502	5.103
1829	8	341.485	0.004	0.461	0.008	0.185	2.598	0.733	0.887	0.489	0.398	0.672	0.519	Yes	0.667	2.041
2343	8	384.141	0.017	0.905	0.014	0.39	5.139	0.729	0.882	0.486	0.557	1.335	1.027	No	0.486	5.139
4118	8	206	0.015	0.841	0.02	0.356	4.773	0.729	0.881	0.486	0.539	1.241	0.954	No	0.486	4.773
1194	8	286.029	0.008	0.606	0.018	0.247	3.456	0.726	0.877	0.484	0.459	0.902	0.691	No	0.484	3.456
4372	12	330.045	0.007	1.725	0.055	0.778	4.389	0.723	0.873	0.723	0.7	0.938	1.977	Yes	1	3.398
6345	12	321	0.008	1.745	0.055	0.788	4.441	0.723	0.872	0.723	0.704	0.95	2.001	Yes	1	3.437
5982	8	258.79	0.008	0.61	0.018	0.249	3.498	0.722	0.872	0.482	0.461	0.917	0.7	No	0.482	3.498
8814	10	307.9	0.003	0.657	0.011	0.274	2.412	0.722	0.871	0.602	0.448	0.566	0.755	No	0.602	2.412
4586	12	320	0.004	1.236	0.084	0.517	3.151	0.722	0.871	0.722	0.59	0.675	1.42	No	0.722	3.151
6346	12	331	0.007	1.733	0.055	0.782	4.425	0.721	0.869	0.721	0.702	0.949	1.994	Yes	1	3.414
2705	8	189.519	0.004	0.422	0.013	0.166	2.44	0.717	0.863	0.478	0.381	0.644	0.489	No	0.478	2.44
8996	12	330.9	0.002	0.991	0.017	0.43	2.547	0.716	0.862	0.716	0.525	0.55	1.149	Yes	0.966	1.973
3614	8	300	0.017	0.866	0.021	0.368	5.036	0.713	0.857	0.475	0.546	1.336	1.011	Yes	0.667	3.84

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
3315	10	168	0.009	1.155	0.033	0.502	4.328	0.708	0.849	0.59	0.6	1.033	1.359	No	0.59	4.328
4760	8	398.62	0.009	0.628	0.012	0.26	3.695	0.705	0.846	0.47	0.468	0.989	0.743	Yes	0.667	2.786
8237	8	36.8	0.003	0.345	0.012	0.132	2.029	0.705	0.845	0.47	0.343	0.544	0.408	No	0.47	2.029
2601	12	366.7	0.007	1.617	0.044	0.728	4.228	0.705	0.845	0.705	0.678	0.925	1.914	No	0.705	4.228
6167	12	302	0.007	1.585	0.041	0.713	4.141	0.705	0.846	0.705	0.671	0.906	1.874	No	0.705	4.141
7433	12	222.64	0.003	1.099	0.08	0.452	2.879	0.704	0.843	0.704	0.554	0.631	1.304	No	0.704	2.879
7435	12	244.55	0.003	1.099	0.08	0.452	2.879	0.704	0.843	0.704	0.554	0.631	1.304	No	0.704	2.879
7474	12	59.67	0.003	1.009	0.078	0.409	2.641	0.704	0.844	0.704	0.53	0.578	1.196	No	0.704	2.641
1828	8	226.726	0.004	0.422	0.007	0.168	2.491	0.703	0.841	0.468	0.381	0.67	0.502	No	0.468	2.491
4916	8	353.4	0.008	0.604	0.018	0.246	3.566	0.703	0.841	0.468	0.458	0.958	0.718	No	0.468	3.566
2919	10	145.793	0.009	1.141	0.017	0.503	4.325	0.701	0.838	0.584	0.596	1.042	1.361	No	0.584	4.325
7432	12	217.36	0.003	1.099	0.08	0.452	2.891	0.701	0.839	0.701	0.554	0.636	1.31	No	0.701	2.891
4526	8	254.279	0	0.136	0.001	0.049	0.808	0.698	0.835	0.466	0.211	0.218	0.163	No	0.466	0.808
5731	10	339.5	0.009	1.141	0.03	0.497	4.342	0.698	0.834	0.582	0.596	1.05	1.368	No	0.582	4.342
7428	12	146	0.003	1.101	0.08	0.453	2.917	0.697	0.832	0.697	0.555	0.645	1.324	No	0.697	2.917
1985	10	338	0.01	1.2	0.032	0.525	4.589	0.695	0.83	0.579	0.611	1.114	1.447	No	0.579	4.589
3261	8	315.36	0.004	0.429	0.013	0.169	2.566	0.694	0.828	0.463	0.384	0.697	0.518	No	0.463	2.566
7465	12	294	0.003	1.081	0.08	0.443	2.875	0.694	0.828	0.694	0.55	0.638	1.305	No	0.694	2.875
3513	10	352	0.013	1.328	0.037	0.586	5.094	0.693	0.827	0.578	0.643	1.239	1.607	Yes	0.833	3.768
1298	12	356	0.004	1.238	0.084	0.518	3.308	0.691	0.823	0.691	0.59	0.736	1.504	No	0.691	3.308
7462	12	214.5	0.003	1.079	0.08	0.442	2.881	0.691	0.824	0.691	0.549	0.641	1.309	No	0.691	2.881
6169	12	421.5	0.007	1.55	0.035	0.698	4.146	0.69	0.822	0.69	0.663	0.924	1.885	Yes	0.753	3.779
2490	8	298.121	0.022	0.952	0.024	0.408	5.749	0.689	0.819	0.459	0.568	1.572	1.162	Yes	0.667	4.222
3611	12	333	0.002	0.88	0.017	0.376	2.373	0.685	0.814	0.685	0.493	0.532	1.081	Yes	1	1.733
7392	8	303.81	0	0.02	0	0.006	0.122	0.683	0.811	0.455	0.079	0.034	0.025	No	0.455	0.122
5903	12	235.5	0.003	1.031	0.018	0.449	2.799	0.681	0.808	0.681	0.536	0.631	1.277	Yes	0.954	2.066
6170	12	148	0.007	1.532	0.033	0.69	4.16	0.681	0.807	0.681	0.659	0.938	1.898	Yes	0.686	4.129
9409	12	80.5	0.004	1.209	0.032	0.529	3.288	0.68	0.806	0.68	0.583	0.742	1.5	No	0.68	3.288
9146	10	270.1	0.003	0.623	0.016	0.256	2.455	0.677	0.8	0.564	0.436	0.609	0.779	No	0.564	2.455
29	8	332.3	0.008	0.56	0.015	0.227	3.455	0.675	0.798	0.45	0.441	0.961	0.702	No	0.45	3.455
320	8	121.755	0.005	0.423	0.018	0.164	2.614	0.675	0.797	0.45	0.381	0.727	0.531	No	0.45	2.614
5123	8	302.063	0.013	0.716	0.016	0.299	4.428	0.674	0.796	0.449	0.499	1.233	0.9	No	0.449	4.428
333	10	355	0.014	1.316	0.037	0.58	5.208	0.674	0.795	0.561	0.64	1.298	1.654	No	0.561	5.208
3030	12	333.002	0.002	0.856	0.017	0.365	2.362	0.672	0.792	0.672	0.487	0.539	1.081	Yes	0.678	2.336
1830	8	217.977	0.005	0.431	0.008	0.172	2.683	0.67	0.79	0.447	0.385	0.751	0.546	Yes	0.468	2.55
708	10	91.867	0.011	1.163	0.033	0.506	4.633	0.67	0.789	0.558	0.602	1.16	1.474	No	0.558	4.633
2882	10	351.002	0.014	1.322	0.037	0.583	5.277	0.669	0.787	0.557	0.641	1.323	1.679	Yes	0.597	4.888
3029	12	334.1	0.002	0.848	0.017	0.361	2.354	0.668	0.786	0.668	0.484	0.539	1.079	Yes	0.67	2.346
1827	8	394.093	0.005	0.422	0.008	0.168	2.652	0.665	0.781	0.443	0.381	0.747	0.541	No	0.443	2.652
3153	12	330.085	0.008	1.629	0.023	0.745	4.542	0.665	0.782	0.665	0.68	1.044	2.084	Yes	0.857	3.518
5983	8	258.79	0.01	0.61	0.018	0.249	3.839	0.664	0.779	0.443	0.461	1.083	0.783	No	0.443	3.839
7461	12	315.12	0.003	1.016	0.079	0.412	2.846	0.663	0.778	0.663	0.532	0.656	1.307	No	0.663	2.846
3613	8	300	0.02	0.86	0.021	0.365	5.423	0.662	0.777	0.441	0.544	1.532	1.107	Yes	0.458	5.2
3835	10	321.984	0.013	1.265	0.036	0.555	5.116	0.661	0.774	0.551	0.627	1.295	1.633	No	0.551	5.116
9483	8	320.58	0.004	0.381	0.012	0.148	2.411	0.66	0.773	0.44	0.361	0.683	0.493	No	0.44	2.411
5284	12	386	0.008	1.623	0.038	0.734	4.57	0.659	0.772	0.659	0.679	1.058	2.102	No	0.659	4.57
7452	12	178.08	0.003	1.014	0.079	0.411	2.863	0.658	0.77	0.658	0.532	0.664	1.318	No	0.658	2.863
5285	12	390.485	0.008	1.607	0.038	0.726	4.54	0.657	0.769	0.657	0.675	1.053	2.09	Yes	0.658	4.533
8533	8	340.1	0.004	0.395	0.005	0.157	2.515	0.656	0.767	0.438	0.368	0.716	0.515	No	0.438	2.515
10362	8	87.9	0.009	0.545	0.013	0.221	3.522	0.648	0.753	0.432	0.435	1.012	0.723	No	0.432	3.522
1682	10	330.279	0.013	1.217	0.019	0.54	5.055	0.646	0.75	0.538	0.616	1.303	1.624	No	0.538	5.055
1272	8	330	0.003	0.338	0.008	0.131	2.206	0.643	0.745	0.429	0.339	0.638	0.454	No	0.429	2.206
4589	12	218.651	0.008	1.509	0.032	0.679	4.37	0.643	0.745	0.643	0.654	1.031	2.024	No	0.643	4.37
1034	8	325.002	0.004	0.379	0.017	0.145	2.478	0.642	0.744	0.428	0.36	0.717	0.51	Yes	0.613	1.748
9513	12	193.1	0.004	1.052	0.018	0.459	3.061	0.641	0.741	0.641	0.542	0.725	1.42	Yes	0.972	2.089
2889	8	405.997	0.004	0.365	0.011	0.141	2.392	0.64	0.739	0.427	0.353	0.694	0.493	No	0.427	2.392
8532	8	360.9	0.004	0.377	0.005	0.149	2.473	0.639	0.738	0.426	0.359	0.718	0.51	No	0.426	2.473
3383	8	273.6	0.025	0.901	0.014	0.388	5.959	0.636	0.732	0.424	0.556	1.739	1.231	Yes	0.667	3.995
617	12	332.92	0.01	1.68	0.024	0.77	4.938	0.635	0.732	0.635	0.691	1.177	2.295	No	0.635	4.938
5469	8	221.37	0.006	0.443	0.013	0.175	2.936	0.634	0.73	0.423	0.39	0.859	0.607	No	0.423	2.936
9537	8	284.129	0.006	0.45	0.047	0.163	2.988	0.633	0.727	0.422	0.393	0.875	0.618	No	0.422	2.988
420	10	118.871	0.011	1.105	0.032	0.478	4.699	0.633	0.728	0.527	0.587	1.231	1.519	Yes	0.833	3.135
5509	8	324.6	0.003	0.331	0.008	0.128	2.203	0.632	0.726	0.421	0.335	0.646	0.456	No	0.421	2.203
9548	10	23.09	0.003	0.525	0.016	0.211	2.238	0.632	0.726	0.527	0.399	0.587	0.724	No	0.527	2.238
10672	8	205	0.004	0.354	0.01	0.137	2.362	0.63	0.723	0.42	0.347	0.694	0.489	No	0.42	2.362
3506	8	333.2	0.013	0.64	0.01	0.266	4.271	0.63	0.724	0.42	0.472	1.254	0.884	No	0.42	4.271
1681	10	327.662	0.014	1.221	0.019	0.542	5.221	0.63	0.723	0.525	0.617	1.372	1.69	No	0.525	5.221

