

APPENDIX K:
WATER AND SEWER REPORTS



To: Nikhil Dhir
Associate Engineer
Ventura Water

From: Adam Bugielski, PE | MKN & Associates, Inc.
Gerardo Hernandez, EIT | MKN & Associates, Inc.

Date: January 18, 2024

Re: Water Analysis Review –Maple Court Development; APN: 079-0-101-425, 079-0-101-445 and 079-0-101-455

1. Introduction

The purpose of this assessment is to determine Maple Court Development impacts to the City's existing water infrastructure and identify any potentially required offsite improvements for this project. The City of Ventura (City) has requested that MKN and Associates, Inc. (MKN) evaluate the water infrastructure as it relates to this project located north of the Maple Street and Maple Court intersection. Results presented in this report utilize criteria outlined in the City's 2023 Water Master Plan and applicable field data. Project flows were calculated and added to the City's hydraulic model. While the model includes information from other projects, this report focuses only on the implications of this development project.

Unless construction for the subject project has commenced within 24 months after this analysis was performed and is diligently pursued thereafter, or if another development significantly changes available capacity, the approved analysis shall be null and void. If the approved components of the scope of the project and other planned projects are unchanged, the Ventura Water General Manager may grant one 12-month extension of time for start of construction without requiring a reevaluation of this analysis. This extension is provided if the initial 24-month period has not already expired.

2. Background

The City owns a hydraulic model for the water distribution system. The hydraulic model was originally produced by the City's Consultants concurrently with the master plan in 2023.

Each of the hydraulic models were based on three basic scenarios: existing, near-term, and ultimate conditions. For purposes of this review, only the existing scenario and the existing-plus-project contributions are considered to determine if this development project creates any deficiencies in the water system. The existing demand scenario is then verified and calibrated (as needed) with any up-to-date information or newly collected field data. Deficiencies caused in the existing-plus-project scenario that are not present in the existing scenario are an impact to the City's infrastructure and should be mitigated prior to the project's connection to the City's water system.

While effort was made to have the most accurate estimates for each development project, calibration of the hydraulic model and review of the City's infrastructure is necessary to ensure the water system is not overburdened. The water model has

been updated and calibrated as new development projects are proposed and as capital improvement projects are constructed. Information from this report is intended to assist the City in determining offsite infrastructure mitigation measures for the project.

3. Project Information and Calculations

The proposed project is located north of the Maple Street and Maple Court intersection **Attachment 1**. The project is located within the City's 430 water pressure zone. Information regarding the proposed project was obtained from City Staff while information related to the existing land use was obtained from the Ventura County Assessor's website and City Staff.

This project consists of constructing 350 multi-family residential units and 4,850 square-feet of commercial space on a 5.75-acre site. For the purposes of hydraulic modeling, the flow of the project is entered into the model at a single node (location).

Steps for calculating the flows for this project begin with land use category and demand factors as outlined in the 2020 Water Demand Factor Study. These results are then entered into the hydraulic model and utilized for this report.

3.1 Flow Calculation

The project's water supply estimate for domestic use is calculated using Table 10 of the 2020 Water Demand Factor Study. Water demand factors are used to determine the project's water flow. **Table 2** displays the calculations for this project's domestic water supply per parcel based on information provided by the developer and the City's Community Development Department.

Table 2 – Domestic Water Supply Calculations

Land Use Category	Demand Factor	Project Quantity	Average Demand (gpd)	Average Demand (gpm)	Average Demand (AFY)
Residential (Multi-Family)	209 gpd/du	350 du	73150	50.80	81.94
Commercial (Multi-Tenant)	155 gpd/ksf	4.85 ksf	751.75	0.52	0.84
Total:				51.32	82.78

The total increase in average water flow contributed to the City's water system is **82.78 AFY**.

3.2 Water Storage Requirements

In addition to calculating the water demands a water storage analysis was conducted on the pressure zone where the project is located. The following criteria were utilized to determine the water storage requirement per 2023 Engineering Standards:

- Operational Storage: Maximum Daily Demand for 7 hrs
- Emergency Storage: Maximum Daily Demand for 8 hrs
- Fire Storage: Largest single Fire flow requirement

Table 3 and **Table 4** display the calculated required water storage based on the above criteria. **Table 3** displays the fire storage requirement for the pressure zone which is dependent on the largest fire requirement in the pressure zone, while **Table 4**

displays the project specific fire storage requirement which is dependent on the land use characterization of the proposed development.

The increase in water storage required as part of this project is 73,901 gallons which includes the required operation and emergency storage. The anticipated storage requirement for the 430 pressure zone is 5,156,201 gallons which is based on the maximum daily demand (MDD) and fire flow requirements. The 430 pressure zone currently has 10.05 million gallons (MG) of available storage. Based on the foregoing calculations, there is a storage surplus of just over 4.89 MG in the 430 pressure zone.

Table 3 – Pressure Zone Storage Requirements

	MDD (gpm)	Duration (hrs)	Volume (gal)
Regulatory	4447	7	1,867,740
Emergency	4447	8	2,134,560
Fire*	4500	4	1,080,000
		Total:	5,082,300

**Fire flow and duration calculated for the maximum requirement within the pressure zone*

Table 4 – Pressure Zone Project Specific Storage Requirements

	MDD (gpm)	Duration (hrs)	Volume (gal)
Regulatory	4529	7	1,902,227
Emergency	4529	8	2,173,974
Fire	4500	4	1,080,000
		Total:	5,156,201

**Fire flow and duration calculated for the project specific land use characterization requirement*

4. Evaluation Criteria

The City's hydraulic models are utilized to report the impact this project may have to the water distribution system. Evaluation criteria outlined in the Water Master Plan is applied to the model results to identify areas where the distribution may be deficient. Section 6.6 of the Water Master Plan describes these criteria as summarized below.

