PLANNING CRITERIA AND DESIGN FLOWS

This chapter presents the planning criteria used to evaluate the capacity of the collection system and to develop design flows. These criteria are based on standards from the City's Engineering Design Standards for Sanitary Sewers (Appendix H) and from engineering judgment and experience. These criteria include the collection system capacity, gravity sewer slopes, and maximum depth of flow within a sewer.

5.1 GRAVITY SEWERS

Several factors determine gravity sewer pipe capacities, including the roughness of the pipe, the chosen maximum allowable depth of downstream flow conditions, and the limiting velocity and slope. The following sections describe the methodology used to assess both existing and future gravity sewer lines.

5.1.1 Manning's Roughness Coefficient (n)

The Manning's roughness coefficient (Manning's n) is a type of friction coefficient that varies based on pipe material, pipe size, depth of flow, smoothness of joints, root intrusion, and other factors. For sewer pipes, the Manning's n typically ranges from 0.011 to 0.017, with 0.013 being a representative value used for system planning.

Initially, because the conditions of existing pipelines were unknown, a conservative Manning's n factor of 0.013 was used to evaluate all existing collection system pipelines. However, pipe roughness values were adjusted within the stated typical range during calibration of the model. Conversely, a Manning's n factor of 0.013 was used for all future pipelines.

5.1.2 Flow Depth Criteria (d/D)

The ratio of maximum flow depth to pipe diameter (d/D) is the primary criterion used to identify capacity-deficient trunk sewers and to determine the size of new improvements. This ratio is defined as the depth (d) of flow in a pipe during peak flow conditions compared to the pipe's diameter (D). A smaller d/D ratio corresponds with a lower flow depth, and a larger d/D ratio corresponds with a higher flow depth. Table 5.1 summarizes the flow depth criteria used for existing and future pipelines.

5.1.2.1 Flow Depth for Existing Sewers

Using a variety of factors, criteria were established to determine the existing sewers' maximum flow depth. These factors included, but were not limited to, the acceptable risk tolerance of the utility as well as local standards and codes. Determining the proper d/D ratio to use is very important. Although a smaller, or more conservative, d/D ratio allows for greater capacity in the pipe to handle peak flows, it may also lead to unnecessary replacement of the existing pipelines. Conversely, using a larger, or less conservative, d/D ratio allows for less capacity in a pipe. This could lead to surcharging, which increases the risk of sanitary sewer overflows (SSOs). Ultimately, the maximum allowable d/D should reduce the risk of SSOs to the fullest extent while being as cost effective as possible.

For the Modesto collection system model, existing pipelines were identified as capacity deficient if the d/D exceeded 0.85. Such pipelines are problematic because they can raise the hydraulic grade line of upstream sewers, which leads to backwater conditions (i.e., system bottleneck). The greater the capacity deficiency, the higher the water levels will surcharge upstream of the bottleneck pipeline(s). The hydraulic model is used to identify these pipelines, known as "backwater" pipelines, to isolate specific pipelines that are the root causes of the capacity deficiency. Capital projects can then be proposed to increase flow capacity for the deficient sewers, which eliminates the backwater conditions that cause surcharging.

5.1.2.2 Flow Depth for New Sewers

When designing new sewers, it is common practice to adopt variable flow depth criteria for different pipe sizes. Typically, design d/D ratios range from 0.5 to 0.92, with the lower values used for smaller pipes. These smaller pipes may experience flow peaks greater than the design flow and can be affected by blockages from debris, paper, or rags. In this case, the proposed new pipelines were sized to convey design flows at a maximum capacity of 70 percent, or a d/D ratio of 0.70. Table 5.1 summarizes the maximum allowable d/D ratios for design flow conditions.

Table 5.1 Maximum Flow Depth Criteria
Wastewater Collection System Master Plan
City of Modesto, California

Existing Sewers	
Peak Wet Weather Flow	Maximum d/D = 0.85
New Sewers	
Peak Wet Weather Flow	Maximum d/D = 0.70

5.1.3 Design Velocities and Minimum Slopes

To minimize the settlement of sewage solids, sewer velocity should be greater than or equal to 2 feet per second (ft/s) for all sewers flowing at maximum depth (based on a roughness coefficient of 0.013). At this velocity, the sewer flow will typically self-clean the pipe. Table 5.2 lists the recommended minimum slopes and their corresponding maximum flows for maintaining self-cleaning velocities (greater than or equal to 2 ft/s) when the pipe flows at maximum depth.

The recommended minimum slopes presented in Table 5.2 are consistent with the City's standards for sewers up to 12 inches in diameter. However, these standards do not specify minimum slopes for sewers with larger diameters.

