

DRAFT

SEWER MASTER PLAN REPORT

CSA 70 BL Bloomington

September 2026



Prepared For

San Bernardino County Department of Public Works – Special Districts

222 W. Hospitality Lane, Second Floor
San Bernardino, CA 92415-0450

Ellie Hargrove

Project Manager

Prepared By

Michael Baker International

40180 County Center Drive, Suite 200
Temecula, CA 92591

Michael Baker
INTERNATIONAL

Miles Costanza, PE

Department Manager

Ivana Awayjan, EIT

Project Manager

Sydney Johnson, EIT

Design Engineer

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SECTION 1 - INTRODUCTION

1.1. PROJECT BACKGROUND

Michael Baker International was contracted by the San Bernardino County Department of Public Works – Special Districts (County) to prepare a Sewer Master Plan for County Service Area 70 Bloomington (CSA 70 BL), located within the Valley Corridor planning area. The purpose of this Sewer Master Plan is to provide a preliminary evaluation of existing and future wastewater service needs within CSA 70 BL and to assess the ability of the existing and planned wastewater collection system to accommodate projected growth. The study evaluates existing wastewater demands, develops future flow projections, identifies potential system constraints, and provides recommendations for future wastewater infrastructure improvements. The results of this study will support ongoing regional wastewater planning efforts and provide information that may be incorporated into future updates of the City of Rialto Wastewater Master Plan.

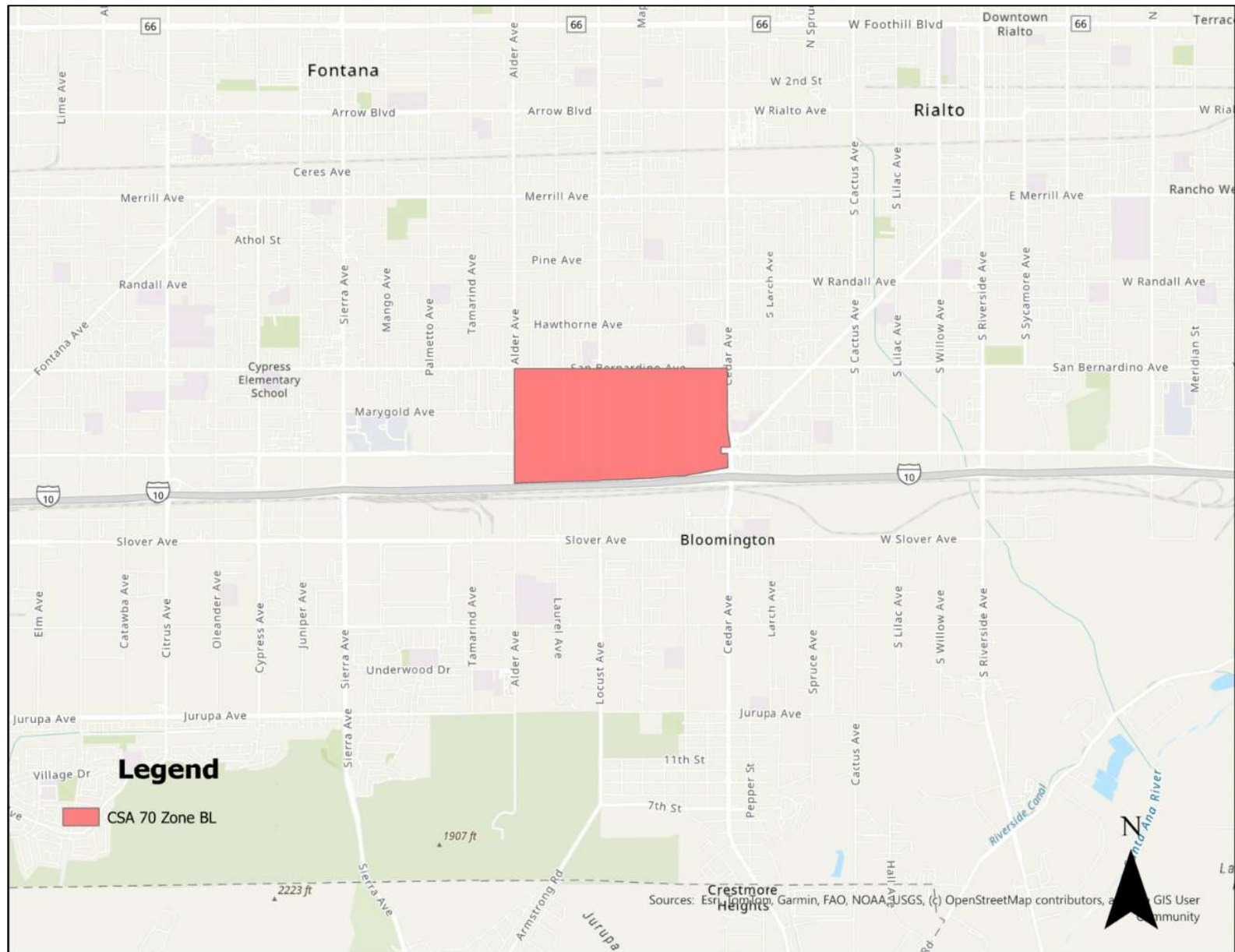
CSA 70 BL is currently pursuing sewer infrastructure improvements funded through the State Water Resources Control Board Clean Water State Revolving Fund (CWSRF) program. This Master Plan provides the technical planning basis for those improvements by evaluating existing system conditions, future wastewater demands, and the capacity of the existing and proposed sewer infrastructure to accommodate projected growth within the study area (Project).

The original study area generally focused on the existing CSA 70 BL boundary located within unincorporated San Bernardino County between the cities of Fontana and Rialto. The Valley Corridor is situated within the Bloomington community of the San Bernardino Valley and is generally bounded by San Bernardino Avenue to the north, Cedar Avenue to the east, Interstate 10 to the south, and Alder Avenue to the west, as shown in Figure 1. The project area lies within the City of Rialto's sphere of influence and is adjacent to the City of Fontana. Following review of the Draft Sewer Master Plan, the County requested that the planning evaluation be expanded to include an additional tributary area located north of the existing CSA 70 BL boundary. Although this area is not currently within CSA 70 BL and there are no existing plans to incorporate it into the service area, the County requested that it be evaluated from a planning perspective due to its location within the spheres of influence of the Cities of Rialto and Fontana and the potential for future development to impact regional wastewater service responsibilities.

The purpose of evaluating the additional tributary area is not to develop a separate sewer master plan for that area, but rather to assess how future wastewater flows generated within the tributary area could affect the capacity and performance of the existing and planned CSA 70 BL wastewater collection system. As such, the expanded planning effort focuses on development of wastewater demand projections, conveyance assumptions, and capacity screening of the existing and proposed CSA 70 BL sewer infrastructure under future buildout conditions.

Figure 2 illustrates both the existing CSA 70 BL service area boundary and the additional tributary area evaluated as part of this study. The distinction between these areas is important because the hydraulic analysis focuses on determining the impacts that future tributary area flows may have on the existing and planned wastewater infrastructure within CSA 70 BL.

Figure 1 CSA 70 Zone BL Boundary



1.2. REFERENCES

- City of Rialto Wastewater Master Plan (2022)
- San Bernardino County Valley Corridor Specific Plan (2017)
- County Service Area 70 Bloomington (BL) Sewer Service Feasibility Study for Sonora Tires (2025)
- County Service Area 70 Bloomington (BL) Sewer Service Feasibility Study for Arrow Plaza (2024)
- County Service Area 70 Bloomington (BL) Sewer Service Feasibility Study for Animal Shelter (2024)
- Marygold Mutual Water Company Water Usage Report
- Fontana Water Usage Report
- Marygold Mutual Water Company Domestic water availability assessment
- West Valley Water District Customer Average Daily Demand (HCF) Exhibit
- Existing As-built drawings for 18" sewer main on Valley Blvd, 8" sewer on Magnolia St, and Geneva manhole on Valley Blvd

1.3. TABLE OF ABBREVIATIONS

Table 1 – Table of Abbreviations

Abbreviation	Name
AC	Acres
ADWF	Average Dry Weather Flow
BL	Bloomington
CSA	County Service Area
EDU	Equivalent Dwelling Unit
FAR	Floor Area Ratio
FT	Feet
HCF	Hundred Cubic Feet
IN	Inch
PDWF	Peak Dry Weather Flow
PFU	Plumbing Fixture Units
RDII	Rainfall Dependent Inflow and Infiltration
ROW	Right of Way
VC/BE	Valley Corridor Bloomington Enterprise
VC/COM	Valley Corridor Commercial
VC/LMR	Valley Corridor Low/Medium Residential
VC/MHR	Valley Corridor Medium/High Residential
VC/MU	Valley Corridor Mixed Use
VCSP	Valley Corridor Specific Plan

SECTION 2 - EXISTING INFRASTRUCTURE

2.1. EXISTING WASTEWATER COLLECTION SYSTEM

2.1.1. Project Boundary

This study focuses on the area represented in Figure 2 below. Any parcels outside the boundary shown in Figure 2 are not a part of this study.

Figure 2 Sewer Master Plan Study Boundary



2.1.2. Existing Land Use

Existing land use within the study area consists primarily of industrial, commercial, residential, public, utility, and vacant properties located within CSA 70 BL and the Valley Corridor planning area. Land use information was obtained from County GIS resources, the Valley Corridor Specific Plan, and available planning documents to characterize existing development conditions and establish the basis for future wastewater demand projections.

The existing land use inventory was used to understand current development patterns, identify major wastewater contributors, and support evaluation of future land use buildout scenarios. Existing land use information also provides context for assessing future development potential within both the CSA 70 BL service area and the additional tributary area evaluated as part of this Master Plan.

For purposes of this Master Plan, existing wastewater demand was not developed using land use based flow estimates. Instead, existing wastewater demand was established using temporary flow monitoring data collected within the wastewater collection system. The monitored flow data provide a more representative assessment of actual system loading and serve as the basis for existing wastewater demand estimates and hydraulic model calibration. The temporary flow monitoring program described in Section 2.2.

2.1.3. Population Analysis

Wastewater demands are typically estimated based on population projection data to evaluate how they align with land use. However, population projection data was not available for the Project area, and therefore this approach was not utilized. Instead, wastewater flows were developed using land use based projections, which provide a more consistent and reliable basis for estimating wastewater generation. Land use data more directly reflects development patterns and associated wastewater demand, whereas population projections can vary depending on assumptions and may not fully capture non-residential contributions.

2.1.4. Existing Gravity Mains

The existing wastewater collection system within the study area consists primarily of a single 18-inch gravity sewer main located within Valley Boulevard extending from Alder Avenue east to Cedar Avenue. The 18-inch sewer serves as the primary trunk sewer within CSA 70 BL and conveys wastewater flows generated from existing development within the service area.

In addition to the 18-inch Valley Boulevard sewer, an existing 8-inch gravity sewer is located within Magnolia Street north of Valley Boulevard. At the time of this study, the Magnolia Street sewer was identified as an existing facility but was not assigned active tributary wastewater flow under existing conditions because no active tributary connections were identified. As such, the line was included in the hydraulic model geometry but carries no existing condition flow. Together, these facilities comprise the existing gravity sewer infrastructure evaluated as part of this Master Plan. See Figure 3 for the existing infrastructure.



Michael Baker
INTERNATIONAL

40810 COUNTY CENTER DR.,
SUITE 200
TEMECULA, CA 92591
PHONE: (951) 676-8042
MBAKERINTL.COM

FIGURE 3

EXISTING FACILITIES

2.2. TEMPORARY FLOW MONITORING

Utility Systems Science & Software (US3) conducted temporary flow monitoring at three locations within the CSA 70 BL wastewater collection system. Monitoring began on January 9, 2026, with flow monitors installed at the Linden Avenue Manhole (Location 2) and Valley Boulevard Manhole (Location 3). The monitor at the Locust Avenue Manhole (Location 1) was reinstalled on January 27, 2026, following identification of a reading error with the original installation. Data collected from the reinstalled monitor were reviewed and incorporated into the analysis.

Three monitoring locations were selected to characterize wastewater flows within the study area:

Location 1: Locust Avenue Manhole

Location 2: Linden Avenue Manhole

Location 3: Valley Boulevard Manhole (ultimate downstream monitoring location)

The monitoring data were evaluated to establish existing wastewater loading conditions and develop hydraulic model calibration parameters. Although Location 1 recorded the highest observed flow of **78.38 gpm on January 27, 2026**, the highest observed flows at Location 2 and Location 3 occurred on **January 12, 2026**, with measured flows of **98.78 gpm** and **153.51 gpm**, respectively.

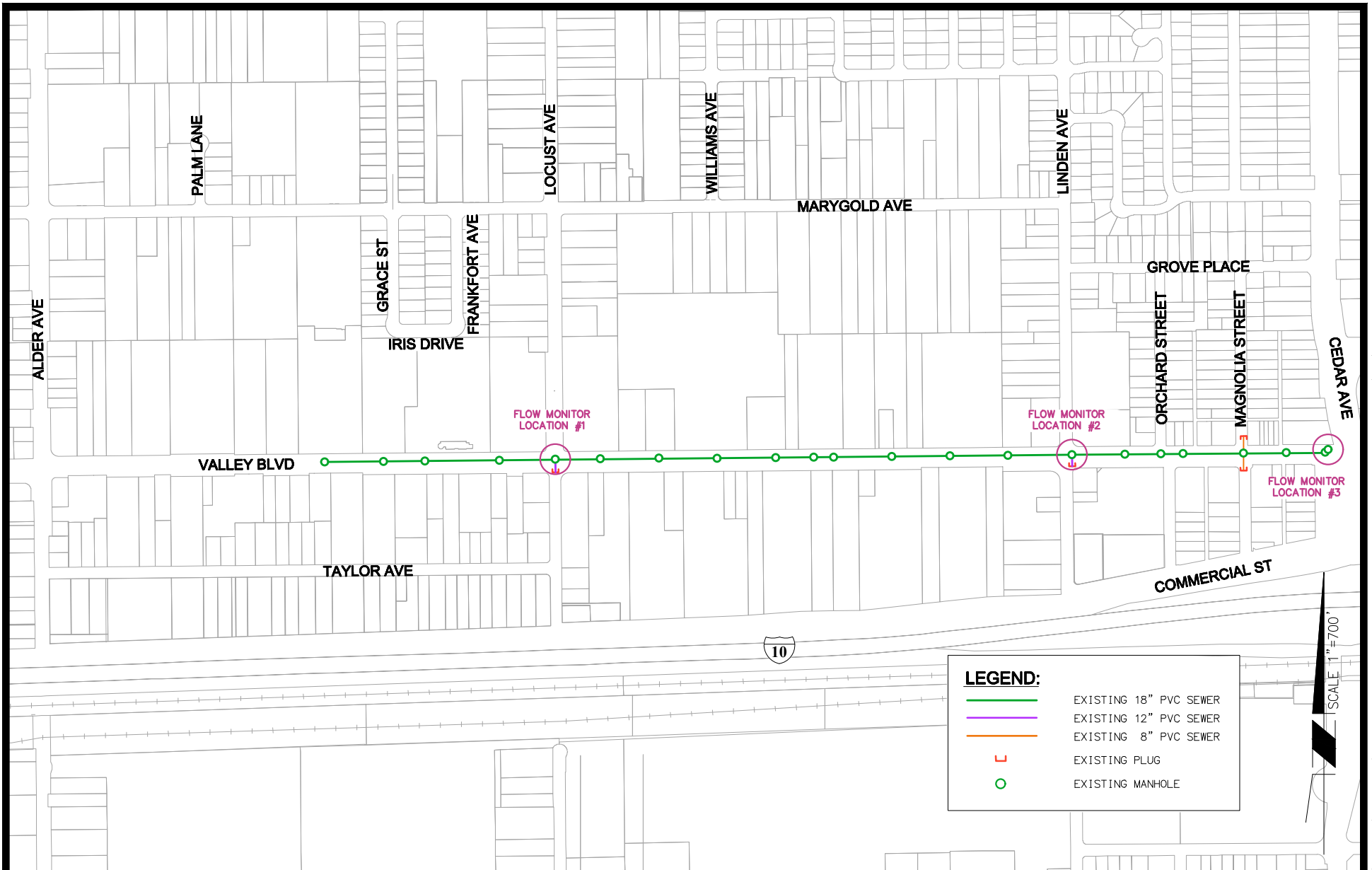
Because Location 3 represents the ultimate flow conveyed through the 18-inch trunk sewer, the January 12, 2026 monitoring data from this location were selected as the basis for development of the model diurnal pattern and evaluation of existing system loading conditions.

Existing wastewater demand estimates used in this Master Plan were developed from the temporary flow monitoring data rather than land use based assumptions. The monitored flows provide the basis for evaluating existing loading conditions within the collection system and for hydraulic model calibration.

The table below summarizes the flow monitoring results at each monitoring location. The complete Temporary Flow Monitoring Results are provided in Appendix A.

Table 2 Summary of Temporary Flow Monitoring

Location	Pipe Size (in)	Avg Velocity (fps)	Max Velocity (fps)	Avg Level (in)	Max Level (in)	Avg Flow (gpm)	Max Flow (gpm)
1	18	0.66	0.90	1.95	3.12	32.15	78.38
2	18	1.72	2.15	1.52	1.94	56.53	98.78
3	18	2.90	3.47	1.44	1.97	87.41	153.51



Michael Baker
INTERNATIONAL

40810 COUNTY CENTER DR.,
SUITE 200
TEMECULA, CA 92591
PHONE: (951) 676-8042
MBAKERINTL.COM

FIGURE 4

TEMPORARY FLOW MONITORING LOCATIONS

2.3. EXISTING WASTEWATER FLOWS

Existing wastewater flows were established using the temporary flow monitoring program described in Section 2.2. The monitored flow data provide a direct measurement of wastewater loading within the CSA 70 BL collection system and were used as the basis for hydraulic model development and evaluation of existing system performance.

2.3.1. Average Dry Weather Flow (ADWF)

The existing Average Dry Weather Flow (ADWF) values used in this Master Plan were developed directly from the monitored flow data and represent measured wastewater flows within the collection system. The monitored ADWF values were subsequently used to establish existing hydraulic model loading conditions and evaluate the performance of the existing wastewater infrastructure.

Table 2 summarizes the monitored flows utilized for hydraulic model development and existing system evaluation.

The flow monitoring data collected during the monitoring period were reviewed to identify representative dry weather conditions for hydraulic model development and calibration. The average flow observed at the downstream monitoring location was approximately **87.4 gpm**.

Future ADWF values were not based on monitored flow data. Instead, future wastewater flows were developed separately using land use-based wastewater generation calculations, as described in Section 3.2.

