



TECHNICAL MEMORANDUM

DATE: October 6, 2009 Project No.: 418-02-07-22

TO: Jack Bond, City of Modesto

CC: Rich Ulm, City of Modesto
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SUBJECT: City of Modesto's 2010 Water System Engineer's Report
Existing and Buildout Demand Evaluation (Demand TM)

1.0 INTRODUCTION

The purpose of this technical memorandum (TM) is to describe the existing and projected water demands that need to be served by the City of Modesto (City) water system for use in the 2010 Water System Engineer's Report.

The City has been providing potable water service to its urban area since 1895 through the purchase and acquisition of several private water companies. Until 1995, the sole source of water supplies to the City was groundwater from the Modesto and Turlock groundwater subbasins.

In the early 1990s, the City, Modesto Irrigation District (MID), and the Del Este Water Company formed a partnership to use a portion of MID's surface water rights for municipal uses. Completed in 1995, the resulting Modesto Regional Water Treatment Plant (MRWTP), in addition to storage and delivery facilities, provides 30 million gallon per day (mgd), on an annual average daily basis, or 33,600 acre-feet per year (af/yr). A Phase Two Expansion of the original project is currently under construction (expected to be completed in early 2010) and will provide an additional capacity of 30 mgd for an annual average total of 60 mgd.

In July of 1995, the City acquired the Del Este Water Company, which had previously served approximately 30 percent of the municipal customers in the Modesto area. As a result of this acquisition, the City became the primary domestic water purveyor in Stanislaus County. The MRWTP delivers treated surface water to municipal customers within the City limits north of the Tuolumne River (southern boundary of MID's service area), including the communities of Salida and Empire.

The following sections of this TM describe the data and methodology used to determine the City's demands for its entire water system and includes the following sections:

- City of Modesto Water System Service Areas;
- Water Supply and Production;
- Unaccounted for Water due to System Losses;
- Water Demand;
- Unit Water Use Factors and Calculated Water Demands;
- Findings and Conclusions; and,
- Recommendations.

2.0 CITY OF MODESTO WATER SYSTEM SERVICE AREAS

In addition to the City of Modesto proper, the City's water system also provides domestic water to several other areas, which were previously served by the Del Este Water Company including the City of Waterford, portions of the cities of Ceres and Turlock, the communities of Salida, Empire, Del Rio, Grayson, and Hickman. The Riverdale Park Tract (approximately 40 acres located in the southwest portion of the contiguous service area) is physically connected to the City's system to provide Riverdale with an emergency backup supply, and has only been used when the single well in the Riverdale area was inoperable or could not meet pressure requirements. A records check of the City's billing data over the last two years indicates the water consumption from this area is negligible; therefore, the existing demands from the Riverdale area have not been included in this analysis.

Salida, South Modesto/North Ceres and Empire are contiguous (interconnected) to the City of Modesto; therefore, these areas will be included in the City's main hydraulic model. The outlying (non-contiguous) service areas of Del Rio, Ceres (Walnut Manor)¹, Grayson, Waterford, Hickman, and portions of Turlock are small systems and will be modeled separately.

2.1 Contiguous Service Area Water System

For the purposes of this TM and the subsequent Engineer's Report, the City's contiguous service area is primarily defined by the current Sphere of Influence (SOI), Salida, North Ceres, and some unincorporated Stanislaus County "islands" within and adjacent to the SOI (Empire is within the SOI).

This contiguous service area consists of approximately 38,200 acres and is categorized as follows:

¹ A separate hydraulic model has not been developed for the small Ceres (Walnut Manor) area (served by Well 213) because it is already builtout and only has about 50 services. However, the supply and demand values have been accounted for in the overall supply and demand calculations.

- Redevelopment Area: Approximately 2,000 acres located in the downtown area of the City.
- Baseline Developed Area: Approximately 21,200 acres which is generally that portion of the City that is already developed.
- Planned Urbanizing Area: Approximately 12,800 acres that extends beyond the existing City limits for which the City would likely extend urban services at some point in the future. The Planned Urbanizing Area is organized into several Comprehensive Planning Districts (CPDs).
- Salida Community Plan: Approximately 1,500 acres that consists of primarily the former Del Este Tariff area within the community of Salida.
- North Ceres: Approximately 700 acres that consists of primarily the former Del Este Tariff area within the City of Ceres' SOI.