Table 5.2 Minimum Slopes for New Pipes
Wastewater Collection System Master Plan
City of Modesto

Pipe Dia. (inch)	Recommended Minimum Slope[1] (ft/ft)	Existing Pipelines Calculated Flow at d/D=0.85[2] (cfs)	(mgd)	New Pipelines Calculated Flow at d/D=0.70[3] (cfs)	(mgd)
8	0.0035[4]	0.74	0.48	0.60	0.39
10	0.0025[4]	1.13	0.73	0.92	0.59
12	0.0020[4]	1.64	1.06	1.33	0.86
15	0.0012	2.31	1.49	1.87	1.21
18	0.0010	3.42	2.21	2.78	1.80
21	0.0008	4.62	2.98	3.75	2.42
24	0.0007	6.17	3.99	5.01	3.24
27	0.0006	7.82	5.05	6.35	4.10
30	0.0005	9.45	6.11	7.68	4.96
33	0.0005	12.2	7.88	9.90	6.40
36	0.0004	13.8	8.88	11.2	7.22
42	0.0003	18.0	11.6	14.6	9.43
48	0.0003	25.6	16.6	20.8	13.5
54	0.0003	35.1	22.7	28.5	18.4

Notes:
(1) Recommended minimum slope for a velocity of 2 ft/s.
(2) Design flow for existing pipes at a d/D of 0.85 and velocity of 2 ft/s.
(3) Design flow for new pipes at a d/D of 0.7 and velocity of 2 ft/s.
(4) City design standards for minimum slopes of sewer lines.

5.1.4 Changes in Pipe Size

When a smaller sewer joins a larger one, the invert of the larger sewer is sufficiently lowered to maintain the same energy gradient. For planning purposes and the design of new pipes, and in the absence of field data, sewer crowns are matched at the manholes.

5.1.5 Lift Stations and Force Mains

The City's design standards require that all sewage lift stations have a standby capacity of 50 percent and a minimum of two pumps. These standards also provide requirements for lift stations with an ultimate design capacity of 500 gallons per minute (gpm) or less. Any lift station with flows larger than that requires an independent analysis. Additional City design standards for these lift stations are provided in Appendix G.

Professional standards of practice suggest that lift stations be evaluated and designed for conveying peak flow at firm capacity, which is equal to a lift station's capacity with the largest pump out of service.

Typically, force mains are sized to flow at a minimum of 3 ft/s under normal operating conditions. To design force mains, the Hazen-Williams formula is commonly used. The velocity equation for the Hazen-Williams formula is as follows:

$V = 1.32 * C * R^{0.63} * S^{0.54}$

Where:

V = mean velocity, ft/s.
C = roughness coefficient.
R = hydraulic radius, ft.
S = slope of the energy grade line, ft/ft.

The value of the Hazen-Williams "C" varies with the type of pipe material used and is influenced by the type of construction and the pipe's age. For this Master Plan, a "C" value of 120 was used.

5.2 DESIGN FLOWS

This section summarizes the historic flows measured at the Sutter Avenue Primary Treatment Facility (Sutter Plant) and presents the calculation of the design flows used to model the existing and future sewer collection system.

5.2.1 Historic Sutter Plant Flows

In addition to the flow monitoring program summarized in Chapter 3, historical Sutter Plant influent flow data since 2011 were reviewed to help establish wastewater flow criteria. Flow data from 2011 to 2014 are summarized in Table 5.3 and are defined below:

- <u>Average Annual Flow (AAF):</u> The average influent flow over the entire year without consideration of the season (dry or wet).
- <u>Average Dry Weather Flow (ADWF):</u> Average influent flow during the months of June through September.
- <u>Average Day Maximum Month Flow (ADMMF):</u> Highest average monthly influent flow during the year.
- <u>Max Day Dry Weather Flow (MDDWF):</u> Highest daily average influent flow during dry weather months.
- <u>Peak Dry Weather Flow (PDWF):</u> Maximum hourly influent flow during the dry weather months.

- Max Day Wet Weather Flow (MDWWF): Highest daily average influent flow during the wet weather months.
- Peak Wet Weather Flow (PWWF): Maximum hourly influent flow during the wet weather months.

As shown in Table 5.3, the ADWF ranged from 20.4 mgd to 20.8 mgd. In addition, the highest hourly flow recorded at the Sutter Plant was 72.8 mgd, which occurred on December 11th, 2014, when the flow monitoring program was active. Average influent flow in Table 5.3 represents the entire year (dry or wet). The values listed in Table 5.3 are different than those in Tables 3.3 and 3.5 because of cumulative error in the field-installed meters and those tables are based on recorded data for a shorter period than the season they represent.

