Appendix I
Stewart Area Water Analysis

Stewart Area Water Analysis

Prepared for

City of Yuba City

November 2016

WEST YOST ASSOCIATES
Consulting Engineers

285-12-16-10

This report printed on 50% post-consumer paper

WEST YOST ASSOCIATES
consulting engineers

WATER WASTEWATER STORMWATER

Stewart Area Water Analysis

Prepared for

City of Yuba City

November 2016

WEST YOST ASSOCIATES
Consulting Engineers

285-12-16-10

Patrick A. Johnston, Senior Engineer — Date

QA/QC Review: Elizabeth T. Drayer, Engineering Manager — Date

Table of Contents

1.0 INTRODUCTION

This report analyzes the effect of the Bogue Stewart Master Plan Area (Stewart Area) development on the City of Yuba City's (City) water distribution system. The land uses that have been provided for this area include residential, commercial, parks/open space and one area with a land use of business, technology and light industry. The planned development will all contribute to the demands on the City's potable water system.

The hydraulic model of the distribution system was originally developed during the 1997 Water Master Plan project, updated during the 2004 Water Master Plan and the 2006 Update to Water Demand and Infrastructure System Evaluation projects, and was later updated by City staff to include some of the piping in Regions 2 and 3. Piping for Region 5 was already included in the model. The model is now in a hydraulic modeling software package called WaterCAD.

For the purpose of this analysis, the Stewart Area consists of two portions. The main portion is bordered on the north by Bogue Road, on the west side by South Walton Avenue, and on the south by Stewart Road. The eastern border is not linear, but serves to include approximately half of the land area between Railroad Avenue and Garden Highway within the Stewart Area. The second portion of the Stewart Area is bordered on the west by Garden Highway, on the south approximately by the extension of Stewart Road, and on the east by Levee Road. The northern border is just south of Drummond Drive. The Stewart Area is highlighted in green on Figure 1-1.

The planned land uses for the area include:

- R-1: Low Density Residential
- R-2: Medium/Low Density Residential
- R-3: Medium/High Density Residential
- C-M: Business, Technology and Light Industry
- C-2: Community Commercial
- C-1: Neighborhood Commercial
- C-O: Office, Office Park
- PF: Public Facility

This report analyzes the expected total water demands from the Stewart Area development and the effect of these demands on the City's potable water distribution system to determine if any improvement projects are triggered by this planned development.

2.0 EVALUATION CRITERIA

The system evaluation criteria that were used to evaluate the effect of the planned Stewart Area development on the City's water system were taken from the 2004 Water Master Plan Update and the 2006 Update to Water Demand and Infrastructure System Evaluation. The effect of the increased water demands from the development of the Stewart Area was determined by using these criteria to evaluate system performance.

2.1 Pipeline Criteria

The criteria used to evaluate the operation of the distribution system pipeline network are shown in Table 2-1.

Table 2-1. Pipeline Velocity and Pressure Criteria

	System Criteria	Value
Allowable Velocities	Maximum Day and Peak Hour Maximum Velocity	7 feet per second (fps)
	Fire-Flow Maximum Velocity	10 fps
Allowable Pressures	Normal Operation Maximum Pressure	60 pounds per square inch (psi)
	Normal Operation Minimum Pressure	40 psi
	Peak Hour Minimum Pressure	30 psi
	Fire-Flow Minimum Pressure (at all junctions)	20 psi

2.2 Booster Pumping Criteria

There are no storage facilities that supply the City distribution system via gravity. Therefore, the pumping facilities must supply the demands in the system. The pumping facilities are considered to be adequately sized if the firm pumping capacity is equal to or larger than the Peak Hour demands on the system. For the City, the firm pumping capacity is defined as the combined capacity of the pumping system with the largest single pump out of service.

2.3 Storage Criteria

The criteria used to evaluate the storage in the City system in the prior Water Master Plan updates includes an operational storage component equal to 25 percent of Maximum Day demands and an emergency storage component equal to 75 percent of Average Day demands. Fire flow storage requirements depend on the flow rate and length of time for different fire flow requirements. The largest fire flow storage value is 1,200,000 gallons, as calculated based on a fire flow demand of 5,000 gallons per minute (gpm) and a duration of four hours.

2.4 Fire Flow Criteria

The minimum fire flow requirements for different land use categories are included in Table 2-2. The system must be capable of supplying these fire flow demands for a duration of four hours.

Table 2-2. Fire Flow Requirements	
Land Use Category	Fire Flow Demand, gpm
R-1: Low Density Residential	2,000
R-2: Medium/Low Density Residential	3,000
R-3: Medium/High Density Residential	3,000
C-M: Business, Technology and Light Industry	5,000
C-2: Community Commercial	5,000
C-1: Neighborhood Commercial	5,000
C-O: Office, Office Park	5,000
PF: Public Facility	4,000

2.5 Peaking Factors

Peaking factors will be used to scale up the Average Day demands to allow the evaluation of the system under Maximum Day and Peak Hour demand conditions based on the performance criteria described in the sections above. According to the 2006 Water Master Plan Update, the City's Maximum Day demands are 2.0 times the Average Day demands, and the City's Peak Hour demands are 3.5 times the Average Day demands. These same peaking factors were used in this analysis to calculate the Maximum Day and Peak Hour demands.