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
3854	10	284.8	0.038	2.011	0.065	0.92	8.605	0.63	0.722	0.525	0.76	2.262	2.785	No	0.525	8.605
10671	8	196	0.004	0.354	0.01	0.137	2.368	0.629	0.721	0.419	0.347	0.697	0.491	No	0.419	2.368
4028	8	350.009	0.034	1.043	0.019	0.454	6.981	0.629	0.721	0.419	0.588	2.054	1.447	Yes	0.478	6.024
10656	8	261.5	0.004	0.354	0.01	0.137	2.371	0.628	0.72	0.419	0.347	0.698	0.491	No	0.419	2.371
1195	8	306.256	0.012	0.606	0.018	0.247	4.062	0.628	0.72	0.419	0.459	1.196	0.842	No	0.419	4.062
3756	12	346	0.004	1.049	0.022	0.456	3.126	0.628	0.72	0.628	0.541	0.752	1.458	No	0.628	3.126
3078	12	330	0.012	1.787	0.026	0.824	5.331	0.627	0.718	0.627	0.713	1.283	2.487	No	0.627	5.331
7563	8	40	0.005	0.377	0.005	0.149	2.532	0.626	0.717	0.418	0.359	0.747	0.525	No	0.418	2.532
3313	10	217	0.008	0.935	0.015	0.404	4.031	0.625	0.715	0.521	0.539	1.065	1.307	Yes	0.833	2.653
5985	8	231.88	0.012	0.615	0.018	0.251	4.162	0.623	0.711	0.415	0.463	1.233	0.865	No	0.415	4.162
4117	8	164.8	0.015	0.667	0.016	0.276	4.54	0.62	0.705	0.413	0.482	1.35	0.945	Yes	0.449	4.12
9759	8	379.5	0.011	0.569	0.008	0.234	3.887	0.618	0.702	0.412	0.445	1.159	0.81	No	0.412	3.887
9129	10	264.1	0.003	0.544	0.013	0.221	2.384	0.617	0.701	0.514	0.406	0.636	0.777	No	0.514	2.384
52	10	331.3	0.015	1.215	0.019	0.539	5.348	0.615	0.697	0.512	0.615	1.432	1.744	Yes	0.525	5.192
4590	12	56.205	0.007	1.335	0.031	0.592	4.092	0.613	0.694	0.613	0.614	1.002	1.923	No	0.613	4.092
1453	10	275.429	0.005	0.667	0.018	0.275	2.961	0.61	0.689	0.508	0.452	0.797	0.968	No	0.508	2.961
9470	8	46.67	0.005	0.377	0.017	0.144	2.624	0.608	0.685	0.405	0.359	0.792	0.55	No	0.405	2.624
395	10	277.396	0.005	0.665	0.018	0.274	2.968	0.607	0.684	0.506	0.451	0.802	0.972	Yes	0.507	2.96
7343	10	221.9	0.005	0.651	0.013	0.27	2.91	0.607	0.683	0.506	0.446	0.786	0.953	No	0.506	2.91
5734	10	137	0.014	1.162	0.03	0.507	5.198	0.606	0.683	0.505	0.602	1.405	1.703	No	0.505	5.198
9471	8	287.2	0.005	0.374	0.017	0.143	2.624	0.605	0.68	0.403	0.358	0.795	0.551	No	0.403	2.624
5981	8	301.31	0.013	0.61	0.018	0.249	4.287	0.604	0.678	0.403	0.461	1.3	0.9	No	0.403	4.287
2917	10	295.58	0.015	1.19	0.018	0.527	5.343	0.604	0.679	0.504	0.609	1.448	1.752	Yes	0.548	4.843
5732	10	187	0.014	1.156	0.03	0.504	5.192	0.604	0.679	0.503	0.6	1.408	1.703	No	0.503	5.192
5733	10	69.045	0.014	1.156	0.03	0.504	5.206	0.603	0.677	0.502	0.6	1.413	1.709	Yes	0.504	5.188
4840	10	337.1	0.014	1.11	0.017	0.488	5.025	0.6	0.672	0.5	0.588	1.368	1.651	Yes	0.597	4.108
9481	10	335.7	0.003	0.535	0.017	0.215	2.426	0.599	0.671	0.5	0.402	0.661	0.798	No	0.5	2.426
4025	10	259.65	0.018	1.281	0.024	0.569	5.833	0.597	0.667	0.498	0.631	1.594	1.92	No	0.498	5.833
2958	8	409.563	0.014	0.618	0.01	0.256	4.416	0.595	0.663	0.397	0.464	1.353	0.932	No	0.397	4.416
3042	8	40.367	0.009	0.496	0.012	0.199	3.551	0.594	0.661	0.396	0.414	1.09	0.75	No	0.396	3.551
9485	10	336.4	0.003	0.528	0.016	0.212	2.426	0.593	0.66	0.494	0.4	0.667	0.801	No	0.494	2.426
2916	10	334.443	0.017	1.205	0.018	0.534	5.559	0.591	0.656	0.492	0.613	1.532	1.837	Yes	0.502	5.428
3335	10	114.4	0.01	0.955	0.026	0.408	4.402	0.591	0.657	0.493	0.545	1.212	1.454	Yes	0.568	3.729
4026	10	340.001	0.018	1.252	0.023	0.555	5.778	0.591	0.656	0.492	0.624	1.592	1.91	Yes	0.495	5.739
5324	10	265.011	0.015	1.145	0.034	0.497	5.279	0.591	0.656	0.493	0.597	1.454	1.744	Yes	0.833	3.248
3081	12	331	0.015	1.858	0.027	0.86	5.961	0.59	0.655	0.59	0.727	1.5	2.838	No	0.59	5.961
2214	8	196	0.01	0.506	0.006	0.206	3.66	0.589	0.652	0.392	0.418	1.13	0.775	No	0.392	3.66
279	8	199.292	0.015	0.627	0.015	0.258	4.532	0.589	0.654	0.393	0.467	1.398	0.959	No	0.393	4.532
9545	8	287.2	0.005	0.358	0.016	0.136	2.591	0.589	0.652	0.392	0.349	0.8	0.549	No	0.392	2.591
7565	8	259.8	0.005	0.358	0.005	0.141	2.594	0.588	0.651	0.392	0.349	0.802	0.55	Yes	0.395	2.572
3515	10	339.697	0.017	1.211	0.032	0.53	5.63	0.587	0.649	0.489	0.614	1.558	1.865	No	0.489	5.63
6371	12	330	0.002	0.695	0.012	0.291	2.245	0.587	0.649	0.587	0.436	0.567	1.071	Yes	0.651	1.985
393	10	344.186	0.005	0.619	0.018	0.253	2.892	0.585	0.646	0.487	0.434	0.802	0.959	Yes	0.497	2.827
392	10	351.82	0.005	0.617	0.018	0.252	2.886	0.584	0.644	0.487	0.433	0.802	0.957	Yes	0.487	2.884
3080	12	331	0.015	1.828	0.027	0.845	5.94	0.584	0.644	0.584	0.721	1.506	2.838	Yes	0.587	5.903
5171	10	120.5	0.005	0.645	0.007	0.27	3.019	0.583	0.643	0.486	0.444	0.839	1.002	No	0.486	3.019
2857	12	356	0.007	1.24	0.084	0.519	4.039	0.583	0.642	0.583	0.591	1.025	1.931	No	0.583	4.039
4140	10	188	0.014	1.084	0.028	0.47	5.094	0.582	0.641	0.485	0.581	1.418	1.692	No	0.485	5.094
1705	10	394	0.017	1.169	0.031	0.51	5.496	0.581	0.64	0.485	0.603	1.531	1.826	No	0.485	5.496
5172	10	156	0.005	0.642	0.007	0.269	3.021	0.581	0.64	0.485	0.443	0.842	1.004	No	0.485	3.021
925	10	216.116	0.013	1.033	0.03	0.444	4.862	0.581	0.639	0.484	0.567	1.355	1.616	Yes	0.833	2.93
2756	10	232.238	0.023	1.362	0.021	0.611	6.429	0.58	0.637	0.483	0.65	1.795	2.139	No	0.483	6.429
7455	8	330.1	0.023	0.751	0.055	0.297	5.544	0.579	0.636	0.386	0.511	1.731	1.18	Yes	0.477	4.351
3079	12	330.997	0.015	1.805	0.027	0.833	5.922	0.579	0.636	0.579	0.716	1.51	2.838	Yes	0.582	5.893
2755	10	238.821	0.024	1.382	0.021	0.621	6.551	0.578	0.633	0.481	0.655	1.834	2.182	Yes	0.791	3.997
8335	10	350.8	0.004	0.565	0.013	0.23	2.682	0.577	0.632	0.481	0.414	0.751	0.894	No	0.481	2.682
4946	8	299.868	0.011	0.517	0.012	0.209	3.843	0.576	0.63	0.384	0.423	1.205	0.82	No	0.384	3.843
1530	12	250.002	0.007	1.245	0.034	0.546	4.114	0.576	0.63	0.576	0.592	1.053	1.975	No	0.576	4.114
7422	12	340.27	0.006	1.168	0.083	0.484	3.864	0.575	0.629	0.575	0.572	0.99	1.856	No	0.575	3.864
2368	8	183.985	0.01	0.49	0.006	0.199	3.664	0.573	0.626	0.382	0.412	1.152	0.783	Yes	0.387	3.605
5333	8	314.881	0.006	0.375	0.008	0.147	2.807	0.573	0.625	0.382	0.358	0.884	0.6	Yes	0.536	1.93
5984	8	258.79	0.016	0.613	0.018	0.25	4.578	0.573	0.626	0.382	0.462	1.44	0.978	No	0.382	4.578
5904	12	137	0.005	1.052	0.018	0.459	3.502	0.572	0.624	0.572	0.542	0.901	1.685	No	0.572	3.502
9408	12	267.12	0.007	1.192	0.031	0.521	3.979	0.571	0.622	0.571	0.578	1.025	1.916	No	0.571	3.979
4945	8	305.107	0.011	0.506	0.01	0.205	3.808	0.57	0.62	0.38	0.418	1.202	0.816	Yes	0.382	3.786
2637	12	386	0.013	1.601	0.037	0.723	5.371	0.569	0.618	0.569	0.674	1.387	2.591	Yes	0.613	4.906
8211	8	253.2	0.022	0.712	0.012	0.299	5.381	0.568	0.617	0.379	0.498	1.704	1.154	Yes	0.667	3.156