Table 5.3 Historic Sutter Plant Influent Flow Data Summary
Wastewater Collection System Master Plan
City of Modesto, California

	Sutter Plant Influent Flow			
Month	**2011**	**2012**	**2013**	**2014**
Jan	20.5	20.2	20.8	19.5
Feb	20.9	20.0	20.2	19.6
Mar	21.8	20.3	20.3	19.7
Apr	21.3	20.5	20.4	20.0
May	19.9	20.4	20.0	19.9
Jun	21.2	21.5	22.3	21.5
Jul	20.9	20.5	20.4	21.4
Aug	18.9	19.0	19.7	18.6
Sep	18.9	19.0	22.6	19.6
Oct	20.1	21.9	21.1	20.2
Nov	20.6	20.8	20.1	20.0
Dec	20.1	21.2	19.7	21.2
Flow Summary				
Average Annual Flow (AAF)	20.4	20.4	20.6	20.0
Average Dry Weather Flow (ADWF)	20.4	20.3	20.8	20.5
Average Day Max Month Flow (ADMMF)	21.8	21.9	22.6	21.5
Max Day Dry Weather Flow (MDDWF)	25.8	31.3	26.6	25.5
Peak Dry Weather Flow (PDWF)	36.5	39.5	36.6	36.3
Max Day Wet Weather Flow (MDWWF)	28.3	27.9	27.0	35.4
Peak Hour Wet Weather Flow (PHWWF)	50.7	51.8	46.9	72.8

Table 5.3 Historic Sutter Plant Influent Flow Data Summary Wastewater Collection System Master Plan City of Modesto, California				
	Sutter Plant Influent Flow			
Month	**2011**	**2012**	**2013**	**2014**
Peaking Factor Summary				
ADWF/AAF	1.00	0.99	1.01	1.02
ADMMF/AAF	1.07	1.07	1.10	1.07
MDDWF/AAF	1.26	1.53	1.29	1.28
PDWF/AAF	1.79	1.93	1.77	1.82
MDWWF/AAF	1.39	1.37	1.31	1.77
PHWWF/AAF	2.48	2.53	2.27	3.64

5.2.2 Existing and Projected Wastewater Flows

During the modeling process, relationships between land use and wastewater flow were identified to predict average wastewater flow. These relationships, called wastewater generation coefficients, were established based on the average wastewater flow generated by each existing land use type. Once coefficients were developed using existing conditions, the land use flow coefficients were used to estimate average day flow through build-out of the study area.

5.2.2.1 Large Wastewater Dischargers

To model customers that discharge large amounts of wastewater, point loads representing eighteen industrial users and three public facilities were input into the hydraulic model in place of the wastewater flow coefficients. Of these twenty-one users, three were not identified. Of the identified users, five discharge into the CSL, and the remaining thirteen discharge into the sanitary sewer. Each of these users was represented as a point load in the hydraulic model. The average daily flows for the thirteen wastewater users ranged from approximately 4,500 gpd (0.0045 mgd) to 652,600 gpd (0.65 mgd).

Table 5.4 summarizes the twenty-one major users, their discharge types, and their wastewater flow generations. Figure 5.1 shows the general locations of the eighteen major dischargers and identifies if they utilize the CSL or sanitary sewer.

5.2.2.2 Existing Wastewater Flow Coefficients and Average Dry Weather Flow

To estimate the amount of flow per acre generated by each land use category, wastewater flow coefficients were developed for each land use classification in the City's General Plan. These coefficients are expressed in gallons per day per acre (gpd/ac) and calculate the average day flow generated from a particular land use. Once the flow coefficients were determined, the resulting flow was entered into the sewer system hydraulic model.

Typically, flow coefficients for residential areas range between 400 to 4,000 gpd/ac, and commercial and industrial areas range from 500 to 2,500 gpd/ac. Open space and agriculture land uses were assumed to generate negligible amounts of sewage flow. For each individual land use type, coefficients were developed using the following procedure:

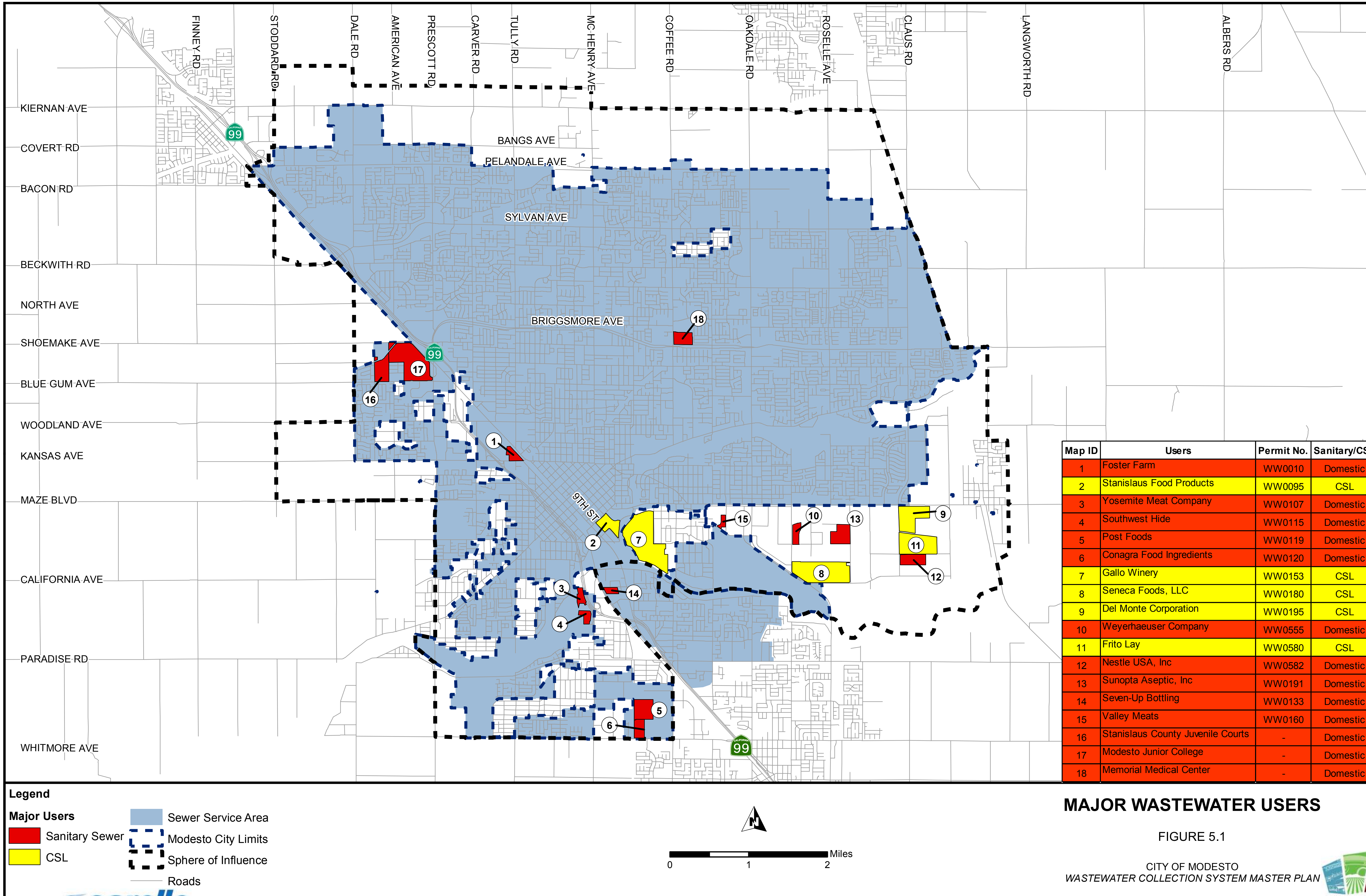
- Average flows for each flow metering tributary area were derived from the flow monitoring data.
- Flows from each of the City's existing significant users (SUs) were identified using the City's meter data. A summary of the average flows from each SU is provided in Table 5.4. Each SU was then assigned to the appropriate flow metering tributary area, and its average flows were subtracted from the average flows measured during the flow monitoring period. Flows associated with the SUs were input into the model as "point loads."
- Using GIS information, the acres for each existing land use type contained in each flow monitoring tributary area were calculated, excluding the SU areas.
- Preliminary coefficients for each land use type were estimated based on the approximate number of dwelling units per acre, the assumed per capita wastewater generation rates, and the typical number of people per dwelling unit for each land use type.
- The coefficients for each flow metering tributary were then balanced (adjusted up or down) to match the calculated average flows from each tributary to the measured flows during the flow monitoring period.
- Once the coefficients for each flowmeter tributary area were balanced, the weighted average of the coefficients for each existing land use type was calculated based on the acreage contribution from each metering tributary area.
- The weighted average wastewater generation coefficients were then adjusted for the entire developed sewer service area until they matched the total metered ADWF of 21.4 mgd. The adjusted weighted average coefficients are considered representative of the wastewater generation by land use for the entire City and are used to project future average wastewater flows.

The calibrated wastewater flow coefficients developed for the Master Plan are summarized in Table 5.5. These flow coefficients are less than those in the previous Master Plan due to California's current drought conditions, the implementation of water meters, and recent economic conditions in the City. This Master Plan estimated an average per capita wastewater generation of 73 gallons per capita per day (gpcd), which is approximately 27 percent lower than the 100 gpcd value assumed in the City's Master Plan.