3.0 MODEL UPDATE

Pipelines for the Stewart Area were added to the model. Two storage facilities were added to the system within the Stewart Area, along with booster pumping facilities, at locations provided by the City. No other updates to the hydraulic model were included. Pipeline alignments and diameters provided by the City were initially used to run the model. The pipe diameters were updated to provide appropriate pressures within the distribution system.

4.0 WATER DEMANDS

The base demands used in the model are those that had been updated during the El Margarita Development Analysis in January 2015. The demands for the El Margarita area are included in the model used for this analysis.

To estimate the demands within the Stewart Area, information on the expected land uses was analyzed, along with non-residential land use demand factors that had been developed during the El Margarita Development Analysis by analyzing billing data. Additional land use factors from information provided by the City for Elementary/Middle School, Open Space and Parks. The demand factors are summarized in Table 4-1 below.

Table 4-1. Demand Factors	
Land Use	Gallons Per Day Per Acre (gpd/ac)
Business, Technology and Light Industry	294
Community Commercial	1,555
Elementary/Middle School	3,455
Manufacturing, Processing and Warehousing	4,995
Neighborhood Commercial	1,549
Office and Office Park	1,121
Open Space	3,740
Parks	3,740
Public and Semi-Public	191
Regional Commercial	570

Information provided by the City included the estimated areas for each non-residential land use within the development area. Demands were calculated using these areas and the demand factors above. For residential areas, a demand of 216 gallons per capita per day (gpcd) was used, along with an estimate of 2.67 persons per dwelling unit. The 216 gpcd value is the 2015 target from the 2015 Urban Water Management Plan. Information provided by the City contained the number of dwelling units estimated within each residential area within the Stewart Area. The residential and non-residential demand estimate calculations produced a total Average Day demand of 1.73 mgd for the Stewart Area, as summarized below in Table 4-2. Open Space was not included, as there is no demand.

Table 4-2. Average Daily Demand for the Stewart Area			
LU Code	Land Use	Area, acre	Flow, gpd
R-1	Low Density Residential	384	967,786
R-2	Medium/Low Density Residential	63	328,869
R-3	Medium/High Density Residential	30	410,117
C-M	Business, Technology and Light Industry	59	17,225
C-2	Community Commercial	35	54,892
C-1	Neighborhood Commercial	8	11,974
C-O	Office/Office Park	8	9,248
EMS	Elementary/Middle School	23	80,701
OS	Open Space	9	34,037
PF	Public Facility (includes Public Facility PG&E Substation and Public Parks	5	890
PK	Parks	17	63,286
Total		641	1,979,026

These demands for the Stewart Area were added to the demands that were already in the model scenarios, as shown in Table 4-3 below.

Table 4-3. Estimated Demands

Scenario	Existing Demands, mgd	El Margarita Demands, mgd	Stewart Area Demands, mgd	Total Anticipated Demands, mgd
Average Day	14.4	1.1	1.98	17.48
Maximum Day	28.8	2.1	3.96	34.86
Peak Hour	50.4	3.7	6.93	61.03

The demands for the Stewart Area were added to the hydraulic model at appropriate junctions within the Stewart Area.

5.0 SYSTEM ANALYSIS

The operation of the City's water distribution system was analyzed with the estimated demands for the Stewart Area development to determine the effect that these demands will have on system operation, and to determine if the system improvements that have been proposed are adequate.

5.1 Storage Analysis

The City's existing storage facilities are summarized in Table 5-1. As indicated in Section 2.3, the total required storage is equal to the sum of the storage components for operational, emergency and fire flow requirements. The operational storage requirement is 25 percent of the Maximum Day demand. The emergency storage requirement is 75 percent of the Average Day demand. The fire flow storage is the largest fire flow storage value, which for the City is 1.2 million gallons (MG).

Table 5-1. Existing Storage Facilities

Tank Site	Total Storage Capacity, MG
Water Treatment Plant	8.0
Harter Tanks	4.0
Sam Brannon Tank	1.0
Rowe Avenue Tank	1.0
Burns Tank	3.0
Sanborn Tank	3.2
Total	20.2

The current storage requirements for the existing system are displayed in Table 5-2, which indicates that there is a current storage requirement of 19.2 MG, which means that there is currently a surplus of 1 MG of storage capacity. This amount of surplus storage would be sufficient to support 0.8 mgd of Average Day demand. Using the residential demand assumptions of 216 gpcd

and 2.67 persons per dwelling unit, this translates to approximately 1,400 additional housing units that could be supported by the existing surplus storage in the City.