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
6372	12	330	0.002	0.669	0.012	0.279	2.25	0.568	0.616	0.568	0.428	0.582	1.086	Yes	0.577	2.205
9436	12	337.4	0.02	2.002	0.061	0.917	6.754	0.566	0.614	0.566	0.754	1.75	3.263	No	0.566	6.754
5420	8	293	0.017	0.629	0.015	0.259	4.803	0.564	0.609	0.376	0.468	1.529	1.033	Yes	0.394	4.528
6373	12	330	0.002	0.66	0.011	0.275	2.243	0.563	0.608	0.563	0.425	0.583	1.086	Yes	0.565	2.231
2270	8	249.778	0.008	0.434	0.013	0.171	3.319	0.562	0.607	0.375	0.386	1.058	0.715	No	0.375	3.319
7955	8	48	0.004	0.298	0	0.117	2.287	0.562	0.606	0.374	0.318	0.73	0.493	No	0.374	2.287
9927	8	40.531	0	0.015	0.001	0.004	0.115	0.562	0.606	0.375	0.069	0.037	0.025	Yes	0.667	0.067
9428	12	362.7	0.02	1.97	0.06	0.901	6.702	0.562	0.607	0.562	0.748	1.744	3.246	No	0.562	6.702
9161	8	242.6	0.01	0.475	0.013	0.189	3.639	0.561	0.605	0.374	0.405	1.161	0.784	No	0.374	3.639
9162	8	329.7	0.012	0.515	0.014	0.207	3.957	0.561	0.604	0.374	0.422	1.264	0.853	No	0.374	3.957
10490	10	178.5	0.004	0.533	0.015	0.215	2.622	0.561	0.604	0.467	0.402	0.749	0.883	No	0.467	2.622
4165	10	150	0.023	1.285	0.024	0.571	6.327	0.56	0.603	0.467	0.632	1.809	2.131	No	0.467	6.327
10491	10	138.2	0.004	0.533	0.015	0.215	2.633	0.559	0.601	0.466	0.402	0.754	0.888	No	0.466	2.633
346	10	299	0.016	1.09	0.028	0.473	5.376	0.559	0.602	0.466	0.583	1.539	1.812	No	0.466	5.376
1234	8	322.959	0.017	0.604	0.007	0.251	4.674	0.557	0.598	0.371	0.458	1.499	1.01	Yes	0.667	2.677
7776	10	346	0.01	0.848	0.049	0.346	4.205	0.557	0.597	0.464	0.512	1.207	1.42	No	0.464	4.205
3076	12	331.996	0.015	1.698	0.025	0.779	5.837	0.557	0.599	0.557	0.695	1.528	2.836	No	0.557	5.837
9516	8	401.4	0.002	0.208	0.002	0.078	1.617	0.556	0.596	0.371	0.263	0.519	0.35	No	0.371	1.617
3075	12	333.005	0.015	1.688	0.024	0.774	5.817	0.556	0.596	0.556	0.693	1.525	2.829	Yes	0.557	5.809
9542	8	283.3	0.01	0.456	0.013	0.181	3.547	0.555	0.594	0.37	0.396	1.141	0.767	Yes	0.372	3.522
5730	10	326.266	0.017	1.095	0.028	0.475	5.472	0.553	0.591	0.461	0.584	1.578	1.852	Yes	0.521	4.718
2957	8	346.509	0.017	0.609	0.009	0.252	4.763	0.552	0.59	0.368	0.46	1.537	1.032	No	0.368	4.763
5319	8	291.037	0.016	0.588	0.006	0.244	4.601	0.552	0.589	0.368	0.452	1.485	0.997	Yes	0.37	4.575
10498	8	226.77	0.006	0.354	0.01	0.137	2.783	0.55	0.586	0.367	0.347	0.901	0.604	No	0.367	2.783
5980	8	301.31	0.018	0.608	0.018	0.248	4.784	0.55	0.586	0.367	0.46	1.548	1.039	No	0.367	4.784
1367	8	100.096	0.002	0.188	0.004	0.069	1.485	0.549	0.583	0.366	0.25	0.481	0.323	No	0.366	1.485
9435	12	280.6	0.022	1.981	0.061	0.906	6.946	0.549	0.583	0.549	0.75	1.839	3.396	No	0.549	6.946
2704	8	75.131	0.007	0.367	0.011	0.142	2.906	0.547	0.58	0.365	0.354	0.944	0.632	Yes	0.421	2.442
7745	10	346	0.003	0.434	0.009	0.173	2.2	0.547	0.581	0.456	0.361	0.639	0.748	No	0.456	2.2
5314	8	184.42	0.016	0.579	0.006	0.24	4.596	0.546	0.579	0.364	0.449	1.495	1	Yes	0.366	4.563
11053	10	3601.58	0.001	0.272	0.004	0.104	1.389	0.544	0.575	0.453	0.283	0.405	0.473	No	0.453	1.389
9434	12	330.7	0.022	1.977	0.061	0.904	7.011	0.544	0.575	0.544	0.75	1.867	3.44	No	0.544	7.011
3852	8	266.8	0.037	0.867	0.013	0.372	6.931	0.543	0.573	0.362	0.546	2.263	1.512	Yes	-0.716	-1.#IO
15	10	244.259	0.012	0.899	0.024	0.382	4.606	0.542	0.572	0.452	0.528	1.346	1.571	No	0.452	4.606
10378	8	38.8	0.009	0.418	0.01	0.165	3.355	0.541	0.57	0.361	0.379	1.098	0.733	Yes	0.667	1.852
335	8	237.074	0	0.014	0	0.004	0.113	0.541	0.57	0.361	0.066	0.037	0.025	No	0.361	0.113
4174	8	283.06	0.005	0.315	0.004	0.123	2.53	0.541	0.571	0.361	0.327	0.828	0.553	No	0.361	2.53
7007	8	148.24	0.002	0.208	0.038	0.063	1.665	0.541	0.57	0.361	0.263	0.545	0.364	No	0.361	1.665
2754	12	236.486	0.012	1.416	0.021	0.638	5.048	0.541	0.571	0.541	0.633	1.348	2.481	No	0.541	5.048
1370	8	175.716	0.017	0.573	0.013	0.234	4.622	0.539	0.567	0.359	0.446	1.516	1.011	Yes	0.376	4.369
236	8	478.1	0.016	0.567	0.013	0.231	4.564	0.539	0.568	0.36	0.444	1.496	0.998	No	0.36	4.564
5318	8	136.58	0.016	0.561	0.006	0.232	4.531	0.539	0.566	0.359	0.442	1.487	0.992	Yes	0.361	4.493
9486	8	271.33	0.005	0.302	0.011	0.114	2.445	0.537	0.563	0.358	0.319	0.804	0.536	No	0.358	2.445
10380	8	37.6	0.009	0.418	0.01	0.165	3.395	0.536	0.561	0.357	0.379	1.118	0.745	No	0.357	3.395
2956	8	374.947	0.018	0.598	0.009	0.247	4.855	0.536	0.561	0.357	0.456	1.599	1.065	Yes	0.363	4.763
9460	8	54.3	0	0.014	0	0.004	0.113	0.536	0.562	0.357	0.066	0.037	0.025	Yes	0.667	0.062
4164	10	258.18	0.027	1.3	0.025	0.578	6.789	0.534	0.558	0.445	0.636	2.004	2.33	No	0.445	6.789
421	8	10	0.07	1.154	0.034	0.501	9.429	0.533	0.557	0.355	0.608	3.115	2.072	Yes	0.667	5.113
280	8	102.813	0.019	0.593	0.009	0.245	4.875	0.531	0.553	0.354	0.454	1.615	1.073	Yes	0.356	4.846
5881	8	303.17	0.002	0.176	0.001	0.065	1.445	0.531	0.553	0.354	0.241	0.479	0.318	No	0.354	1.445
3156	12	356.1	0.012	1.425	0.021	0.642	5.196	0.531	0.554	0.531	0.635	1.405	2.572	No	0.531	5.196
1818	10	340	0.016	0.994	0.028	0.426	5.245	0.53	0.55	0.441	0.556	1.557	1.806	Yes	0.463	4.945
3150	12	338	0.017	1.648	0.023	0.754	6.037	0.53	0.55	0.53	0.684	1.636	2.993	Yes	0.712	4.259
4175	8	351.305	0.006	0.32	0.004	0.125	2.641	0.529	0.55	0.353	0.329	0.877	0.582	No	0.353	2.641
1817	10	335.4	0.015	0.961	0.026	0.411	5.09	0.528	0.548	0.44	0.546	1.514	1.754	Yes	0.441	5.082
2836	12	55.078	0.01	1.286	0.035	0.566	4.732	0.528	0.548	0.528	0.602	1.285	2.349	No	0.528	4.732
1400	8	65.711	0.028	0.722	0.024	0.298	5.986	0.527	0.547	0.352	0.501	1.992	1.321	Yes	0.667	3.201
9424	12	329.8	0.024	1.962	0.06	0.897	7.239	0.527	0.546	0.527	0.747	1.968	3.596	No	0.527	7.239
9437	12	330	0.025	2.007	0.064	0.918	7.395	0.527	0.546	0.527	0.755	2.01	3.673	No	0.527	7.395
2955	8	271.72	0.018	0.573	0.008	0.236	4.769	0.526	0.544	0.35	0.446	1.59	1.054	No	0.35	4.769
2918	10	220.036	0.022	1.155	0.017	0.51	6.14	0.526	0.545	0.439	0.6	1.83	2.119	No	0.439	6.14
1303	12	380.595	0.015	1.562	0.03	0.707	5.777	0.526	0.544	0.526	0.666	1.573	2.872	Yes	0.542	5.558
168	12	185.223	0.005	0.923	0.026	0.393	3.413	0.526	0.544	0.526	0.506	0.929	1.696	No	0.526	3.413
3151	12	337	0.017	1.64	0.023	0.75	6.057	0.526	0.545	0.526	0.682	1.648	3.011	Yes	0.528	6.032
9423	12	349	0.024	1.962	0.06	0.897	7.255	0.526	0.544	0.526	0.747	1.975	3.607	No	0.526	7.255
4939	8	331.995	0.024	0.662	0.01	0.276	5.512	0.525	0.543	0.35	0.48	1.839	1.219	Yes	0.518	3.516
9422	12	340.1	0.024	1.954	0.055	0.895	7.234	0.525	0.543	0.525	0.745	1.971	3.598	No	0.525	7.234