Table 5.4 Summary of Flow Data for Major Wastewater Dischargers
Wastewater Collection System Master Plan
City of Modesto, California

Map ID	MU Name	Permit #	Type	Wastewater Discharge[1] (gallons)[2]	Wastewater Discharge[1] (gallons/day)[3]
1	Foster Farms	WW0010	Domestic	238,198,000	652,600
2	Stanislaus Food Products	WW0095	CSL	635,042,000	1,739,800
3	Yosemite Meat Company	WW0107	Domestic	36,921,000	101,200
4	Southwest Hide	WW0115	Domestic	2,748,000	7,500
5	Post Foods	WW0119	Domestic	17,845,000	48,900
6	Conagra Food Ingredients	WW0120	Domestic	21,316,000	58,400
7	Gallo Winery	WW0153	CSL	350,906,000	961,400
8	Seneca Foods, LLC	WW0180	CSL	274,664,000	752,500
9	Del Monte Corporation	WW0195	CSL	251,204,000	688,200
10	Weyerhaeuser Company	WW0555	Domestic	5,804,000	15,900
11	Frito Lay	WW0580	CSL	211,599,000	579,700
12	Nestle USA, Inc.	WW0582	Domestic	112,285,000	307,600
13	Sunopta Aseptic, Inc.	WW0191	Domestic	43,812,000	120,000
14	Seven-Up Bottling	WW0133	Domestic	35,111,000	96,200
15	Valley Meats	WW0160	Domestic	1,642,000	4,500
16	Unknown	WW0579	Domestic	2,372,000	6,500
17	Unknown	WW0515	Domestic	16,560,000	45,400
18	Unknown	WW0565	Domestic	48,771,000	133,600
19	Modesto Junior College, West Campus [4]	-	Domestic	24,567,000	67,300
20	Juvenile Center[4]	-	Domestic	207,176,000	567,600
21	Memorial Hospital[4]	-	Domestic	52,560,000	144,000

Notes:
(1) Source: Table C-1 of the City of Modesto Evaluation of Wastewater Rates, Brown and Caldwell, Final, April 2014.
(2) Rounded to the nearest thousand.
(3) Gallons per day = Total Gallons / 365, rounded to the nearest hundred.
(4) Data provided by City staff.



Map ID	Users	Permit No.	Sanitary/CSL
1	Foster Farm	WW0010	Domestic
2	Stanislaus Food Products	WW0095	CSL
3	Yosemite Meat Company	WW0107	Domestic
4	Southwest Hide	WW0115	Domestic
5	Post Foods	WW0119	Domestic
6	Conagra Food Ingredients	WW0120	Domestic
7	Gallo Winery	WW0153	CSL
8	Seneca Foods, LLC	WW0180	CSL
9	Del Monte Corporation	WW0195	CSL
10	Weyerhaeuser Company	WW0555	Domestic
11	Frito Lay	WW0580	CSL
12	Nestle USA, Inc	WW0582	Domestic
13	Sunopta Aseptic, Inc	WW0191	Domestic
14	Seven-Up Bottling	WW0133	Domestic
15	Valley Meats	WW0160	Domestic
16	Stanislaus County Juvenile Courts	-	Domestic
17	Modesto Junior College	-	Domestic
18	Memorial Medical Center	-	Domestic

carollo

MAJOR WASTEWATER USERS

FIGURE 5.1

CITY OF MODESTO
WASTEWATER COLLECTION SYSTEM MASTER PLAN

MODESTO CALIFORNIA

pw://Carollo/Documents/Client/CA/Modesto/9704A00 - WW Collection/Data/MXDs/Fig 5_1.mxd