Water Distribution System Requirements

- Minimum Domestic Pressure: 40 psi
- Maximum Domestic Pressure: 150 psi
- Minimum Fire Flow Pressure: 20 psi
- Maximum MDD Pipe Flow Velocity: 5 ft/s
- Maximum Fire Flow Pipe Velocity: 15 ft/s

5. Existing Infrastructure & Hydraulic Model Calibration

This section describes the existing infrastructure presented in the hydraulic model.

5.1 Water Distribution Infrastructure

The proposed project is located in the City's 430 pressure zone. Storage for this zone is provided by the Corbett tank, the two (2) Foothill Tanks, Long Canyon Tank number 1, and two (2) Sexton Tanks which total 10.05 MG of storage.

The demands for this project were modeled at one point of connection (POCs) to the distribution system. The west side of the project connects to an existing 8" CIP pipeline along Maple Court (Junction J4069). This report includes the results of both domestic water supply and a simulated fire demand (Junction J4069). The local water distribution system and the project location can be seen in **Attachment 2**. The results from the hydraulic model for the pipelines and pressure nodes can be found in **Attachment 3**. Once the new development's demand was added to the water hydraulic model, the surrounding infrastructure was analyzed for existing pressure zone MDD plus project demands. No local pipes exceeded the maximum MDD pipe flow velocity. Additionally, existing pressure zone MDD plus project specific demands and fire flow were analyzed. Fire flow requirements were analyzed in both the 2023 Water Master Plan and this project specific infrastructure review utilizing a commercial fire flow demand of 4500 gpm; after applying the fire flow, the 8" CIP pipe (L4872) located on Maple Court exceeds the maximum fire flow pipe velocity as well as the 6" pipe, located from the intersection of Cherry Street and Wesley Avenue to the intersection of Maple Street and Wesley Avenue, and the 8" pipes located from the intersection of Maple Court and Maple Street to the intersection of Maple Street and College Drive.

6. Conclusion

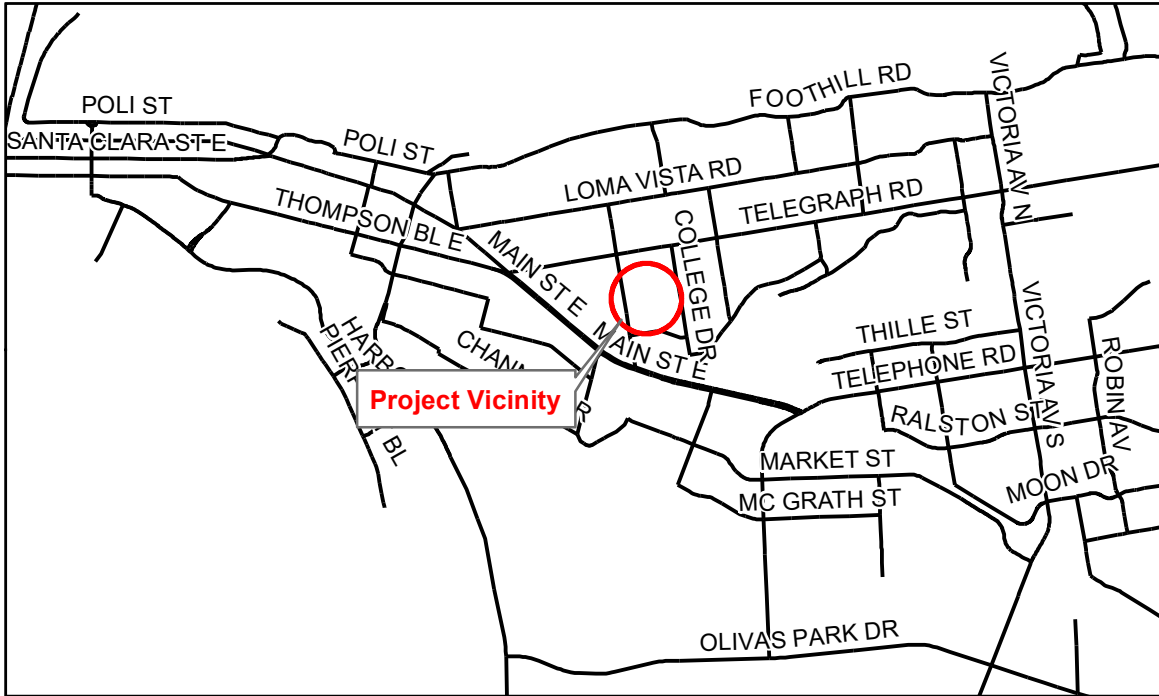
The water hydraulic model results, found in **Attachment 3**, show all local pipe velocities are within the City's Master Plan design criteria at maximum daily demands. All but four local pipe pressures are within the City's Master Plan design criteria at maximum daily demands and fire flow. As stated in Section 3.2 of this report, the pressure zone has sufficient available water storage to serve this development. Based on the information provided for the development and results from the City's water hydraulic model, the increase in water demand will require improvements to the City's distribution system. This will require upsizing the 8" pipes from the intersection of Mills Road and Maple Street to the cul-de-sac on Maple Court to a minimum of 12" diameter. The Maple Court development will also need to be transitioned from the 430 pressure zone to the 330 pressure zone by isolating the Maple Court infrastructure east of Mills Road. The design of the improvements to the water system should include a review of existing service connections along Maple Street.