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
7774	10	243.46	0.003	0.407	0.008	0.161	2.171	0.524	0.542	0.437	0.349	0.649	0.75	No	0.437	2.171
9484	10	299.7	0.004	0.476	0.015	0.189	2.544	0.524	0.541	0.437	0.378	0.76	0.88	No	0.437	2.544
1252	10	244.85	0.012	0.841	0.014	0.359	4.505	0.523	0.539	0.436	0.51	1.348	1.558	No	0.436	4.505
1299	12	224.65	0.014	1.456	0.029	0.654	5.418	0.523	0.539	0.523	0.642	1.48	2.699	No	0.523	5.418
3284	12	386	0.017	1.598	0.037	0.722	5.952	0.523	0.539	0.523	0.674	1.626	2.966	Yes	0.546	5.641
4818	8	247.212	0.01	0.424	0.012	0.167	3.561	0.522	0.538	0.348	0.382	1.193	0.789	No	0.348	3.561
7341	10	346	0.004	0.481	0.011	0.193	2.589	0.522	0.537	0.435	0.381	0.776	0.897	No	0.435	2.589
8334	10	349.2	0.004	0.481	0.011	0.193	2.587	0.522	0.537	0.435	0.381	0.775	0.896	No	0.435	2.587
2927	12	330	0.017	1.642	0.039	0.743	6.124	0.522	0.538	0.522	0.683	1.675	3.053	No	0.522	6.124
10369	8	149.4	0.01	0.418	0.01	0.165	3.515	0.521	0.536	0.347	0.379	1.179	0.779	No	0.347	3.515
3792	8	307.6	0.018	0.562	0.008	0.231	4.723	0.521	0.536	0.348	0.442	1.583	1.047	No	0.348	4.723
4130	12	356	0.01	1.242	0.084	0.52	4.646	0.521	0.536	0.521	0.591	1.272	2.319	No	0.521	4.646
10379	8	110.2	0.01	0.418	0.01	0.165	3.525	0.52	0.534	0.347	0.379	1.184	0.782	No	0.347	3.525
3809	8	255.177	0.015	0.506	0.01	0.205	4.271	0.52	0.534	0.347	0.418	1.435	0.948	Yes	0.363	4.026
678	8	334.984	0.009	0.4	0.015	0.155	3.378	0.52	0.534	0.347	0.37	1.134	0.75	No	0.347	3.378
302	10	224.4	0.014	0.906	0.025	0.385	4.889	0.52	0.534	0.433	0.53	1.469	1.695	No	0.433	4.889
670	12	356	0.018	1.633	0.039	0.739	6.117	0.52	0.535	0.52	0.681	1.677	3.054	No	0.52	6.117
10382	8	37.8	0.01	0.418	0.01	0.165	3.534	0.519	0.532	0.346	0.379	1.189	0.785	No	0.346	3.534
3505	8	406	0.022	0.622	0.01	0.258	5.257	0.519	0.533	0.346	0.465	1.767	1.167	Yes	0.383	4.636
7344	10	352.1	0.008	0.667	0.014	0.277	3.614	0.519	0.532	0.432	0.452	1.088	1.255	No	0.432	3.614
2924	12	325.2	0.018	1.638	0.039	0.741	6.153	0.519	0.532	0.519	0.682	1.689	3.075	Yes	0.521	6.131
9429	12	332.5	0.026	1.97	0.06	0.901	7.398	0.519	0.533	0.519	0.748	2.03	3.696	No	0.519	7.398
9430	12	332.8	0.026	1.97	0.06	0.901	7.398	0.519	0.533	0.519	0.748	2.03	3.696	No	0.519	7.398
9433	12	378.1	0.026	1.975	0.061	0.903	7.419	0.519	0.533	0.519	0.749	2.037	3.708	No	0.519	7.419
7456	8	229.7	0.033	0.749	0.055	0.296	6.355	0.518	0.53	0.345	0.51	2.14	1.413	No	0.345	6.355
8200	8	341.4	0.004	0.259	0.005	0.098	2.198	0.518	0.53	0.345	0.295	0.74	0.489	No	0.345	2.198
8555	8	309.6	0.01	0.422	0.007	0.168	3.58	0.518	0.53	0.345	0.381	1.206	0.796	Yes	0.407	2.927
301	10	292.9	0.015	0.912	0.025	0.388	4.952	0.518	0.53	0.431	0.532	1.492	1.72	No	0.431	4.952
5986	8	239.4	0.022	0.617	0.018	0.252	5.246	0.517	0.529	0.344	0.463	1.769	1.167	No	0.344	5.246
9149	8	285	0.016	0.524	0.008	0.214	4.452	0.517	0.529	0.345	0.426	1.501	0.991	No	0.345	4.452
9726	8	250	0.005	0.285	0.02	0.103	2.419	0.517	0.53	0.345	0.31	0.815	0.538	No	0.345	2.419
3334	10	343.172	0.015	0.923	0.025	0.393	5.015	0.517	0.53	0.431	0.535	1.511	1.743	No	0.431	5.015
9417	12	350	0.014	1.421	0.036	0.633	5.364	0.517	0.53	0.517	0.634	1.476	2.684	No	0.517	5.364
2939	8	216.329	0.017	0.53	0.013	0.214	4.526	0.515	0.525	0.343	0.428	1.53	1.009	Yes	0.441	3.342
2954	8	345.005	0.019	0.566	0.008	0.233	4.829	0.515	0.526	0.344	0.443	1.631	1.076	Yes	0.378	4.292
3379	10	406	0.015	0.914	0.014	0.394	4.995	0.515	0.526	0.429	0.532	1.509	1.739	No	0.429	4.995
7340	10	256.37	0.004	0.481	0.011	0.193	2.634	0.515	0.525	0.429	0.381	0.797	0.917	Yes	0.833	1.366
9148	8	286	0.016	0.514	0.007	0.21	4.404	0.514	0.524	0.343	0.422	1.491	0.982	Yes	0.343	4.404
9150	8	86	0.016	0.519	0.008	0.212	4.447	0.514	0.524	0.343	0.424	1.505	0.992	Yes	0.344	4.431
3020	8	151.25	0.017	0.525	0.013	0.212	4.51	0.513	0.522	0.342	0.427	1.528	1.007	Yes	0.342	4.499
4173	8	303.661	0.006	0.306	0.003	0.119	2.625	0.513	0.522	0.342	0.322	0.889	0.586	Yes	0.351	2.537
9591	8	350	0	0.013	0	0.004	0.111	0.513	0.523	0.342	0.064	0.038	0.025	No	0.342	0.111
9419	12	210.5	0.026	1.926	0.053	0.882	7.349	0.513	0.522	0.513	0.74	2.033	3.691	No	0.513	7.349
7454	8	300.5	0.034	0.751	0.055	0.297	6.457	0.512	0.521	0.342	0.511	2.19	1.442	No	0.342	6.457
1302	12	319.175	0.017	1.544	0.03	0.698	5.908	0.512	0.52	0.512	0.662	1.637	2.97	Yes	0.519	5.808
2899	12	220.358	0.015	1.458	0.029	0.655	5.578	0.512	0.52	0.512	0.642	1.545	2.804	Yes	0.637	4.274
3001	8	185.131	0.017	0.535	0.012	0.217	4.623	0.51	0.517	0.34	0.431	1.572	1.034	Yes	0.35	4.461
1140	10	245.836	0.011	0.76	0.019	0.318	4.202	0.51	0.517	0.425	0.483	1.278	1.469	No	0.425	4.202
9727	8	266.88	0.004	0.265	0.018	0.095	2.295	0.509	0.515	0.339	0.298	0.782	0.514	Yes	0.342	2.271
8390	12	321.6	0.015	1.45	0.039	0.646	5.586	0.509	0.515	0.509	0.641	1.553	2.815	No	0.509	5.586
5317	8	349.969	0.019	0.555	0.006	0.229	4.817	0.508	0.514	0.339	0.439	1.642	1.079	Yes	0.349	4.641
1300	12	379.55	0.015	1.456	0.029	0.654	5.629	0.508	0.513	0.508	0.642	1.568	2.839	No	0.508	5.629
2366	12	320.993	0.015	1.448	0.039	0.645	5.589	0.508	0.514	0.508	0.64	1.555	2.817	Yes	0.509	5.584
10344	8	84.6	0.006	0.302	0.002	0.118	2.631	0.507	0.513	0.338	0.32	0.898	0.59	Yes	0.46	1.821
1301	12	300.881	0.015	1.458	0.029	0.655	5.64	0.507	0.512	0.507	0.642	1.571	2.845	No	0.507	5.64
9512	12	94.5	0.008	1.031	0.018	0.449	3.993	0.507	0.512	0.507	0.536	1.113	2.015	Yes	0.574	3.422
6370	12	296.09	0.003	0.612	0.01	0.253	2.376	0.506	0.51	0.506	0.408	0.663	1.2	Yes	0.534	2.217
177	10	191.634	0.017	0.933	0.015	0.403	5.22	0.505	0.509	0.421	0.538	1.597	1.832	Yes	0.471	4.539
3382	10	415.212	0.016	0.912	0.014	0.393	5.105	0.505	0.509	0.421	0.532	1.562	1.791	Yes	0.425	5.043
3041	8	193.158	0.016	0.498	0.012	0.2	4.369	0.504	0.507	0.336	0.415	1.497	0.982	Yes	0.339	4.321
8201	8	306.6	0.004	0.259	0.005	0.098	2.276	0.504	0.506	0.336	0.295	0.78	0.512	No	0.336	2.276
9473	8	287.2	0.005	0.277	0.014	0.102	2.432	0.504	0.507	0.336	0.306	0.833	0.547	Yes	0.544	1.406
9487	8	302.21	0.005	0.269	0.009	0.101	2.363	0.504	0.507	0.336	0.301	0.809	0.531	Yes	0.447	1.675
9425	12	351.3	0.028	1.962	0.06	0.897	7.66	0.504	0.506	0.504	0.747	2.144	3.876	No	0.504	7.66
3300	12	133.004	0.018	1.552	0.036	0.699	6.063	0.503	0.506	0.503	0.663	1.698	3.069	No	0.503	6.063
10381	8	110.4	0.011	0.418	0.01	0.165	3.696	0.501	0.501	0.334	0.379	1.272	0.833	No	0.334	3.696
10383	8	110.2	0.011	0.418	0.01	0.165	3.698	0.501	0.501	0.334	0.379	1.273	0.834	No	0.334	3.698

ID	Diameter (in)	Length (ft)	Slope	Total Flow	Unpeakable Flow (mgd)	Peakable Flow (mgd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (mgd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
2837	8	211.483	0.02	0.562	0.015	0.228	4.971	0.501	0.502	0.334	0.442	1.71	1.12	No	0.334	4.971
762	8	227.465	0.013	0.441	0.013	0.174	3.895	0.501	0.502	0.334	0.389	1.34	0.878	Yes	0.378	3.335
3105	8	445	0.004	0.248	0.003	0.094	2.195	0.5	0.5	0.333	0.288	0.756	0.495	Yes	0.481	1.421
3077	12	331.998	0.022	1.717	0.025	0.789	6.763	0.5	0.5	0.5	0.699	1.901	3.433	Yes	0.564	5.824
5581	15	339.655	0.004	2.627	0.081	1.236	3.779	0.819	0.999	1.024	0.816	0.63	2.629	Yes	1.25	3.312
4066	15	360.999	0.002	2.086	0.045	0.969	3.004	0.818	0.998	1.022	0.724	0.502	2.09	Yes	1.229	2.64
5580	15	323.946	0.003	2.368	0.075	1.102	3.458	0.806	0.984	1.007	0.773	0.589	2.406	Yes	1.25	2.986
1442	24	371.491	0.018	18.707	0.829	10.521	11.087	0.774	0.945	1.549	1.845	1.564	19.791	Yes	2	9.213
3742	18	10.4	0.001	1.992	0.064	0.911	2.102	0.773	0.944	1.16	0.668	0.343	2.111	Yes	1.5	1.744
8617	24	324.418	0.019	18.717	0.833	10.525	11.254	0.763	0.93	1.527	1.846	1.612	20.119	Yes	2	9.218
8616	27	112.563	0.01	18.717	0.833	10.525	8.959	0.758	0.923	1.705	1.869	1.219	20.286	Yes	2.25	7.283
1909	21	101.405	0.001	2.654	0.082	1.25	2.105	0.756	0.92	1.323	0.74	0.326	2.884	Yes	1.75	1.707

Appendix F

CIP Summary Sheets

Project Title: Palmetto Ave and Valley Blvd

Project ID	Project Type	Existing Facility	Improvement Phase
H-1	Diversion Structure	No Facility	Near-Term

2023 Cost Estimate $128,000

Project Location: Intersection of Palmetto Avenue and Valley Boulevard

Purpose: Address potential capacity (depth over-diameter (d/D) ratios) issues for existing sewerlines downstream of targeted diversion structure.