Figure 1 shows the various General Plan designated land uses within the contiguous service area. Figures are included in Attachment A that show the Redevelopment Area, Baseline Developed Area, and the Planned Urbanizing Area within the City's General Plan Boundary as well as locations of individual CPDs.

With the addition of North Ceres, the existing land uses within the contiguous service area are categorized according to the City's General Plan land use designations and are summarized in Table 1. This information was used to calculate the areas associated with each land use designation, and their subsequent water demand allocation, in the development of the hydraulic model.

Within the SOI, the City Community and Economic Development Department (CEDD) has designated several CPDs for future development areas, which specify the type and amount of development. To determine the existing vs. buildout land uses, the City CEDD provided information regarding the acreage of the CPD planning areas that were developed as of May 2006. A summary of this data is provided in Attachment A. However, since the Beckwith/Dakota, Kiernan/Carver North, and various other CPD's surrounding the community of Salida are outside of the SOI, they were not included as part of this evaluation.

Of the approximate total of 38,230 acres within the contiguous service area, about 26,880 acres are already developed (70 percent), leaving 11,350 acres (30 percent) to be developed. These areas are summarized in Table 2. The developed areas will be considered as part of the existing land use condition for modeling purposes. Areas not developed as of May 2006, will be considered as part of the buildout (estimated to occur around 2038) scenario.

Table 1. Contiguous Service Area Buildout (2038) Scenario Land Uses

Land Use Designation	Service Area at Buildout, acres ^(a)	Percent of Total Contiguous Service Area
Residential (R)	13,403	35%
Village Residential (VR)	7,557	20%
Redevelopment Planning District (RPD)	1,972	5%
Commercial (C)	1,474	4%
Regional Commercial (RC)	359	1%
Industrial (I)	3,278	9%
Mixed Use (MU)	3,435	9%
Business Park (BP)	2,411	6%
Open Space (OS)	2,156	5%
Salida Community Plan (SCP)	1,468	4%
North Ceres ^(b)	714	2%
Total	38,227	100%

(a) Based on General Plan land use map and CPD land use map shapefiles provided by City staff (modesto_gp_lu.shp and GP_LU in CPDs 07-07 for landuse spreadsheet.shp) in January 2008.

(b) A portion of North Ceres is within the former Del Este Tariff Area and has been interconnected with the South Modesto system. Based on Water Rate Zones map provided by City staff (wtr_rate_zones_agreement.shp) in January 2008.

2.2 Outlying Service Area Water Systems

As stated above, the City also provides groundwater service to several small, outlying areas previously served by the Del Este Water Company. These areas include Del Rio, Ceres (Walnut Manor), Grayson, Waterford, Hickman and portions of Turlock. Attachment B shows the location for each of the outlying service areas. Pursuant to discussions with City staff, it was confirmed that the service areas for the outlying systems have not changed, except for the City of Waterford, since 2002 when those boundary areas were provided to West Yost Associates (WYA) for development of the original hydraulic model. Since 2002, Waterford has expanded their General Plan limits; however, the City is not obligated and currently does not intend to serve water to those new areas. Therefore, the recently updated Waterford General Plan boundary will not be included in this evaluation. Buildout of the outlying areas to be served by the City, as well as estimates of currently developed and undeveloped areas, are shown in Table 3.

Table 2. Developed and Undeveloped Portions of the Contiguous Service Area

	A	B	A-B
Land Use Designation	Service Area at Buildout, acres ^(a)	Currently Undeveloped Service Area, acres ^(b)	Currently Developed Service Area, acres
Residential (R)	13,403	226	13,177
Village Residential (VR)	7,557	5,081	2,476
Redevelopment Planning District (RPD)	1,972	0	1,972
Commerical (C)	1,474	0	1,474
Regional Commercial (RC)	359	348	11
Industrial (I)	3,278	1,456	1,822
Mixed Use (MU)	3,435	17	3,418
Business Park (BP)	2,411	2,168	243
Open Space (OS)	2,156	2,054	102
Salida Community Plan (SCP)	1,468	0	1,468
North Ceres ^(c)	714	0	714
Total	38,227	11,350	26,877
Percent Total General Plan Area	100%	30%	70%

^(a) Based on General Plan land use map and CPD land use map shapefiles provided by City staff (modesto_gp_lu and GP_LU in CPDs 07-07 for landuse spreadsheet.shp) in January 2008.

^(b) Based on information obtained from the City's Community and Economic Development Department on acreage buildout of CPDs (see Appendix A), and residential vacancy map (vacant_residential_12-07.shp) and City staff. For the purposes of this analysis, information from the City describing vacant and underdeveloped areas were taken together and considered undeveloped areas.