2.3.2. Peak Dry Weather Flow (PDWF)

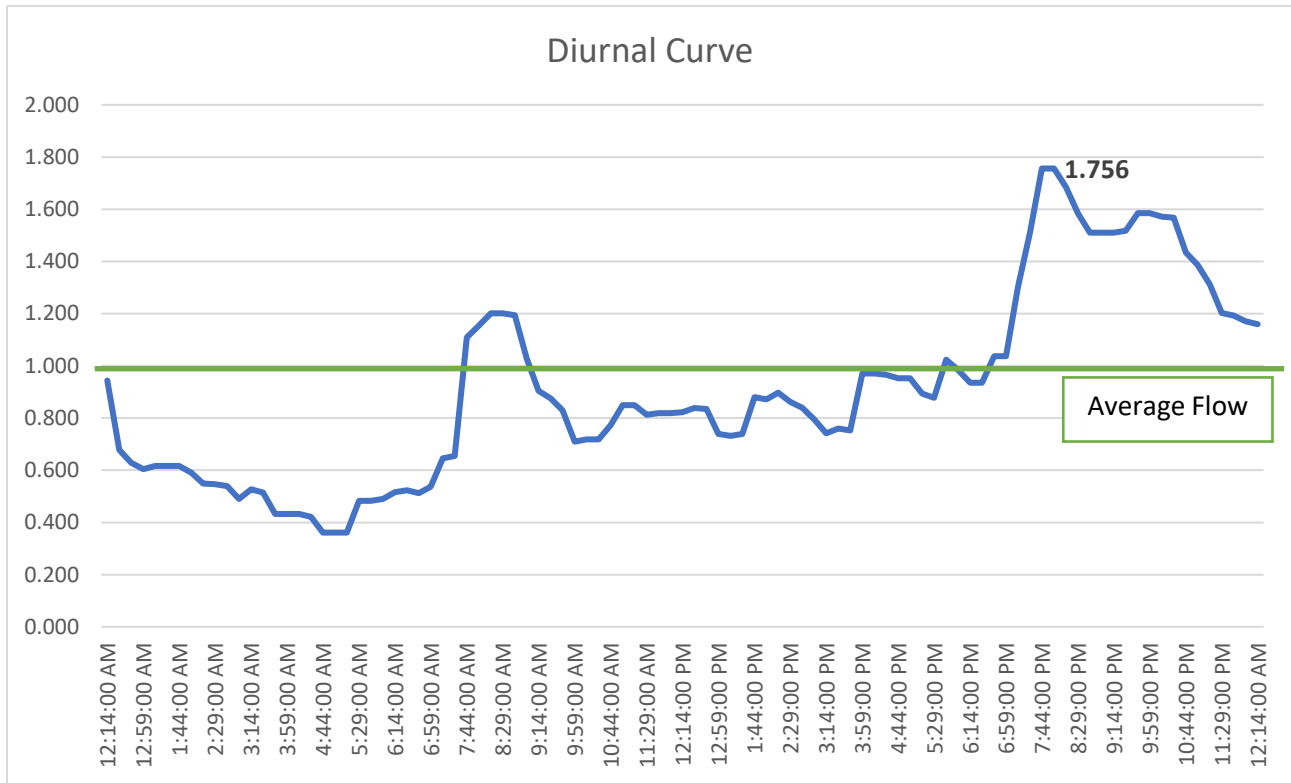
The Peak Dry Weather Flow (PDWF) peaking factor was developed using data collected during the temporary flow monitoring program described in Section 2.2. The maximum monitored flow, **153.5 gpm** occurred on Monday, January 12, 2026, which was selected as representative of a conservative, typical weekday condition. Based on this analysis the peaking factor was calculated to be 1.75 times the average flow.

As a validation check, the resulting peaking factor was compared to the hydraulic model diurnal patterns presented in the City of Rialto Wastewater Master Plan. The comparison indicated that the selected peaking factor is slightly more conservative than the peaking factors identified in the City of Rialto Wastewater Master Plan, which generally range from 1.5 to 1.6. While conservative, the selected peaking factor of 1.75 falls within a reasonable range and is considered appropriate for planning and design purposes.

Table 3 Summary of Existing Flows

Avg Flow (gpm)	Peaking Factor	Max Flow (gpm)
87.4	1.75	153.5

Figure 5 Diurnal Curve from Temporary Flow Monitoring (January 12, 2026)



2.3.3. Peak Wet Weather Flow (PWWF)

The sanitary sewer system and storm drainage system within the study area operate independently. Therefore, significant rainfall dependent inflow and infiltration (RDII) is not expected. Because the purpose of this Master Plan is to evaluate planning level conveyance capacity and future wastewater service demands, PDWF conditions were selected as the primary hydraulic design condition. No separate RDII or PWWF simulations were performed as part of this evaluation.

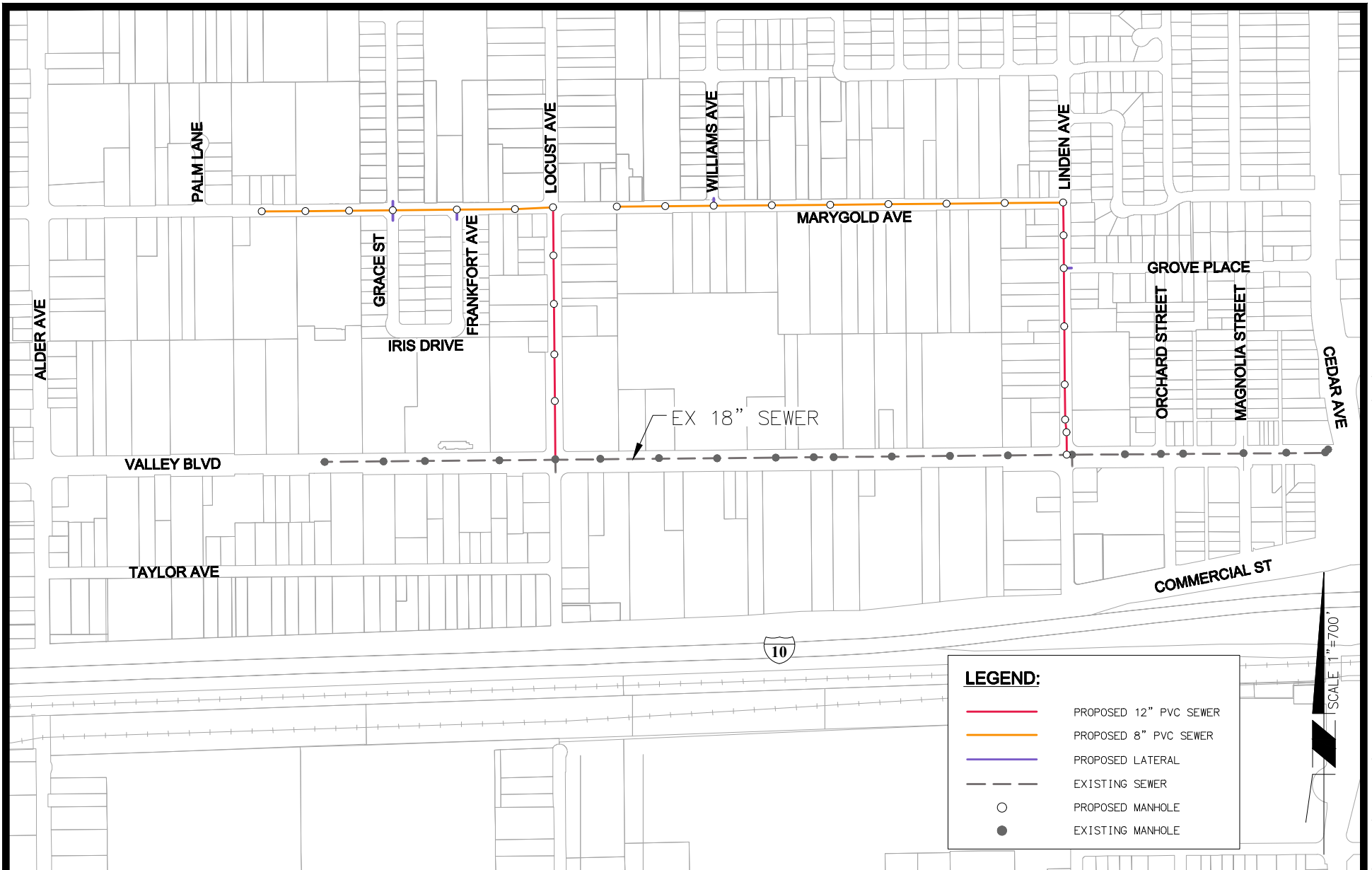
SECTION 3 - FUTURE PLANNING

3.1. FUTURE INFRASTRUCTURE

The report and associated hydraulic model evaluate two future development scenarios to assess the performance of the existing and planned CSA 70 BL wastewater collection system under future buildout conditions. The infrastructure improvements associated with each scenario are described below, while the corresponding wastewater flow projections are presented in Section 3.2.

Scenario 1 – Phase 1: This scenario reflects the first phase of improvements based on a recent design project, *Bloomington Sewer Expansion Project* that includes the addition of 8-inch and 12-inch gravity sewer lines. Wastewater flows were assigned to parcels determined to be serviceable by the proposed Phase 1 sewer infrastructure within the CSA 70 BL service area. The Phase 1 improvements are shown in Figure 6 and the wastewater generation calculations are represented in Table 4.

Scenario 2 – Phase 2: The second scenario represents the ultimate buildout conditions, assuming all proposed sewer extensions are constructed as identified in Figure 7. This scenario was developed to assess the long term capacity and performance of the existing and planned CSA 70 BL wastewater collection system under ultimate buildout conditions. The hydraulic model incorporates projected wastewater flows from parcels within the CSA 70 BL service area, as well as projected wastewater flows from the additional tributary area evaluated as part of this Master Plan. The wastewater generation calculations are represented in Table 5. The results of these scenarios are discussed in Section 4 – Hydraulic Model Evaluation.

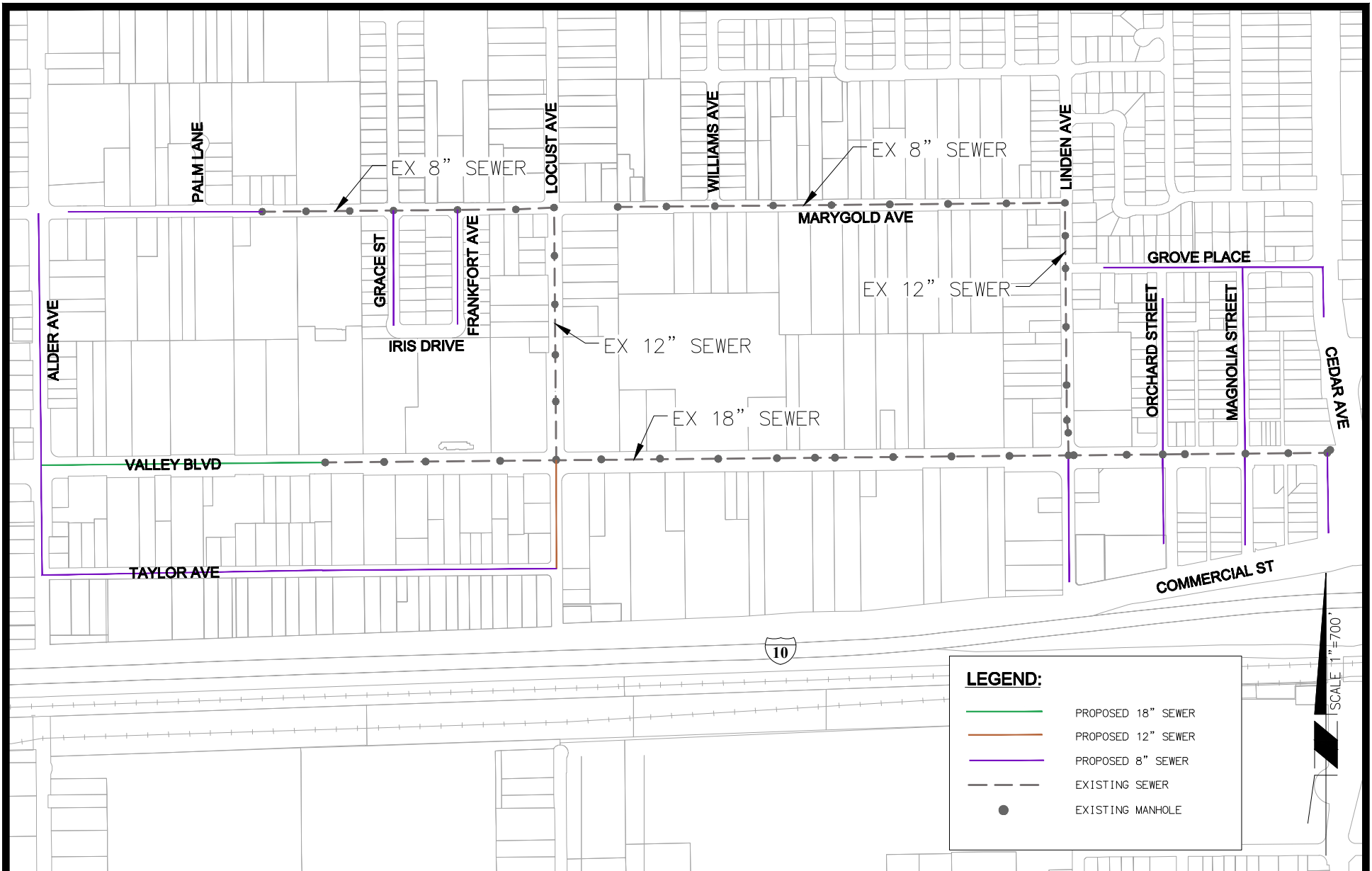


Michael Baker
INTERNATIONAL

40810 COUNTY CENTER DR.,
SUITE 200
TEMECULA, CA 92591
PHONE: (951) 676-8042
MBAKERINTL.COM

FIGURE 6

PROPOSED FACILITIES-PHASE 1



Michael Baker
INTERNATIONAL

40810 COUNTY CENTER DR.,
SUITE 200
TEMECULA, CA 92591
PHONE: (951) 676-8042
MBAKERINTL.COM

FIGURE 7

PROPOSED FACILITIES-PHASE 2

3.2. FUTURE WASTEWATER FLOW PROJECTIONS

Future wastewater flow projections were developed based on planned land uses identified in the Valley Corridor Specific Plan (VCSP). Future wastewater demands were estimated by applying wastewater generation factors and density assumptions to the future land use designations to quantify projected Average Dry Weather Flow (ADWF) under future buildout conditions.

Existing wastewater flows were established using the temporary flow monitoring program described in Section 2.2, while future wastewater flows were developed using land use based projections to estimate wastewater generation associated with future development. To maintain consistency throughout the analysis, the same wastewater generation factors, density assumptions, and peaking methodologies were applied to all future land use classifications.

For **Scenario 1 (Phase 1)**, wastewater flow projections were developed for parcels tributary to the proposed Phase 1 sewer infrastructure associated with the *Bloomington Sewer Expansion Project*. The resulting wastewater generation calculations are presented in Table 4 and corresponding study area is depicted in Figure 8.

For **Scenario 2 (Phase 2)**, wastewater flow projections were developed for parcels tributary to the ultimate buildout sewer system within the CSA 70 BL service area, as well as projected wastewater flows from the additional tributary area evaluated as part of this Master Plan. The resulting wastewater generation calculations are presented in Table 5 and corresponding study area is depicted in Figure 9.

The projected ADWF values for each scenario were converted to Peak Dry Weather Flow (PDWF) using the peaking factor developed from the temporary flow monitoring program described in Section 2.3.2. These projected flows were subsequently incorporated into the hydraulic model to evaluate the capacity and performance of the existing and planned wastewater collection system under future buildout conditions.

3.2.1. Future Land Use

Table 4 – Future Wastewater Generation – Scenario 1 (Phase 1)

Type	Name	Acre [1]	Density	Generation Factor	Average Demand (ADWF)		Peaking Factor [5]	Peak Demand (PDWF)	
		ac	EDU/ac [2]	gpd/ac or gpd/EDU [4]	gpd	gpm		gpd	gpm
BL/RM	Bloomington Multiple Residential	23	24	150	81,695	57	1.75	142,966	99
BL/RS	Bloomington Single Residential	8	10	150	11,442	8		20,024	14
BL/RS-20M	Bloomington Single Residential - 20,000 sqft minimum	25	3 ^[3]	150	11,093	8		19,413	13
VC/BE	Valley Corridor Bloomington Enterprise	114	-	350	39,986	28		69,975	49
VC/COM	Valley Corridor Commercial	21	-	1200	25,556	18		44,724	31
VC/LMR	Valley Corridor Low/Medium Residential	80	10	150	120,035	83		210,060	146
VC/MHR	Valley Corridor Medium/High Residential	13	24	150	46,602	32		81,554	57
VC/MU	Valley Corridor Mixed Use	35	40	150	212,100	147		371,175	258
TOTALS		319			548,509	381		959,890	667

- [1] Acreage may vary slightly from the VCSP due to acreage data being derived from the SB County's GIS Shapefiles. Also, the total acreage for VC/COM varies significantly due to a portion of the parcels being outside the boundary of this study.
- [2] The residential densities summarized in the table above are based on the Valley Corridor Specific Plan (VCSP), Section 3.1.2, *Land Use Districts*.
- [3] The VCSP does not explicitly specify a density for the BL/RS 20M designation. Therefore, a density of approximately 3 EDU/ac was assumed for this analysis. While the VCSP allows single-family residential densities of up to 10 dwelling units per acre, use of the maximum density was considered overly conservative and would overstate projected wastewater flows.
- [4] The wastewater generation factors used are based on the values from the City of Rialto Wastewater Master Plan Update August 2022, Table ES-2. and were assumed as follows:
- VC/BE, a non-residential generation factor for low density industrial of 350 gpd/acre
 - VC/COM, a general non-residential generation factor of 1200 gpd/acre
 - VC/MU, the most conservative alternative was selected which was a very high density residential (40 EDU/ac) with a residential generation factor of 150 gpd/EDU
- [5] The peaking factor was developed using data collected during temporary flow monitoring.