Attachments:

Attachment 1 – Location Map

Attachment 2 – 430 Water Pressure Zone Map

Attachment 3 – Water Model Results



City of Ventura
Infrastructure Review
Maple Court
Development

Attachment 1:
Location Map



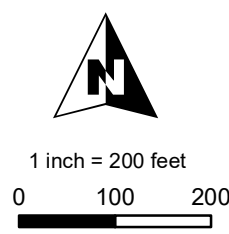
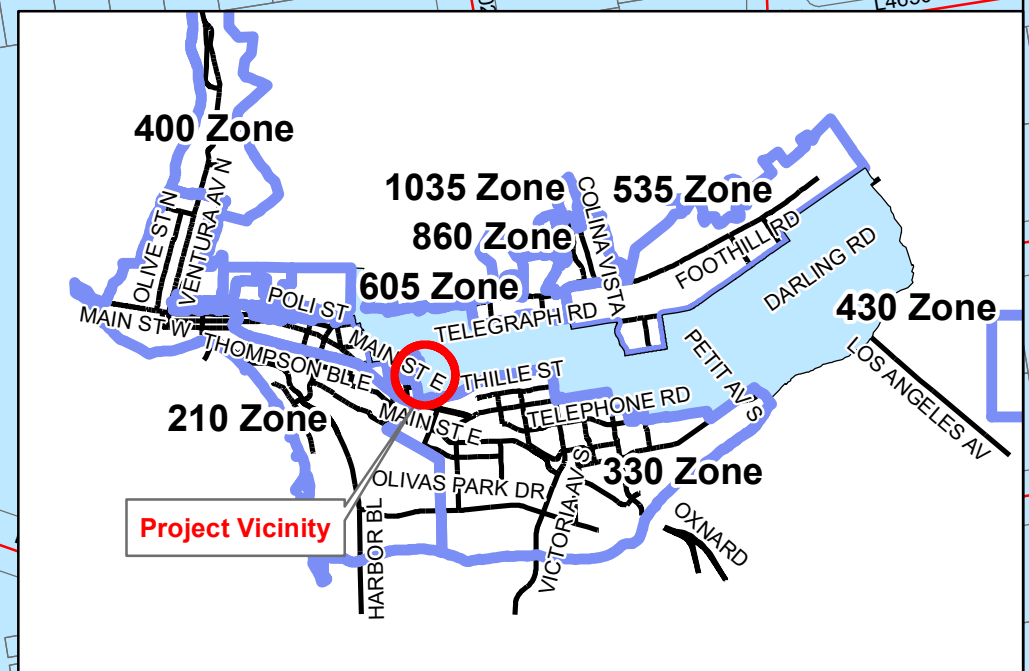
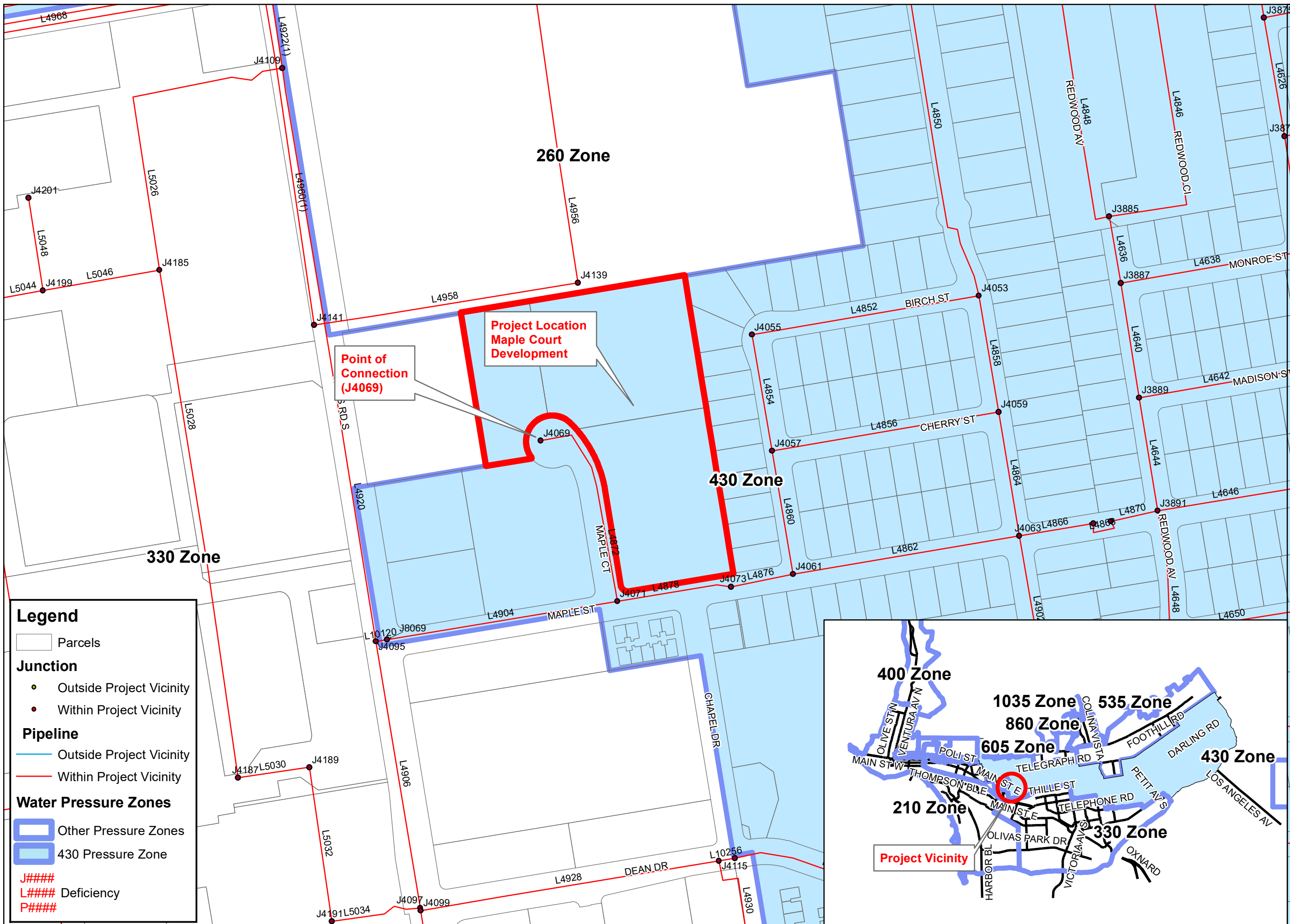
1 inch = 100 feet
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City of Ventura
Infrastructure Review
Maple Court
Development