Table 5-2. Storage Requirements with Current Demand

Scenario	Anticipated Demands, mgd	Storage Requirement	Storage Requirement, MG
Average Day	14.4	Emergency Storage is 75% of Average Day Demand	10.8
Maximum Day	28.8	Operational Storage is 25% of Maximum Day Demand	7.2
Fire Flow		5,000 gpm for 4 hours	1.2
Total			19.2

The current storage requirements for the existing system, when the demands for El Margarita are included, are shown in Table 5-3.

Table 5-3. Storage Requirements with Current Demand with El Margarita Demands

Scenario	Anticipated Demands, mgd	Storage Requirement	Storage Requirement, MG
Average Day	15.5	Emergency Storage is 75% of Average Day Demand	11.6
Maximum Day	30.9	Operational Storage is 25% of Maximum Day Demand	7.7
Fire Flow		5,000 gpm for 4 hours	1.2
Total			20.5

The current storage requirements for the existing system, when the demands for both the El Margarita and Stewart Areas are included, are shown in Table 5-4.

Table 5-4. Storage Requirements with Current Demand with El Margarita and Stewart Area Demands

Scenario	Anticipated Demands, mgd	Storage Requirement	Storage Requirement, MG
Average Day	17.14	Emergency Storage is 75% of Average Day Demand	13.1
Maximum Day	34.19	Operational Storage is 25% of Maximum Day Demand	8.7
Fire Flow		5,000 gpm for 4 hours	1.2
Total			23.0

The required capacity of additional storage facilities to provide adequate storage for the existing demand conditions plus both the demands for both the El Margarita and Stewart Areas is 2.8 MG (Required Storage of 23.0 MG – Existing Storage of 20.2 MG).

The individual storage requirements for the current system demands, the El Margarita Area and the Stewart Area, shown separately, are as follows:

- Current System: 19.2 MG
- El Margarita Area: 1.4 MG
- Stewart Area: 2.5 MG

The information provided by the City indicated that two new storage facilities are proposed for the Stewart Area, one on the west side and one on the east side. The system hydraulic model was used to determine if the two storage facilities could be combined into one location. The model indicated that the system can operate adequately with one larger storage facility located in either of the proposed locations within the Stewart Area.

5.2 Pumping Analysis

The City's existing firm booster pumping capacity is summarized in Table 5-5. The firm booster pumping capacity is defined as the combined capacity of all booster pumping facilities with the largest unit out of service. The City's distribution system is served entirely by its pumping facilities. Therefore, the firm capacity should be equal to or greater than the Peak Hour demand. The largest pump is the 7.4 million gallons per day (mgd) pump located at the water treatment plant. The firm pumping capacity of the City's distribution system is 55.2 mgd.

Table 5-5. Pumping Capacity

Location	Firm Pumping Capacity, mgd
Water Treatment Plant (Existing High Lift Pump Station)	30.0
Booster Pumps at Sam Brannon Tank Site	1.3
Booster Pumps at Rowe Avenue Tank Site	1.3
Booster Pumps at Garden/Burns Tank Site	3.3
Booster Pumps at Harter Tank Site	10.8
Booster Pumps at Sanborn Tank Site	8.5
Total	55.2

As shown in Section 4.0 Water Demands, the anticipated Peak Hour demands after the El Margarita and Stewart areas are fully developed are projected to be 61.0 mgd. This is higher than the firm pumping capacity of 55.2 mgd presented above. Therefore, the firm pumping capacity of the new pump station at the proposed storage facility planned for the Stewart Area must be at least 5.8 mgd.

5.3 Pipeline Analysis

The estimated demands for the Stewart Area were added to the hydraulic model to determine if the existing distribution system has sufficient capacity to support these demands, and to determine if the pipelines that have been proposed are adequately sized. For each scenario, if the pumps at the Water Treatment Plant (WTP) were not sufficient, as indicated by pressures in the system that did not meet the pressure criteria, then additional pumps were turned on to increase supply and boost pressure.

As indicated in Table 2-1, the minimum pressure criterion for normal operating conditions is 40 psi, which will be used to evaluate Maximum Day demand conditions. The minimum pressure criterion for Peak Hour demand conditions is 30 psi. The minimum pressure criterion for Maximum Day demand plus fire flow is 20 psi.

The pressures in the distribution system under Maximum Day demand conditions for existing demands plus demands for the El Margarita and Stewart Areas, with four pumps operating at the WTP pump station and one pump operating at the Burns/Garden Pump Station, are displayed on Figure 5-1.

