Appendix J

Merced Wastewater Collection System Analysis 2021 Update

TECHNICAL MEMORANDUM

To: Stephen Peck – Peck Planning and Development

From: Brian McCauley, PE, Henry Liang, PE, and Jason Wong, EIT

Date: October 8, 2021

Re: Merced Wastewater Collection System Analysis 2021 Update

Background

In late 2017, the City of Merced (City) issued a Final Draft Wastewater Collection System Master Plan (WCS Master Plan) prepared by Stantec Consulting Services, Inc. (Stantec). The WCS Master Plan (Stantec Consulting Services, Inc., 2017) is supported largely by a PCSWMM wastewater collection system model (model) developed by Stantec. The model evaluated three scenarios to determine the wastewater collection system capacity and necessary improvements. The scenarios modeled are as follows:

1. Existing – Current conditions were evaluated to determine the capacity within the existing trunk sewer system with only existing connections producing wastewater flow.
2. Entitled - Interim development conditions, defined by City staff, were evaluated to identify any remaining capacity in the existing trunk sewer system. The developments identified included those in full buildout of the 2030 General Plan, projects in the North Merced Sewer Assessment District, and full buildout of the UC Merced campus.
3. Build Out – Full build out conditions of the Specific Urban Development Plan (SUDP) were evaluated to determine pipe sizes and slopes for future trunk sewers and pump stations.

Model Scenarios and Inputs

MKN & Associates (MKN) has obtained the model used to develop the WCS Master Plan and has performed an update based on recent per capita wastewater flow findings. MKN issued a letter to the City in May 2021 detailing the findings that residential per capita wastewater flows for recently constructed and new residential homes are approximately 45-50 gallons per capita per day (gpcd), which is much lower than the value of 85 gpcd used in the WCS Master Plan. As described in MKN's letter to the City, MKN performed flow monitoring over a period of more than three months on the Bellevue Ranch development, consisting of approximately 1,500 homes built between 2006 and 2021. Results of MKN's flow monitoring indicated that per capita flows were between 41 and 42 gpcd. As a conservative measure of wastewater generation in recently constructed and new residential homes, MKN recommended using a wastewater generation value of 45-50 gpcd, 10%-20% higher than measured flows. MKN performed the model update with the intention of maintaining the model's original structure and illustrating the effects of the updated per capita flows from new developments.

In addition to updating per capita wastewater flows, MKN developed additional scenarios to the model that utilized the City's list of planned and approved developments as of September 2021.

MKN reran one of the original scenarios from the WCS Master Plan and evaluated two new scenarios. Each scenario and a description of the changes made for the new scenarios are shown in Table 1, below.

Table 1: WCS Analysis Update Scenarios

MKN Scenario	WCS Master Plan Scenario	Changes from WCS Master Plan Scenario
Existing	Existing	• No Changes
Near-Term[1]	Existing	• New Developments added to Existing scenario • New Developments revised to 50 GPCD
Near-Term w/ VST[1, 2]	Existing	• New Developments added to Existing scenario • VST Development added to Existing scenario • New Developments and VST Development revised to 50 GPCD

[1] *"New Developments" include those on the City's planned and approved development list as of September 2021.*

[2] *"VST Development" represents the Virginia Smith Trust development, not included in the planned and approved developments list.*

The model scenarios were each evaluated under wet weather conditions to demonstrate a "worst case" flow. Wet weather peaking was not modified from the original model inputs, although data exists supporting lower peaking factors especially in newer developments. It should be acknowledged that all scenarios likely overstate practical "worst-case" flows due to a highly overstated wet weather peaking factor which was developed based on a 200-year precipitation event.

Additionally, existing residential flows were not reduced for the purposes of this modeling despite evidence that per capita flows are likely overstated in the WCS Master Plan. The WCS Master Plan and the model evaluate the wastewater collection system based on 85 gpcd. However, as presented in MKN's letter to the city, there is significant data to support a wastewater generation value of 59-61 gpcd. MKN and Stantec have reached a consensus that an appropriate value for existing residential wastewater flows is 60-65 gpcd. It should be additionally acknowledged that all scenarios likely overstate wastewater flows due to the use of 85 gpcd in the model for existing residential units.

Based on actual and projected reported flows from University of California at Merced (UCM), the Existing scenario and Near-Term scenarios estimated wastewater generation from UCM at 0.30 million gallons per day (MGD) and 0.45 MGD, respectively.