Attachment 2:
430 Water
Pressure Zone Map



Water Model Result

Pressure Node Summary

Date:	<u>1/10/2024</u>	Demand Location:	<u>J4069</u>
Project Name:	<u>Maple Court</u>	Pressure Zone:	<u>430</u>

Water Model Pressure Results - Pressures (at Nodes)

[illegible]

	Nodes with < 40 psi for the MDD at Peak Hour Flow Condition
	Nodes with > 150 psi for the MDD at Peak Hour Flow Condition
	Nodes with < 20 psi for the MDD at Fire Flow Condition
*	Point of Connection

Requirement criteria above is based on the City's Water Master Plan Section 6

Water Model Result

Pipe Velocity Summary

Date:	1/10/2024	Demand Location:	J4069
Project Name:	Maple Court	Pressure Zone:	430

Water Model Pressure Results - Velocities (in Pipes)

[illegible]

Pipelines that exceed 5 ft/s for the MDD at Peak Hour Flow Condition

Pipelines that exceed 15 ft/sec for the MDD at Fire Flow Condition

Requirement criteria above is based on the City's Water Master Plan Section 6

CITY OF VENTURA

Ventura On-Call Services

Project No.: 201881-10
Date: January 5, 2024
Prepared By: Julia Semmens
Reviewed By: Ryan Orgill, PE
Subject: Hydraulic Analysis Report for the Maple Court Development

Digitally signed by Ryan F. Orgill
Contact Info: Carollo Engineers, Inc.
Date: 2024.01.08 15:17:53 -0800



Introduction

The City of Ventura (City) collects and disposes of wastewater flows generated within the City service area, which generally follows the City boundaries. The wastewater collection system consists of approximately 300 miles of gravity mains up to 42 inches in diameter, 6,700 manholes, and 11 lift stations (LS). Wastewater flows within the collection system drain to the Ventura Water Reclamation Facility (VWRF), which produces tertiary effluent that is discharged to the Santa Clara River Estuary or is used for landscape irrigation. The VWRF has an average dry weather flow (ADWF) of approximately 7.3 million gallons per day (mgd).

This project memorandum (PM) summarizes the evaluation of the proposed Maple Court development in relation to the City's wastewater collection system. Figure 1 shows an overview of the Maple development as well as the point of connection (POC) at which wastewater flows generated by the development would discharge to the City's collection system. The Maple development is located at the intersection of Maple Court and West Maple Street. As currently proposed, the development covers approximately half an acre and consists of 350 multi-family residential (MFR) units and 5,000 square feet of commercial space. For the purposes of this study, it was assumed that wastewater flows from the development would discharge to City manhole SMH-03487.

This PM is organized as follows:

- **Introduction.** This section summarizes the study purpose, provides an overview of the proposed development, and describes the report structure.
- **Background.** This section summarizes findings from the City's 2022 *Wastewater Collection System Master Plan (Master Plan)* that pertain to the proposed development and this study.
- **Capacity Analysis.** This section discusses the capacity analysis that was performed to evaluate implications from the proposed development on the City's wastewater collection system.
- **Conclusions.** This section summarizes key findings and recommendations resulting from the hydraulic analysis.