Figure 5-2 shows the system pressures in the distribution system under Peak Hour demand conditions for existing demands plus demands for the El Margarita and Stewart Areas, with four pumps operating at the WTP, two pumps at the Harter Tank Site, one pump operating at the Sanborn Tank Site, one pump operating at the Burns/Garden Storage Facility and one pump operating at the proposed storage facility on the west side of the Stewart Area. The results show that a minimum pressure of 30 psi is maintained within the distribution system, except for one small area west of El Margarita, which is where the demands for the El Margarita area are assigned. This is likely caused by the demands for the El Margarita area being represented by a single demand in this location and has nothing to do with the Stewart Area development.

The model was run within the Stewart Area under Maximum Day for existing demands plus demands for the El Margarita and Stewart Areas plus Fire Flow demand conditions. Fire flow demands were assigned to junctions within the hydraulic model according to the adjacent planned land uses. The pipeline diameters were sized in the model to maintain a minimum pressure of 20 psi during the fire flow demand conditions. Figure 5-3 displays in red the recommended pipeline diameters for the pipeline network within the Stewart Area based on the Fire Flow analysis.

The pressures shown on Figure 5-4 indicate the residual pressure at each junction when the fire flow demand is added to that junction. Fire flow demands are not added all at the same time. The residual pressures are calculated individually for each junction, with only the fire flow for that junction added to the system. For these results, three pumps were operating at the WTP pump station, one pump was operating at the Sanborn Tank Site and one pump was operating at the storage facility proposed for the east side of the Stewart Area.

6.0 SUMMARY OF FINDINGS

The analysis described above showed that when both the El Margarita and Stewart Areas are fully developed, additional pumping and storage facilities will be required. The analysis also showed that the pipeline network that has been proposed for the Stewart Area is adequate for all areas

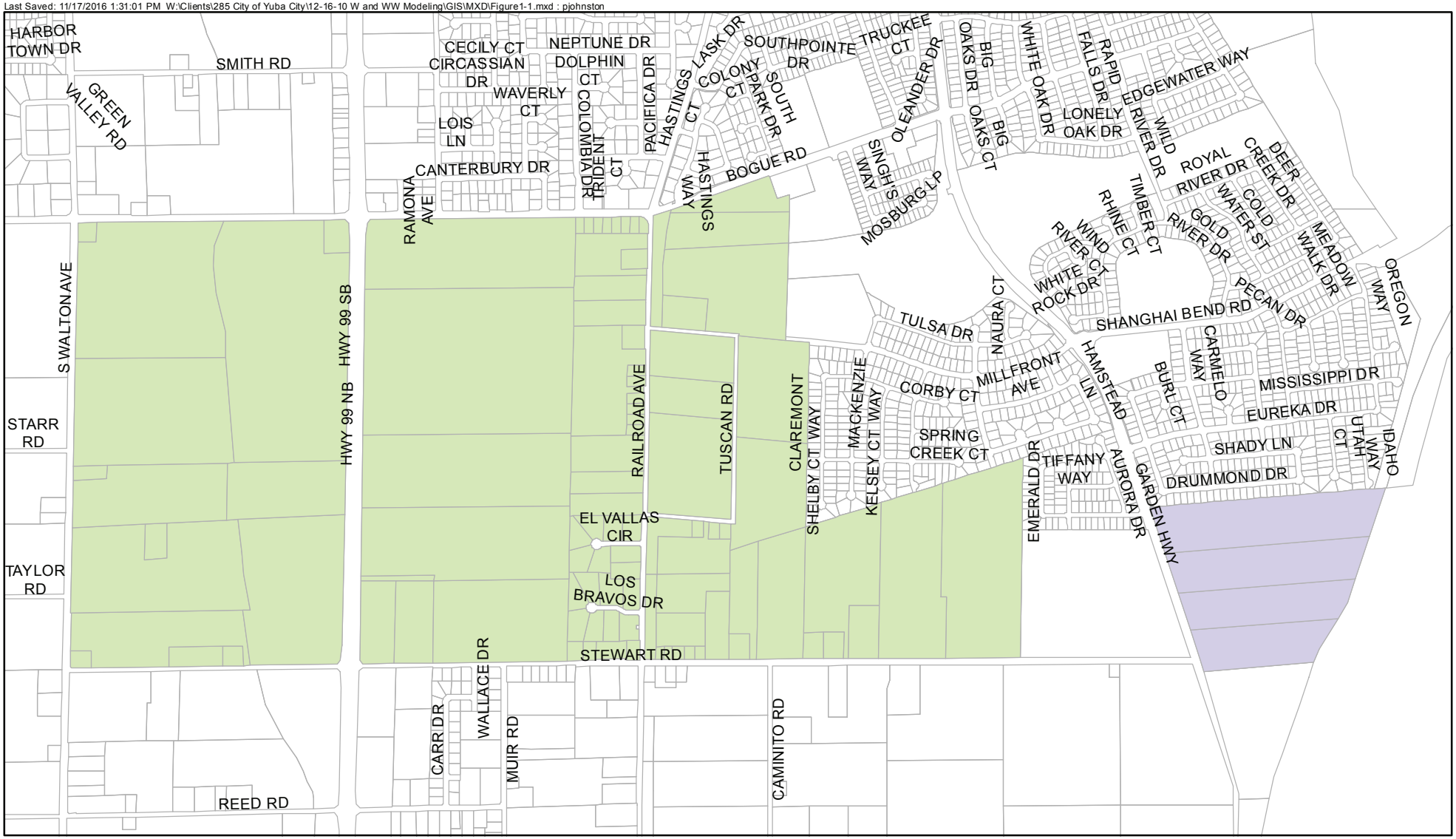
except for the southwest corner, where larger pipeline diameters are needed to provide adequate fire flow capacity.