Proposed Facility: Install diversion sluice gate to divert flow into 15-inch dia. parallel line in Valley Blvd.

Required When: Recommended prior to any new construction upstream

Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 11125 (Valley Blvd.) - 10 inch dia.	450,000	225,000	448,000

Project Description:

This project will install a new stainless steel sluice gate within the existing manhole on Valley Blvd where Pipe 5208 (10-inch dia.) splits into a 10-inch and 15-inch parallel gravity mains. Divert at minimum 50% of flow to 15-inch sewerline.

Project Map

Project Title: Alder Ave and Hawthorne Ave (GM)

Project ID	Project Type	Existing Facility	Improvement Phase
H-2	Gravity Pipeline	6" Diameter	Near-Term

2023 Cost Estimate $669,000

Project Location: Alder Avenue from Athol Street to Hawthorne Avenue

Purpose: Address capacity (depth over-diameter (d/D) ratios) for existing 6-in sewer that have surpassed District d/D standards in Alder Avenue.

Proposed Facility: Approximately 1,350 LF of 10-inch diameter VCP or PVC pipe

Required When: Recommended prior to any new construction upstream

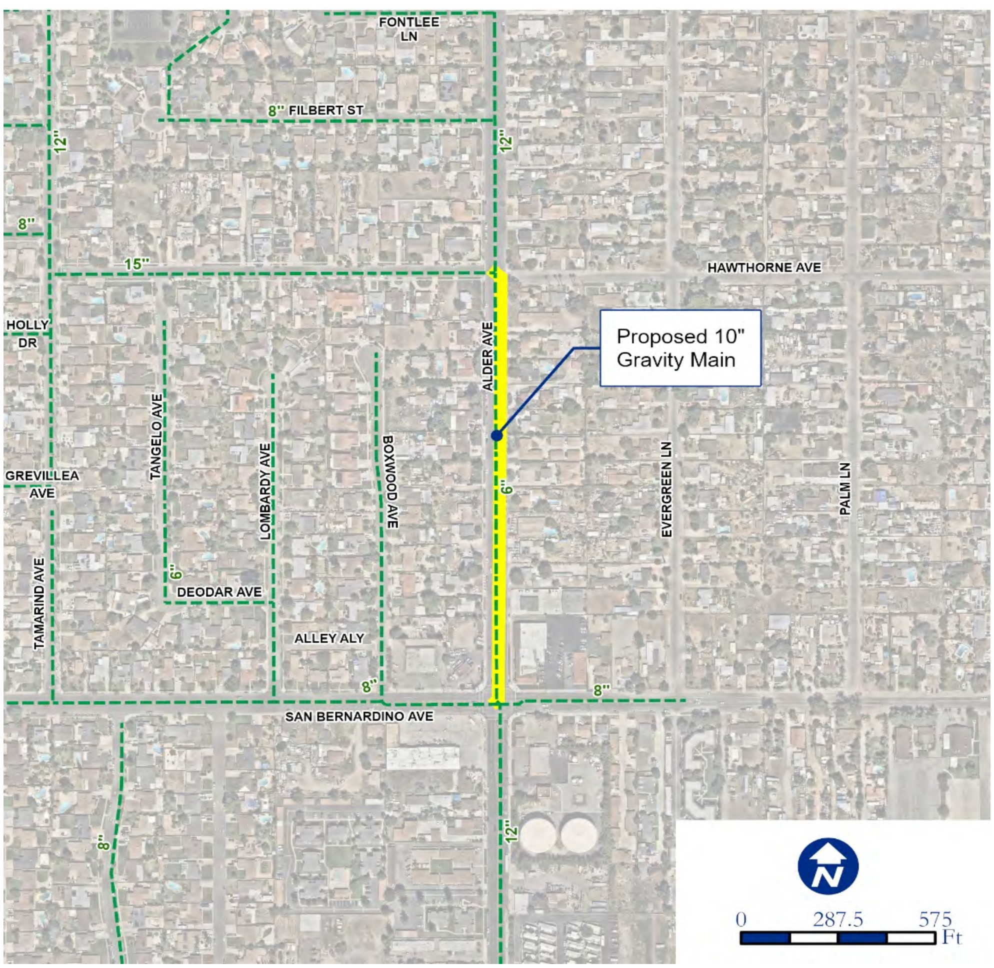
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 5137 (Alder Ave.) - 6 inch dia.	487,000	208,000	414,000

Project Description:

This project will upsize the existing pipeline in Alder Avenue to 10-inch diameter with capacity to convey flows from upstream developments north of Hawthorne Avenue.

Project Map



Project Title: Alder Ave and Hawthorne Ave (DS)

Project ID	Project Type	Existing Facility	Improvement Phase
H-3	Diversion Structure	No Facility	Near-Term

2023 Cost Estimate $128,000

Project Location: Intersection of Alder Avenue and Hawthorne Ave

Purpose: Address potential capacity (depth over-diameter (d/D) ratios) issues for existing sewerlines downstream of targeted diversion structure.

Proposed Facility: Install diversion sluice gate to split flow into exist. 15-inch dia. line in Hawthorne Ave. and proposed 8-inch dia. line in Alder Ave

Required When: In conjunction with Project H-2

Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 8910 (Hawthorne Ave.) - 15 inch dia.	1,028,000	1,701,000	1,867,000
Pipe 8911 (Alder Ave.) - 6 inch dia.	414,000	82,000	414,000

Project Description:

This project will install a new stainless steel sluice gate within the existing manhole L24_41 at Hawthorne Ave/Alder Ave. Proposed structure to split 50% flows into existing 15-inch dia. sewerline in Hawthorne Ave and proposed 8-inch dia. sewerline in Alder Ave.

Project Map

Project Title: Granada Ave and Alder Ave

Project ID	Project Type	Existing Facility	Improvement Phase
H-4	Gravity Pipeline	8"-10" Diameter	Near-Term

2023 Cost Estimate $2,436,000

Project Location: Alder Avenue from Athol Street to Hawthorne Avenue

Purpose: Address capacity (depth over-diameter (d/D) ratios) for existing 8-in and 10-in sewer that have surpassed District d/D standards in Granada Ave, Laurel Ave, and Athol St.

Proposed Facility: Approximately 1,350 LF of 12-inch diameter VCP or PVC pipe
Approximately 1,800 LF of 15-inch diameter VCP or PVC pipe

Required When: Recommended prior to any new construction upstream

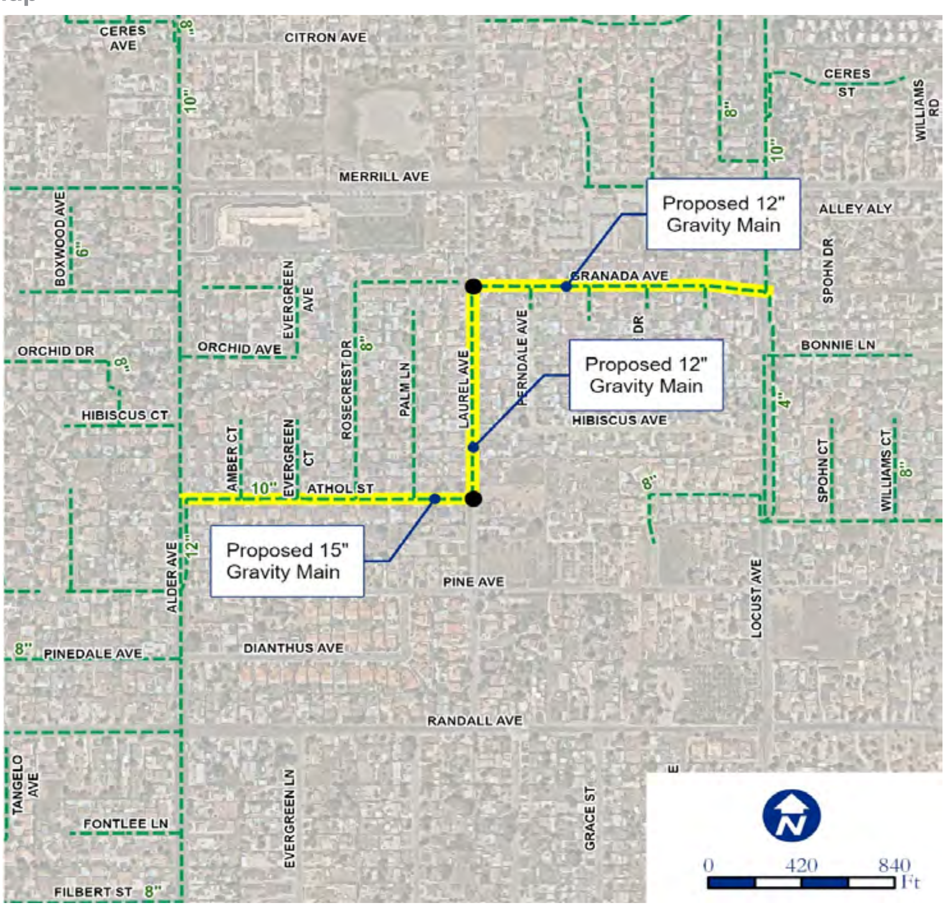
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 1759 (Granada Ave.) - 8 inch dia.	506,000	328,000	654,000
Pipe 4224 (Laurel Ave.) - 8 inch dia.	517,000	304,000	605,000
Pipe 351 (Athol St.) - 10 inch dia.	575,000	389,000	776,000

Project Description:

This project will upsize the existing pipelines in Granada Ave. and Laurel Ave. to 12-inch dia., as well as the pipeline in Athol St. to 15-inch dia with capacity to convey flows from upstream developments north of Granada Avenue.