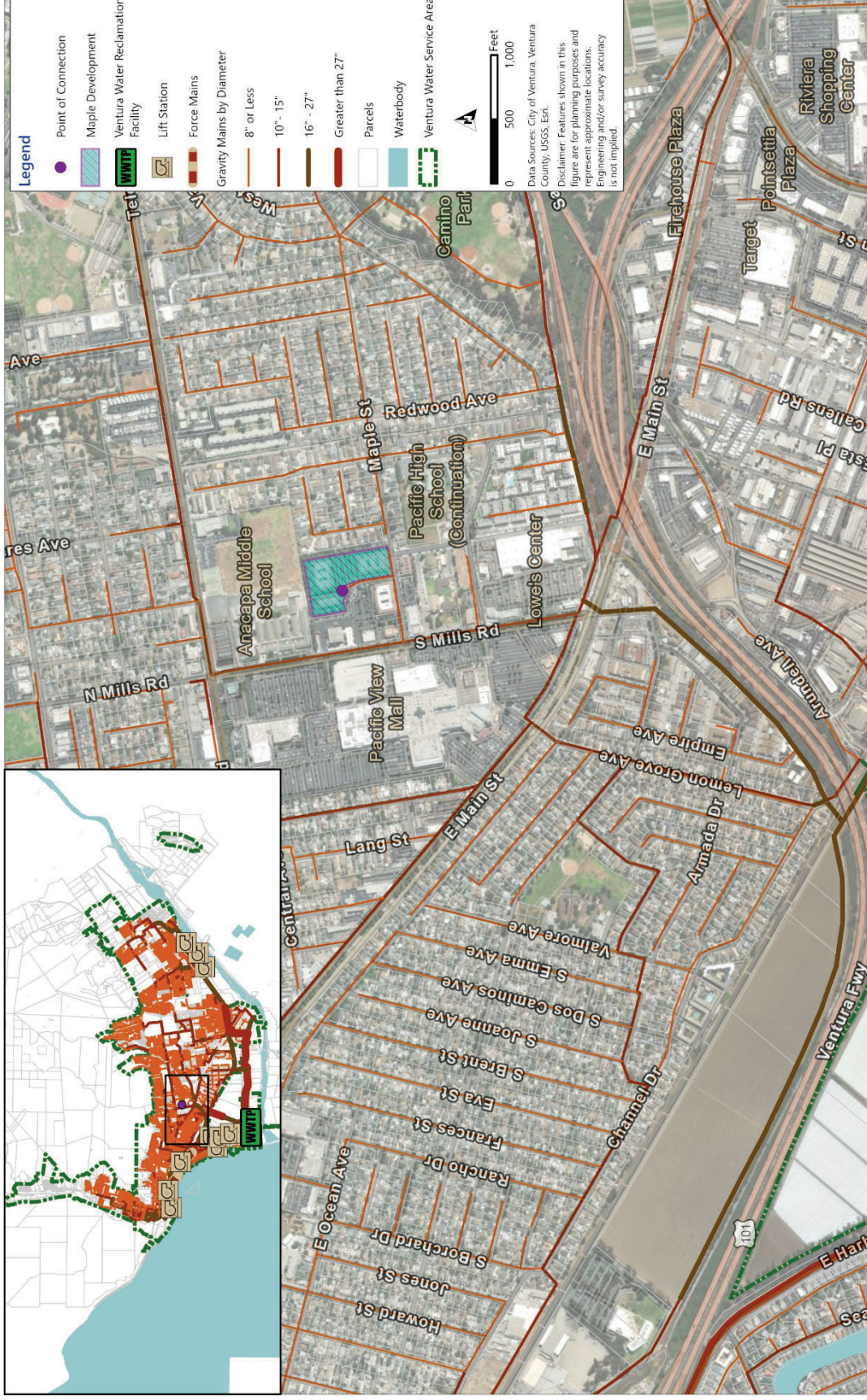


Figure 1 Overview of Maple Development

Unless construction for the subject project has commenced within 24 months after this analysis was performed and is diligently pursued thereafter, or if another development significantly changes available capacity, the approved analysis shall be null and void. If the approved components of the scope of the project and other planned projects are unchanged, the Ventura Water General Manager may grant one 12-month extension of time for start of construction without requiring a reevaluation of this analysis. This extension is provided if the initial 24-month period has not already expired.

Background

The following describe flow conditions within the City's wastewater collection system and summarize the 2022 *Master Plan* findings as they relate to the proposed development.

Wastewater Flow Conditions

The City's wastewater collection system contains both gravity and pressurized components. Flows generated by customers generally discharge into gravity sewers that transfer flows downstream, either directly to the VWRP or to a LS. The 11 LSs located throughout the collection system pump flows through pressurized force mains (FMs) to downstream gravity sewers.

Wastewater flows within the collection system have varying hydraulic characteristics depending on factors such as upstream and downstream conditions and pipeline diameter, roughness, and slope. The following describe flow conditions that occur within gravity and pressurized collection systems:

- **Non-surcharged gravity flow:** Gravity flow conditions occur when wastewater flows freely from an area at a higher elevation to another area at a lower elevation. When the flow through a gravity main is less than the pipeline's capacity, the flow is considered non-surcharged. In this case, the flow depth is below the pipeline crown along the entire length of the pipeline.
- **Surcharged gravity flow:** Gravity mains surcharge when the flow depth exceeds the pipeline crown at any point along the pipeline. Surcharging within a gravity sewer can occur due to a capacity deficiency or due to backwater conditions, as described below:
 - » **Surcharging due to backwater conditions:** If the flow depth is higher at the downstream end of the pipeline compared to the upstream end, the pipeline is surcharged due to backwater conditions. This occurs when downstream hydraulic conditions, such as a hydraulic bottleneck or a change in pipeline slope or diameter, cause flows to back up into upstream sewers.
 - » **Surcharging due to capacity:** If the flow depth at the upstream end of the pipeline is higher than that at the downstream end, the pipeline is surcharged due to its own capacity limitations. In this case, the pipeline itself does not have sufficient capacity to accommodate tributary flows and becomes a hydraulic bottleneck.

Figure 2 shows the hydraulic profile of gravity sewers surcharged due to backwater and capacity.

- **Pressurized flow in FMs:** LSs collect flows from upstream sewers into storage basins called wet wells. Flows from the wet wells are then pumped through an FM system into the downstream collection system, producing pressurized conditions in the FMs. In some cases, LS hydraulics can affect downstream flow conditions due to pumps turning on and off. For example, gravity mains downstream of the North Bank LS experience flow spikes due to the LS cycling.