FIGURE 8

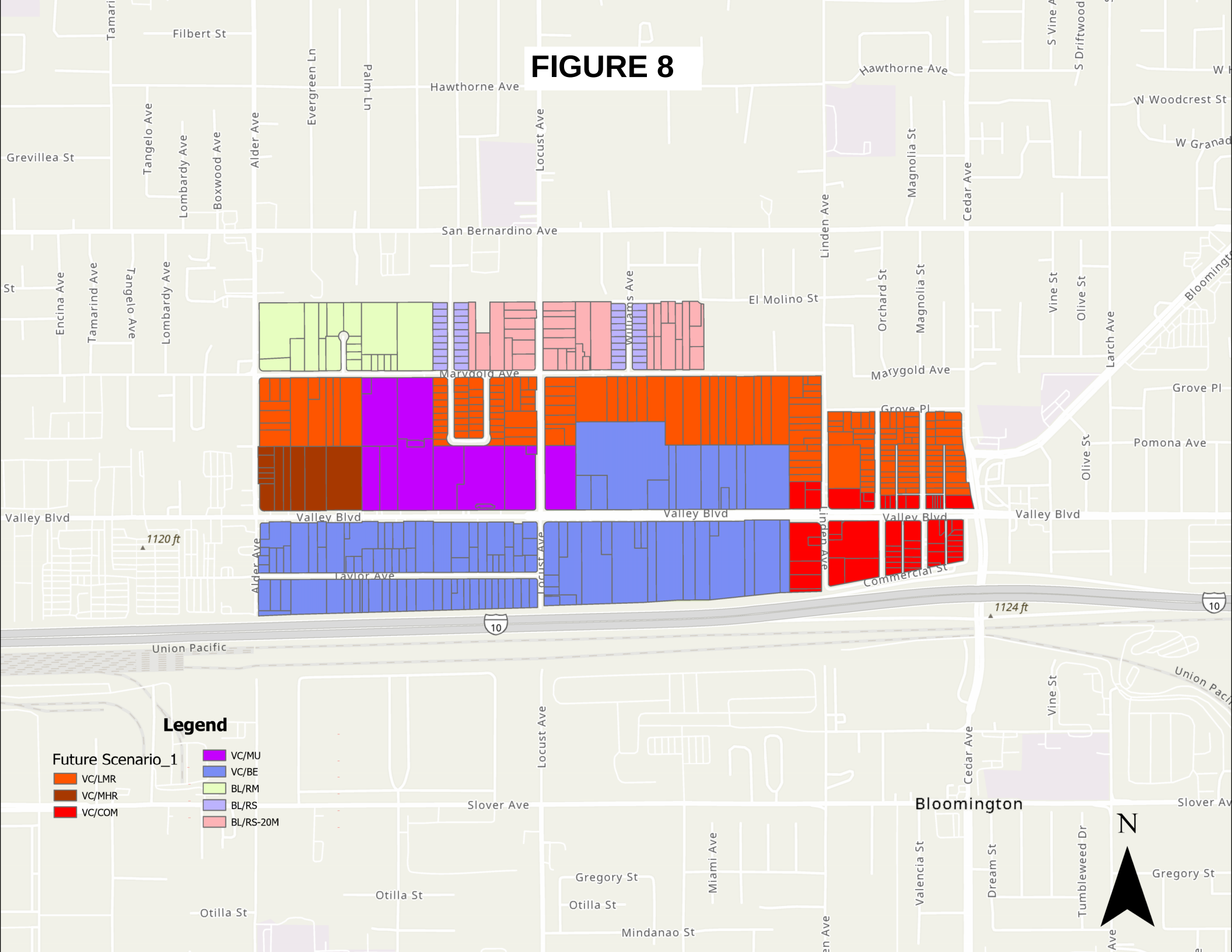
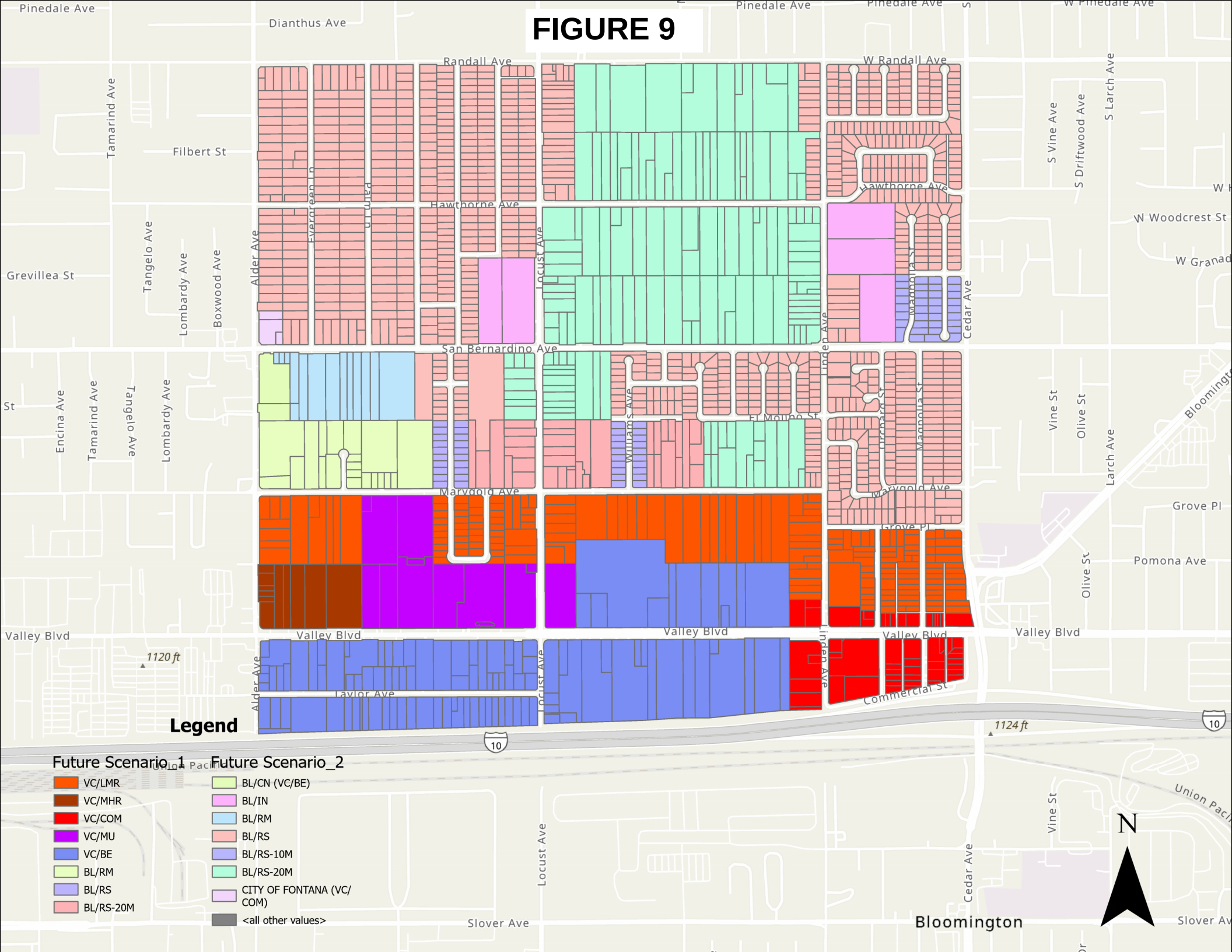


Table 5 – Future Wastewater Generation – Scenario 2 (Phase 2)

Type	Name	Acre [1]	Density		Generation Factor	Average Demand (ADWF)		Peaking Factor [5]	Peak Demand (PDWF)	
		ac	Students	EDU/ac [2]	gpd/ac or gpd/EDU or gpd/student [4]	gpd	gpm		gpd	gpm
BL/RM	Bloomington Multiple Residential	40	-	24	150	142,693	99	1.75	249,713	173
BL/RS	Bloomington Single Residential	253	-	10	150	380,203	264		665,356	462
BL/IN	Bloomington Institutional	24	1,145 ^[6]		15	17,175	12		30,056	21
BL/RS-10M	Bloomington Single Residential - 10,000 sqft minimum	7	-	5 ^[3]		5,261	4		9,207	6
BL/RS-20M	Bloomington Single Residential - 20,000 sqft minimum	187	-	3 ^[3]	150	83,998	58		146,997	102
VC/BE ^[7]	Valley Corridor Bloomington Enterprise	118	-	-	350	41,305	29		72,284	50
VC/COM	Valley Corridor Commercial	24	-	-	1200	28,465	20		49,814	35
VC/LMR	Valley Corridor Low/Medium Residential	80	-	10	150	120,035	83		210,060	146
VC/MHR	Valley Corridor Medium/High Residential	13	-	24	150	46,602	32		81,554	57
VC/MU	Valley Corridor Mixed Use	35	-	40	150	212,100	147		371,175	258
TOTALS		780	1,145	-	-	1,077,838	748		1,886,216	1310

- [1] Acreage may vary slightly from the VCSP due to acreage data being derived from the SB County's GIS Shapefiles. Also, the total acreage for VC/COM varies significantly due to a portion of the parcels being outside the boundary of this study.
- [2] The residential densities summarized in the table above are based on the Valley Corridor Specific Plan (VCSP), Section 3.1.2, *Land Use Districts*.
- [3] The VCSP does not explicitly specify a density for the BL/RS-10M and BL/RS-20M designation. Therefore, a density of approximately 5 EDU/ac and 3 EDU/ac, respectively, was assumed for this analysis. While the VCSP allows single-family residential densities of up to 10 dwelling units per acre, use of the maximum density was considered overly conservative and would overstate projected wastewater flows.
- [4] The wastewater generation factors used are based on the values from the City of Rialto Wastewater Master Plan Update August 2022, Table ES-2. and were assumed as follows:
- VC/BE, a non-residential generation factor for low density industrial of 350 gpd/acre
 - VC/COM, a general non-residential generation factor of 1200 gpd/acre
 - VC/MU, the most conservative alternative was selected which was a very high density residential (40 EDU/ac) with a residential generation factor of 150 gpd/EDU
- [5] The peaking factor was developed using data collected during temporary flow monitoring.
- [6] The BL/IN (Bloomington Institutional) land use designation was assigned a wastewater generation rate of 15 gpd/student, consistent with assumptions presented in the City of Rialto Wastewater Master Plan. Student enrollment data were obtained from the National Center for Education Statistics (NCES) database and rounded up, where appropriate, for planning-level analysis. Based on this approach, two existing schools were identified within the study area, resulting in an assumed total enrollment of 1,145 students.
- [7] The County GIS identifies certain parcels as BL/CN; however, based on aerial imagery, site information, and parcel use, these properties were assumed to represent the Marygold Mutual Water Company office buildings and associated utility facilities. Therefore, the parcels were evaluated under the VC/BE land use category for wastewater flow projections.

FIGURE 9



SECTION 4 - HYDRAULIC MODEL EVALUATION

4.1. MODEL DEVELOPMENT

A hydraulic model of the sanitary sewer system was developed using **InfoWorks ICM (dynamic model)** to evaluate existing and future system performance. The model was constructed to represent the physical characteristics of the collection system, including pipe sizes, alignments, slopes, and connectivity. It was used to assess system capacity, flow conveyance, and depth-to-diameter (d/D) ratios throughout the study area.

Model development was based on the best available data, including GIS data, as-built record drawings provided by San Bernardino County, and temporary flow monitoring data collected by US3. The model incorporates flow projections developed as a part of this study and was applied to evaluate both the existing conditions and future planning scenarios. The goal of the model is to identify capacity constraints and proposed improvements. Key Model assumptions are listed below in the table.

Table 6 Model Assumptions

Modeling Element	Assumption
Routing	If street-facing parcel is not a parcel type that would tie into the sanitary system, it was routed and kept in the model with a population of zero (0).
Trade Waste	Not used –none provided
Additional Foul Flow	Not used –none provided
Baseflow	Not used –none provided
Velocity	Model adjusted to keep within 2 to 5 feet per second (fps)
Sanitary Flows	Same diurnal curves used for weekday and weekends.
Sanitary Loads	Sanitary loads were calculated as gpd/unit, with acre as the unit (not population)
Inverts	Inverts interpolated in ICM when invert data was unavailable
Diurnal Curves	Were developed from the temporary flow monitoring data.
RDII	Assumed no infiltration or losses in pipes.
	Assumed 100% connectivity between sub catchment and node (i.e. no flow routed elsewhere) and an impervious connection.

4.2. HYDRAULIC MODEL CALIBRATION

The hydraulic model for existing conditions was developed and calibrated using Average Dry Weather Flow (ADWF) derived directly from the temporary flow monitoring data described in Section 2.2. The monitored ADWF represents typical wastewater loading within the sanitary sewer system and served as the baseline condition for model calibration.

For future planning scenarios, ADWF was developed using wastewater generation calculations based on planned land uses, density assumptions, and generation factors described in Section 3.2. These future ADWF values were then converted to Peak Dry Weather Flow (PDWF) using the peaking factor developed from the temporary flow monitoring data.

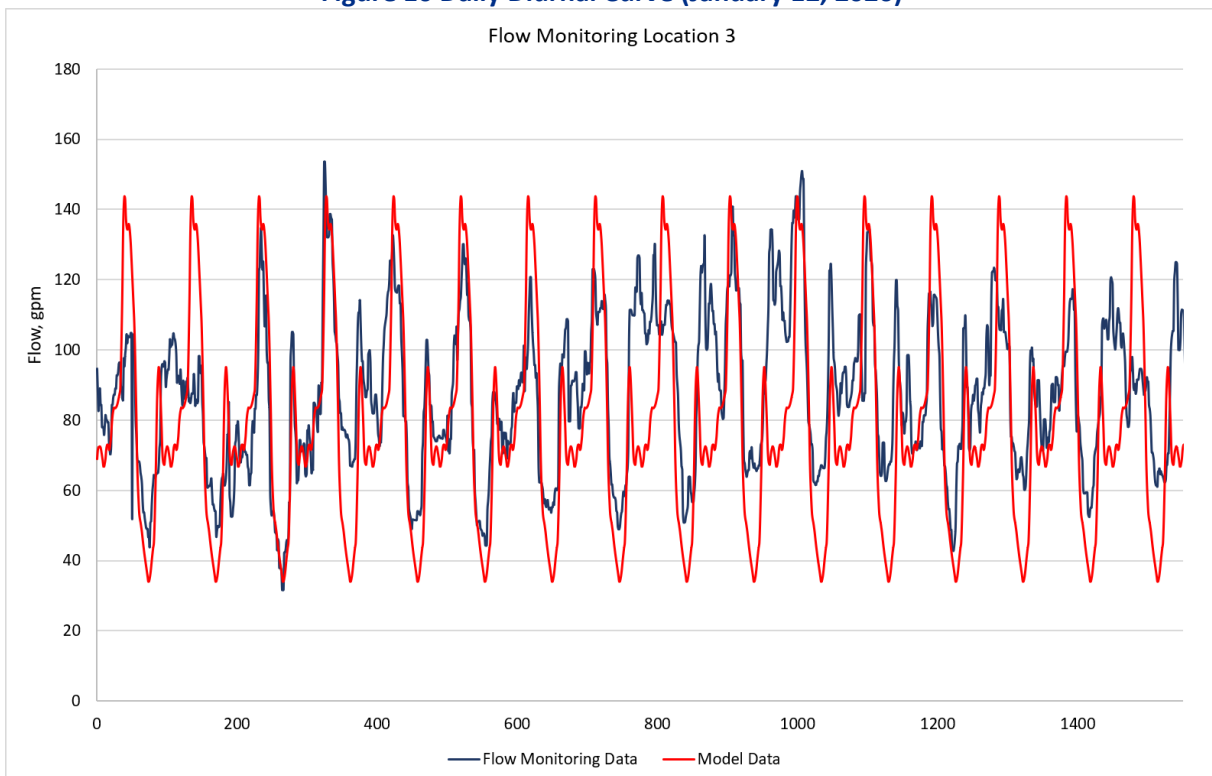
Peak Dry Weather Flow (PDWF) was derived by applying a peaking factor of 1.75 to the ADWF. This peaking factor reflects the diurnal variability observed during the temporary flow monitoring. The PDWF was used to evaluate the system's capacity under both existing and future planning scenarios.

4.2.1. Diurnal Curve Development and Calibration

InfoWorks ICM requires the application of a repeatable, diurnal curve that reflects daily oscillations in wastewater generation. For the model, a diurnal curve was estimated and calibrated based on the Existing Condition scenario and applied to Scenarios 1 and 2. The curve is based on a proportional increase and decrease of the provided daily average per capita flow over 24 hours.

Figure 10 compares the adopted diurnal curve to the observed flow monitoring data collected at Flow Monitoring Location 3 (Cedar Avenue). Because the diurnal pattern must represent a repeatable condition suitable for dynamic hydraulic modeling, the curve was developed to reflect the overall daily flow trend rather than replicate individual short-duration peaks and troughs observed during the monitoring period. As a result, the modeled peak and minimum flows do not exactly match the maximum and minimum values observed in the monitoring data. The observed maximum and minimum flow events represent isolated occurrences within the 24-hour monitoring record and are not considered representative of the recurring daily wastewater generation pattern. Therefore, the adopted diurnal curve was calibrated to match the overall shape and timing of the observed flow pattern while providing a reasonable representation of typical system behavior for use in dynamic hydraulic simulations. Figure 10 illustrates the relationship between the observed flow monitoring data and the adopted model diurnal pattern.

Figure 10 Daily Diurnal Curve (January 12, 2026)



4.3. DESIGN CRITERIA

The proposed wastewater system was evaluated using the County of San Bernardino Special Districts Department Standards for Sanitary Sewer as summarized in the table below.

Table 7 – Design Criteria

Value	Parameter
Minimum Pipe Diameter	8-inch
Minimum Pipe Slopes (ft/ft)	
8-inch	0.004
12-inch	0.0022
18-inch	0.0012
Manning's Roughness Coefficient (n)	0.013
Minimum Velocity at minimum d/D	2 fps
Maximum Flow Depth in All Pipes (d/D)	50 %

4.4. MODEL RESULTS

The Valley Corridor Sewer Master Plan was developed using InfoWorks ICM to create a dynamic, unsteady flow model. This modeling approach allows for time-varying interactions among all elements of the pipe system, including independent pipe characteristics and the spatial location of the pipes within the system. The software uses two primary unsteady flow equations: the full Saint-Venant equations to conserve mass and momentum, and the dynamic wave solution to account for hydraulic forces in the system. As such, this unsteady modeling can represent impacts to sewer systems, such as surcharge, backwater, and pressurized flow conditions. The software can also integrate multiple scenarios into a single network, allowing for efficient testing of multiple alternatives within a clean, streamlined modeling package. It is a highly useful and powerful software for understanding the performance of gravity sewer collection systems. It should be noted that due to the dynamic nature of the modeling platform, results may vary from typical one-dimensional calculations.

Because of the nature of the dynamic, unsteady ICM model, results can differ slightly from steady state models or one-dimensional pipe calculations. Differences between steady state models and unsteady state models can vary depending on the complexity of the system; however, the Valley Corridor model was intentionally designed to keep any variation under 5%.

4.4.1. Existing System Model Results

The existing conditions were modeled to establish a baseline understanding of the current system performance and available capacity. The existing system performance was evaluated under Peak Dry Weather Flow (PDWF) conditions derived by applying a peaking factor of 1.75 to the calibrated Average Dry Weather Flow (ADWF). The model results are displayed in Table 8 below and the corresponding model network is shown in Figure 11. The model results indicate that the existing 18-inch sewer main operates well below capacity.

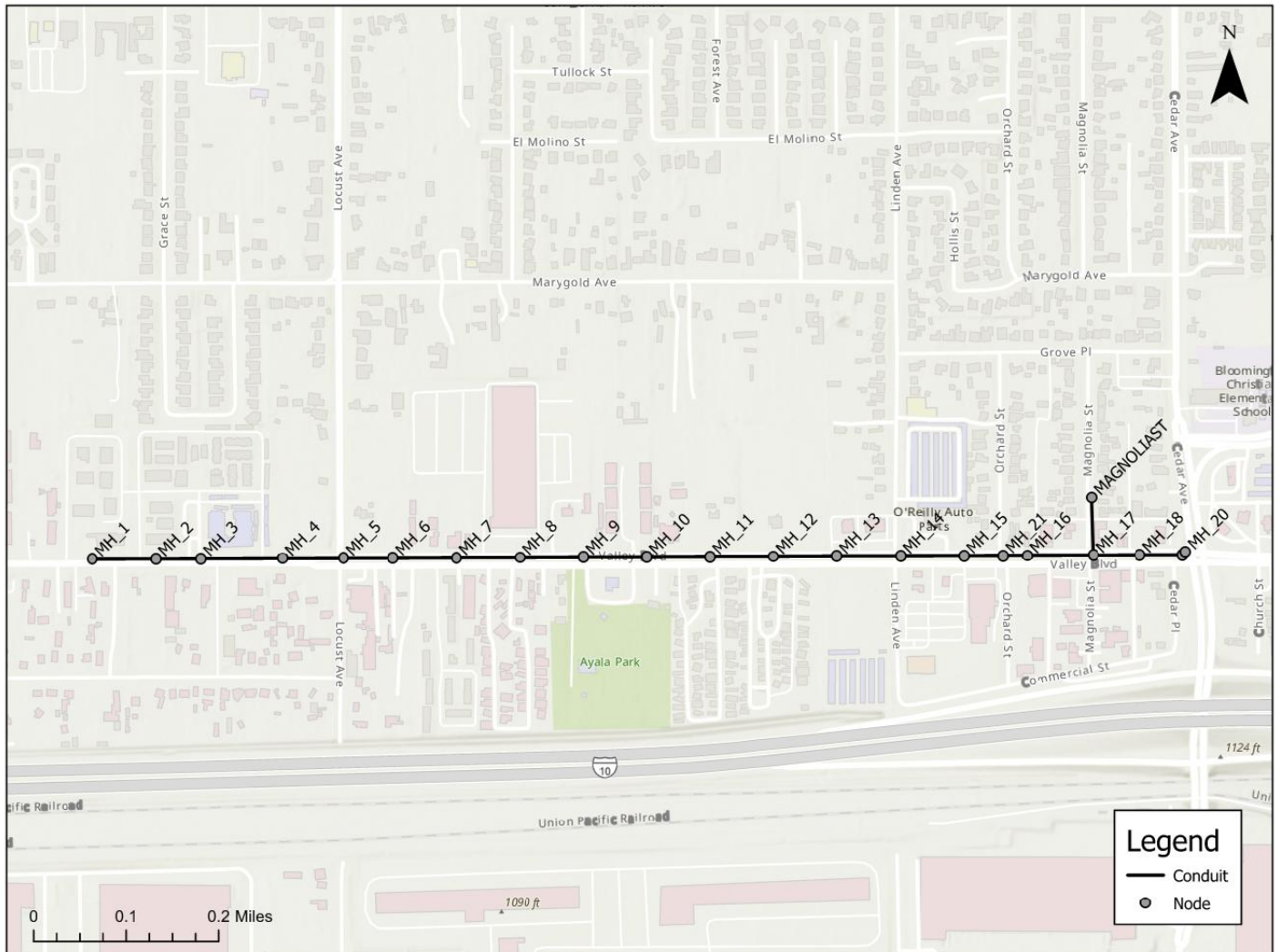
No critical capacity deficiencies were identified under existing conditions.