Project Map



Project Title: Marygold Ave and Palmetto Ave

Project ID	Project Type	Existing Facility	Improvement Phase
H-5	Gravity Pipeline	10" Diameter	Near-Term

2023 Cost Estimate $780,000

Project Location: Alder Avenue from Athol Street to Hawthorne Avenue

Purpose: Address capacity (depth over-diameter (d/D) ratios) for existing 10-in sewer that have surpassed District d/D standards in Palmetto Ave

Proposed Facility: Approximately 1,300 LF of 15-inch diameter VCP or PVC pipe

Required When: Recommended prior to any new construction upstream

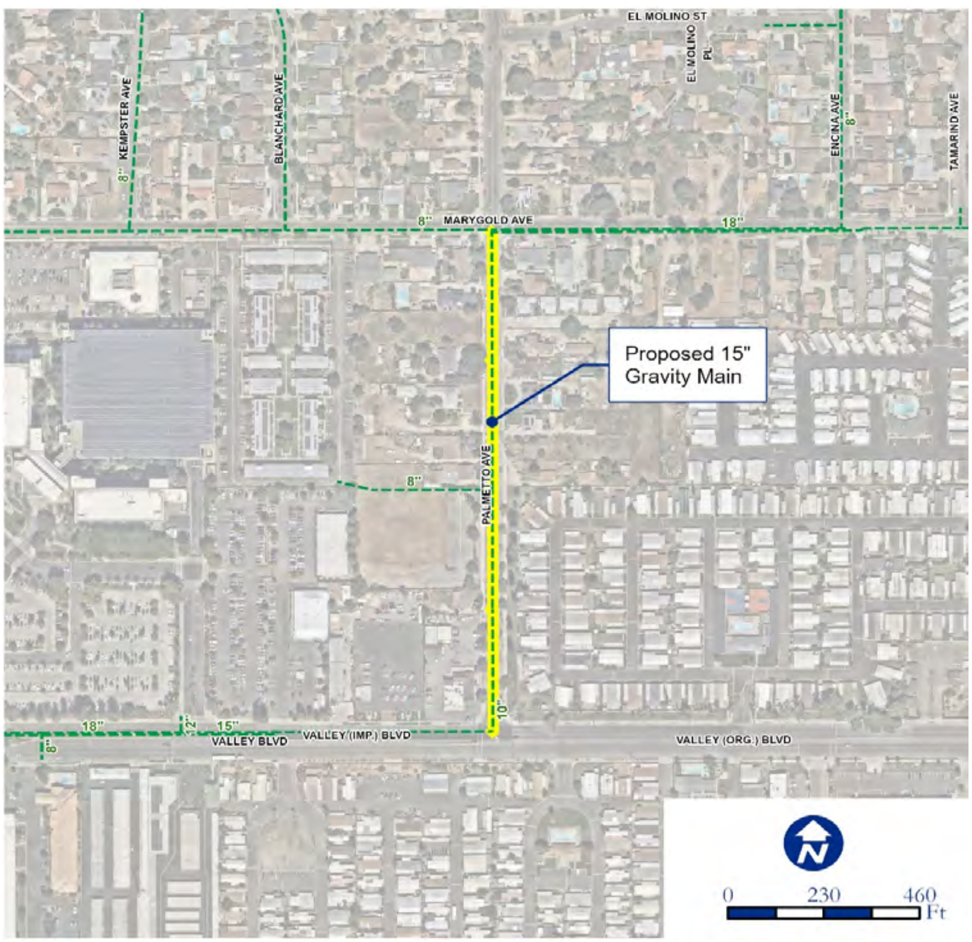
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 8392 (Palmetto Ave.) - 10 inch dia.	830,000	449,000	896,000

Project Description:

This project will upsize the existing 10-inch sewerline in Palmetto Ave to 15-inch dia. providing additional capacity to convey flows southwest into the dual gravity mains in Valley Blvd.

Project Map



Project Title: Juniper Ave and Randall Ave

Project ID	Project Type	Existing Facility	Improvement Phase
H-6	Gravity Pipeline	18" Diameter	Near-Term

2023 Cost Estimate **$2,134,000**

Project Location: Alder Avenue from Athol Street to Hawthorne Avenue

Purpose: Address capacity (depth over-diameter (d/D) ratios) for existing 18-in sewer that have surpassed District d/D standards in Filbert St and Cypress Ave.

Proposed Facility: Approximately 2,650 LF of 24-inch diameter VCP or PVC pipe

Required When: Recommended prior to any new construction upstream

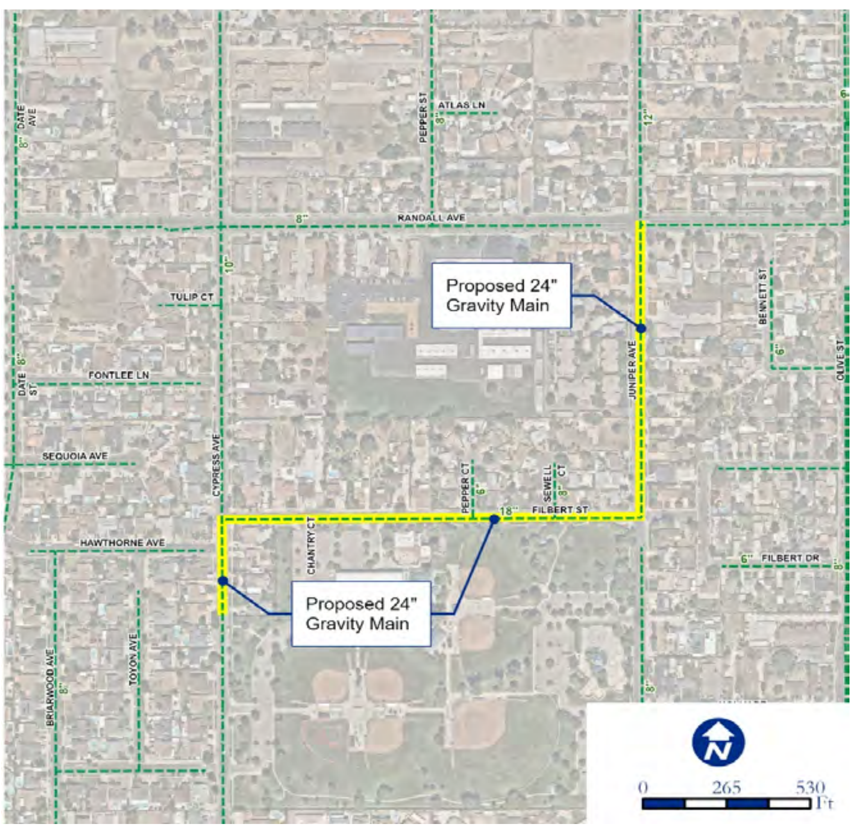
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 3069 (Juniper Ave.) - 18 inch dia.	3,717,000	7,823,000	8,583,000
Pipe 2221 (Filbert St.) - 18 inch dia.	3,727,000	2,766,000	3,035,000
Pipe 2222 (Cypress Ave.) - 18 inch dia.	4,014,000	2,766,000	3,035,000

Project Description:

This project will upsize the existing 18-inch sewerline in Juniper Ave, Filbert St, and Cypress Ave to 24-inch dia. providing additional capacity to convey flows south into Cypress Ave.

Project Map



Project Title: Oleander Ave and Orange Way

Project ID	Project Type	Existing Facility	Improvement Phase
H-7	Gravity Pipeline	10"-12" Diameter	Near-Term

2023 Cost Estimate $714,000

Project Location: Portion of Orange Way and Oleander Ave. north of railroad (RR)

Purpose: Address capacity (depth over-diameter (d/D) ratios) for existing 10-in and 12-in sewer that have surpassed District d/D standards in Orange Way and Oleander Ave.

Proposed Facility: Approximately 300 LF of 10-inch diameter VCP or PVC pipe
Approximately 1,000 LF of 12-inch diameter VCP or PVC pipe
Lower MH I21_22 invert elevation to improve slope

Required When: Recommended prior to any new construction upstream

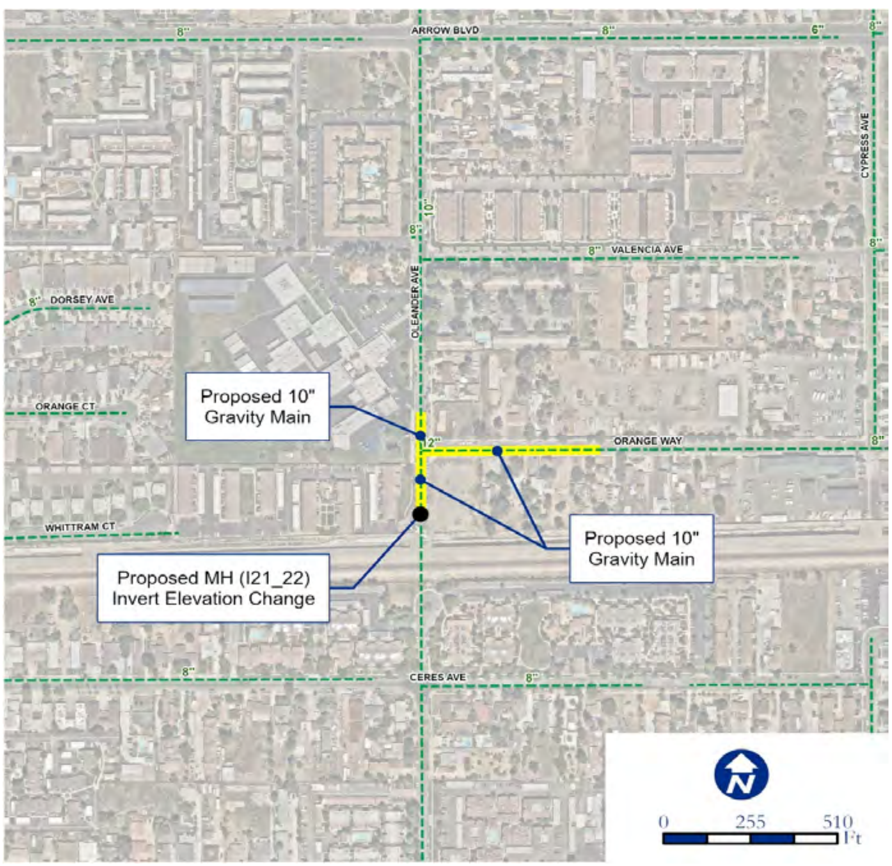
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 1178 (Orange Way) - 12 inch dia.	1,030,000	939,000	1,030,000
Pipe 3028 (Oleander Ave.) - 12 inch dia.	1,261,000	1,150,000	1,261,000

Project Description:

This project's primary objective is to lower the existing invert elevation of manhole I21_22, increasing upstream slope and improving hydraulic deficiencies just prior to RR crossing. Will effect upstream pipe ID 3611 (12-inch), 1178 (12-inch), 3027 (10-inch), and 3028 (12-inch) requiring replacement.