The analysis showed that the City's current storage facilities are not sufficient to support the development of both the El Margarita and Stewart Areas. The storage deficit is estimated to be 2.8 MG.

The analysis showed that the City's current pumping facilities are not sufficient to support the development of both the El Margarita and Stewart Areas. The firm pumping capacity deficit is estimated to be 5.8 mgd.

While the City's existing pipeline network is adequate to support the Stewart Area development, the pipelines proposed within the Stewart Area are not. It is recommended that the pipelines in the southwest corner of the Stewart Area be installed as 16-inch diameter pipelines to support the fire flow demands in this area.

Last Saved: 11/17/2016 1:31:01 PM W:\Clients\285 City of Yuba City\12-16-10 W and WW Modeling\GIS\MXD\Figure1-1.mxd : pjohnston



Symbology

- Western Stewart Area
- Eastern Stewart Area
- Parcels

N

0 2,000 4,000

Scale in Feet

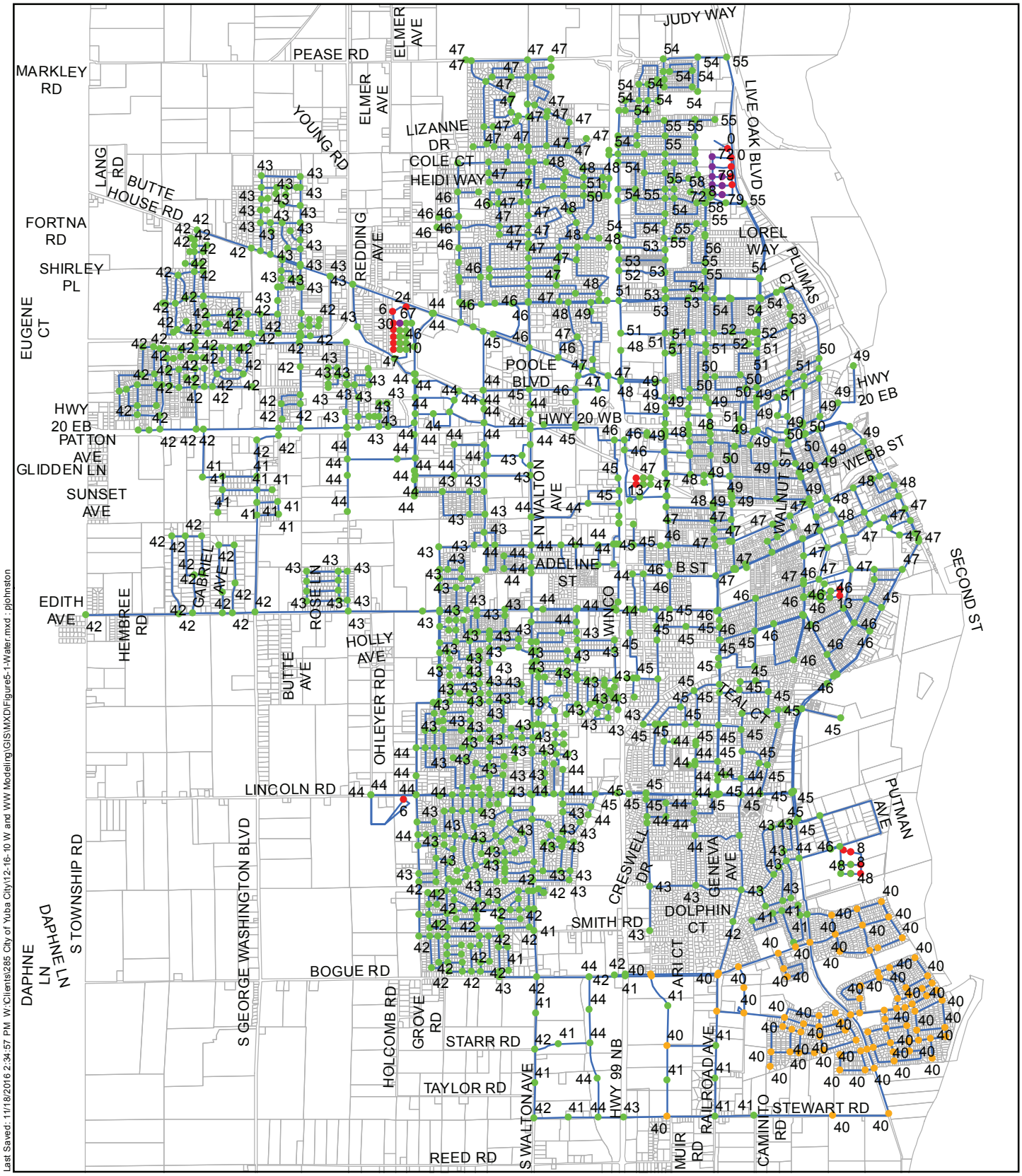
YUBA CITY

WEST YOST ASSOCIATES

Figure 1-1

Bogue Stewart Master Plan Area Development

City of Yuba City
Bogue Stewart Master Plan
Area Analysis



Last Saved: 11/18/2016 2:34:57 PM W:\Clients\285 City of Yuba City\12-16-10 W and WW Modeling\GIS\MXD\Figure5-1-Water.mxd : pjohnston