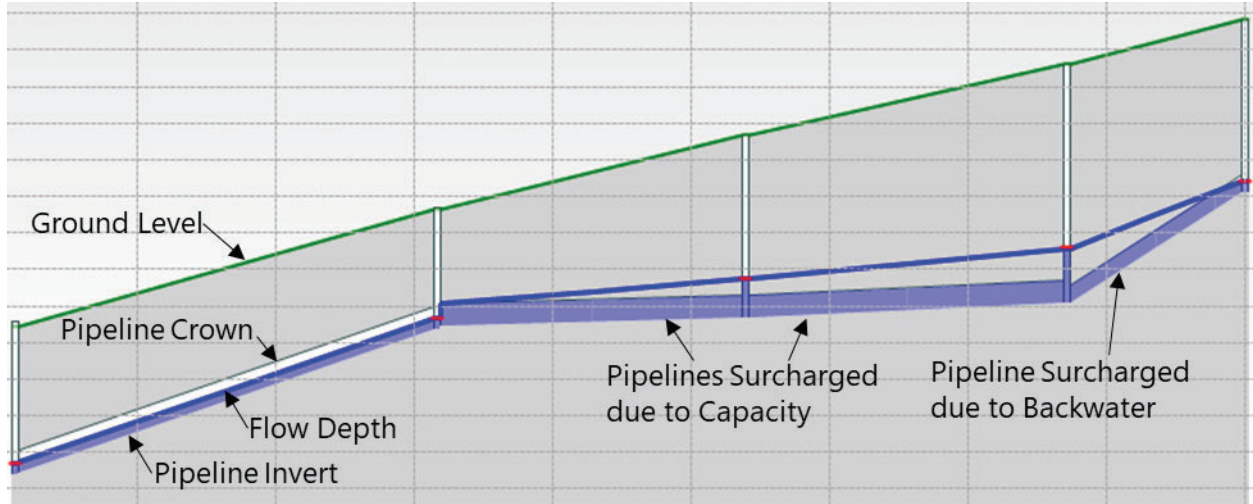


Figure 2 *Surcharging Conditions in Gravity Sewers*

Master Plan Findings

As part of the 2022 *Master Plan*, Carollo developed a calibrated hydraulic model to evaluate collection system capacity and size improvements through the buildout planning horizon¹. Figure 3 shows the recommended *Master Plan* gravity main improvements in the vicinity of the development. As shown, the development contributes to *Master Plan* projects GM-13 and GM-20.

This analysis evaluated the City's collection system with and without flows from the Maple development to identify any additional projects triggered by the development that were not identified in the *Master Plan*.

¹ Each collection system capacity improvement identified in the *Master Plan* assumes removal of all upstream hydraulic bottlenecks. Alleviating upstream bottlenecks causes downstream peak flows to increase by reducing flow attenuation. Therefore, some downstream capacity improvements mitigate capacity deficiencies that are not expected to occur until other upstream improvements are implemented.



Figure 3 Recommended Master Plan Improvements Downstream of Maple Development

Capacity Analysis

This section discusses the methodology used to evaluate hydraulic implications from the development on the City's wastewater collection system and presents the hydraulic model results.

Wastewater Flows for the Proposed Development

Dry and wet weather flows associated with the proposed development were determined using methodologies consistent with the *Master Plan*. The following outlines the process used to calculate the flows generated by the Maple development:

1. The development's average day demand (ADD) was calculated by multiplying the number of equivalent dwelling units (EDUs) by the water duty factor associated with the given land use type. This resulted in a total ADD of 6,688 gallons per day (gpd).
2. The ADD was multiplied by a return-to-sewer (RTS) ratio of 0.62, which is consistent with the RTS ratio used in the *Master Plan* to calculate the ADWF. The development's ADWF was calculated to equal 4,147 gpd.
3. Since the development is within a developed portion of the City's collection system, it is not expected to generate additional inflow and infiltration. Therefore, no additional wet weather flows were added to account for the development.
4. The development's estimated ADWF was added to the hydraulic model at the POC, shown on Figure 1, to evaluate hydraulic implications on the City's wastewater collection system, as described in the following section.

The projected flows for the Maple Court development are shown in Table 1.

Table 1 Wastewater Flows for the Maple Development

Land Use	EDU	Area (ksf)	Water Duty Factor ⁽¹⁾ (gpd/EDU or gpd/ksf)	ADD (gpd)	ADWF ⁽²⁾ (gpd)
MFR	350	N/A	209	73,150	45,353
Commercial	N/A	5	155	775	481
Total	350	5	N/A	73,925	45,834

Notes:

(1) Source: *Ventura Water Master Plan*.

(2) The ADWF was calculated by multiplying the ADD by a RTS ratio of 0.62, as consistent with the City's *Master Plan*.

ksf - thousand square feet

Hydraulic Analysis

The City's updated wastewater collection system hydraulic model was used to evaluate the implications of the development on the existing downstream collection system infrastructure. For this study, the collection system infrastructure downstream of the Maple development was evaluated against the City's planning criteria with and without the projected flows from the development. In accordance with the City's *Master Plan*, the system was modeled under 10-year, 24-hour design storm, or peak wet weather flow (PWWF), conditions to evaluate collection system hydraulic capacity. The model was run without any capacity improvements (e.g., those identified in the *Master Plan*) to assess implications from the development on the existing system.

The City uses peak flow depth to pipeline diameter (d/D) ratios to evaluate existing gravity mains and size improvements. Existing gravity mains are flagged if the maximum d/D ratio exceeds 92 percent, which is considered full flow for pipelines operating under gravity conditions. New gravity mains are sized to maintain the following maximum d/D ratios depending on pipeline location and size:

- Gravity mains of any size that cross major roadways: 50 percent.
- Gravity mains 15 inches in diameter or smaller: 67 percent.
- Gravity mains larger than 15 inches in diameter: 75 percent.

The near-term model scenario was used to complete this analysis, which assumes existing flows plus flows for near-term planned developments. The following near-term developments were verified for this study since they are currently being evaluated under separate efforts:

- | | | |
|-----------------|------------------------|----------|
| ▪ Grove. | ▪ College Courts. | ▪ Tides. |
| ▪ Anastasi. | ▪ Santa Clara. | |
| ▪ Olive Street. | ▪ Day Road Apartments. | |

Attachment A shows the peak modeled flows and d/D ratios for all gravity mains downstream of the development under near-term PWWF conditions with and without the development. The following describes key findings from the model analysis:

- Additional flows associated with the Maple development contribute to noticeable increases in modeled maximum flows and d/D ratios for the 8-inch diameter pipes along Maple Court and Maple Street directly downstream of the development. However, the d/D ratios in these pipes remain below 92 percent even with the added flows from the Maple development.
- Several pipelines downstream of the proposed development have modeled d/D ratios greater than 92 percent both with and without the development. Apart from the pipelines encompassed in *Master Plan* projects GM-13 and GM-20, the pipelines with modeled d/D ratios greater than 92 percent surcharge due to backwater conditions. Calculated d/D ratios for these pipelines under normal flow conditions are below 92 percent, indicating that the pipelines would have surplus available capacity if downstream bottlenecks were removed.