Project Map



ALBERT A. WEBB ASSOCIATES

https://webbassociates.sharepoint.com/sites/WEBBAQUA/Shared Documents/Projects/2022/22-0200/Reports/Master Plan/Appendix/Appendix F - CIP Summary.xlsx

Project Title: Westgate West SP (Ph. 1)

Project ID	Project Type	Existing Facility	Improvement Phase
H-8	Gravity Pipeline	None	Long-Term

2023 Cost Estimate $2,152,000

Project Location: Westgate Specific Plan between Victoria St and Baseline Ave

Purpose: Provide sewer backbone infrastructure for future Westgate (West) SP

Proposed Facility: Approx. 2,520 LF of 10-inch and 1,600 LF of 12-inch diameter VCP or PVC pipe

Required When: Recommended prior to development of Specific Plan

Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
-	-	-	-

Project Description:

This project installs the proposed 10-inch and 12-inch dia. backbone infrastructure piping for the Westgate Specific Plan connecting to a 21-inch dia. trunk line in Cherry Ave.

Project Map

https://webbassociates.sharepoint.com/sites/WEBBAQUA/Shared Documents/Projects/2022/22-0200/Reports/Master Plan/Appendix/Appendix F - CIP Summary.xlsx

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Project Title: Westgate East SP (Ph. 2)

Project ID	Project Type	Existing Facility	Improvement Phase
H-9	Gravity Pipeline	None	Long-Term

2023 Cost Estimate $1,695,000
Project Location: Walnut Ave between Cherry Ave and San Sevaine Rd
Purpose: Provide sewer backbone infrastructure for future Westgate (East) SP
Proposed Facility: Approximately 3,000 LF of 12-inch diameter VCP or PVC pipe
Required When: Recommended prior to development of Specific Plan

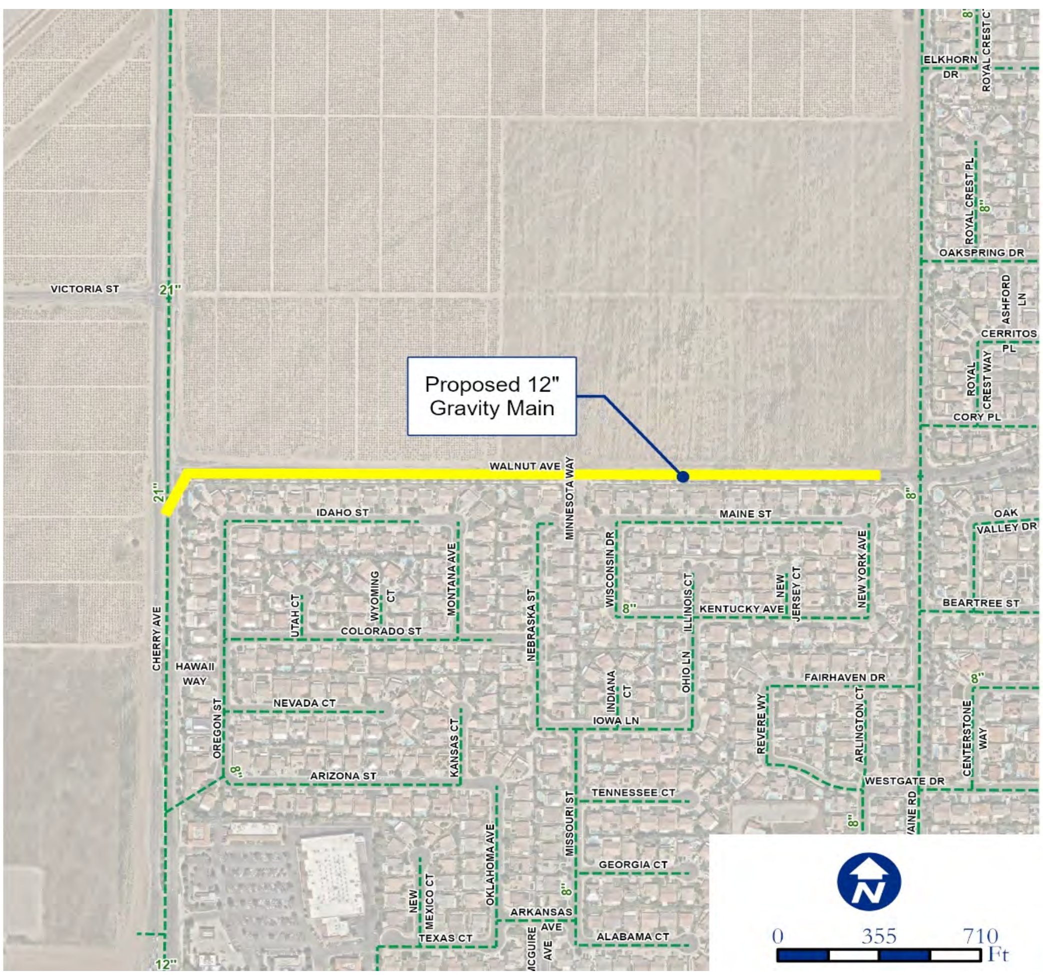
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
-	-	-	-

Project Description:

This project installs the proposed 12-inch dia. backbone infrastructure piping for the Westgate East Specific Plan connecting to a 21-inch dia. trunk line in Cherry Ave.

Project Map



Project Title: **Arboretum SP**

Project ID	Project Type	Existing Facility	Improvement Phase
H-10	Gravity Pipeline	None	Long-Term

2023 Cost Estimate $649,000

Project Location: Oak Grove Ave between Gardens St and Casa Grande Ave

Purpose: Provide sewer backbone infrastructure for future Arboretum SP

Proposed Facility: Approximately 1,310 LF of 10-inch diameter VCP or PVC pipe

Required When: Recommended prior to completion of Arboretum SP

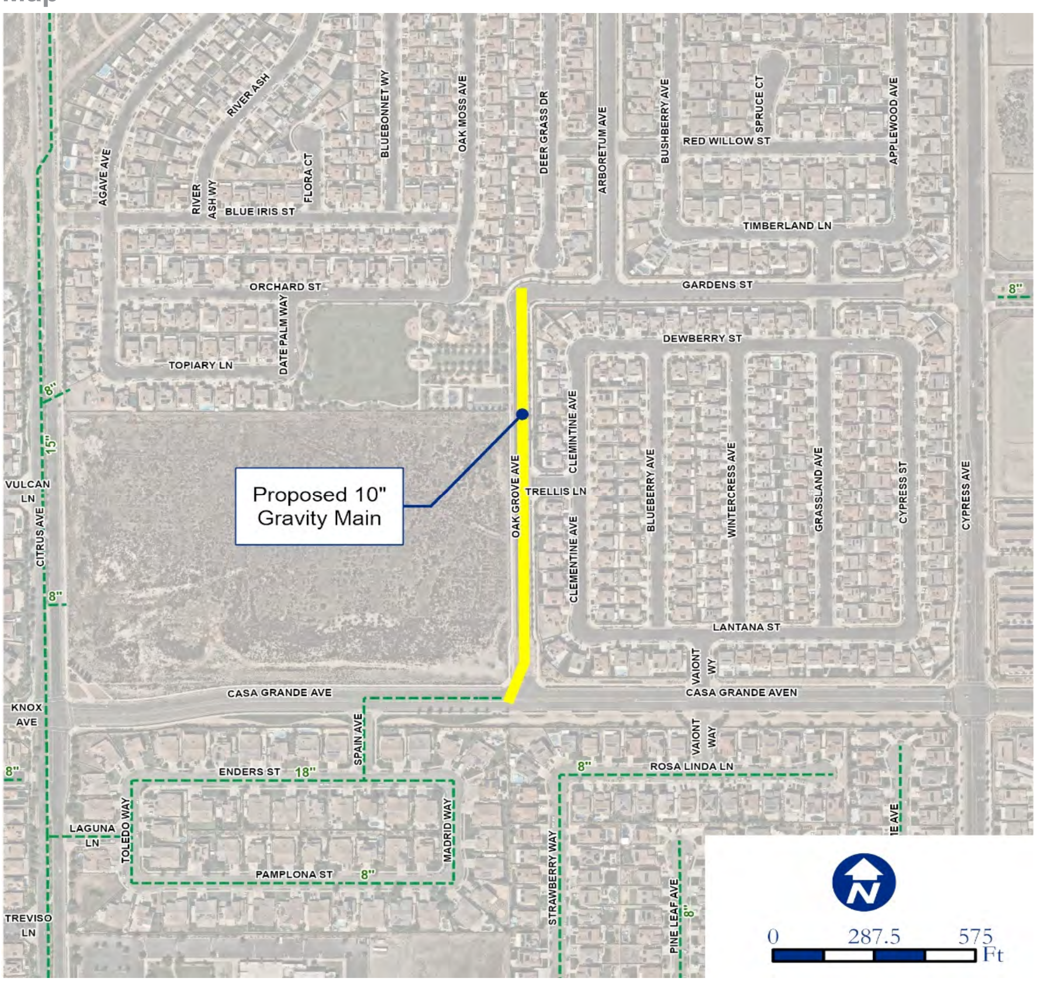
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd) for d/D limit	Available Capacity (gpd) for full-flow conditions
-	-	-	-

Project Description:

This project installs the proposed 10-inch dia. backbone infrastructure piping for the Arboretum Specific Plan connecting to an 18-inch dia. collector line in Casa Grande Ave.

Project Map



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Project Title: Tamarind Ave and Grevillea St

Project ID	Project Type	Existing Facility	Improvement Phase
H-11	Gravity Pipeline	15" Diameter	Long-Term

2023 Cost Estimate $1,273,000

Project Location: Alder Avenue from Athol Street to Hawthorne Avenue

Purpose: Address capacity (depth over-diameter (d/D) ratios) for existing 15-in sewer that are expected to surpass District d/D standards in Tamarind Ave, Grevillea Ave, and Palmetto Ave.