Symbology

PRESSURE

- < 30 psi
- 30 - 40 psi
- 40 - 60 psi
- 60 - 65 psi
- > 65 psi

Pipes

Parcels

N

0 2,500 5,000

Scale in Feet

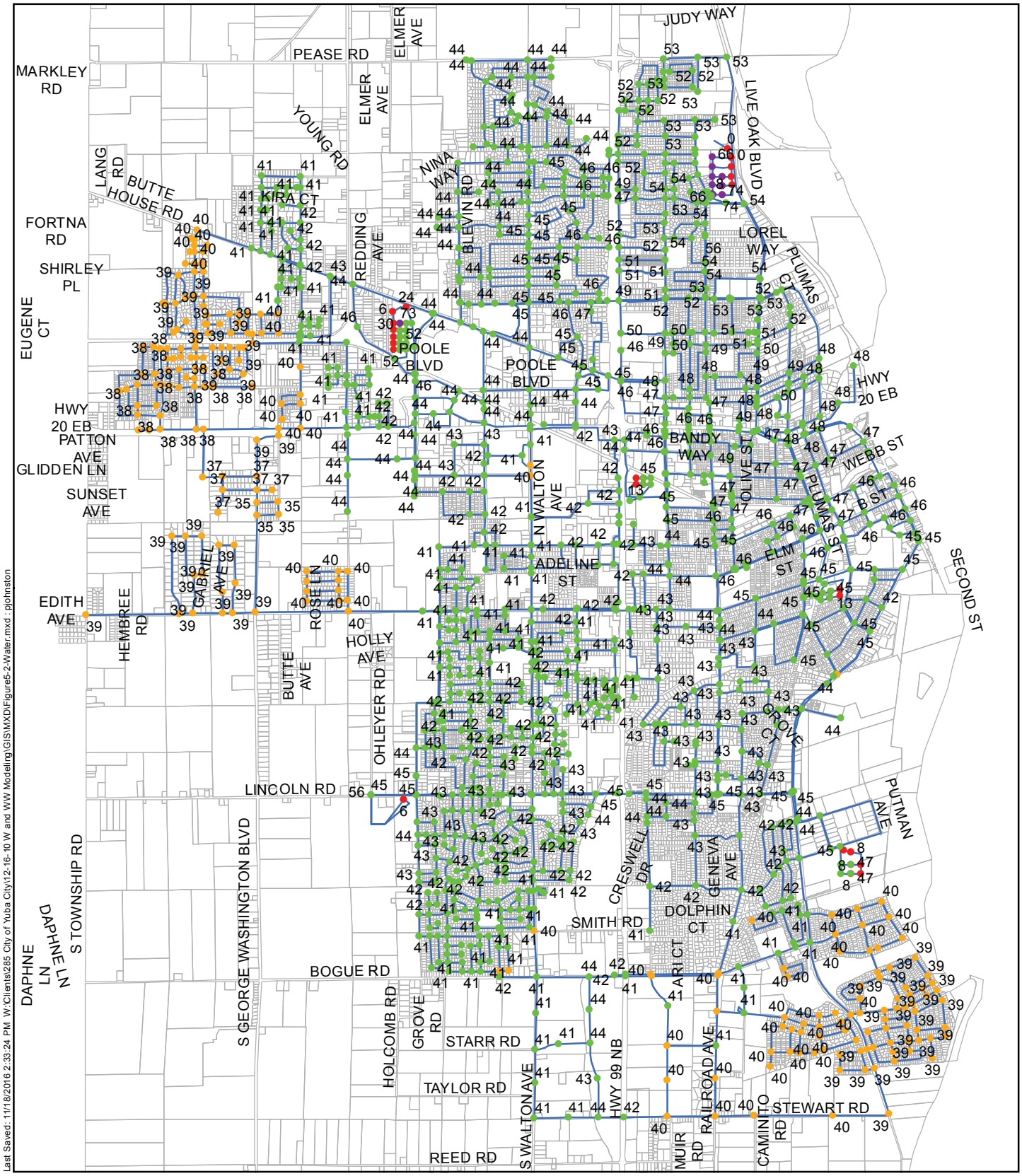
YUBA CITY

WEST YOST ASSOCIATES

Figure 5-1

System Pressures for Maximum Day Demands

City of Yuba City
Bogue Stewart Master Plan
Area Analysis



Last Saved: 11/18/2016 2:33:24 PM W:\Clients\285 City of Yuba City\12-16-10 W and WW Modeling\GIS\MXD\Figure5-2-Water.mxd - pjohnston