**Table 5.5 Existing ADWF by Land Use
Wastewater Collection System Master Plan
City of Modesto, California**

Land Use Category	Land Use Code	Existing Sewer Service Area				
		Developed Acres (gr. acres)	Partial Development(1) (gr. acres)	Wastewater Flow Coefficients (gpd/gr. acres)	Wastewater Flow (mgd)	Percent of Total Flow (%)
Residential	R	15,481	74	910	14.16	65.84
Village Residential	VR	21	0	800	0.02	0.08
Mixed Use	MU	1,265	0	800	1.01	4.71
Downtown	D	630	0	570	0.36	1.67
Commercial	C	1,474	17	600	0.89	4.16
Regional Commercial	RC	172	0	500	0.09	0.40
Business-Commercial-Residential	BCR	34	3	580	0.02	0.10
Business Park	BP	186	21	500	0.10	0.48
Industrial	I	1,732	211	1,000	1.94	9.04
Open Space	OS	263	0	0	0.00	0.00
North Ceres	-	878	0	-	0.72	3.34
Major Point Load						
Juvenile Detention Facility	-	35	-	-	0.57	2.65
Modesto Junior College	-	160	-	-	0.07	0.31
Memorial Hospital	-	43	-	-	0.14	0.65
Foster Farms	-	14	-	-	0.65	3.04
Yosemite Meat company	-	12	-	-	0.10	0.47
Southwest Hide	-	12	-	-	0.01	0.04
Post Foods	-	39	-	-	0.05	0.23
Conagra Food Ingredients	-	20	-	-	0.06	0.27
Weyerhaeuser Company	-	15	-	-	0.02	0.07
Nestle USA, Inc.	-	27	-	-	0.31	1.43
Sunopta Aseptic, Inc.	-	35	-	-	0.12	0.56
Seven-Up Bottling	-	8	-	-	0.10	0.45
Valley Meats	-	7	-	-	0.004	0.02
Total		**22,563**	**327**		**21.5**	

Note:
(1) Partial Development was multiplied by 0.5 to represent sewer flows of partial development.

To ensure that the flow coefficient estimates were accurate, an overall wastewater flow balance was performed. Applying the coefficients to land uses yielded a total influent ADWF of 19.3 mgd. With the addition of major dischargers, a total ADWF of 21.5 mgd was estimated, which is less than a 1 percent difference from the measured flow of 21.4 mgd.

As with most cities in California, residential land use makes up the majority of developed land and wastewater flow, as is shown in Table 5.5. For Modesto, residential customers account for approximately 66 percent of the current flow (14.2 mgd), the industrial sector accounts for 9 percent (1.9 mgd), and north Ceres, Empire, and other land uses account for the remaining 25 percent (5.4 mgd).

5.2.2.3 Projected Average Dry Weather Flow

Table 5.6 compares wastewater coefficients for existing conditions with those recommended for modeling future development. As shown in the table, future wastewater coefficients are larger than the existing coefficients and reflect increased density for future development. Future residential and village residential flow coefficients (1340 gpd/acre) were calculated assuming a mid-density value of 6.6 dwelling units per acre (DU/ac), an occupancy factor of 2.9 people per dwelling unit (people/DU), and a per capita flow of 73 gpcd

Developing an accurate estimate of the quantity of wastewater is an important part of maintaining and sizing sewer system facilities for both existing conditions and future developments. To determine the future ADWF for build-out of the study area, the wastewater generation coefficients were multiplied by the build-out land use acreage described in the City's General Plan. These coefficients represent proposed build-out conditions.

Table 5.7 summarizes the projected increase in wastewater flow at build-out of the General Plan. As shown in the table, future flows are projected to increase by 60 percent to approximately 34.4 mgd.

For north Ceres, flow data and land development was derived from the City of Ceres Master Plan dated July 2013. This Master Plan, drafted by Stantec Consulting Services Inc., provides existing and projected flows for average dry weather and peak wet weather. As a result, there are no wastewater coefficients for north Ceres in Table 5.7.

For areas outside of City limits but within the SOI, such as Empire and county islands, flow projections were calculated based on the City's General Plan land use designation and are therefore not included in a separate line item in Table 5.7.

Table 5.6 Comparison of Wastewater Flow Coefficients Wastewater Collection System Master Plan City of Modesto, California

Land Use Category	Land Use Code	Existing Wastewater Flow Coefficients (gpd/acres)	Future Wastewater Flow Coefficients (gpd/acres)
Residential	R	910	1,340
Village Residential	VR	800	1,340
Mixed Use	MU	800	840
Downtown(1)	D	570	--
Commercial	C	600	630
Regional Commercial	RC	500	530
Business-Commercial-Residential	BCR	580	610
Business Park	BP	500	530
Industrial	I	1,000	1,050

Note:

(1) Future Downtown wastewater flow projections are based on the assumption that individual districts within the downtown area will generate specific flows. Therefore, future wastewater flow coefficients for Downtown are not included in this table.