Table 8 Existing System Hydraulic Model Results

Pipe Reach (ICM ID)	Manhole (ICM ID)		Pipe Diameter	Pipe Slope	Pipe Length (ft)	Peak Flow (gpm)	Velocity (ft/s)	d/D (%)
	Start	Finish	(in)					
MH_1.1	MH_1	MH_2	18	0.003	210	0.0 ^[1]	0.0	5.0
MH_2.1	MH_2	MH_3	18	0.002	210	0.0 ^[1]	0.0	5.0
MH_3.1	MH_3	MH_4	18	0.002	382	0.0 ^[1]	0.0	5.0
MH_4.1	MH_4	MH_5	18	0.002	285	56.1	0.9	12.0
MH_5.1	MH_5	MH_6	18	0.002	230	55.9	0.9	12.0
MH_6.1	MH_6	MH_7	18	0.002	296	55.8	0.9	12.0
MH_7.1	MH_7	MH_8	18	0.002	296	55.7	0.9	12.0
MH_8.1	MH_8	MH_9	18	0.002	296	55.6	0.9	12.0
MH_9.1	MH_9	MH_10	18	0.002	296	55.6	0.9	12.0
MH_10.1	MH_10	MH_11	18	0.002	296	55.5	0.9	12.0
MH_11.1	MH_11	MH_12	18	0.002	296	55.4	0.9	12.0
MH_12.1	MH_12	MH_13	18	0.002	296	55.4	0.9	12.0
MH_13.1	MH_13	MH_14	18	0.002	296	94.8	1.3	15.0
MH_14.1	MH_14	MH_15	18	0.002	296	94.8	1.3	15.0
MH_15.1	MH_15	MH_21	18	0.002	182	94.7	1.3	15.0
MH_21.1	MH_21	MH_16	18	0.002	110	94.7	1.3	15.0
MH_16.1	MH_16	MH_17	18	0.002	308	94.7	1.3	15.0
MH_17.1	MH_17	MH_18	18	0.002	216	94.7	1.3	15.0
MH_18.1	MH_18	MH_19	18	0.002	150	94.6	1.3	15.0
MH_19.1	MH_19	MH_20	18	0.061	35	144.5	1.4	13.0
MAGNOLIAST.1	MAGNOLIAST	MH_17	8	0.020	34	0.0 ^[1]	0.0	10.0

- [1] Some pipes exhibit non-zero d/D values despite little or no assigned flow. This is a result of the dynamic hydraulic simulation performed using InfoWorks ICM, where pipe depths may be influenced by backwater effects, surcharge conditions, and downstream hydraulic controls causing the hydraulic grade line to extend through upstream portions of the collection system.

Figure 11 Existing Model Network



4.4.2. Future Scenario 1 (Phase 1) Model Results

Future Scenario 1 (Phase 1) evaluates the addition of an 8-inch sewer along Marygold Avenue and 12-inch sewer improvements along Locust Avenue and Linden Avenue. Phase 1 assumes that parcels fronting the proposed sewer alignments will be serviced by the new sewer lines in combination with the existing 18-inch sewer main.

This scenario was evaluated under Peak Dry Weather Flow (PDWF) conditions. The model results are summarized in Table 9, and the corresponding model network is shown in Figure 12.

The results indicate that the existing 18-inch sewer main and proposed 12-inch sewer facilities maintain sufficient capacity under PDWF conditions. Several proposed 8-inch sewer segments along the Phase 1 sewer network exhibit d/D values slightly above the recommended planning-level design criterion of 0.50, with a maximum modeled d/D of approximately 0.59.

Because the Phase 1 scenario includes a limited sewer network, wastewater flows are concentrated within fewer sewer segments and have fewer opportunities for flow dispersion than under the ultimate buildout condition. In addition, the parcel-level flow allocation resulted in a greater concentration of projected wastewater flows entering the eastern portion of the Phase 1 sewer system relative to the western portion. While this represents a reasonable planning-level assumption for evaluating system performance, the actual distribution of future development and sewer connections may differ from the modeled flow allocations.

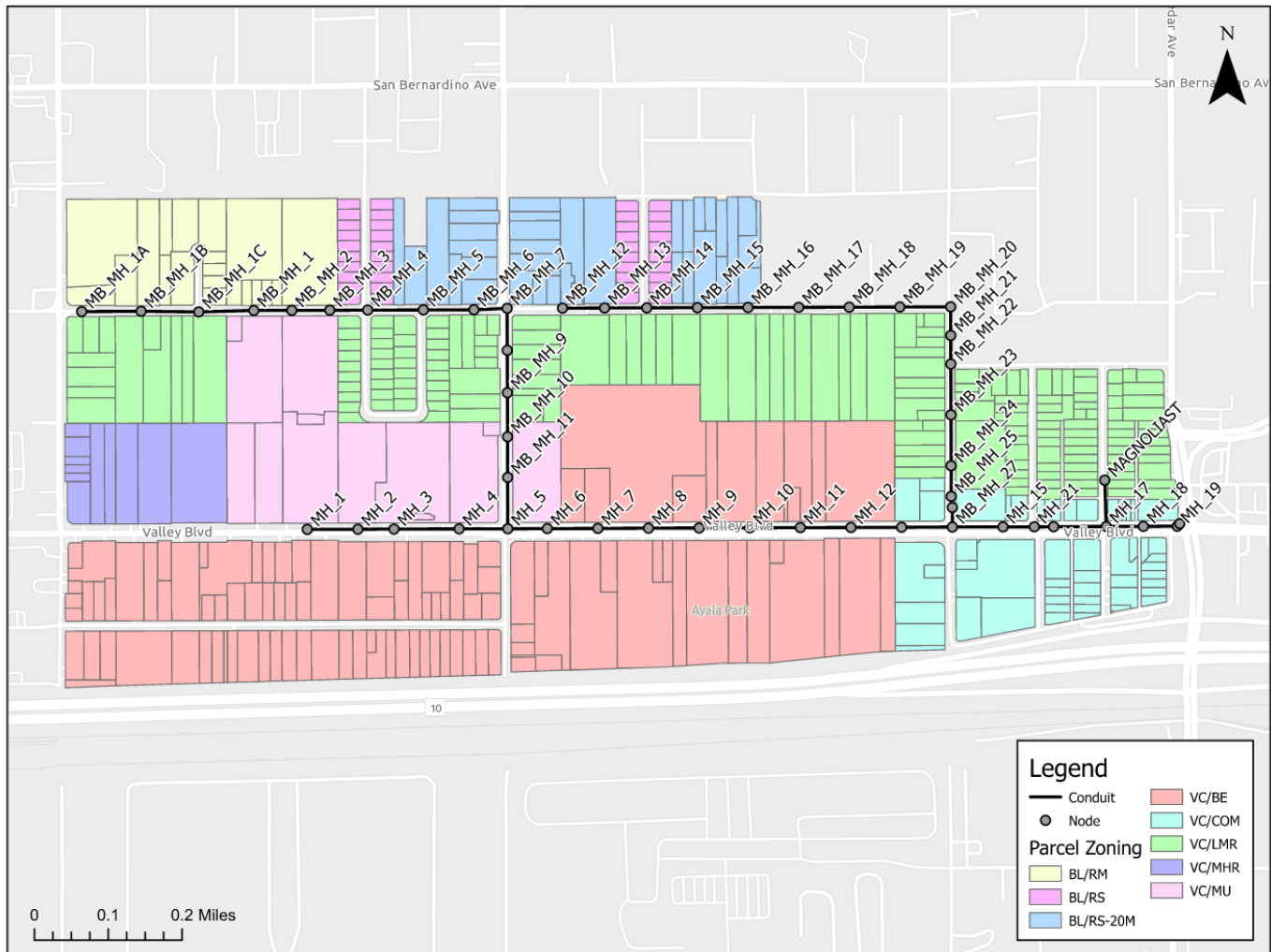
Overall, the hydraulic analysis demonstrates that the proposed Phase 1 improvements provide a viable framework for expanding wastewater service within CSA 70 BL. The identified d/D exceedances should be considered planning-level indicators of potential capacity constraints and should be reevaluated during future planning and design phases as development patterns, connection locations, and collection system configurations become better defined.

Table 9 Future Scenario 1 (Phase 1) Hydraulic Model Results

Pipe Reach (ICM ID)	Manhole (ICM ID)		Pipe Diameter (in)	Pipe Slope	Pipe Length (ft)	Peak Flow (gpm)	Velocity (ft/s)	d/D (%)
	Start	Finish						
MH_1.1	MH_1	MH_2	18	0.003	210	135.0	2.0	16.0
MH_2.1	MH_2	MH_3	18	0.002	210	162.9	2.1	19.0
MH_3.1	MH_3	MH_4	18	0.002	382	204.0	2.3	22.0
MH_4.1	MH_4	MH_5	18	0.002	285	205.6	1.3	25.0
MH_5.1	MH_5	MH_6	18	0.002	230	464.5	2.7	32.0
MH_6.1	MH_6	MH_7	18	0.002	296	493.1	2.9	33.0
MH_7.1	MH_7	MH_8	18	0.002	296	495.8	2.9	33.0
MH_8.1	MH_8	MH_9	18	0.002	296	502.9	2.9	34.0
MH_9.1	MH_9	MH_10	18	0.002	296	506	2.9	34.0
MH_10.1	MH_10	MH_11	18	0.002	296	509.7	2.9	34.0
MH_11.1	MH_11	MH_12	18	0.002	296	513	2.9	34.0
MH_12.1	MH_12	MH_13	18	0.002	296	517.2	2.9	34.0
MH_13.1	MH_13	MB_MH_27	18	0.002	296	521.8	2.6	34.0
MB_MH_27.1	MB_MH_27	MH_15	18	0.002	296	611.2	3.1	37.0
MH_15.1	MH_15	MH_21	18	0.002	182	611.1	3.1	37.0
MH_21.1	MH_21	MH_16	18	0.002	110	627.8	3.0	37.0
MH_16.1	MH_16	MH_17	18	0.002	308	628	3.0	37.0
MH_17.1	MH_17	MH_18	18	0.002	216	642.1	3.1	38.0
MH_18.1	MH_18	MH_19	18	0.002	150	651.8	3.2	37.0
MH_19.1	MH_19	MH_20	18	0.061	35	651.7	6.3	19.0
MB_MH_1A.1	MB_MH_1A	MB_MH_1B	8	0.006	329	29.9	1.4	21.0
MB_MH_1B.1	MB_MH_1B	MB_MH_1C	8	0.004	345	50.9	1.7	28.0
MB_MH_1C.1	MB_MH_1C	MB_MH_1	8	0.004	314	82.2	2.0	35.0
MB_MH_1.1	MB_MH_1	MB_MH_2	8	0.004	221	135.4	2.4	45.0
MB_MH_2.1	MB_MH_2	MB_MH_3	8	0.004	225	170	2.6	51.0
MB_MH_3.1	MB_MH_3	MB_MH_4	8	0.004	221	197.7	2.7	56.0
MB_MH_4.1	MB_MH_4	MB_MH_5	8	0.004	326	204.3	2.7	57.0
MB_MH_5.1	MB_MH_5	MB_MH_6	8	0.004	296	209.4	2.8	58.0
MB_MH_6.1	MB_MH_6	MB_MH_7	8	0.004	193	215.5	2.8	59.0
MB_MH_12.1	MB_MH_12	MB_MH_13	8	0.004	246	1.8	0.2	11.0
MB_MH_13.1	MB_MH_13	MB_MH_14	8	0.004	246	10.9	0.8	15.0
MB_MH_14.1	MB_MH_14	MB_MH_15	8	0.004	296	22.6	1.2	20.0
MB_MH_15.1	MB_MH_15	MB_MH_16	8	0.004	296	29.6	1.4	22.0
MB_MH_16.1	MB_MH_16	MB_MH_17	8	0.004	296	39.7	1.6	25.0
MB_MH_17.1	MB_MH_17	MB_MH_18	8	0.004	296	48.3	1.7	27.0
MB_MH_18.1	MB_MH_18	MB_MH_19	8	0.004	296	56.7	1.8	29.0
MB_MH_19.1	MB_MH_19	MB_MH_20	8	0.004	301	62	1.8	31.0
MB_MH_7.1	MB_MH_7	MB_MH_8	12	0.002	282	219.6	2.5	37.0
MB_MH_8.1	MB_MH_8	MB_MH_9	12	0.005	206	222.3	2.5	31.0

Pipe Reach (ICM ID)	Manhole (ICM ID)		Pipe Diameter (in)	Pipe Slope	Pipe Length (ft)	Peak Flow (gpm)	Velocity (ft/s)	d/D (%)
	Start	Finish						
MB_MH_9.1	MB_MH_9	MB_MH_10	12	0.016	256	227.6	3.4	25.0
MB_MH_10.1	MB_MH_10	MB_MH_11	12	0.014	236	232.1	3.2	26.0
MB_MH_11.1	MB_MH_11	MH_5	12	0.022	299	232.1	3.7	23.0
MB_MH_20.1	MB_MH_20	MB_MH_21	12	0.002	165	62.6	1.7	20.0
MB_MH_21.1	MB_MH_21	MB_MH_22	12	0.012	165	63.4	1.7	16.0
MB_MH_22.1	MB_MH_22	MB_MH_23	12	0.013	296	65.5	1.8	16.0
MB_MH_23.1	MB_MH_23	MB_MH_24	12	0.013	296	74	1.9	17.0
MB_MH_24.1	MB_MH_24	MB_MH_25	12	0.029	177	82	2.4	15.0
MB_MH_25.1	MB_MH_25	MB_MH_26	12	0.029	61	83.2	2.4	15.0
MB_MH_26.1	MB_MH_26	MB_MH_27	12	0.029	112	85.8	2.5	16.0
MAGNOLIAST.1	MAGNOLIAST	MH_17	8	0.020	34	8.2	0.8	12.0
NOTE	The reported d/D values exceeding the recommended design criteria are limited to select 8-inch sewer segments and are primarily attributable to planning-level assumptions regarding future flow routing. Because the ultimate conveyance infrastructure has not yet been designed, these results should not be interpreted as a definitive indication of future capacity deficiencies. Additional analysis will be required during subsequent planning and design phases to confirm final flow routing and collection system requirements.							

Figure 12 Model Network for Scenario 1 (Phase 1)



4.4.3. Future Scenario 2 (Phase 2) Model Results

Future Scenario 2 (Phase 2) represents the ultimate buildout condition of the wastewater collection system and assumes that all developable parcels within the CSA 70 BL service area, as well as the additional tributary area, are connected and contributing flow. This scenario was developed to evaluate the long term capacity of the proposed sewer system and determine whether the downstream CSA 70 BL collection system can accommodate future wastewater demands under buildout conditions.

To evaluate the potential impacts of future development within the additional tributary area, projected wastewater flows were introduced to the hydraulic model at the proposed 12-inch sewer facilities, at manholes MB_MH_7 and MB_MH_20, respectively. This approach was selected to assess the availability of downstream capacity within the existing and planned CSA 70 BL wastewater collection system. Preliminary evaluations indicated that assigning the entirety of the additional tributary area flows to the existing 8-inch sewer segments would create localized capacity deficiencies that are not representative of a realistic future buildout condition. As future development occurs, additional local collection

infrastructure would be required to convey wastewater flows from the tributary area to the larger downstream collection system.

Overall, the results indicate that the proposed trunk sewer system is capable of accommodating projected future wastewater demands from both the CSA 70 BL service area and the additional tributary area. Although several sewer segments exceed the recommended planning-level d/D criterion, these exceedances do not represent significant constraints at the master planning level and should be reevaluated during future planning and design phases as development patterns, local collection system layouts, and sewer connection locations become better defined.

Table 10 summarizes the Future Scenario 2 (Phase 2) hydraulic model results, and the corresponding model network is shown in Figure 13.