Symbology

PRESSURE

- < 30 psi
- 30 - 40 psi
- 40 - 60 psi
- 60 - 65 psi
- > 65 psi

Pipes

Parcels

N

0 2,500 5,000

Scale in Feet

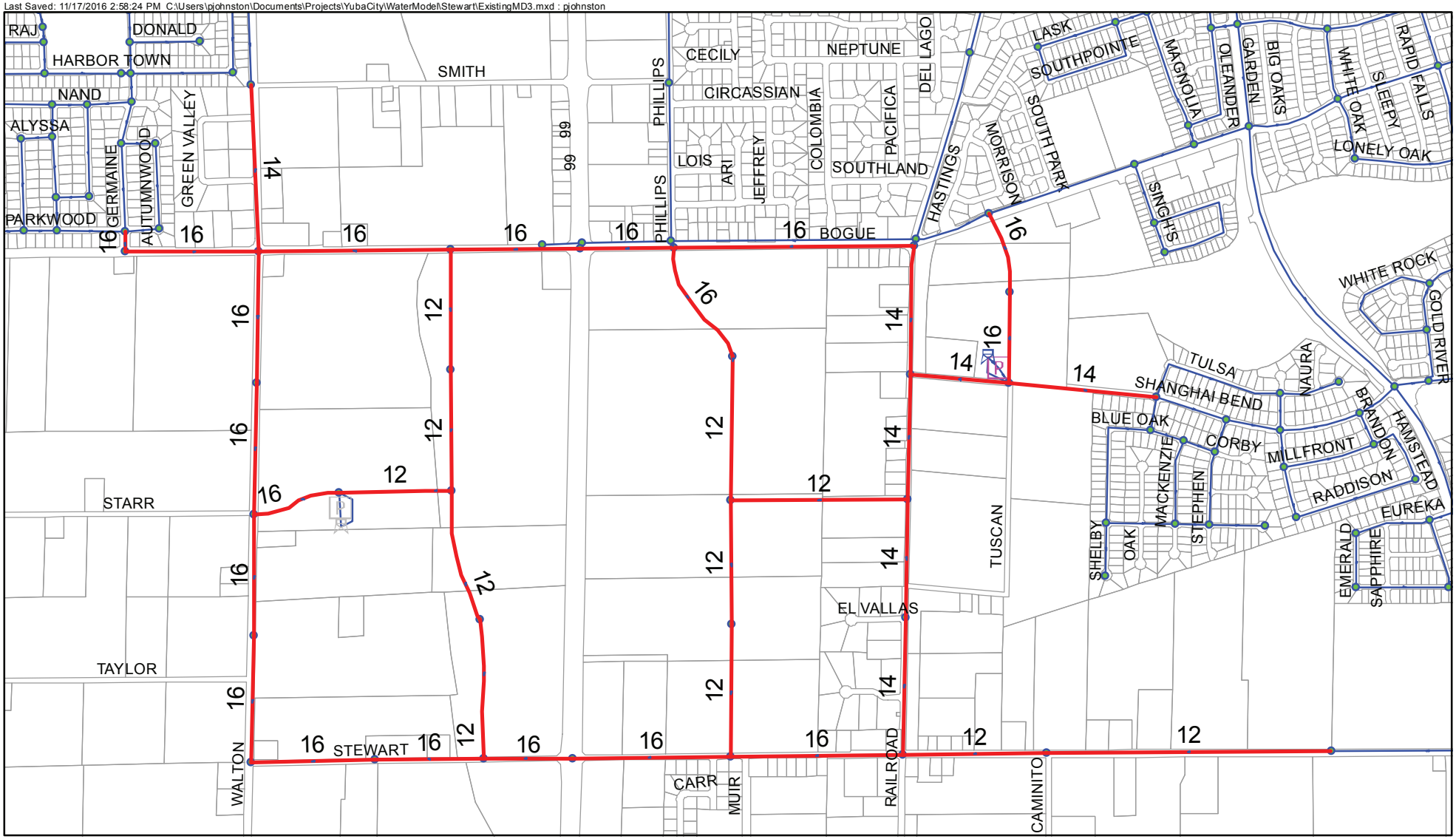
YUBA CITY

WEST YOST ASSOCIATES

Figure 5-2

System Pressures for Peak Hour Demands

City of Yuba City
Bogue Stewart Master Plan
Area Analysis



Symbology

- Proposed Pipe with Diameter
- Existing Pipes
- Parcels

N

0 2,000 4,000

Scale in Feet