Proposed Facility: Approximately 1,900 LF of 18-inch diameter VCP or PVC pipe

Required When: An additional 380 EDU's are connected upstream of limiting segment

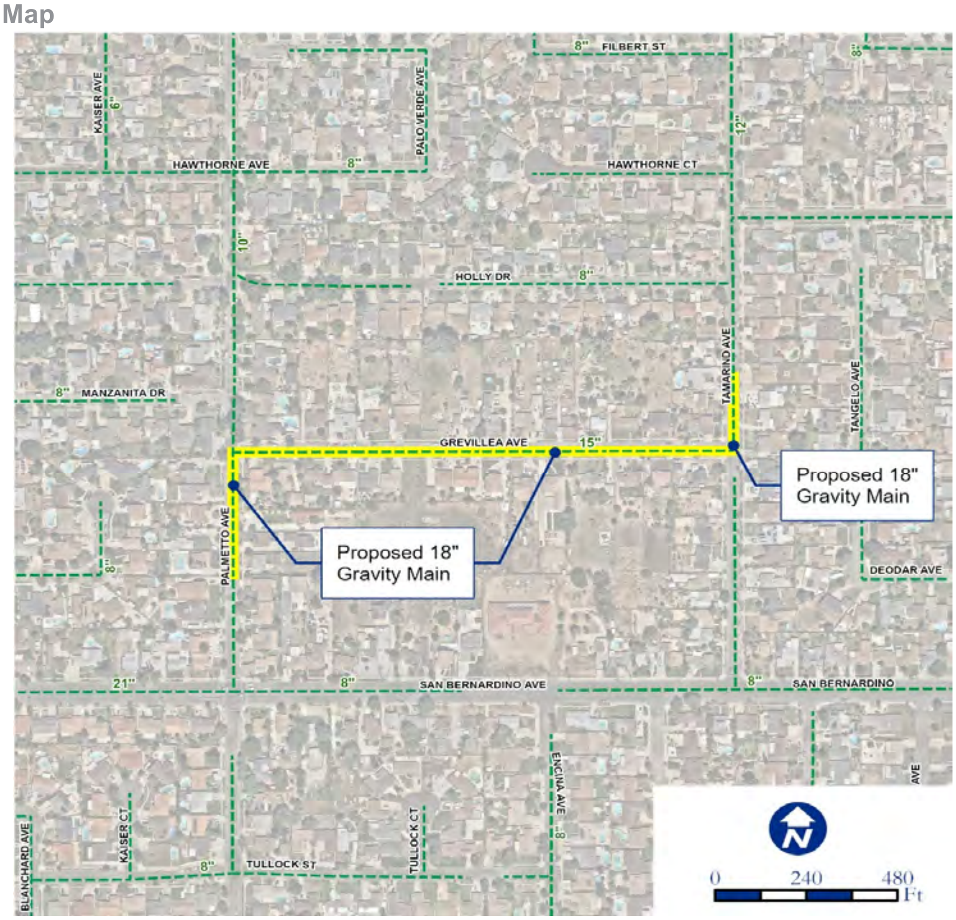
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd) for d/D limit	Available Capacity (gpd) for full-flow conditions
Pipe 1052 (Tamarind Ave.) - 15 inch dia.	1,842,000	2,084,000	2,286,000
Pipe 5580 (Grevillea Ave.) - 15 inch dia.	1,768,000	2,084,000	2,286,000
Pipe 5581 (Palmetto Ave.) - 15 inch dia.	2,127,000	2,406,000	2,640,000

Project Description:

This project will upsize the existing 15-inch sewerline in Tamarind Ave, Grevillea Ave, and Palmetto Ave to 18-inch dia. providing additional capacity to convey flows south into San Bernardino Ave.

Project Map



ALBERT A. WEBB ASSOCIATES

Project Title: Alder Ave and Pine Ave

Project ID	Project Type	Existing Facility	Improvement Phase
H-12	Gravity Pipeline	12" Diameter	Long-Term

2023 Cost Estimate $1,290,000

Project Location: Alder Avenue from Athol Street to Hawthorne Avenue

Purpose: Address capacity (depth over-diameter (d/D) ratios) for existing 12-in sewer that is expected to surpass District d/D standards in Alder Ave.

Proposed Facility: Approximately 2,150 LF of 15-inch diameter VCP or PVC pipe

Required When: An additional 510 EDU's are connected upstream of limiting segment

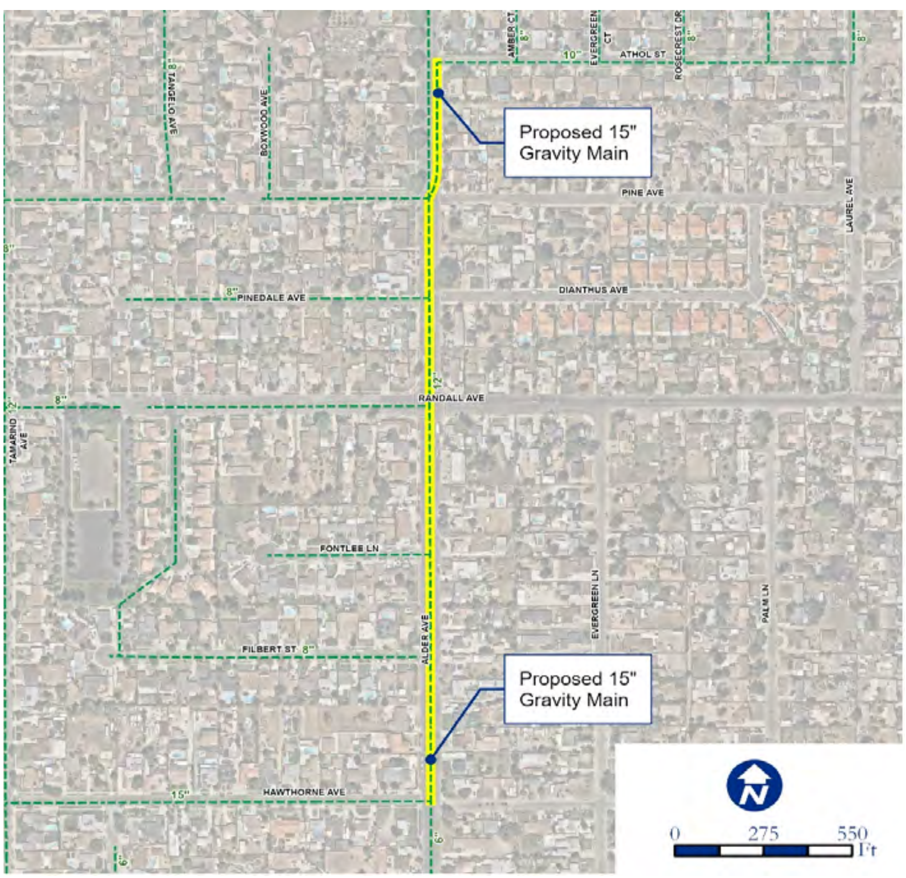
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 8909 (Alder Ave.) - 12 inch dia.	1,456,000	2,570,000	2,820,000

Project Description:

This project will upsize the existing 12-inch sewerline in Alder Ave providing additional capacity to convey flows south into San Bernardino Ave.

Project Map



Project Title: Arrow Blvd Interceptor

Project ID	Project Type	Existing Facility	Improvement Phase
S-1	Gravity Pipeline	None	Near-Term (in design)

2023 Cost Estimate $8,907,000

Project Location: Arrow Blvd from Beech Ave to Ilex St, Beech Ave from Muscat Ave to Arrow Bld

Purpose: Provide sewer infrastructure for unincorporated Fontana area and existing septic users

Proposed Facility: Approximately 7,700 LF of 15-inch diameter pipe, 5,300 LF of 12-inch diameter pipe, 2,350 LF of 8-inch diameter pipe. All VCP or PVC pipe.

Required When: An additional 510 EDU's are connected upstream of limiting segment

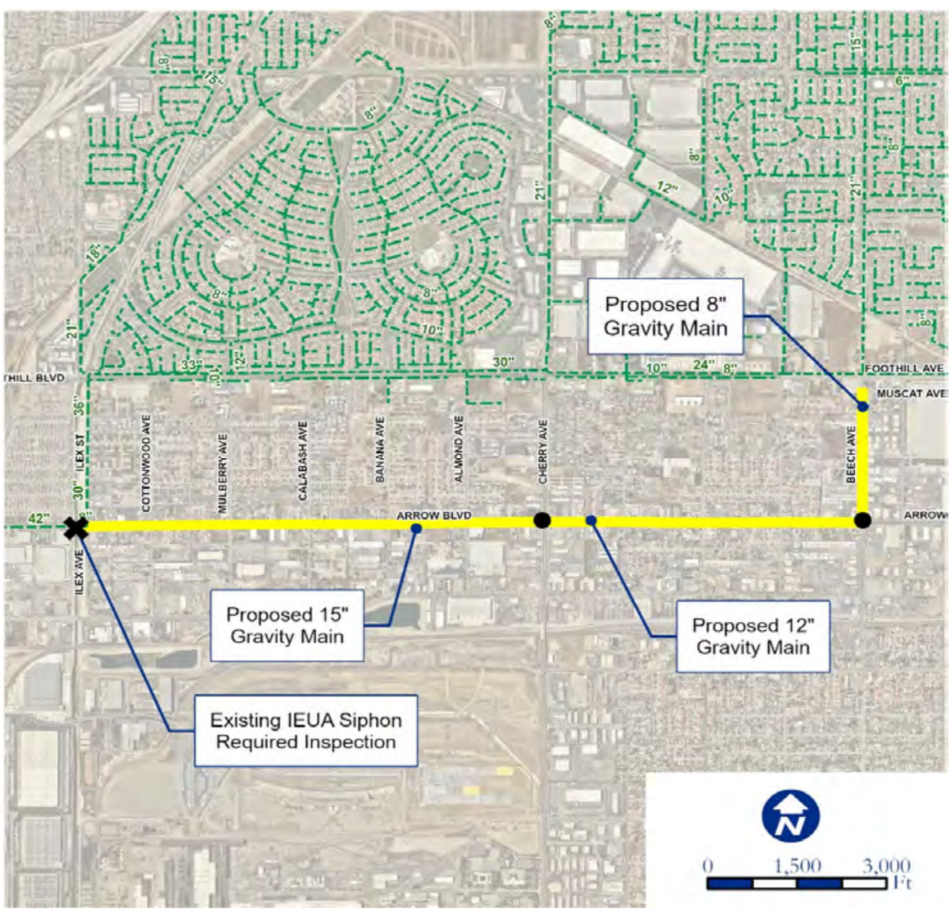
Project Hydraulics:

Limiting Segment	Existing Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 8909 (Alder Ave.) - 12 inch dia.	1,456,000	2,570,000	2,820,000

Project Description:

This project will upsize the existing 12-inch sewerline in Alder Ave providing additional capacity to convey flows south into San Bernardino Ave.

Project Map



ALBERT A. WEBB ASSOCIATES

https://webbassociates.sharepoint.com/sites/WEBBAQUA/Shared Documents/Projects/2022/22-0200/Reports/Master Plan/Appendix/Appendix F - CIP Summary.xlsx

Project Title: Maple Ave

Project ID	Project Type	Existing Facility	Improvement Phase
S-2	Gravity Pipeline	None	Long-Term

2023 Cost Estimate $6,354,250

Project Location: Maple Ave from Arrow Blvd to Randall Ave, Randall Ave from Maple Ave to Locust Ave, Locust Ave from Randall Ave to San Bernardino Ave, and San Bernardino Ave from Locust Ave to Alder Ave

Purpose: Provide sewer infrastructure for unincorporated Fontana area and existing septic users

Proposed Facility: Approximately 2,650 LF of 15-inch diameter pipe, 2,650 LF of 12-inch diameter pipe, 6,600 LF of 10-inch diameter pipe. All VCP or PVC pipe

Required When: An additional 510 EDU's are connected upstream of limiting segment

Project Hydraulics:

Downstream Segment	Ultimate Model Flow (gpd)	Available Capacity (gpd)	
		for d/D limit	for full-flow conditions
Pipe 11225 (San Bern. Ave.) - 15 inch dia	688,000	1,701,000	1,867,000

Project Description:

This project will provide sewer infrastructure to the eastern side of the City boundary that is currently on septic and/or fall within the unicorporated area within the service area. The proposed line will replace the Locust Lift Station and all tributary flows. To reduce downstream overflow, existing diversion manhole L24_41 will need to divert 35% of flow (max 0.86 MGD) southerly down Alder Ave with the remaining 65% draining west in Hawthorne Ave.

Project Map