Conclusions

The hydraulic analysis indicates that additional flows generated by the Maple development contribute to increased peak flows and d/D ratios in the downstream collection system under near-term PWWF conditions. However, no additional projects apart from those identified in the *Master Plan* are triggered by the development.

ATTACHMENT A **MODELING RESULTS**

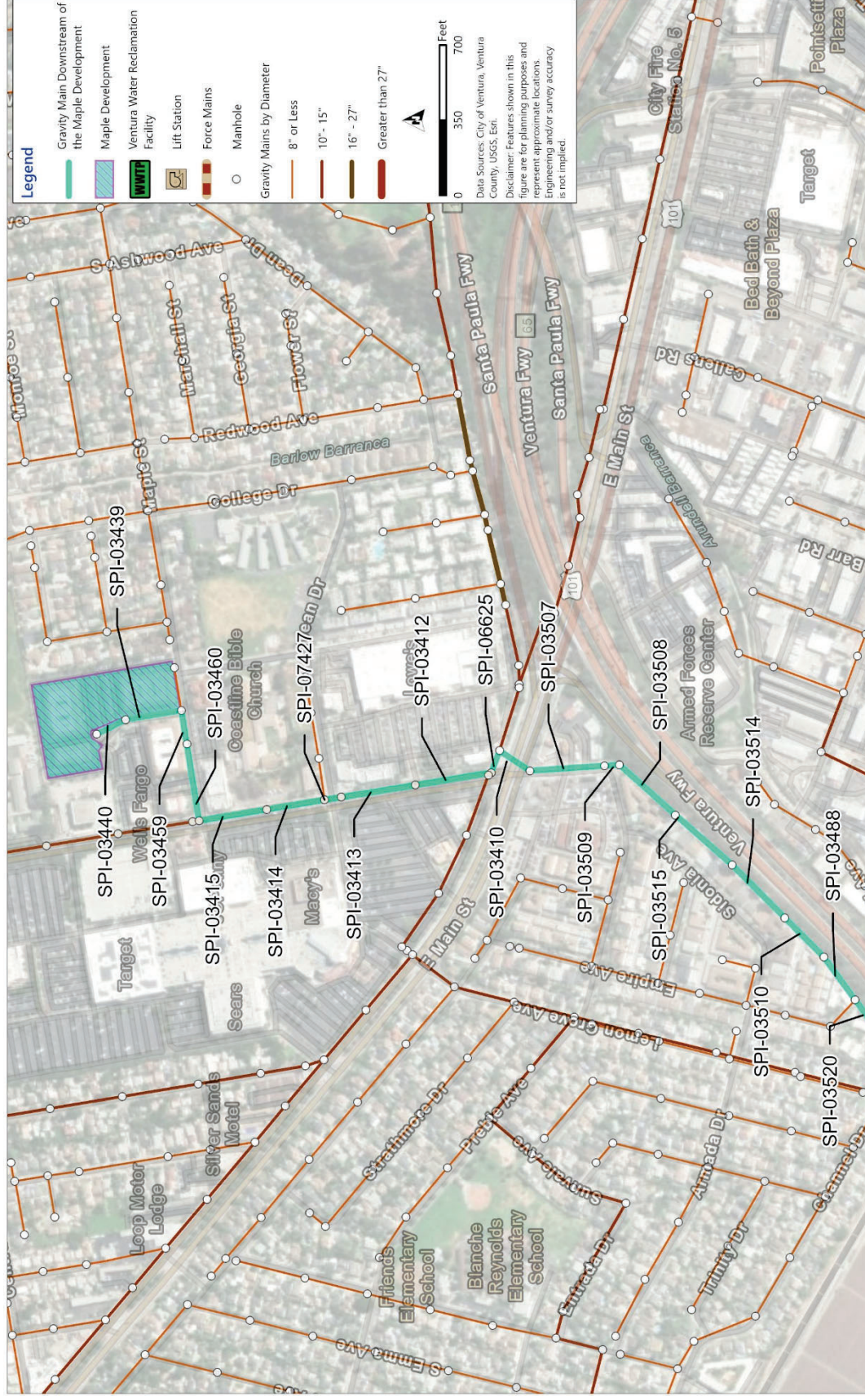


Figure A.1 Gravity Mains Downstream of the Maple Development - Section 1



Figure A.2 Gravity Mains Downstream of the Maple Development - Section 2



Figure A.3 Gravity Mains Downstream of the Maple Development - Section 3

Table A.1 Hydraulic Model Results for Gravity Mains Downstream of the Maple Development Under Near-Term Conditions