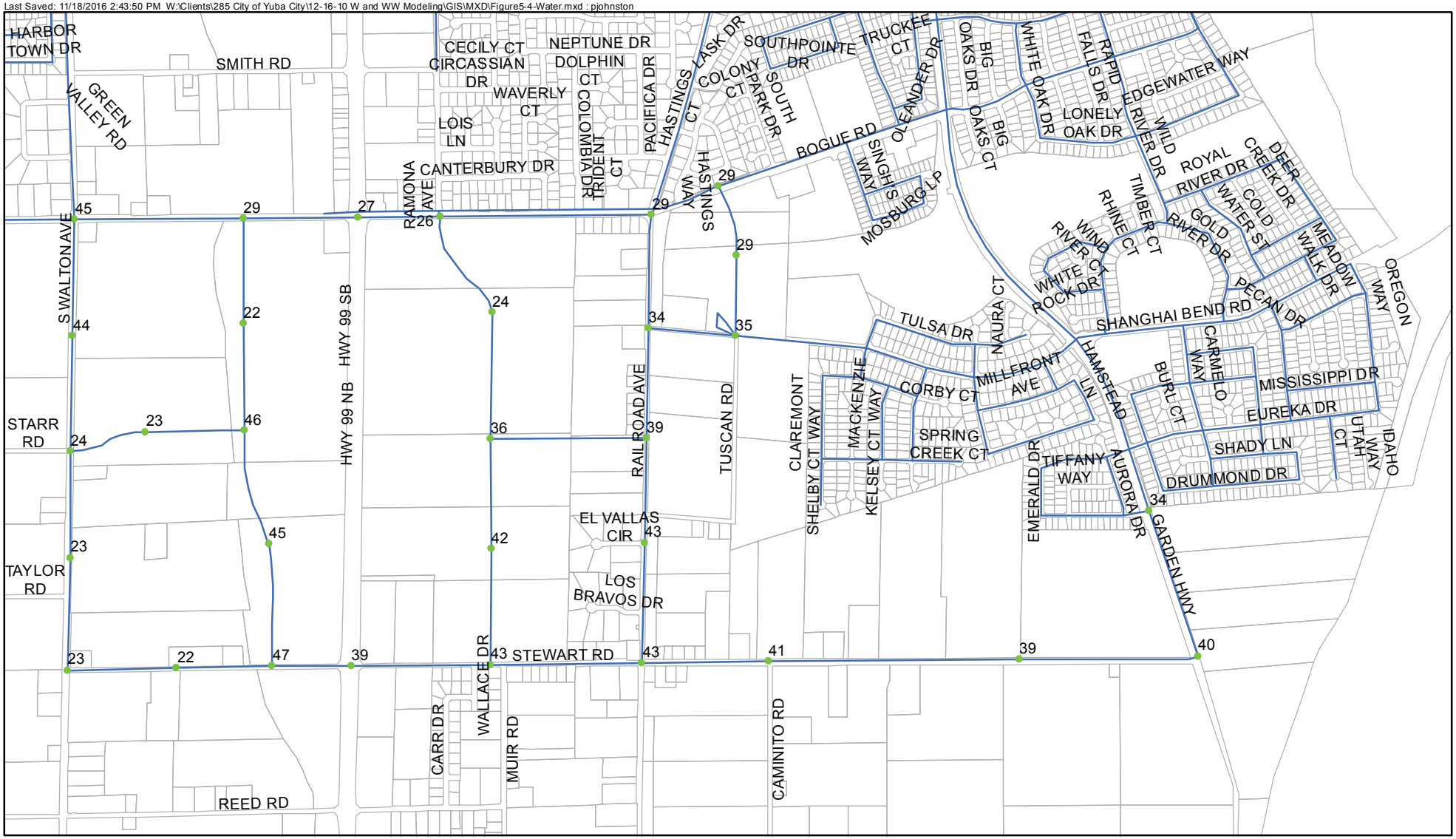
YUBA CITY

WEST YOST ASSOCIATES

Figure 5-3

Recommended Pipeline Diameters

City of Yuba City
Bogue Stewart Master Plan
Area Analysis



Symbology

Residual Pressure

- < 20 psi
- > 20 psi
- Pipes
- Parcels

YUBA CITY

WEST YOST ASSOCIATES

Figure 5-4

Residual Pressures with Max Day + Fire Flow Demands with Recommended Diameters

City of Yuba City
Bogue Stewart Master Plan
Area Analysis