^(c) A portion of North Ceres is within the former Del Este Tariff Area and has been interconnected with the South Modesto system. Based on Water Rate Zones map provided by City staff (wtr_rate_zones_agreement.shp) in January 2008.

Table 3. Developed and Undeveloped Portions of the Outlying Service Areas

Service Area	Service Area at Buildout, acres ^(a)	Estimate of Percent Developed ^(b)	Estimated Existing Developed Service Area, acres ^(b)	Estimated Existing Undeveloped Service Area, acres ^(b)
Del Rio	590	60%	354	236
Ceres (Walnut Manor)	29	100%	29	0
Grayson	120	75%	90	30
Waterford	950 ^(c)	90%	855	95
Hickman	146	90%	131	15
Portions of Turlock (three areas)	99	100%	99	0
Total Outlying Service Areas	1,913	--	1,557	356

^(a) Based on information obtained from the City in 2002 and updated in January 2008.

^(b) Estimated based on existing water connections by City staff in January 2008.

^(c) Does not include any of the new area adopted as part of the expanded General Plan limits.

3.0 WATER SUPPLY AND PRODUCTION

3.1 Water Supply Sources

The City obtains its water supply from two sources: MID treated surface water supplies and numerous City groundwater wells. The MID surface water supplies are treated at the MID's MRWTP located near the Modesto Reservoir, and conveyed to the City via transmission mains and two terminal storage tanks (owned by MID and constructed as part of the MRWTP project) for direct use. The City has approximately 119 operational wells (an operational well is defined as any well that has not been formally abandoned), 94 of these are currently in production, and are located throughout the contiguous and outlying service areas. These wells discharge directly into the distribution system or into one of the City's seven active storage tanks (Tanks 3, 4, 5, 6, 7, and 8 in the contiguous service area and Tank 9 in the Grayson outlying service area).

It should be noted that due to water quality and/or hydrogeologic conditions, local groundwater supplies are inadequate to meet certain water demands within the Salida and South Modesto/North Ceres portions of the contiguous service area. As a result, water is sometimes moved from interior sources via the interconnected transmission and distribution pipeline system to outer areas so as to supplement the locally available groundwater supplies. In Salida, the movement is via a metered connection (Meter No. PRE1296301) and two additional unmetered pipeline connections. In South Modesto/North Ceres, it is via flows from Tank 6 (located in North Modesto, north of the river) to Tank 7 (located in South Modesto) and flows which cross the river near Highway 99 to flow into Tank 3 (located in South Modesto).

3.2 Water Production

Water production for the City's entire water system (both contiguous and outlying service areas) is summarized in Table 4 for calendar years 2000 through 2009.

Table 4. Annual Water System Production (2000 to 2009)^(a,b,c)

Water Supply	Annual Water Production, gallons				
	2000	2001	2002	2003	2004
Surface Water	10,984,790,144	11,381,164,032	11,054,016,168	11,511,966,400	11,433,991,299
Groundwater	13,919,374,936	14,987,618,945	16,066,730,430	15,483,545,853	15,217,531,578
Total, gallons	24,904,165,080	26,368,782,977	27,120,746,598	26,995,512,253	26,651,522,877
Total, acre-feet	76,428	80,923	83,231	82,846	81,791
Annual Average Daily Production, mgd	68.2	72.2	74.3	74.0	73.0
Water Supply	2005	2006	2007	2008	2009
Surface Water	10,592,208,614	10,917,791,035	11,916,691,162	10,438,079,956	9,240,393,430
Groundwater	15,178,152,334	14,744,535,117	13,969,100,199	14,744,031,578	13,786,597,276
Total, gallons	25,770,360,948	25,662,326,152	25,885,791,361	25,182,111,534	23,026,990,706
Total, acre-feet	79,086	78,755	79,441	77,281	70,670
Annual Average Daily Production, mgd	70.6	70.3	70.9	69.0	63.1

^(a) Data provided by City staff (2000 - 2006 Water System Summary by Year.xls) in December 2007.

^(b) Includes MRWTP surface water and all groundwater from contiguous and outlying service areas.

^(c) Data provided by City staff (Monthly system flow totals 2000 to present.xls) in April 2010.