Pipeline Label	Existing Diameter (inches)	Modeled PWWF (gpm)		Modeled Maximum d/D (%)		Calculated Maximum d/D Under Normal Flow Conditions ⁽¹⁾ (%)	Percent Increase in PWWF	Percent Increase in d/D	Notes
		Without Maple	With Maple	Without Maple	With Maple				
SPI-03440	8	1	44	2%	17%	N/A	6,824%	733%	None.
SPI-03439	8	2	44	4%	17%	N/A	2,722%	346%	None.
SPI-03459	8	2	45	4%	16%	N/A	1,837%	307%	None.
SPI-03460	8	3	51	52%	64%	N/A	1,379%	22%	None.
SPI-03415	10	1,221	1,262	100%	100%	74%	3%	0%	Modeled d/D exceeds 92% due to backwater conditions.
SPI-03414	10	1,225	1,265	100%	100%	73%	3%	0%	Modeled d/D exceeds 92% due to backwater conditions.
SPI-07427	10	1,227	1,266	100%	100%	N/A	3%	0%	Pipeline segment included in Master Plan project GM-13.
SPI-03413	10	1,227	1,265	100%	100%	N/A	3%	0%	Pipeline segment included in Master Plan project GM-13.
SPI-03412	10	1,227	1,265	100%	100%	N/A	3%	0%	Pipeline segment included in Master Plan project GM-13.
SPI-06625	12	1,229	1,267	86%	86%	N/A	3%	1%	Pipeline segment included in Master Plan project GM-13.
SPI-03410	18	2,135	2,173	57%	58%	N/A	2%	1%	None.
SPI-03507	18	2,136	2,175	70%	71%	N/A	2%	2%	None.
SPI-03509	18	2,136	2,174	74%	75%	N/A	2%	2%	None.
SPI-03508	18	2,140	2,179	80%	82%	N/A	2%	2%	None.
SPI-03515	18	2,142	2,180	73%	74%	N/A	2%	2%	None.
SPI-03514	18	2,146	2,184	65%	66%	N/A	2%	1%	None.
SPI-03510	18	2,145	2,184	63%	63%	N/A	2%	1%	None.
SPI-03488	18	2,147	2,185	63%	64%	N/A	2%	1%	None.
SPI-03520	18	2,188	2,226	64%	64%	N/A	2%	1%	None.
SPI-03531	18	2,187	2,226	54%	55%	N/A	2%	1%	None.
SPI-03534	18	2,454	2,493	55%	56%	N/A	2%	1%	None.

Pipeline Label	Existing Diameter (inches)	Modeled PWWF (gpm)		Modeled Maximum d/D (%)		Calculated Maximum d/D Under Normal Flow Conditions ⁽¹⁾ (%)	Percent Increase in PWWF	Percent Increase in d/D	Notes
		Without Maple	With Maple	Without Maple	With Maple				
SPI-03532	27	3,281	3,320	70%	70%	N/A	1%	1%	None.
SPI-03529	27	3,312	3,351	69%	69%	N/A	1%	1%	None.
SPI-03486	27	3,312	3,351	66%	66%	N/A	1%	1%	None.
SPI-03485	30	3,926	3,968	61%	62%	N/A	1%	1%	None.
SPI-03633	30	3,925	3,968	61%	61%	N/A	1%	1%	None.
SPI-03792	30	3,925	3,967	61%	62%	N/A	1%	1%	None.
SPI-03791	30	3,924	3,966	64%	64%	N/A	1%	1%	None.
SPI-03790	30	3,924	3,966	54%	54%	N/A	1%	1%	None.
SPI-03789	30	3,924	3,967	47%	48%	N/A	1%	1%	None.
SPI-03798	24	3,923	3,966	64%	64%	N/A	1%	1%	None.
SPI-03797	24	3,923	3,966	64%	64%	N/A	1%	1%	None.
SPI-03796	24	3,923	3,966	64%	64%	N/A	1%	1%	None.
SPI-03795	24	3,923	3,965	64%	64%	N/A	1%	1%	None.
SPI-03794	24	3,923	3,965	64%	64%	N/A	1%	1%	None.
SPI-03793	24	3,923	3,965	65%	65%	N/A	1%	1%	None.
SPI-03815	24	3,922	3,964	60%	61%	N/A	1%	1%	None.
SPI-03814	24	3,922	3,964	57%	58%	N/A	1%	1%	None.
SPI-03813	24	3,921	3,964	44%	44%	N/A	1%	1%	None.
SPI-03812	30	3,936	3,964	52%	52%	N/A	1%	0%	None.
SPI-03811	30	3,922	3,964	71%	72%	N/A	1%	1%	None.
SPI-03833	30	3,989	4,025	89%	89%	N/A	1%	0%	None.
SPI-03834	30	3,972	4,011	100%	100%	67%	1%	0%	Modeled d/D exceeds 92% due to backwater conditions.
SPI-00476	42	11,524	11,613	100%	100%	47%	1%	0%	Modeled d/D exceeds 92% due to backwater conditions.
SPI-03828	36	11,551	11,641	100%	100%	N/A	1%	0%	Pipeline segment included in Master Plan project GM-20.

Pipeline Label	Existing Diameter (inches)	Modeled PWWF (gpm)		Modeled Maximum d/D (%)		Calculated Maximum d/D Under Normal Flow Conditions ⁽¹⁾ (%)	Percent Increase in PWWF	Percent Increase in d/D	Notes
		Without Maple	With Maple	Without Maple	With Maple				
SPI-03827	42	11,563	11,649	100%	100%	N/A	1%	0%	Pipeline segment included in Master Plan project GM-20.
SPI-03826	42	11,570	11,628	100%	100%	N/A	0%	0%	Pipeline segment included in Master Plan project GM-20.
SPI-03816	42	11,553	11,630	100%	100%	N/A	1%	0%	Pipeline segment included in Master Plan project GM-20.
SPI-07312	42	11,593	11,678	100%	100%	N/A	1%	0%	Pipeline segment included in Master Plan project GM-20.
SPI-07311	42	16,776	16,767	100%	100%	N/A	0%	0%	Pipeline segment included in Master Plan project GM-20.
SPI-07313	42	17,137	17,108	100%	100%	N/A	0%	0%	Pipeline segment included in Master Plan project GM-20.

Notes:

(1) The maximum d/D ratio under normal flow conditions with the development flows was calculated using Manning's equation and shows the percent of each pipeline's capacity that is utilized under peak flow conditions, ignoring effects from downstream hydraulic bottlenecks.

d/D - flow depth to pipeline diameter; gpm - gallons per minute; N/A - not applicable; PWWF - peak wet weather flow