Analysis Criteria

Collection system pipe capacity was determined in the model by analyzing depth over pipe diameter (d/D) ratios. The WCS Master Plan uses the following criteria for capacity:

- d/D shall be a maximum of 0.70 for gravity flow trunk sewers with diameters up to 24 inches.
- d/D shall be a maximum of 1.00 for gravity flow trunk sewers with diameters greater than 24 inches.
- When the manhole rim elevation is less than 8-feet above the exit pipe crown elevation, no surcharging is allowed.
- When the manhole rim elevation is equal to or greater than 8-feet above the exist pipe crown elevation, up to 1-foot of surcharging above the top of pipe is acceptable.

Analysis Results

The model results from the Existing, Near-Term, and Near-Term with VST scenarios indicated all wastewater collection system trunk lines within the acceptable capacity criteria. A summary of the evaluated trunk lines and the capacity assessment under each scenario is shown in Table 2 on the following page.

Table 2: Wastewater Collection System Capacity Assessment 2021								
Sewer Trunk Line	Diameter (in)	Design d/D	New Near-Term w/ VST		New Near-Term		Existing	
			Max Flow (mgd)	Max d/D	Max Flow (mgd)	Max d/D	Max Flow (mgd)	Max d/D
Bellevue Ave from UC Merced to West of Golf Rd	21	0.7	1.79	0.35	0.89	0.24	0.70	0.22
Bellevue Ave to G St	24	0.7	1.76	0.39	0.89	0.28	0.69	0.25
G St from Bellevue Ave to Yosemite Ave	27	1.0	2.91	0.54	1.99	0.44	1.43	0.37
From G St at Yosemite to Black Rascal Creek at M St	30	1.0	5.20	0.75	4.32	0.67	3.53	0.59
Black Rascal Creek from M St to R St	36	1.0	6.20	0.72	5.32	0.65	4.52	0.59
From Black Rascal Creek at R St to Intersection of Meadows Ave and Lougborough Dr	39	1.0	6.74	0.65	5.85	0.59	5.03	0.56
Meadows Ave from Loughborough Dr to Olive Ave	43	1.0	6.75	0.58	5.87	0.53	5.02	0.49
Meadows Ave at Olive Ave	39	1.0	6.75	0.63	5.87	0.58	5.03	0.53
Meadows Ave at Olive Ave to Devonwood Dr	42	1.0	7.68	0.61	6.78	0.57	5.91	0.52
Devonwood Dr from Meadows Ave to Austin Ave	42	1.0	7.68	0.61	6.80	0.57	5.93	0.52
Austin Ave from Devonwood Dr to Loughborough Dr	42	1.0	7.76	0.6	6.86	0.55	5.99	0.51
From Loughborough Dr to Willowbrook Dr at Madrid Ave	42	1.0	7.86	0.55	6.96	0.51	6.04	0.46
From Willowbrook Dr at Madrid Ave to Stonybrook Ave at Creekside Dr	42	1.0	7.86	0.57	6.96	0.53	6.03	0.49
Stonybrook Ave from Creekside Dr to Brookside Dr	42	1.0	7.87	0.55	6.97	0.51	6.05	0.47
From Brookside Dr to Just Southeast of Stephen Grey Park	42	1.0	7.89	0.57	6.99	0.53	6.07	0.49
From Just Southeast of Stephen Grey Park to Highway 59	36	1.0	11.17	0.41	10.25	0.39	9.16	0.36
From Highway 59 to X St at Highway 140	39	1.0	11.20	0.66	10.29	0.61	9.19	0.56
From X St at Highway 140 to N West Ave at W Childs Ave	42	1.0	11.26	0.75	10.35	0.69	9.26	0.65
From N West Ave at W Childs Ave to Just South of Riggs Ave	48	1.0	11.31	0.71	10.41	0.67	9.32	0.63
From Just South of Riggs Ave to Hartley Slough Just South of W Dickenson Ferry Rd	48	1.0	11.29	0.64	10.39	0.61	9.31	0.57
Pipeline adjacent to the Hartley Slough	48	1.0	11.24	0.62	10.34	0.59	9.26	0.55
From the Hartley Slough to Entrance of WWTF	48	1.0	11.17	0.54	10.27	0.52	9.20	0.49
Pipeline to WWTF	60	1.0	22.27	0.35	21.32	0.34	19.71	0.33

Despite the wet weather peaking factors and existing residential per capita flows that are currently overstated, the Existing scenario indicated no issues with capacity.

Under the Near-Term scenario, the City's list of planned and approved developments were added to the Existing scenario at 50 gallons per capita per day (GPCD). The Near-Term with VST scenario included the Near-Term scenario with the addition of the VST development at 50 GPCD. The results indicate that under near-term planning conditions, the wastewater collection system has sufficient capacity and does not require increased capacity to accommodate the planned, approved, and VST developments. The Near-Term with VST scenario represents a conservative estimate of all flows through the wastewater collection system through the buildout of the VST development.