The City's total water production, for both the contiguous and outlying service areas, by month for 2005 through 2009 is shown on Figure 2. Production from the MRWTP fluctuates predictably throughout the year, averaging about 39 mgd during the summer months (June to September) and 24 mgd during the winter months (November to February), or approximately 30 mgd on an annual average daily basis (the MRWTP has a functional capacity to produce 42.5 mgd and has been permitted by the State to produce 45 mgd for the last few years). From the data used to develop Figure 2, groundwater production is about 40 mgd on an annual average daily basis; however, seasonal fluctuations are such that the summertime use of groundwater is significantly higher than wintertime use. For example, groundwater production for the five years of data averaged 69 mgd in August to meet the high summer demand, while the average groundwater production in February was only 17 mgd.

For reference purposes, Table 5 shows the City's 2006 (year with the highest ratio of Maximum Day production to Average Day production) total water system production by service area.

Table 5. 2006 Water Production by Service Area ^(a,b)

Service Area	Existing (2006) Production, gallons	Existing (2006) Production, acre-feet	Existing (2006) Annual Average Daily Production, mgd
Contiguous Service Area:			
Surface Water	10,917,791,035	33,505	29.91
Groundwater	13,585,708,658	41,693	37.22
Subtotal Contiguous Service Area	24,503,499,693	75,198	67.13
Outlying Service Areas:			
Del Rio	226,027,422	694	0.62
Ceres (Walnut Manor) ^(c)	9,487,532	29	0.03
Grayson	57,218,042	176	0.16
Waterford	687,804,750	2,111	1.88
Hickman	63,265,837	194	0.17
Portions of Turlock	115,022,876	353	0.32
Subtotal Outlying Service Areas	1,158,826,459	3,557	3.18
Total	25,662,326,152	78,755	70.31

^(a) Data provided by City staff (2000 - 2006 Water System Summary by Year.xls) in December 2007.

^(b) Includes MRWTP surface water and all groundwater from the contiguous and outlying service areas.

^(c) Data provided by City staff (monthly well flow totals 2002 to present.xls) in January 2008.

3.3 Maximum Day Production

Daily water production data for the City's entire water system (both contiguous and outlying service areas) was evaluated to determine Maximum Day production totals. A summary of the maximum water production days from 2000 to 2009 is provided in Table 6 and shows that the Maximum Day peaking factor (the ratio of Maximum Day production to Average Day production) ranged from 1.63 in 2007 to 1.87 in 2006. The 10-year average Maximum Day peaking factor is 1.75 and will be used for this TM and the subsequent Engineer's Report (in previous TM's, a factor of 1.74 had been used).

Table 6. Maximum Day Water Production ^(a,b)

Year	Average Day Production, mgd	Date Corresponding to Maximum Day Production	Maximum Day Production, mgd	Maximum Day Peaking Factor
2000	68.2	August 1	118.2	1.73
2001	72.2	August 8	124.6	1.72
2002	74.3	July 10	128.9	1.73
2003	74.0	July 22	133.3	1.80
2004	73.0	July 22	124.9	1.71
2005	70.6	August 9	129.3	1.83
2006	70.3	July 25	131.4	1.87
2007	70.8	August 30	115.4	1.63
2008	69.0	August 28	116.5	1.69
2009	63.1	July 19	110.3	1.75
10-year Average	70.6	--	123.3	1.75

^(a) Data for 2000 to 2002 from Final Water Demand Evaluation TM completed by WYA in March 2003. Data for 2003 to 2007 provided by City staff (daily_water_flow.txt) in November 2007. Data for 2008 and 2009 provided by City staff in April 2010 (daily total system-wide flow last five years.xls).

^(b) Includes MRWTP surface water and all groundwater from contiguous and outlying service areas.

3.4 Peak Hour Production

The combined hourly water production data from the contiguous and outlying service areas was evaluated to determine Peak Hour production total (water produced and pumped from all sources including the MRWTP, wells, and City owned tanks). Based on hourly production data for the period from July 24, 2006 through July 26, 2006, the Peak Hour production was 7.2 million gallons from 8:00 to 9:00 p.m. on July 25, 2006 (this date was used because it generated the largest Maximum Day peaking factor from Table 6). Figure 3 shows the hourly water production by source on July 25, 2006. The MRWTP provided 58.2 mgd or 34 percent of the supply; the wells provided 98.9 mgd or 57 percent of the supply; and approximately 15.9 mgd, or 9 percent of the supply was provided from the City owned tanks. This Peak Hour production is equivalent to 173.0 mgd or about 2.46 times the Average Day demand for 2006. A Peak Hour peaking factor of 2.46 will be used for this TM and the subsequent Engineer's Report (in previous TM's, a factor of 2.53 had been used). Table 7 summarizes the adopted peaking factors.