5.2.3 Design Storm

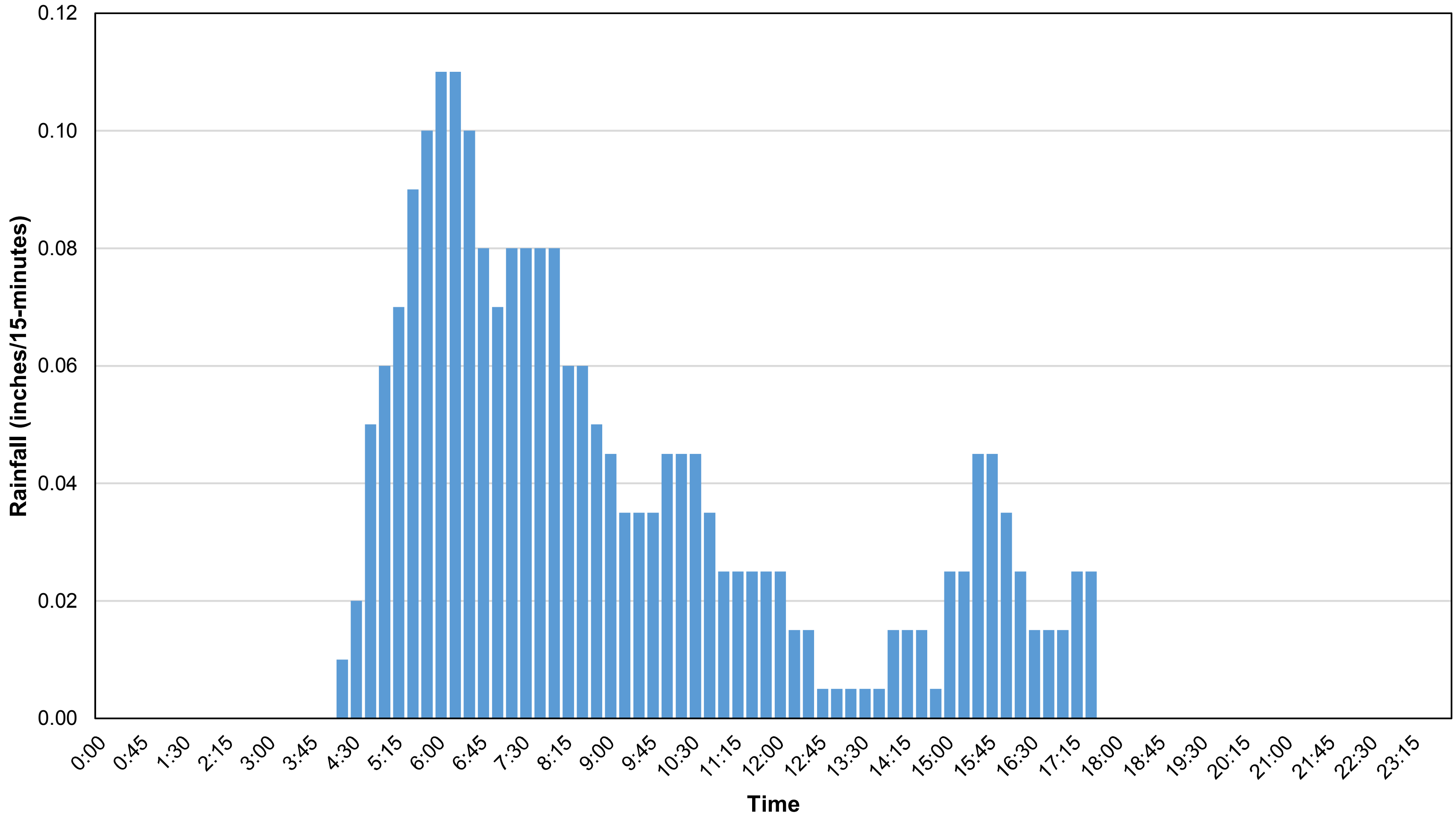
Design storms are rainfall events used to analyze a collection system's performance under extreme wet weather events. The first step in developing a design storm is to define its recurrence interval and rainfall duration. The recurrence interval is based on the probability that a given rainfall event will occur or be exceeded in any given year. For example, a "100-year storm" means there is a 1 in 100 chance that a storm this size or larger will occur at a specific location in any year. Duration is the length of time in which the rainfall occurs.

In California, it is an industry standard to use a 10-year, 24-hour design storm to analyze wastewater collection system performance during PWWF conditions. Figure 5.2 shows the estimated rainfall intensity generated from the 10-year, 24-hour design storm. For this Master Plan, the 10-year, 24-hour design storm was modified to mimic the December 11, 2014, storm event, which had a peak intensity of 0.42 in/hr and a total rainfall volume of 2.2 inches.