Table 10 Future Scenario 2 (Phase 2) Hydraulic Model Results

Pipe Reach (ICM ID)	Manhole (ICM ID)		Pipe Diameter (in)	Pipe Slope	Pipe Length (ft)	Peak Flow (gpm)	Velocity (ft/s)	d/D (%)
	Start	Finish						
PR-252.1	PR-252	MH_5	12	0.002	191	12.7	0.1	64.0 ^[1]
MB_MH_7.1	MB_MH_7	MB_MH_8	12	0.002	282	530.5	3.3	61.0 ^[1]
MH_17.1	MH_17	MH_18	18	0.002	216	1302.1	3.5	56.0 ^[2]
PR-120.1	PR-120	MH_19	8	0.010	284	1.2	0.0	56.0 ^[2]
MB_MH_6.1	MB_MH_6	MB_MH_7	8	0.004	193	191	2.7	55.0 ^[2]
MB_MH_27.1	MB_MH_27	MH_15	18	0.002	296	1210.9	3.3	54.0 ^[2]
MH_16.1	MH_16	MH_17	18	0.002	308	1227.6	3.1	54.0 ^[2]
MH_18.1	MH_18	MH_19	18	0.002	150	1306.8	4.0	54.0 ^[2]
MB_MH_5.1	MB_MH_5	MB_MH_6	8	0.004	296	188.1	2.7	54.0 ^[2]
MH_15.1	MH_15	MH_21	18	0.002	182	1215.1	3.4	53.0 ^[2]
MH_21.1	MH_21	MH_16	18	0.002	110	1227.5	3.3	53.0 ^[2]
MB_MH_4.1	MB_MH_4	MB_MH_5	8	0.004	326	179.8	2.6	53.0 ^[2]
MB_MH_3.1	MB_MH_3	MB_MH_4	8	0.004	221	170.1	2.6	51.0 ^[2]
PR-237.1	PR-237	MH_17	8	0.002 ^[3]	273	71.7	1.8	51.0 ^[2]
MB_MH_8.1	MB_MH_8	MB_MH_9	12	0.005	206	533.2	3.3	49.0
MH_13.1	MH_13	MB_MH_27	18	0.002	296	854.8	2.3	48.0
MB_MH_2.1	MB_MH_2	MB_MH_3	8	0.004	225	145.5	2.4	47.0
MB_MH_20.1	MB_MH_20	MB_MH_21	12	0.002	165	339.9	2.9	47.0
PR-236.1	PR-236	PR-237	8	0.016	91	70.9	1.0	46.0
MH_6.1	MH_6	MH_7	18	0.002	296	826.5	3.1	44.0
MH_7.1	MH_7	MH_8	18	0.002	296	829.1	3.1	44.0
MH_8.1	MH_8	MH_9	18	0.002	296	836.1	3.1	44.0
MH_9.1	MH_9	MH_10	18	0.002	296	839.1	3.1	44.0
MH_10.1	MH_10	MH_11	18	0.002	296	842.7	3.1	44.0
MH_11.1	MH_11	MH_12	18	0.002	296	846	3.1	44.0
MH_12.1	MH_12	MH_13	18	0.002	296	850.1	3.1	44.0
MH_5.1	MH_5	MH_6	18	0.002	230	797.8	3.0	43.0
MB_MH_1.1	MB_MH_1	MB_MH_2	8	0.004	221	110.9	2.2	40.0

Pipe Reach (ICM ID)	Manhole (ICM ID)		Pipe Diameter (in)	Pipe Slope	Pipe Length (ft)	Peak Flow (gpm)	Velocity (ft/s)	d/D (%)
	Start	Finish						
MB_MH_19.1	MB_MH_19	MB_MH_20	8	0.004	301	108.5	2.2	40.0
MB_MH_10.1	MB_MH_10	MB_MH_11	12	0.014	236	543.1	4.4	38.0
MB_MH_18.1	MB_MH_18	MB_MH_19	8	0.004	296	93.3	2.1	37.0
MH_4.1	MH_4	MH_5	18	0.002	285	216.9	0.8	36.0
MB_MH_9.1	MB_MH_9	MB_MH_10	12	0.016	256	538.6	4.6	36.0
MB_MH_11.1	MB_MH_11	MH_5	12	0.022	299	543.1	5.1	34.0
MB_MH_17.1	MB_MH_17	MB_MH_18	8	0.004	296	74.6	1.9	33.0
PR-240.1	PR-240	MH_21	8	0.011	183	3.3	0.3	33.0
MB_MH_21.1	MB_MH_21	MB_MH_22	12	0.012	165	340.7	3.5	32.0
MB_MH_16.1	MB_MH_16	MB_MH_17	8	0.004	296	62.8	1.8	31.0
MB_MH_22.1	MB_MH_22	MB_MH_23	12	0.013	296	342.9	3.6	31.0
MB_MH_23.1	MB_MH_23	MB_MH_24	12	0.013	296	348.2	3.7	31.0
MB_MH_1C.1	MB_MH_1C	MB_MH_1	8	0.004	314	57.4	1.8	29.0
MB_MH_26.1	MB_MH_26	MB_MH_27	12	0.029	112	360.4	4.8	29.0
MB_MH_15.1	MB_MH_15	MB_MH_16	8	0.004	296	43.2	1.6	26.0
MB_MH_24.1	MB_MH_24	MB_MH_25	12	0.029	177	356.6	4.8	26.0
MB_MH_25.1	MB_MH_25	MB_MH_26	12	0.029	61	357.7	4.8	26.0
PR-233.1	PR-233	PR-234	8	0.010	149	64.8	2.0	26.0
PR-234.1	PR-234	PR-235	8	0.009	161	66.5	2.1	26.0
PR-235.1	PR-235	PR-236	8	0.010	147	69.4	2.2	26.0
MH_19.1	MH_19	MH_20	18	0.061	35	1308	8.6	25.0
PR-108.1	PR-108	PR-233	8	0.011	133	63.4	2.0	25.0
PR-227.1	PR-227	PR-108	8	0.022	208	35	1.2	25.0
PR-228.1	PR-228	PR-108	8	0.010	209	27.9	0.9	25.0
MH_3.1	MH_3	MH_4	18	0.002	382	215.9	2.3	22.0
MB_MH_14.1	MB_MH_14	MB_MH_15	8	0.004	296	29.8	1.4	22.0
PR-219.1	PR-219	PR-100	8	0.004	175	29.9	1.4	22.0
PR-220.1	PR-220	PR-219	8	0.004	262	29.9	1.2	22.0
PR-246.1	PR-246	PR-220	8	0.004	159	26	1.0	22.0
MB_MH_1B.1	MB_MH_1B	MB_MH_1C	8	0.004	345	26	1.3	21.0
PR-221.1	PR-221	PR-246	8	0.004	158	24.8	1.0	21.0
PR-222.1	PR-222	PR-221	8	0.004	283	22.3	1.0	21.0
PR-251.1	PR-251	PR-252	12	0.002	197	11.3	0.4	21.0
MH_2.1	MH_2	MH_3	18	0.002	210	176.2	2.2	20.0
PR-101.1	PR-101	PR-222	8	0.004	266	19.9	0.9	20.0
PR-109.1	PR-109	PR-228	8	0.009	170	3.9	0.2	18.0
MH_1.1	MH_1	MH_2	18	0.003	210	149.5	2.1	17.0
PR-106.1	PR-106	PR-107	8	0.017	200	1.7	0.1	17.0
PR-107.1	PR-107	PR-227	8	0.022	209	34.2	1.9	17.0
PR-218.1	PR-218	MH_1	18	0.008	198	83.7	0.9	17.0

Pipe Reach (ICM ID)	Manhole (ICM ID)		Pipe Diameter (in)	Pipe Slope	Pipe Length (ft)	Peak Flow (gpm)	Velocity (ft/s)	d/D (%)
	Start	Finish						
MB_MH_13.1	MB_MH_13	MB_MH_14	8	0.004	246	11.7	0.8	16.0
PR-200.1	PR-200	PR-118	8	0.004	249	10.3	0.7	16.0
PR_225.1	PR_225	PR_226	8	0.001	212	3.8	0.2	16.0
PR_226.1	PR_226	MB_MH_5	8	0.001	196	5.6	0.5	16.0
PR-201.1	PR-201	PR-200	8	0.004	297	9.2	0.6	15.0
PR-202.1	PR-202	PR-201	8	0.004	245	8	0.6	15.0
PR_223.1	PR_223	PR_224	8	0.001	200	3.8	0.3	15.0
PR_224.1	PR_224	MB_MH_4	8	0.001	193	5.9	0.5	15.0
PR_104.1	PR_104	PR_223	8	0.001	190	1.7	0.1	14.0
PR_105.1	PR_105	PR_225	8	0.001	181	1.8	0.1	14.0
PR-203.1	PR-203	PR-202	8	0.004	222	7.3	0.5	14.0
PR-204.1	PR-204	PR-203	8	0.004	257	6.6	0.5	14.0
PR-205.1	PR-205	PR-204	8	0.004	210	5.5	0.4	14.0
PR-206.1	PR-206	PR-205	8	0.004	279	4.2	0.3	13.0
PR-231.1	PR-231	PR-232	8	0.020	178	6.5	0.6	13.0
PR-232.1	PR-232	MH_21	8	0.012	215	7.8	0.7	13.0
MB_MH_1A.1	MB_MH_1A	MB_MH_1B	8	0.006	329	5	0.5	12.0
PR-207.1	PR-207	PR-206	8	0.004	238	3.4	0.3	12.0
PR-208.1	PR-208	PR-207	8	0.004	197	2.8	0.3	12.0
PR-209.1	PR-209	PR-208	8	0.004	230	1.8	0.2	12.0
PR-230.1	PR-230	PR-231	8	0.023	173	4.2	0.4	12.0
MB_MH_12.1	MB_MH_12	MB_MH_13	8	0.004	246	1.8	0.2	11.0
PR-110.1	PR-110	PR-229	8	0.011	132	1.9	0.2	11.0
PR-112.1	PR-112	PR-230	8	0.021	188	2.2	0.2	11.0
PR-113.1	PR-113	PR-241	8	0.012	215	2.8	0.3	11.0
PR-114.1	PR-114	PR-239	8	0.016	185	2.4	0.3	11.0
PR-115.1	PR-115	PR-238	8	0.015	204	1.8	0.2	11.0
PR-117.1	PR-117	PR-209	8	0.004	247	0.8	0.1	11.0
PR-118.1	PR-118	PR-251	12	0.002	179	11	0.6	11.0
PR-119.1	PR-119	PR-120	8	0.008	145	0.5	0.1	11.0
PR-215.1	PR-215	PR-216	18	0.007	180	62.6	1.4	11.0
PR-216.1	PR-216	PR-217	18	0.008	189	82.3	1.7	11.0
PR-217.1	PR-217	PR-218	18	0.007	225	83.1	1.7	11.0
PR-229.1	PR-229	PR-109	8	0.010	149	3.4	0.3	11.0
PR-238.1	PR-238	MH_17	8	0.013	229	2.6	0.3	11.0
PR-239.1	PR-239	PR-240	8	0.013	189	3.2	0.3	11.0
PR-241.1	PR-241	PR-242	8	0.008	192	2.8	0.3	11.0
PR-242.1	PR-242	MB_MH_27	8	0.007	215	3.1	0.3	11.0
PR-100.1	PR-100	PR-212	18	0.008	152	0	0.0	10.0
PR-210.1	PR-210	PR-117	8	0.004	195	0.3	0.0	10.0

Pipe Reach (ICM ID)	Manhole (ICM ID)		Pipe Diameter (in)	Pipe Slope	Pipe Length (ft)	Peak Flow (gpm)	Velocity (ft/s)	d/D (%)
	Start	Finish						
PR-211.1	PR-211	PR-210	8	0.004	185	0.1	0.0	10.0
PR-213.1	PR-213	PR-214	18	0.007	173	42.3	1.0	10.0
PR-214.1	PR-214	PR-215	18	0.007	180	62.4	1.5	10.0
PR-212.1	PR-212	PR-213	18	0.007	186	33.7	1.0	9.0
PR-100.1	PR-100	PR-211	8	0.004	180	33.2	1.1	8.0
[1]	The reported d/D values exceed the recommended maximum design criterion of 0.50; however, these exceedances occur under a conservative ultimate buildout scenario intended to test downstream system capacity. Projected tributary area flows were routed directly to the proposed 12-inch sewer segments at MB_MH_7 and MB_MH_20 because future service to the additional study area would realistically be conveyed to the trunk sewer system rather than through the existing 8-inch local collection sewers. Additionally, pipe PR-252.1 is a proposed facility that has not yet been designed or constructed and is currently modeled at minimum slope. Therefore, the reported d/D values should not be interpreted as definitive design deficiencies and may be reduced during final design and infrastructure planning.							
[2]	Approximately twelve (12) sewer segments, consisting of both 8-inch and 18-inch pipelines, exhibit d/D values of up to approximately 0.56 under Scenario 2. While these values slightly exceed the recommended planning-level design criterion of 0.50, they represent a conservative PDWF condition evaluated as a snapshot in time. The limited magnitude of the exceedance and the available downstream capacity indicate that these segments do not present a significant constraint at the master planning level. Therefore, the results are considered acceptable for planning purposes and do not warrant additional improvements at this stage.							
[3]	Slopes below the recommended minimum design slope occur in select proposed 8-inch sewer segments where maintaining gravity conveyance to the existing 18-inch sewer system controls the profile. These segments represent planning-level assumptions only and should be reassessed during final design when detailed survey, utility conflicts, and final connection elevations are available.							

Figure 13 Model Network for Scenario 2 (Phase 2)

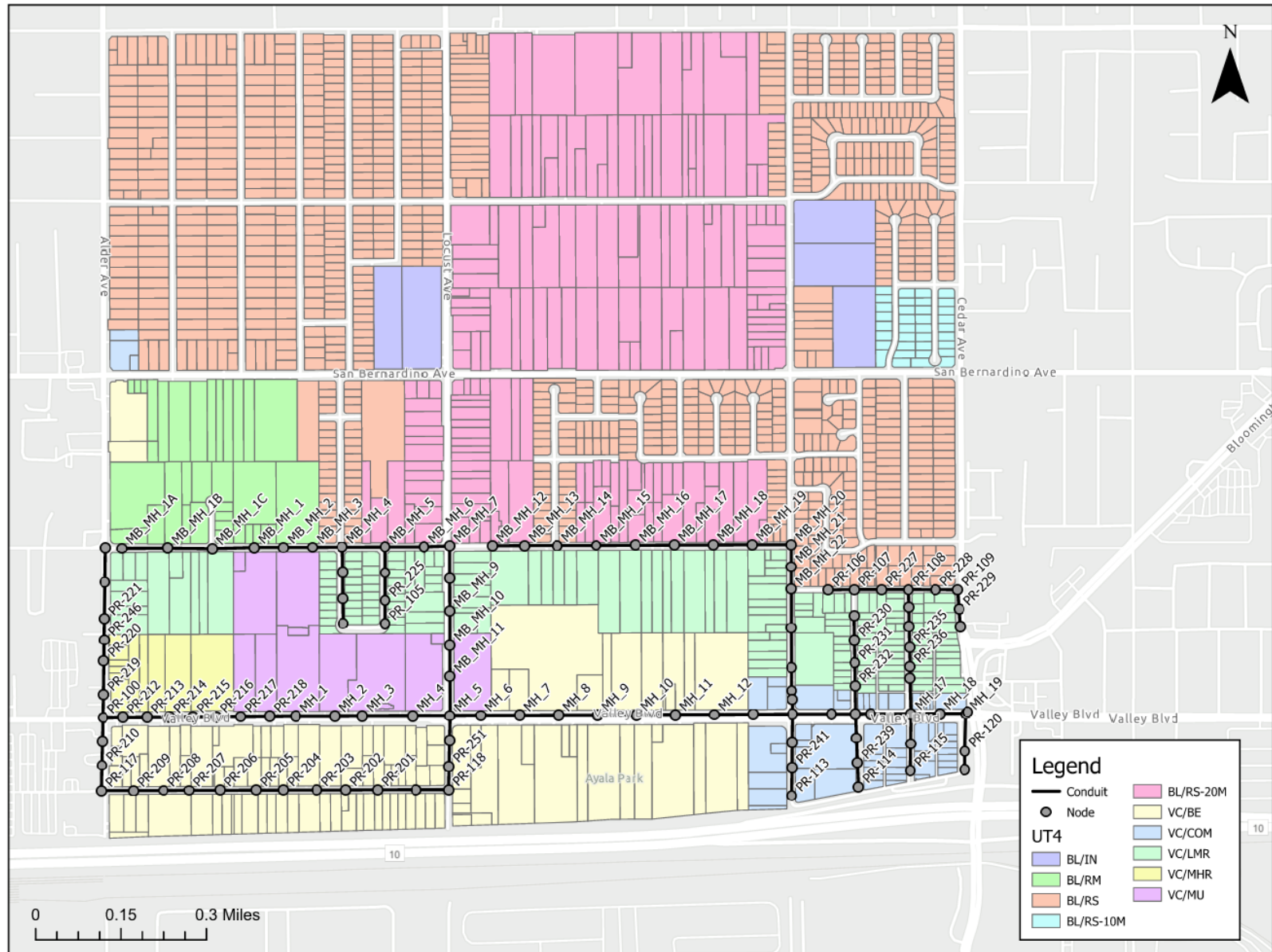
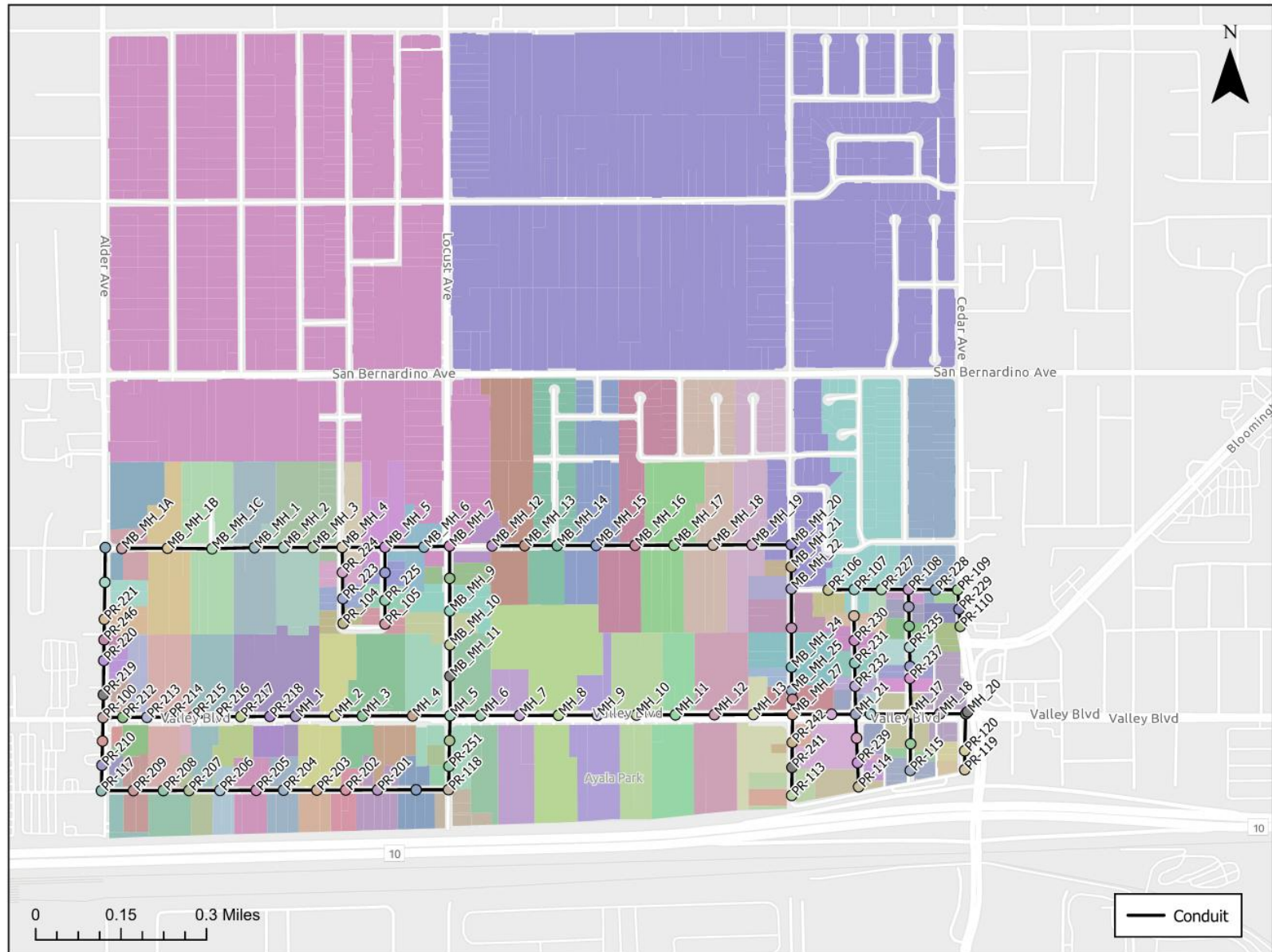


Figure 14 Scenario 2 (Phase 2) Assumed Wastewater Routing



SECTION 5 - CONCLUSION AND RECOMMENDATIONS

5.1. CONCLUSIONS

The Sewer Master Plan provides a planning level evaluation of the existing and proposed CSA 70 BL wastewater collection system under Existing Conditions, Scenario 1 (Phase 1), and Scenario 2 (Phase 2). Existing wastewater loading was established using temporary flow monitoring data, while future wastewater demands were developed using planned land uses, wastewater generation factors, density assumptions, and peaking factors derived from the monitoring program. Hydraulic evaluations were performed under Peak Dry Weather Flow (PDWF) conditions to assess the capacity and performance of the wastewater collection system.