Figures 1 through 3 present the findings of the model update and indicate the d/D ratios for the portions of the system impacted by the VST development. As shown in these figures, the Near-Term and Near-Term with VST scenarios modeled indicate that the City's wastewater collection system has sufficient capacity to accommodate flows through buildout of all approved projects, including the VST development.

10/5/2021 11:00:31 PM N:\Virginia Smith Trust\VST-2020-001-Infrastructure Analysis & Feasibility Study\300 Engineering\302 GIS\MapDocument\Figure 1_Existing Wastewater System Analysis.mxd

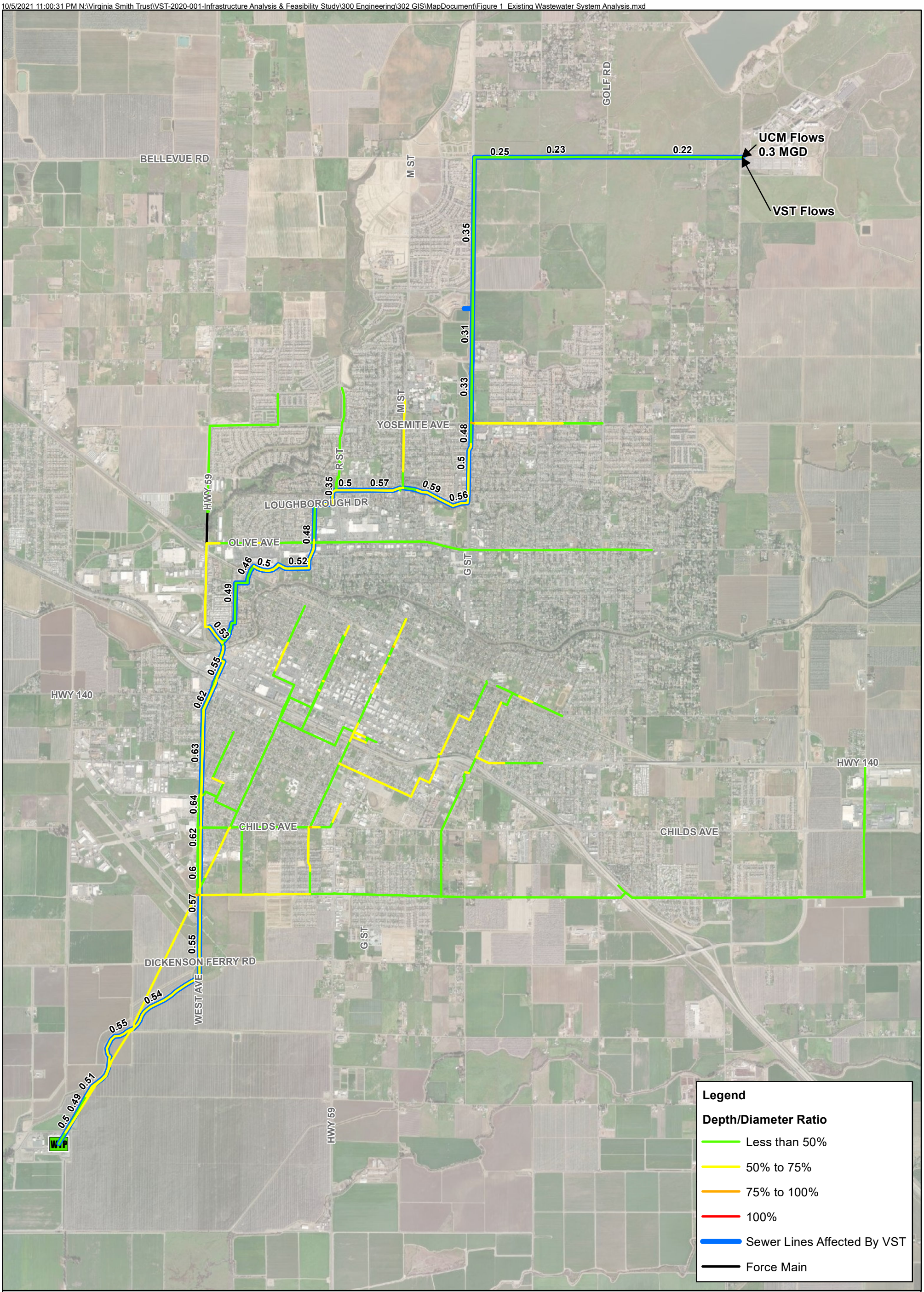


Figure 1:

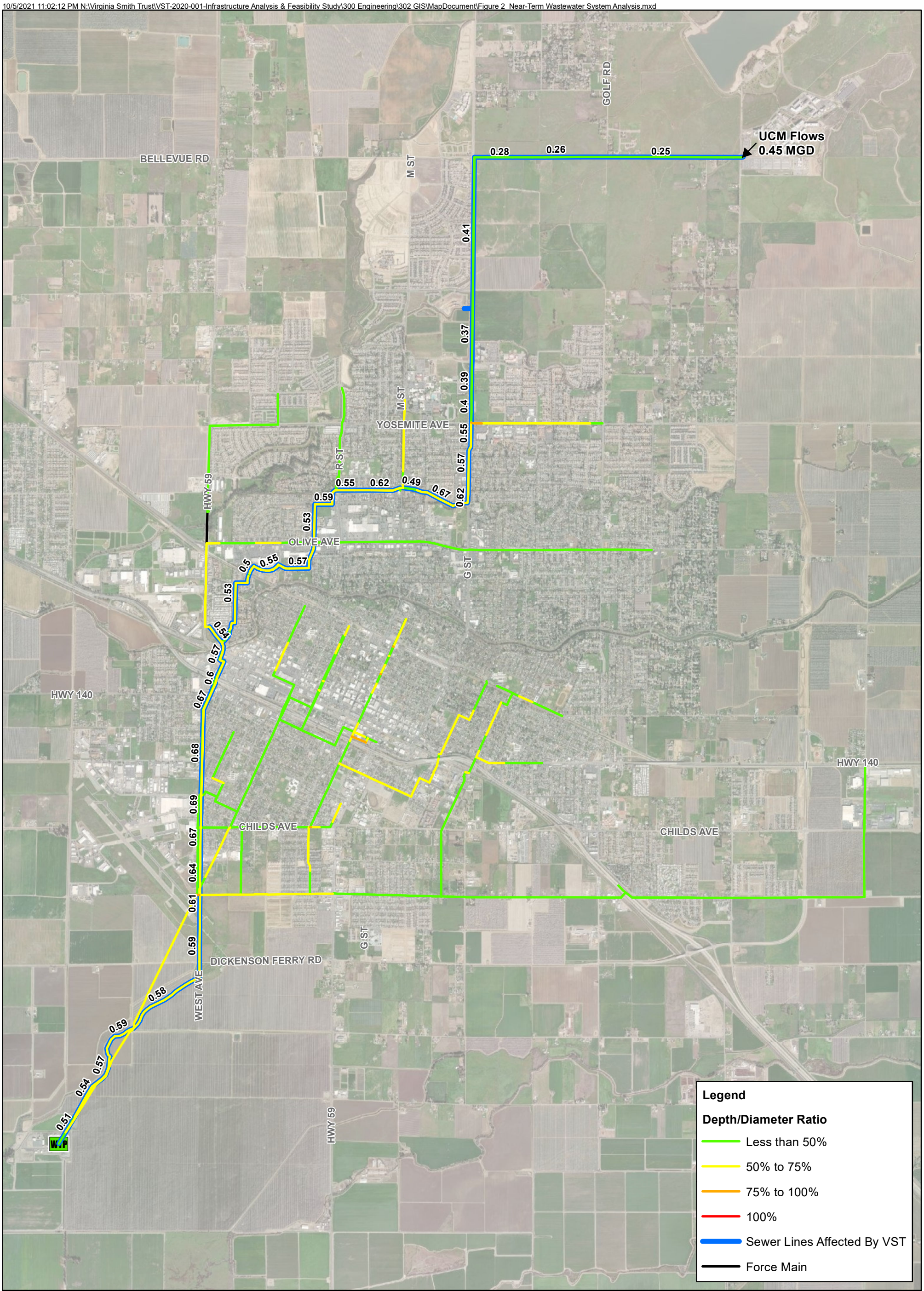
Existing Wastewater System Analysis

Virginia Smith Trust
Infrastructure Analysis and
Feasibility Study

1 inch = 3,500 feet

0 1,750 3,500

10/5/2021 11:02:12 PM N:\Virginia Smith Trust\VST-2020-001-Infrastructure Analysis & Feasibility Study\300 Engineering\302 GIS\MapDocument\Figure 2_Near-Term Wastewater System Analysis.mxd



VIRGINIA SMITH TRUST

Figure 2:

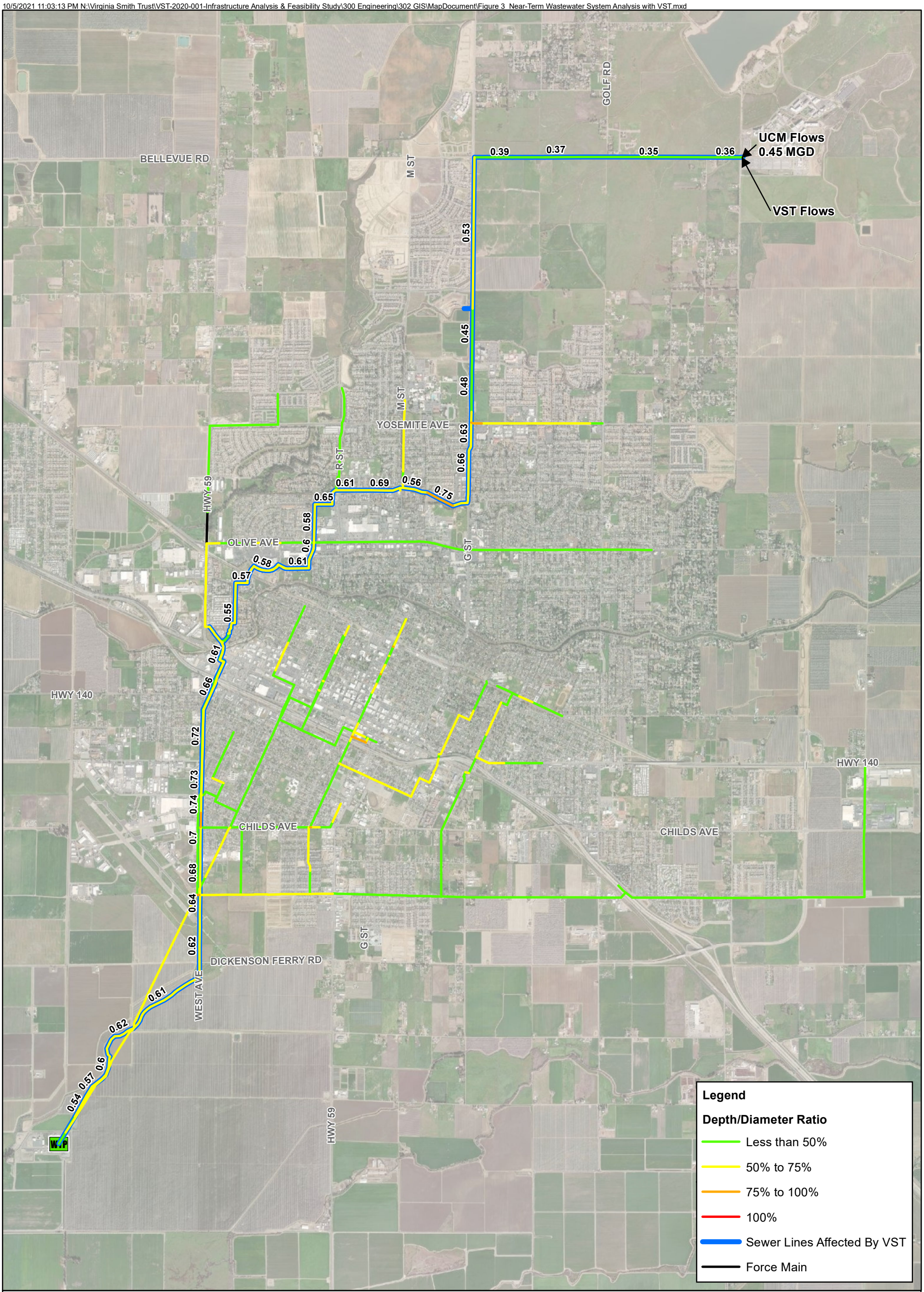
New Near-Term Wastewater System Analysis

Virginia Smith Trust
Infrastructure Analysis and
Feasibility Study

1 inch = 3,500 feet

0 1,750 3,500

10/5/2021 11:03:13 PM N:\Virginia Smith Trust\VST-2020-001-Infrastructure Analysis & Feasibility Study\300 Engineering\302 GIS\MapDocument\Figure 3_Near-Term Wastewater System Analysis with VST.mxd



VIRGINIA SMITH TRUST

Figure 3:

Near-Term Wastewater System Analysis w/ VST

Virginia Smith Trust
Infrastructure Analysis and
Feasibility Study

1 inch = 3,500 feet

0 1,750 3,500