Table 5.7 Build-Out Flow Projections
Wastewater Collection System Master Plan
City of Modesto, California

Land Use Category	Land Use Code	Existing Sewer Service Area				Future Sewer Service Area			Total Flow (Existing + Future) (mgd)
		Developed (gr. acres)	Partial Development(1) (gr. acres)	Wastewater Flow Coefficients (gpd/gr. acres)	Existing Wastewater Flow (mgd)	Developable Acres (gr. acres)	Wastewater Flow Coefficients (gpd/gr. acres)	Flows from Future Development (mgd)	
Residential	R	15,481	74	910	14.16	2,749	1,340	3.68	17.84
Village Residential	VR	21	0	800	0.02	2,511	1,340	3.37	3.38
Mixed Use	MU	1,265	0	800	1.01	117	840	0.10	1.11
Downtown	D	630	0	570	0.36	673	--	0.53(2)	0.63
Commercial	C	1,474	17	600	0.89	326	630	0.21	1.10
Regional Commercial	RC	172	0	500	0.09	623	530	0.33	0.42
Business-Commercial-Residential	BCR	34	3	580	0.02	1,083	610	0.66	0.68
Business Park	BP	186	21	500	0.10	2,879	530	1.53	1.63
Industrial	I	1,732	211	1,000	1.94	1,201	1,050	1.26	3.20
Open Space	OS	263	0	0	0.00	1,818	0.00	0.00	0.00
North Ceres	-	878	0	-	0.72	434	-	0.58	1.30
Major Point Load									
Juvenile Detention Facility		35	-	-	0.57	-	-	0.00	0.57
Modesto Junior College	-	160	-	-	0.07	-	-	0.00	0.07
Memorial Hospital	-	43	-	-	0.14	-	-	0.00	0.14
Foster Farms	-	14	-	-	0.65	-	-	0.44	1.09
Yosemite Meat company	-	12	-	-	0.10	-	-	0.07	0.17
Southwest Hide	-	12	-	-	0.01	-	-	0.00	0.01
Post Foods	-	39	-	-	0.05	-	-	0.03	0.08
Conagra Food Ingredients	-	20	-	-	0.06	-	-	0.04	0.10
Weyerhaeuser Company	-	15	-	-	0.02	-	-	0.01	0.03
Nestle USA, Inc.	-	27	-	-	0.31	-	-	0.20	0.51
Sunopta Aseptic, Inc.	-	35	-	-	0.12	-	-	0.08	0.20
Seven-Up Bottling	-	8	-	-	0.10	-	-	0.06	0.16
Valley Meats	-	7	-	-	0.004	-	-	0.006	0.01
Total		**22,563**	**327**		**21.5**	**14,415**		**13.2**	**34.4**

Notes:
(1) Partial development acreage was reduced by 50 percent to calculate wastewater flows.
(2) Flow from future users includes redevelopment areas that are currently generating wastewater in the downtown area. The assumption is that a specific percentage of the area will be redeveloped and will generate higher rates of wastewater. Therefore, the existing Downtown flows and the future flows do not add up to the total future flow.



10-YEAR, 24-HOUR DESIGN STORM

FIGURE 5.2

CITY OF MODESTO
WASTEWATER COLLECTION SYSTEM MASTER PLAN

carollo

MODESTO
CALIFORNIA

5.2.4 Existing and Projected Peak Wet Weather Flow

Wet weather infiltration and inflow (I/I) occurring during and after rainfall events will increase flows in the collection system and cause peak wet weather flow (PWWF), which is the highest hourly flow after the design storm event. The City's sewers and lift stations were evaluated based on their capacity to convey the PWWF.

Throughout the system, the existing PWWF was derived using the hydraulic modeling results. This was accomplished by routing the 10-year, 24-hour design storm through the hydraulic model, which was calibrated to both dry weather and wet weather conditions. Similarly, the build-out PWWF was derived by routing a 10-year, 24 hour design storm through the hydraulic model. Peak I/I rates for future growth areas (e.g., vacant areas within the existing service area and growth areas outside of the current service area) were developed based on a peak I/I rate of 1,000 gallons per day per acre (gpd/ac), which is a value commonly used throughout California to estimate peak I/I rates in new growth areas.

Table 5.8 presents a summary of existing and build-out flows for both dry weather and wet weather. When storm drain cross connections are removed, the PWWF decreases by approximately 13.8 mgd, which equates to a 20 percent reduction. As shown in Table 5.8, the City's ADWF is projected to increase from 21.4 mgd to 34.4 mgd, a 61 percent increase. The PWWF is projected to increase from 68.6 mgd to approximately 77.1 mgd by build-out, a 12 percent increase. Therefore, the citywide PWWF-to-ADWF peaking factor is projected to decrease from roughly 3.21 to 2.24 by build-out. This decrease is partially associated with removing storm drain cross connections and dampening peak flows, which typically occurs as wastewater collection systems grow.

Table 5.8 Existing and Build-Out Design Flows
Wastewater Collection System Master Plan
City of Modesto, California

Flow Condition	ADWF (mgd)	PWWF (mgd)	PWWF Peaking Factor
Existing	21.4	68.6(1)	3.21
Existing	21.4	54.2(2)	2.53
Build-Out	34.4	77.1(2)	2.24

Notes:
(1) With storm drainage connections to sanitary sewer system.
(2) Without storm drainage connections to the sanitary sewer system.