Existing Conditions:

Under Existing Conditions, the hydraulic model indicates that the existing 18-inch gravity sewer within Valley Boulevard operates well below the County's recommended depth-to-diameter (d/D) criterion and maintains substantial available capacity. No significant hydraulic constraints were identified within the existing sewer system under current loading conditions.

Scenario 1 – Phase 1:

Scenario 1 evaluates the proposed Phase 1 sewer improvements associated with the Bloomington Sewer Expansion Project, including new 8-inch and 12-inch gravity sewer facilities. The hydraulic analysis indicates that the existing 18-inch trunk sewer and proposed 12-inch sewer facilities provide adequate conveyance capacity under projected PDWF conditions. Several 8-inch sewer segments exhibited modeled d/D values slightly exceeding the County's criterion of 50 percent (%). However, these results are largely attributable to the limited extent of the Phase 1 system and assumed parcel-level flow routing used for planning purposes. As developments, connection locations, and sewer configurations become more defined, these segments should be reevaluated during subsequent planning and design phases.

Scenario 2 – Phase 2:

Scenario 2 represents the ultimate buildout condition and includes projected wastewater demands from the CSA 70 BL service area as well as the additional tributary area evaluated as part of this Master Plan. The analysis indicates that the proposed trunk sewer system can accommodate projected wastewater demands under ultimate buildout conditions. Several sewer segments, including certain 8-inch, 12-inch, and 18-inch facilities, exhibit d/D values slightly exceeding the County's criterion. These exceedances occur under conservative planning assumptions intended to evaluate downstream system capacity and should not be interpreted as definitive design deficiencies. Rather, they identify locations that warrant further evaluation as future development and collection system planning advance.

Overall, the analysis demonstrates that the existing and proposed wastewater collection infrastructure provides a viable framework for accommodating projected future wastewater demands within CSA 70 BL and evaluating the potential impacts of future development within the additional tributary area. The

results support continued implementation of the Bloomington Sewer Expansion Project and provide a planning basis for future wastewater infrastructure improvements, system expansion, and regional wastewater planning efforts.

5.2. RECOMMENDATIONS

Table 11 below summarizes the recommendations from the hydraulic analysis.

Table 11 Summary of Recommendations

No.	Item	Recommendation
1	Implementation of the Bloomington Sewer Expansion Project	The hydraulic evaluation indicates that the proposed Phase 1 improvements provide a viable framework for expanding wastewater service within CSA 70 BL under projected Peak Dry Weather Flow (PDWF) conditions. Future design efforts should verify final pipe alignments, slopes, and connection locations prior to construction.
2	Reevaluate Sewer Segments Exceeding the County's d/D	Several sewer segments evaluated under Scenario 1 and Scenario 2 exhibited d/D values slightly greater than the County's recommended planning-level criterion of 0.50. These exceedances should be revisited as development, tributary areas, and collection system layouts become more refined. Final design should confirm whether modifications to pipe sizing, slope, or routing are warranted.
3	Refine Flow Routing as Development Occurs	The master planning analysis relies on parcel-level flow allocation and conceptual routing assumptions. As specific development projects are proposed, wastewater flow assignments should be updated to reflect actual connection points and service areas, and the hydraulic model should be updated accordingly.
4	Maintain and Update the Hydraulic Model as New Information Becomes Available	The hydraulic model should be updated periodically to incorporate future sewer extensions, revised land use information, updated parcel development assumptions, record drawings, and observed system conditions. Maintaining the model as a living planning tool will improve its usefulness for future wastewater infrastructure and development planning efforts.

APPENDIX A – FLOW MONITORING RESULTS

Flow Monitoring Standard Data Report

Prepared for:
Michael Baker International
San Bernardino
Ivana M Awayja
ivana.awayjan@mbakerintl.com
951-506-2041



Utility Systems Science and Software, Inc.
601 N. Parkcenter Dr. Suite 209
Santa Ana, CA 92705
Phone 714-542-1004 Fax: 714-542-1332

Methods & Procedures & Equipment

Methods and Procedures

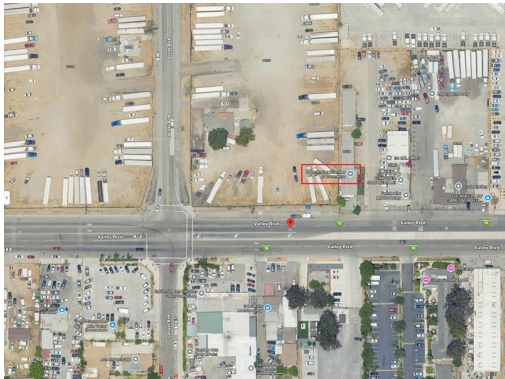
Utility Systems Science & Software provided San Bernardino with an off the shelf, non-proprietary flow monitoring solution that included three states of the art Hach Flo-Dar® AV Sensor systems. The project course of action is listed below. The US³ team:

- Assessed permitting and traffic control at the sites on Locust Ave, Linden Ave and Valley Blvd in Bloomington, CA.
- Prepared the traffic control plan and obtained a City Encroachment Permit.
- Installed and removed traffic control in accord with approved traffic control plans per California Temporary Traffic Control Handbook (CATTCH) requirements for the installation, calibration and removal of equipment.
- Validated the sites for suitability for sewer flow monitoring for the CSA 70 BL - Bloomington Project.
 - **Site 1: Locust Ave MH 1** had no laterals with slow to moderate open channel hydraulics. Reading was monitored at the upstream line as it provided the best hydraulics during inspection.
 - **Site 2: Linden Ave MH 2** had pipes entering from north and south with slow to moderate open channel hydraulics with some turbulence due to inflow from lateral. Reading was monitored at the downstream line to get the total flow.
 - **Site 3: Valley Blvd MH 3 Alt** had no laterals with slow to moderate open channel hydraulics. Reading was monitored at the downstream line to get the total flow. Site was relocated to one manhole upstream from the original site due to bad hydraulics.
- Installed and calibrated the flow monitoring equipment at the sites per manufacturer recommendations on 01/09/2026.
 - Follow-up on the installations confirmed equipment was reading properly.
 - Collected 15-minute interval depth and velocity data points over the entire monitoring period.
- Removed the equipment on 01/27/2026 and validated the data.
 - All of the equipment went through diagnostic testing before and after the study with less than a 1% deviation between manual and meter level readings and less than a 5% deviation between manual and meter velocity readings.
 - Equipment calibration was verified in accordance with manufacturer specifications.
- Prepared the data reports.
 - The table below contains a summary of the average (Avg) and maximum (Max) velocities (Vel) and levels (Lev) collected during this study as well as the calculated flow rates (Flow).

Site	Pipe Size (in)	Avg Vel (fps)	Max Vel (fps)	Avg Lev (in)	Max Lev (in)	Avg Flow (gpm)	Max Flow (gpm)
1	18	0.66	0.90	1.95	3.12	32.15	78.38
2	18	1.72	2.15	1.52	1.94	56.53	98.78
3	18	2.90	3.47	1.44	1.97	87.41	153.51

Customer Name: Michael Baker International	Site Address: ~18156 Valley Blvd #8 Bloomington CA 92316	Site Name: Locust Ave MH 1
---	---	-----------------------------------

Access: MH southwest of address, located to the right of Locust and Valley Blvd intersection	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4">System Type</th> </tr> <tr> <td style="text-align: center;">Sanitary</td> <td style="text-align: center;">Storm</td> <td style="text-align: center;">Combined</td> <td style="text-align: center;">Other</td> </tr> <tr> <td style="text-align: center;">X</td> <td></td> <td></td> <td></td> </tr> </table>	System Type				Sanitary	Storm	Combined	Other	X				Install Date: January 27, 2026 Install Time: 08:18
System Type														
Sanitary	Storm	Combined	Other											
X														

 Map	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2">Device Statistics</th> </tr> <tr> <td>Meter Depth (in):</td> <td>159.16"</td> </tr> <tr> <td>MH Coordinates:</td> <td>34.070501, -117.408755</td> </tr> <tr> <td>Device SN:</td> <td>n/a</td> </tr> <tr> <td>Avg Measured Level (in)</td> <td>1.50"</td> </tr> <tr> <td>Avg Measured Velocity</td> <td>0.60FPS</td> </tr> <tr> <td>Multiplier</td> <td>1.00</td> </tr> <tr> <th colspan="2">Notes</th> </tr> <tr> <td colspan="2">Slow to moderate open channel hydraulics</td> </tr> <tr> <th colspan="2">Traffic Safety</th> </tr> <tr> <td colspan="2">Used arrow board, cones & signs in accord w/site-specific CATTCH requirements.</td> </tr> <tr> <th colspan="2">Land Use</th> </tr> <tr> <td style="text-align: center;">Residential</td> <td style="text-align: center;">Commercial</td> </tr> <tr> <td style="text-align: center;">Industrial</td> <td style="text-align: center;">Trunk</td> </tr> <tr> <td></td> <td style="text-align: center;">X</td> </tr> <tr> <td>Field Conditions</td> <td>Sunshine</td> </tr> <tr> <td>Manhole Depth (in)</td> <td>185.00"</td> </tr> <tr> <td>Monitored Pipe Size (in)</td> <td>18"</td> </tr> <tr> <td>Inner Pipe Size (in) (In/Out)</td> <td>18"/18"</td> </tr> <tr> <td>Pipe Shape</td> <td>Round</td> </tr> <tr> <td>Pipe Condition</td> <td>Fair</td> </tr> <tr> <td>Manhole Material</td> <td>Concrete (cast in place)</td> </tr> <tr> <td>Silt (in)</td> <td>0.00"</td> </tr> <tr> <td>Sensor Offset (in)</td> <td>25.84"</td> </tr> <tr> <td>Sensor Dist. to Crown (in)</td> <td>7.84"</td> </tr> <tr> <td>Flow Direction</td> <td>East</td> </tr> <tr> <td>Sensor Direction</td> <td>Upstream</td> </tr> </table>	Device Statistics		Meter Depth (in):	159.16"	MH Coordinates:	34.070501, -117.408755	Device SN:	n/a	Avg Measured Level (in)	1.50"	Avg Measured Velocity	0.60FPS	Multiplier	1.00	Notes		Slow to moderate open channel hydraulics		Traffic Safety		Used arrow board, cones & signs in accord w/site-specific CATTCH requirements.		Land Use		Residential	Commercial	Industrial	Trunk		X	Field Conditions	Sunshine	Manhole Depth (in)	185.00"	Monitored Pipe Size (in)	18"	Inner Pipe Size (in) (In/Out)	18"/18"	Pipe Shape	Round	Pipe Condition	Fair	Manhole Material	Concrete (cast in place)	Silt (in)	0.00"	Sensor Offset (in)	25.84"	Sensor Dist. to Crown (in)	7.84"	Flow Direction	East	Sensor Direction	Upstream
Device Statistics																																																							
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Sensor Dist. to Crown (in)	7.84"																																																						
Flow Direction	East																																																						
Sensor Direction	Upstream																																																						

 Traffic Safety	
--	--

Customer Name: Michael Baker International

Site Address: ~18156 Valley Blvd #8 Bloomington CA 92316

Site Name: Locust Ave MH 1



Site



Before Install



Sewer Map



Installed



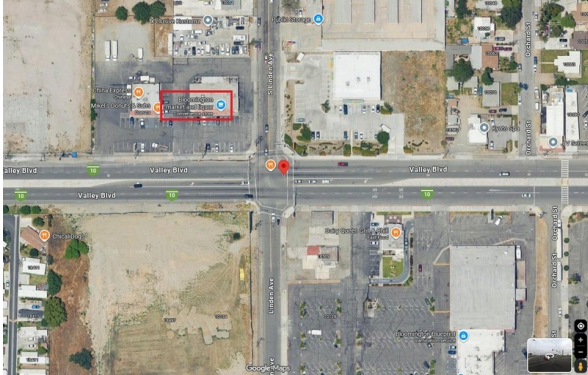
Upstream



Upstream Pipe Size

Customer Name: Michael Baker International	Site Address: ~18484 Valley Blvd Bloomington CA 92316	Site Name: Linden Ave MH 2
---	--	-----------------------------------

Access: MH southeast of address, located on Linden Ave and Valley Blvd intersection	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4">System Type</th> </tr> <tr> <td style="width: 25%;">Sanitary</td> <td style="width: 25%;">Storm</td> <td style="width: 25%;">Combined</td> <td style="width: 25%;">Other</td> </tr> <tr> <td style="text-align: center;">X</td> <td></td> <td></td> <td></td> </tr> </table>	System Type				Sanitary	Storm	Combined	Other	X				Install Date: January 9, 2026 Install Time: 09:11
System Type														
Sanitary	Storm	Combined	Other											
X														



Map



Traffic Safety

Gas			
O2	H2S	CO	LEL
20.9%	0ppm	0ppm	0%

Device Statistics	
Meter Depth (in): 172.70"	
MH Coordinates: 34.070521, -117.400732	
Device SN: n/a	
Avg Measured Level (in)	1.30"
Avg Measured Velocity	1.51FPS
Multiplier	1.00
Notes	
Slow to moderate open channel hydraulics with some turbulence due to inflow from lateral.	
Traffic Safety	
Used arrow board, cones & signs in accord w/site-specific CATTCH requirements.	
Land Use	
Residential	Commercial
	X
Industrial	Trunk
Field Conditions	Sunshine
Manhole Depth (in)	199.00"
Monitored Pipe Size (in)	18"
Inner Pipe Size (in) (In/Out)	18"/18"
Pipe Shape	Round
Pipe Condition	Fair
Manhole Material	Concrete (cast in place)
Silt (in)	0.00"
Sensor Offset (in)	26.30"
Flow Direction	East
Sensor Direction	Downstream

Customer Name: Michael Baker
International

Site Address: ~18484 Valley Blvd Bloomington CA
92316

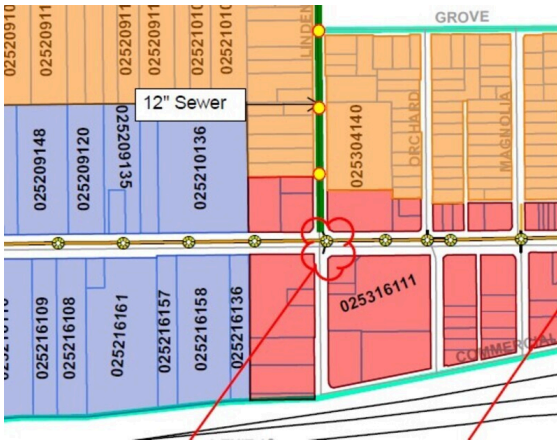
Site Name: Linden Ave MH
2



Site



Before Install



Sewer Map



Installed



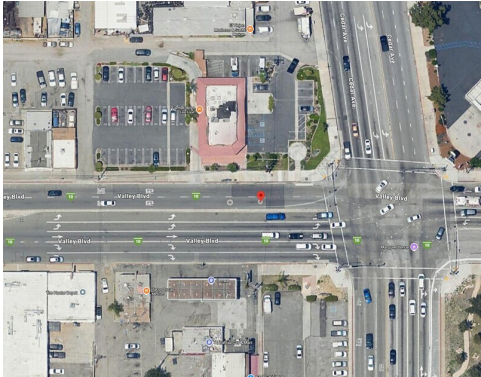
Downstream



Downstream Pipe Size

Customer Name: Michael Baker International	Site Address: ~18694 Valley Blvd Bloomington CA 92316	Site Name: Valley Blvd MH 3 Alt
---	--	--

Access: MH south of address, located near Valley Blvd and Cedar Ave intersection	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4">System Type</th> </tr> <tr> <td style="width: 25%;">Sanitary</td> <td style="width: 25%;">Storm</td> <td style="width: 25%;">Combined</td> <td style="width: 25%;">Other</td> </tr> <tr> <td style="text-align: center;">X</td> <td></td> <td></td> <td></td> </tr> </table>	System Type				Sanitary	Storm	Combined	Other	X				Install Date: January 9, 2026 Install Time: 10:39
System Type														
Sanitary	Storm	Combined	Other											
X														



Map



Traffic Safety

Gas			
O2	H2S	CO	LEL
20.9%	0ppm	0ppm	0%

Device Statistics	
Meter Depth (in): 134.04"	
MH Coordinates: 34.07055, -117.396574	
Device SN: n/a	
Avg Measured Level (in)	1.50"
Avg Measured Velocity	2.96FPS
Multiplier	1.00
Notes	
Slow to moderate open channel; Site was relocated to one manhole upstream from the original site due to bad hydraulics	
Traffic Safety	
Used arrow board, cones & signs in accord w/site-specific CATTCH requirements.	
Land Use	
Residential	Commercial
Industrial	Trunk
	X
Field Conditions	Sunshine
Manhole Depth (in)	161.00"
Monitored Pipe Size (in)	18"
Inner Pipe Size (in) (In/Out)	18"/18"
Pipe Shape	Round
Pipe Condition	Fair
Manhole Material	Concrete (cast in place)
Silt (in)	0.00"
Sensor Offset (in)	26.96"
Sensor Dist. to Crown (in)	8.96"
Flow Direction	East
Sensor Direction	Downstream

Customer Name: Michael Baker
International

Site Address: ~18694 Valley Blvd Bloomington CA
92316

Site Name: Valley Blvd MH 3
Alt



Site



Before Install



Sewer Map



Installed



Downstream



Downstream Pipe Size

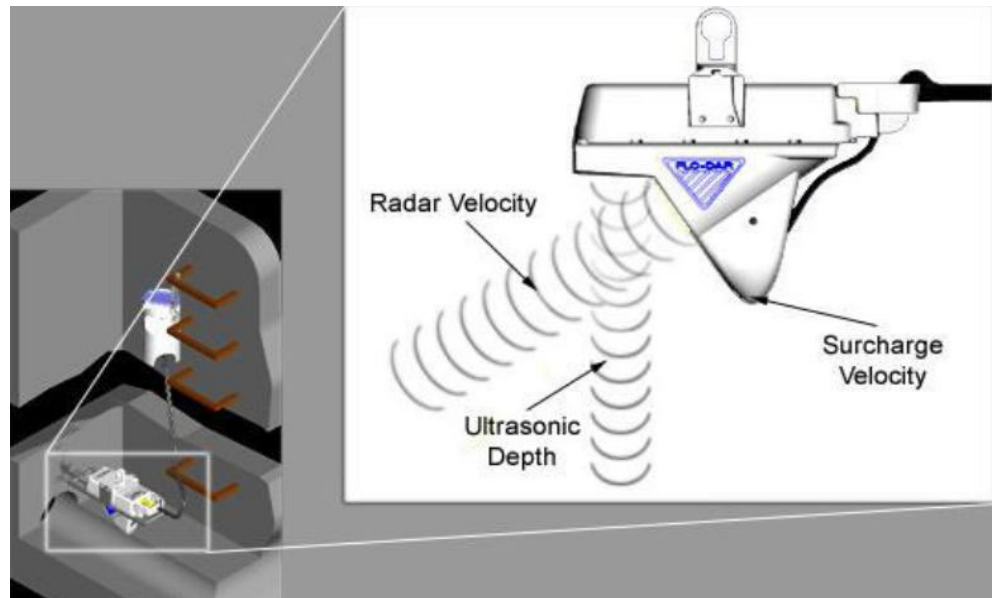
Equipment

Figure above: Equipment installed for the Sewer Flow Monitoring Study



Figure above: Web-Enabled Flo-Dar® AV Sensor, Radar-Based Velocity/Area Flow Meter

FloDar® AV Sensor Specifications:

- **Enclosure**
 - IP68 Waterproof rating, Polystyrene
- **Dimensions**
 - 160.5 W x 432.2 L x 297 D mm (6.32 x 16.66 x 11.7 in.),
 - With SVS, D = 387 mm (15.2 in.)
- **Weight**
 - 4.8 kg (10.5 lbs.)
- **Operating Temperature**
 - -10 to 50°C (14 to 122°F)
- **Storage Temperature**
 - -40 to 60°C (-40 to 140°F)
- **Power Requirements**
 - Supplied by FL900 Flow Logger, Flo-Logger, or Flo-Station
- **Interconnecting Cable**
 - Disconnect available at both sensor and logger or Flo-Station
 - Polyurethane, 0.400 (±0.015) in. diameter; IP68
 - Standard length 9 m (30 ft), maximum 305 m (1000 ft)
- **Cables – available in two styles:**
 - connectors at both ends
 - connector from sensor with open leads to desiccant hub, desiccant hub with connector to logger. A potting/sealant kit will be included. This can be used to run the cable through conduit.
- **Certification**
 - Certified to: FCC Part 15.245: FCC ID: VIC-FLODAR24
 - Industry Canada Spec. RSS210. v7: IC No.: 6149A-FLODAR24

SURCHARGE DEPTH MEASUREMENT

- Auto zero function maintains zero error below 0.5 cm (0.2 in.)
- **Method**
 - Piezo-resistive pressure transducer with stainless steel diaphragm
- **Range**
 - 3.5 m (138 in.), overpressure rating 2.5 x full scale

VELOCITY MEASUREMENT

- **Method**
 - Radar
- **Range**
 - 0.23 to 6.10 m/s (0.75 to 20 ft/s)

- **Frequency Range**
 - 24.075 to 24.175 GHz, 15.2 mW (max.)
- **Accuracy**
 - $\pm 0.5\%$; ± 0.03 m/s (± 0.1 ft/s)

DEPTH MEASUREMENT

- **Method**
 - Ultrasonic
- **Standard Operating Range from Flo-Dar® Housing to Liquid**
 - 0 to 152.4 cm (0 to 60 in.)
- **Optional Extended Level Operating Range from Transducer Face to Liquid**
 - 0 to 6.1 m (0 to 20 ft.) with 43.18 cm (17 in.) dead band, temperature compensated.
- **Accuracy**
 - $\pm 1\%$; ± 0.25 cm (± 0.1 in.)

FLOW MEASUREMENT

- **Method**
 - Based on Continuity Equation
- **Accuracy**
 - $\pm 5\%$ of reading typical where flow is in a channel with uniform flow conditions and is not surcharged, $\pm 1\%$ full scale max.

SURCHARGE CONDITIONS DEPTH/VELOCITY DEPTH (Std with Flo-Dar® Sensor)

- **Surcharge depth supplied by Flo-Dar® sensor.**

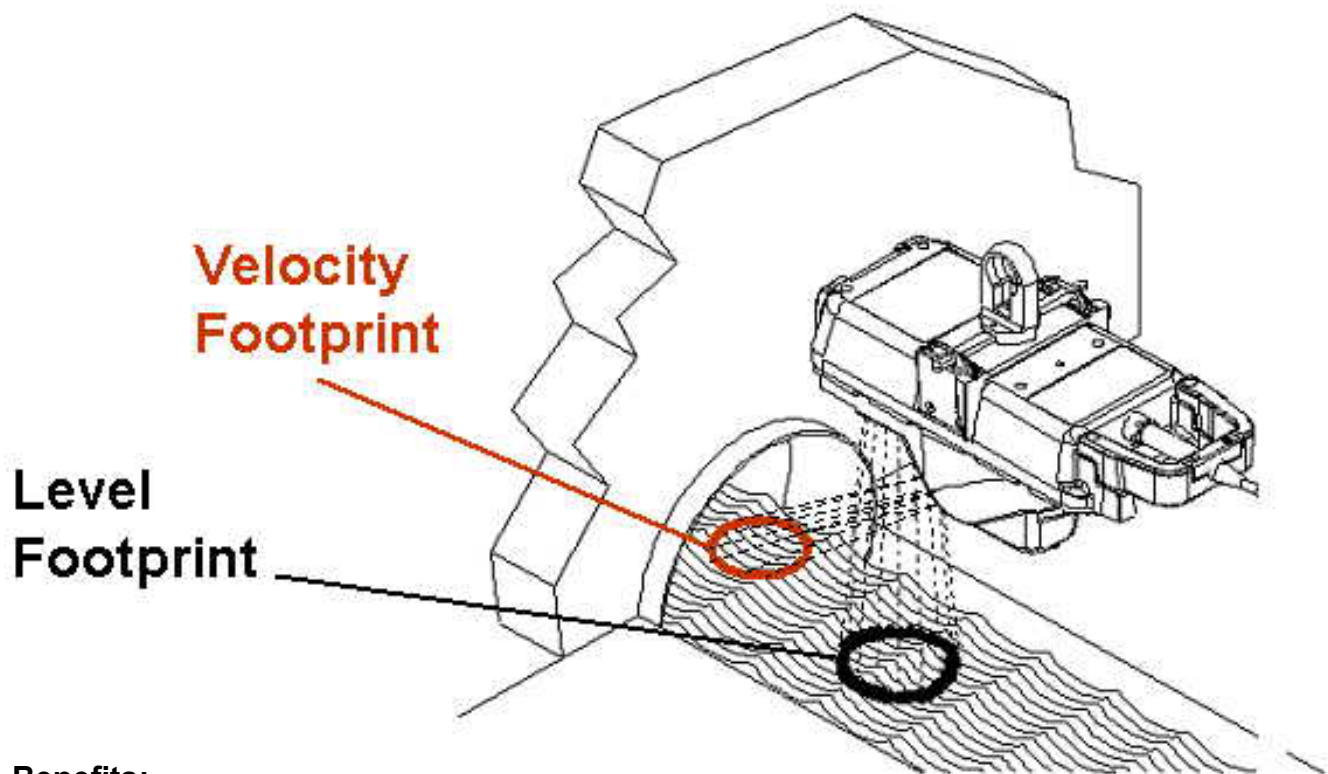
VELOCITY (Optional Surcharge Velocity Sensor)

- **Method**
 - Electromagnetic
- **Range**
 - ± 4.8 m/s (± 16 ft/s)
- **Accuracy**
 - ± 0.15 ft/s or 4% of reading, whichever is greater.
- **Zero Stability**
 - ± 0.05 ft/s

The Flo-Dar® Open Channel Flow Meters provide an innovative approach to open channel flow monitoring. Combining digital Doppler radar velocity sensing with ultrasonic pulse echo level sensing Flo-Dar® provides accurate open channel flow monitoring without the fouling problems associated with submerged sensors.

Perfect Solution for Difficult Flow Conditions:

- Flows with High Solids Content
- High Temperature Flows
- Caustic Flows
- Large Man-Made Channel
- High Velocities
- Shallow Flows

**Benefits:**

1. Personnel have no contact with the flow during installation.
2. Maintenance caused by sensor fouling is eliminated.
3. Field Replaceable/Interchangeable Sensors and Monitors

How It Works

Flo-Dar® transmits a digital Doppler radar beam that interacts with the fluid and reflects back signals at a different frequency than that which was transmitted. These reflected signals are compared with the transmitted frequency. The resulting frequency shift provides an accurate measure of the velocity and the direction of the flow. Level is detected by ultrasonic pulse echo. Flow is then calculated based on the Continuity Equation:

$$Q = V \times A, \text{ Where } Q = \text{Flow}, V = \text{Average Velocity and } A = \text{Area}$$

Accurate Flow Measurements

Flo-Dar® provides the user with highly accurate flow measurements under a wide range of flows and site conditions. By measuring the velocity of the fluid from above, Flo-Dar® eliminates accuracy problems inherent with submerged sensors including sensor disturbances, high solids content and distribution of reflectors.

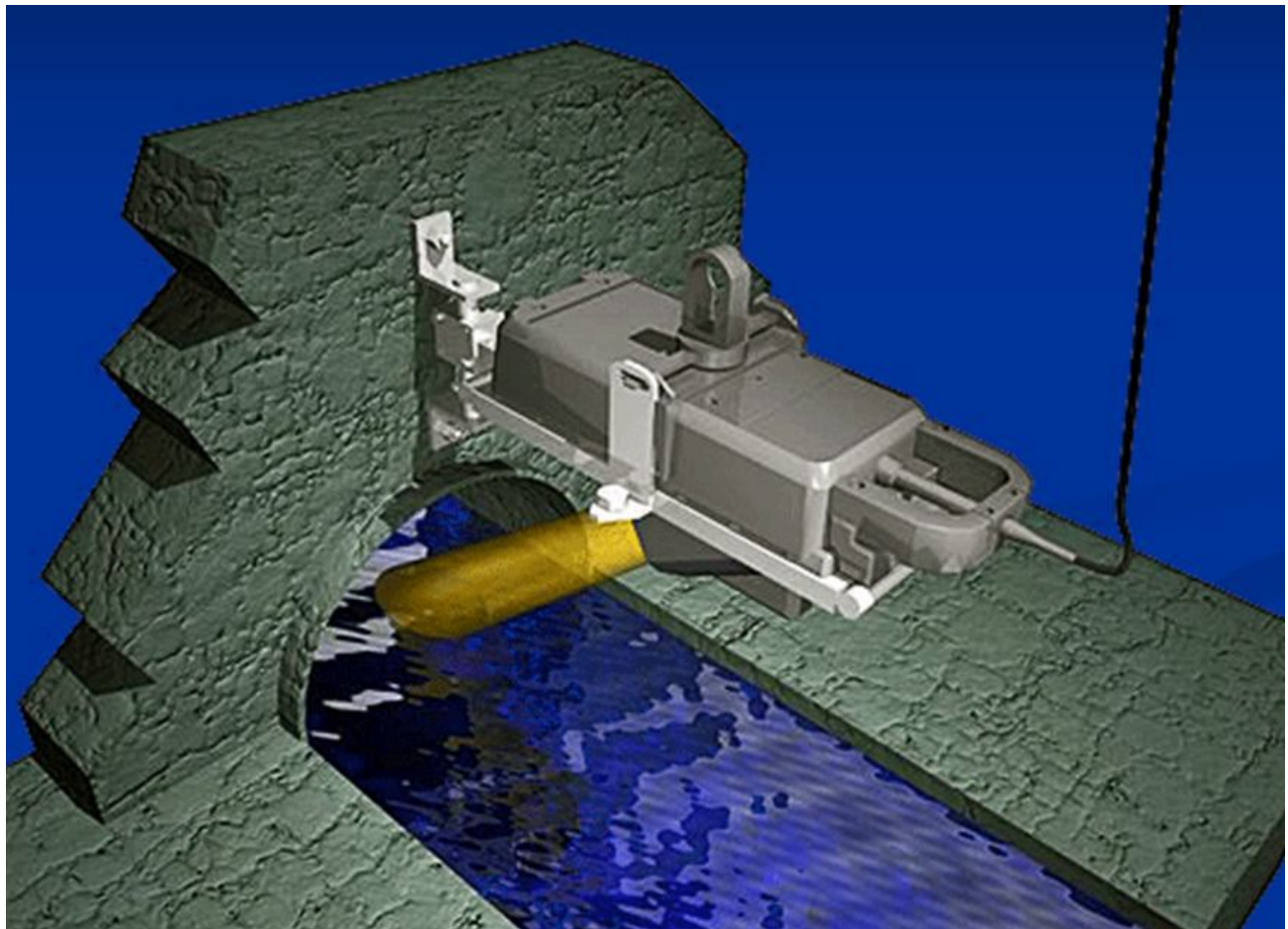


Figure above: US³ utilizes exclusively Hach March-McBirney Flo-Dar® Meters

US³ Company Information

US³ is a California Corporation **Federal ID No. 33-0729605** and qualifies as a Minority Business Enterprise. US³ has certified as an MBE with the California Public Utility Commission's authorized clearinghouse, **Verification Number: 97ES0008**.

US³ is a specialty service company for the Water & Waste Water industry, providing monitoring and control for Utilities since 1996. US³ is in the forefront of this industry by taking the proven technological approaches developed in other high-tech industries and applying them to protect one of our most precious natural resources - our water.

US³ engineers and technical personnel have applied advanced instrumentation system technology to water/wastewater open channel flow monitoring, pipeline evaluation, engineering, and data analysis, all coupled to the power of the Internet. This unique integrated systems approach allows the company to bring greater insight and intelligence to gathering information about water/wastewater system performance of our clients, and in turn, to support the fulfillment of their commitments to manage and cost effectively design, operate, and maintain these systems.

Moreover, **US³** supports Municipalities, Consulting Engineering firms and other water/waste water systems integrators by providing temporary technical services for engineering, software programming and technical site maintenance and calibration site support work, primarily in the Water and Waste Water industries.



Figure at right: All US³ technicians are certified for Confined Space Entry.

Key Personnel Assigned

US³ provided the necessary resources to fully implement this project. Primary in support of this effort were the following personnel:

Mr. Mark Serres: Mr. Serres is a degreed electrical engineer with over 30 years of experience with fresh/wastewater systems, project management, and systems integration in relation to complex industrial systems. This includes experience in industrial automation and water/wastewater industries. Mr. Serres is responsible for assuring client satisfaction and marshalling the required resources to meet the project requirements.

Mr. Thomas Williams: Mr. Williams is an Engineering Manager with over 25 years of experience in complex systems development for wastewater monitoring. This experience includes hydraulic compatibility, instrumentation, communications and analysis. Mr. Williams is responsible for assuring that the required equipment is designed and calibrated to meet the project requirements.

Darlene Szczublewski, PE: Mrs. Szczublewski is a licensed Civil Engineer in multiple states. She has over 20 years of engineering experience with stormwater/wastewater related projects. She assisted in the completion of several Sanitary Sewer Evaluation Surveys and Capacity Analysis projects to meet Consent Decrees as well as completing numerous Infiltration and Inflow (I&I) studies for other clients. Mrs. Szczublewski has developed numerous flow data analysis techniques to present a clear informative picture of flow in a monitored system. Her work also includes the development of training programs for clients describing I&I and capacity analysis methodologies. Mrs. Szczublewski is responsible for analyzing the data as well as the data collection process and assuring that the reports meet the project requirements.

Name, title, address and telephone number of persons to contact regarding this US³ project.

Darlene Szczublewski, PE
Senior Civil Engineer
darlene.szczublewski@uscubed.com

1300 Hill Street
El Cajon, CA 92020
619-546-4281 (work)
619-246-5304 (cell)

Tom Williams
Engineering Manager
tom.williams@uscubed.com

1300 Hill Street
El Cajon, CA 92020
619-546-4281 (work)
619-398-7799 (cell)

APPENDIX B – SUPPLEMENTAL INFOWORKS ICM INFORMATION

Unsteady Flow Modeling

The Valley Corridor Sewer Master Plan was developed using InfoWorks ICM to create a dynamic, unsteady flow model. This modeling approach allows for time-varying interactions among all elements of the pipe system, including independent pipe characteristics and the spatial location of the pipes within the system. The software uses two primary unsteady flow equations: the full Saint-Venant equations to conserve mass and momentum, and the dynamic wave solution to account for hydraulic forces in the system. As such, this unsteady modeling can represent impacts to complex storm and sewer systems, such as surcharge, backwater, and pressurized flow conditions. The software can also integrate multiple scenarios into a single network, allowing for efficient testing of multiple alternatives within a clean, streamlined modeling package. It is a highly useful and powerful software for understanding the performance of sewer and storm collection systems. It should be noted that due to the dynamic nature of the modeling platform, results may vary from typical one-dimensional calculations.

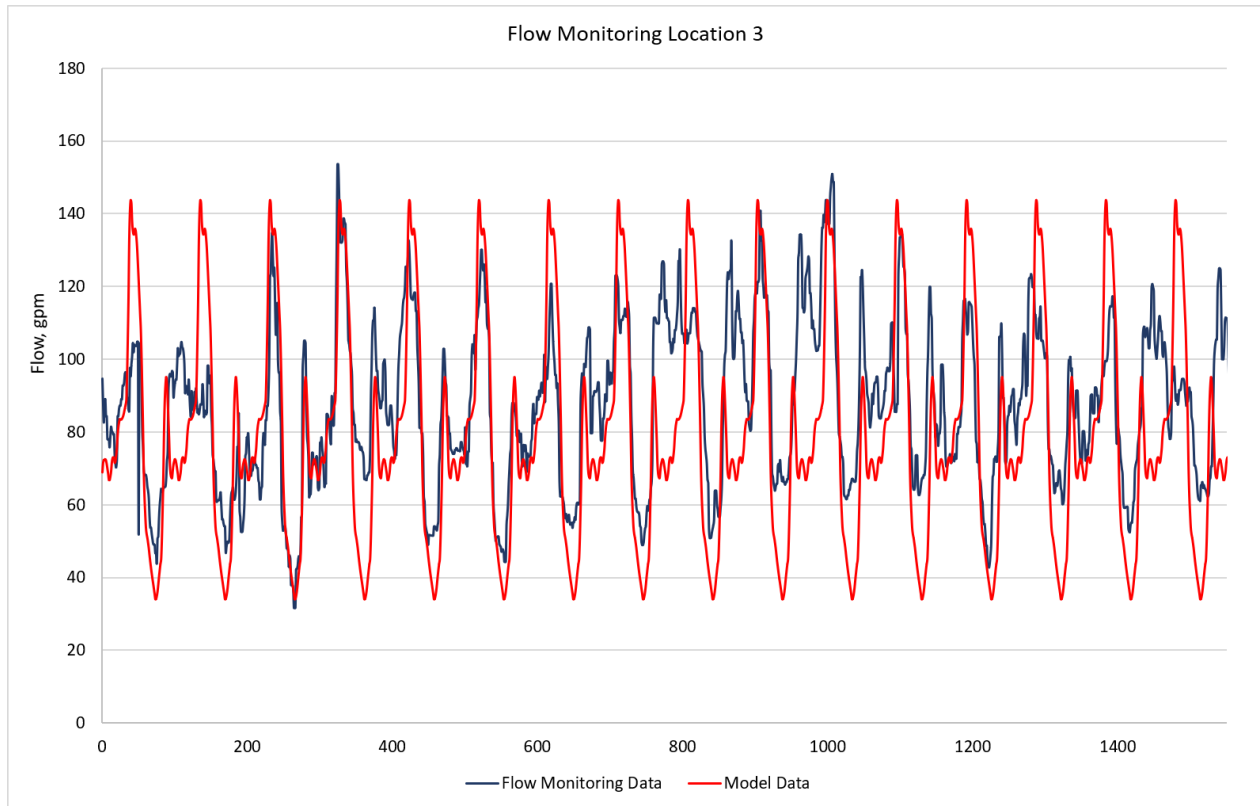
Explanation of Variation from Calcs

Because of the nature of the dynamic, unsteady ICM model, results can differ slightly from steady state models or one-dimensional pipe calculations. Differences between steady state models and unsteady state models can vary depending on the complexity of the system; however, the Valley Corridor model was intentionally designed to keep any variation under 5%.

Existing Conditions:

Pipe MH_19.1

In sewer models, InfoWorks ICM requires the application of a repeatable, diurnal curve that reflects daily oscillations in wastewater generation. For the Valley Corridor model, a diurnal curve was estimated and calibrated based on the Existing Condition scenario and applied to Scenarios 1 and 2. The curve is based on a proportional increase and decrease of the provided daily average per capita flow over 24 hours. The diurnal curve for the Valley Corridor model is pictured below, against the observed data at Flow Monitoring Location 3 (Cedar Ave). Because the diurnal curve needs to be repeatable, it must be developed to represent the overall pattern of a system that fluctuates daily in wastewater generation. Therefore, as indicated in the figure below, while the numerical maximum and minimum observed peaks may not match the model, the curve better represents typical conditions. The maximum and minimum observed peaks are considered outliers in this data.



At Flow Monitoring Location 3 (Cedar Ave), the peak observed flow is over 150 gpm. The model was calibrated at this location to represent the typical conditions in this diurnal system. The model data follows a similar pattern to the flow monitoring data. To achieve the balance of representing the system as a whole and reflecting minimum and maximum trends, the calibrated daily peak flow is less than 150 gpm (144.5 gpm). Therefore, the peak over 150 gpm will not be represented in the modeling results at pipe MH_19.1.

Scenario 2

[Laterals into the mainline](#)

In Scenario 2, additional infrastructure was integrated into the mainline along Valley Boulevard. In unsteady dynamic modeling, it is typical to see tailwater impacts at the downstream end of laterals from higher flood depths in those larger pipes. This allows for a more robust understanding of the integrated workings of the system. The incoming laterals in the Valley Corridor model were oriented with a downstream invert offset to the main 18" pipe, to avoid these tailwater impacts as the system flow converges to the point at Valley Boulevard and

Cedar Ave. Each downstream lateral invert was raised by less than one foot, which exceeds the maximum depth in the mainline, creating free flow out of the lateral and avoiding high d/D ratios. To note, avoiding tailwater impacts with measures such as downstream pipe invert offsets should be incorporated into the design to ensure that the model is representative of the actual conditions with appropriate accuracy.

[MB_MH_7 and MB_MH_20](#)

Scenario 2 also investigates whether the 18" mainline has the capacity to service the neighborhoods between Marygold Ave and W Randall Ave. To confirm the available level of service, the parcels between San Bernardino Ave and W Randall Ave were routed directly to the 12" pipes along Locust Ave and S Linden Ave. This routing was selected with the assumption that the infrastructure for the additional neighborhoods would connect to the mainline at this location. It would be unrealistic to route them to any other pipes. For example, the 8" in pipes along Marygold Ave would only be designed to accommodate the level of service in the immediate parcels.

[MB_MH_7.1](#)

The depth to diameter ratio (d/D) is directly calculated as the 'surcharge state' for conduits in the InfoWorks ICM model results based on the capacity or surcharge at the upstream and downstream ends. InfoWorks ICM's ability to model dynamic flow like backwater can result in the capacity of a pipe being exceeded at the downstream end, while the pipe may not show full at the upstream end. The d/D ratio calculated in the model accounts for larger of the maximum modeled depths (d) between the upstream and downstream depths.

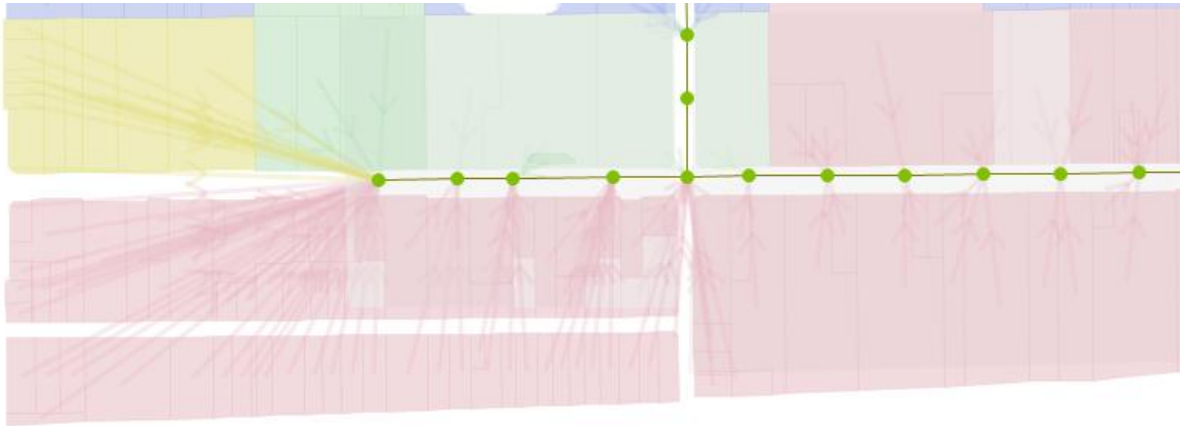
When the pipe is not at capacity, the surcharge state calculates similar to a typical d/D, in that it is the ratio of water depth to pipe diameter. Therefore, a surcharge state of 0.6 corresponds to 60% full. However, once the pipe exceeds its capacity at either end, the surcharge calculation state diverges slightly from a typical d/D calculation. A value of 1 means that the pipe is full (100%) and that the flow running through it is equal or less than the pipe capacity. A value of 2 also means that the pipe is full, but that the flow exceeds the pipe capacity. There are no fractions above a value of 1, the only options are 1 or 2 to indicate whether the flow through a pipe has reached the maximum.

[MB_MH_2.1 to MB_MH_6.1](#)

The series of pipes along the west side of Marygold Ave include additional pipe systems in Scenario 2 that are not included in Scenario 1. These pipes systems are along Grace St and Frankfort Ave. The additional pipes in the system in Scenario adjusts routing and increases system capacity so that the results show lower d/D ratios in the pipes along Marigold compared to Scenario 1.

PR252.1

This pipe exhibits significantly different flows between the steady state calculations and the model due to routing differences. In Scenario 1, all of the flow from the southwest corner of the study area is routed to the 18" pipe along Valley Boulevard.



However, in Scenario 2, the added pipes allow for more distribution of the parcel inflows. The sanitary inflows are applied along the new 8-inch pipes that they front, as shown below. This difference in routing accounts for differences between the two models.

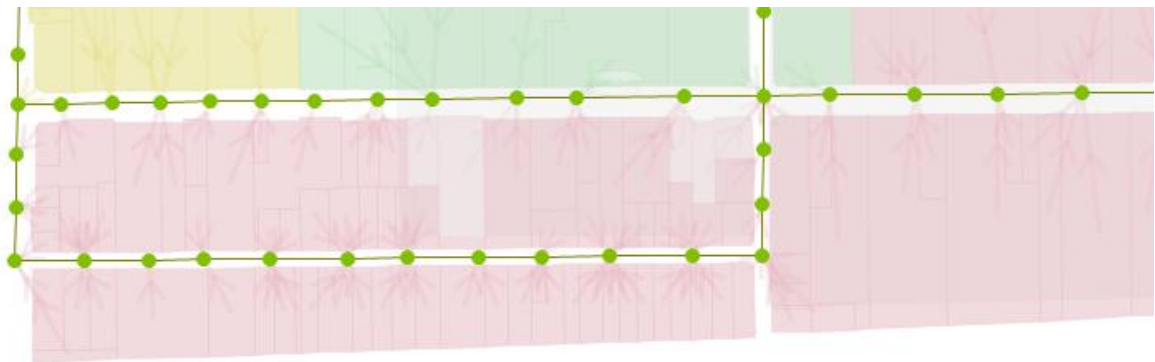


FIGURE 1 EXISTING CONDITIONS (18-INCH VALLEY BLVD)

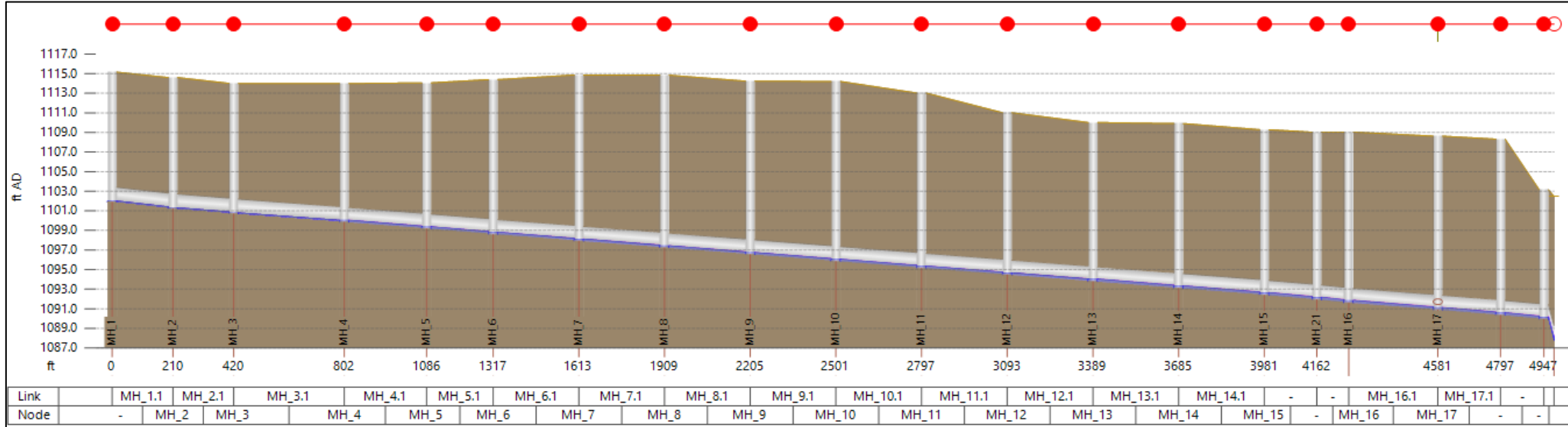


FIGURE 2 SCENARIO 1 (18-INCH VALLEY BLVD)

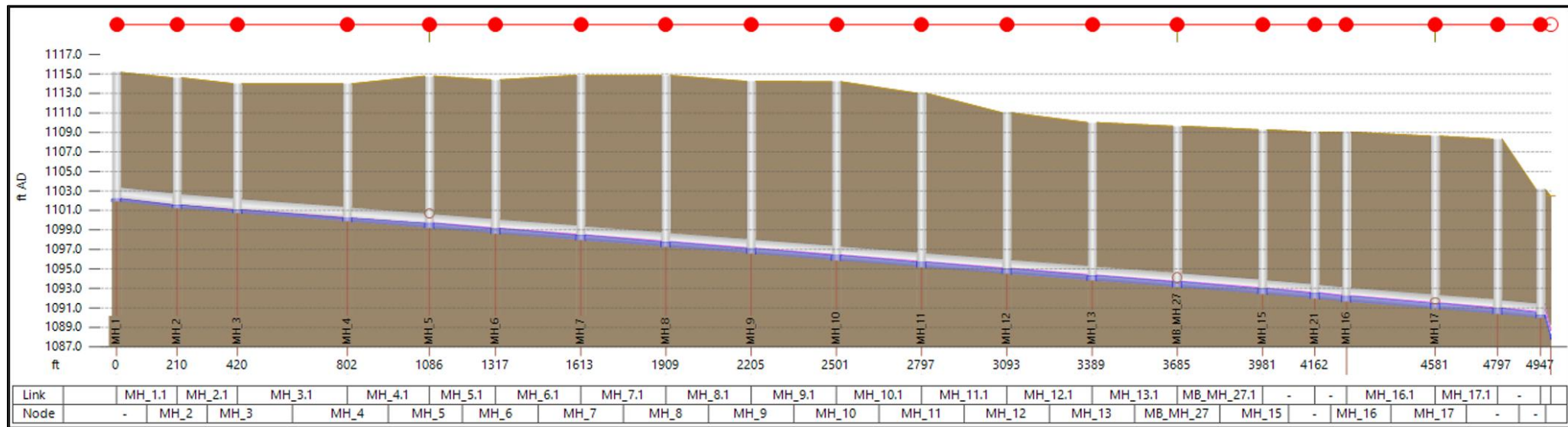
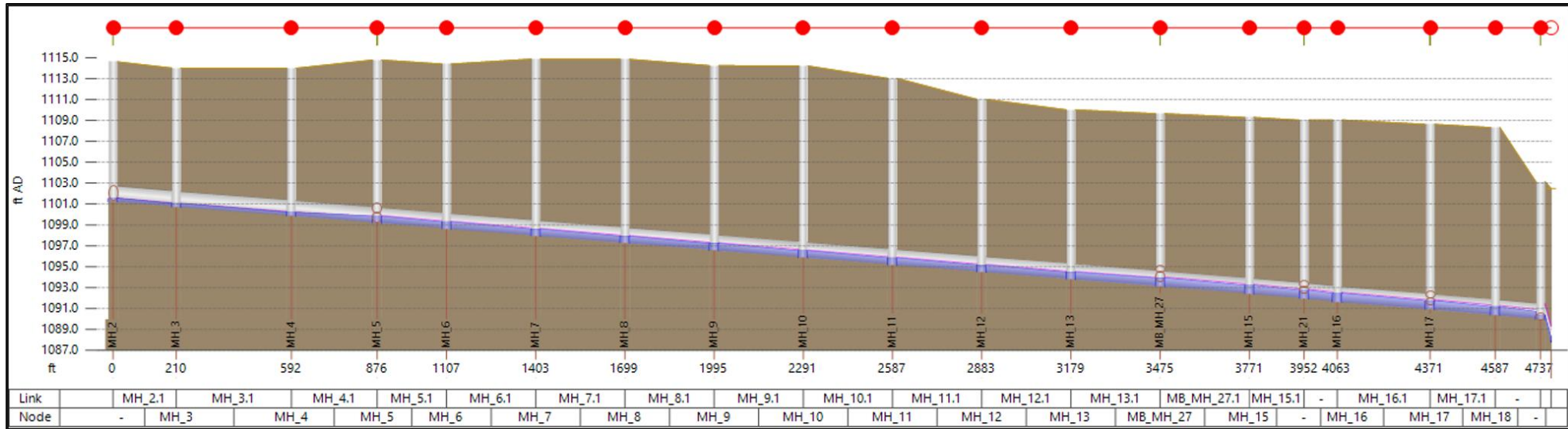
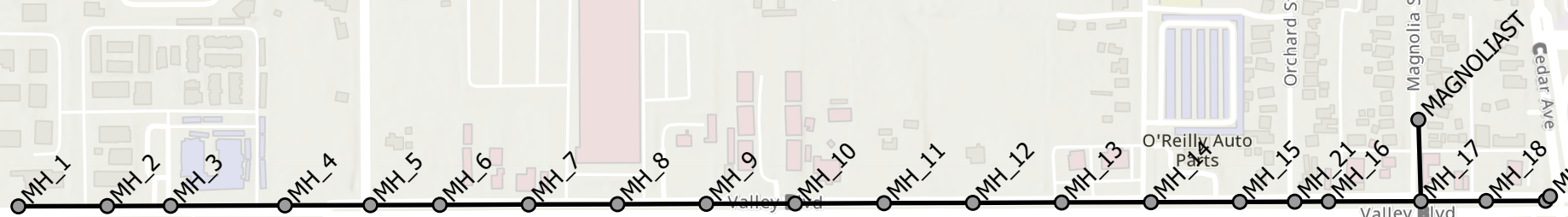


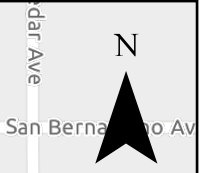
FIGURE 3 SCENARIO 2 (18-INCH VALLEY BLVD)





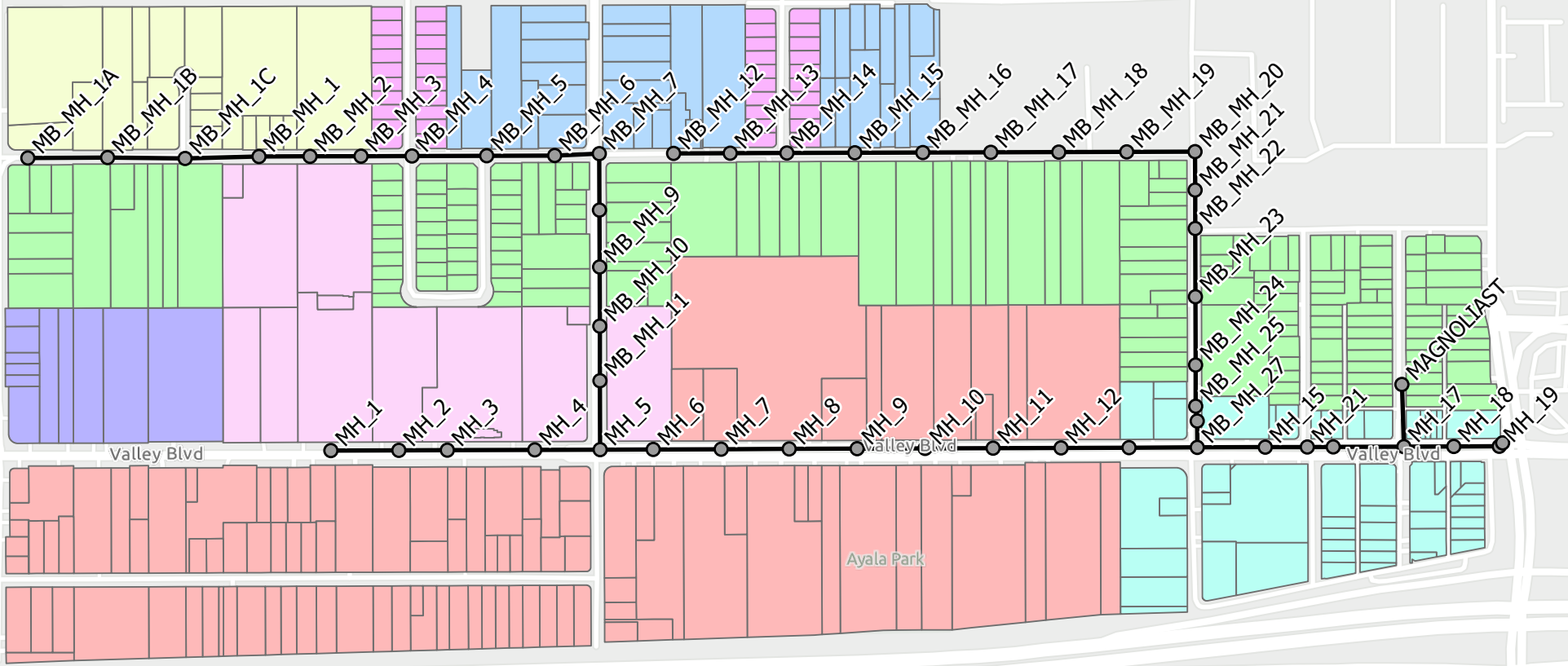
Legend

- Conduit
- Node



San Bernardino Ave

San Bernardino Ave



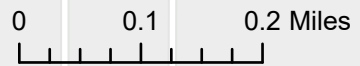
Valley Blvd

Ayala Park

Valley Blvd

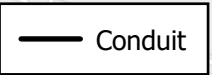
MAGNOLIAST

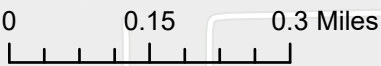
10



Legend

- | | |
|---------------|--------|
| — Conduit | VC/BE |
| ● Node | VC/COM |
| Parcel Zoning | VC/LMR |
| BL/RM | VC/MHR |
| BL/RS | VC/MU |
| BL/RS-20M | |





Legend

Conduit

Node

UT4

BL/IN

BL/RM

BL/RS

BL/RS-10M

BL/RS-20M

VC/BE

VC/COM

VC/LMR

VC/MHR

VC/MU