Table 7. Water Demand Peaking Factors

Demand Condition	Peaking Factor ^(a,b)
Maximum Day	1.75 x Average Day
Peak Hour	2.46 x Average Day

^(a) Based on available water production data, and includes the contiguous and outlying service area's data factored together.

^(b) These two peaking factors will be used in calculations for future demand projections.

4.0 UNACCOUNTED FOR WATER DUE TO SYSTEM LOSSES

Ideally, if the City read individual meters for every customer, the metered water use should exactly equal the amount of water that is being produced from the City's wells and tanks plus the MRWTP terminal storage booster pumps. However, this is not the case for the City's water distribution system because the City does not currently meter all of their customers, which means a direct comparison between actual customer water use and production data is not relevant. In addition, even though the production does indeed equal total system water demand, customer water use typically does not equal production because the total system water demand also includes unmeasured system losses. These "lost" flows are referred to as unaccounted for water.

There are various reasons why the total customer water use is less than the total amount of water produced by the City. The most common reasons for unaccounted for water are due to system losses such as leakage, errors in measurement, and unmetered usage.

- **Leakage:** Leakage is frequently the largest component of unaccounted for water and includes distribution losses from supply pipes, distribution and trunk mains, customer services up to the meter, and tanks. The amount of leakage varies from system to system, but there is a general correlation between the age of a system and the amount of unaccounted for water. Other factors affecting leakage include system pressure (the higher the pressure, the more leakage), frequency of main and service pipe breaks, and the extent of leakage detection and control policies.
- **Errors in Measurement:** Flow measurements are not always exact, and thus metered customer usage may contain inaccuracies. Some flow meters under-register actual usage at low flow rates, especially as they age.
- **Unmetered Usage:** The City may have illegal connections or other types of unmetered water use (not including residential flat rate usage). Not all unmetered usage is due to water theft, as fire hydrants, blow-offs, and other maintenance appurtenances are typically not metered.

Water utilities strive to minimize the amount of unaccounted for water; however, it is difficult, if not impossible, to eliminate entirely. A survey of water agencies in the United States conducted by the American Water Works Association (AWWA) found that unaccounted for water in utilities across the country varied between 7.5 percent to 25 percent².

Because the City does not meter all customer water use, it is difficult to calculate the exact amount of unaccounted for water lost throughout the entire system. For purposes of this evaluation, unaccounted for water for the overall system is assumed to be 15 percent. As an example, based on the 2006, total production of 78,755 acre-feet (70.3 mgd) from the contiguous and outlying service areas, 15 percent unaccounted for water equals about 11,813 acre-feet (10.5 mgd) of water. Evaluation of available metered customer water use data, described below, indicates that the assumed 15 percent unaccounted for water quantity is a reasonable estimate for

² Survey of State Agency Water Loss Reporting Practices, Final Report to the American Water Works Association, prepared by Janice A. Beecher, Ph.D., Beecher Policy Research, Inc., January 2002.

the City's entire system losses. However, metering and reading of the City's entire residential sector will be required to verify this.

5.0 WATER DEMAND

The total system water demand is the driving force behind the hydraulic dynamics occurring in water distribution systems. Anywhere that water can leave the system represents a point of demand (e.g., a customer's faucet, a leaky main, or an open fire hydrant). There are typically two main components of total system water demand, they include:

- Customer water use or customer demand: the water required to meet the non-emergency needs of users in the system. This demand type typically represents the metered portion of the total water demand.
- Unaccounted for water or unmetered system losses: the portion of total water demand that is "lost" due to system leakage, theft, unmetered water use (not including residential flat rate usage), or other causes.

As mentioned above, the City does not yet meter all customer water use within its system; however, the City is currently retrofitting existing residential water services with meters that do not yet have them (commercial and industrial customers are already metered). According to the City's 2006 (used to coincide with 2006 data used elsewhere in this TM and the 2010 Water System Engineer's Report) Annual Report to the California Department of Health Services (now known as Department of Public Health), the City has a total of 77,422 water accounts (includes all customer types). Of these, only 13,340 accounts are billed based on metered customer use. The remaining 64,082 accounts are billed based on a flat rate.

A summary of the metered customer water use for 2003 through 2006 is provided in Table 8.

Table 8. Metered Customer Water Use (2003 to 2006)^(a,b)

Year	Metered Customer Use, cf	Metered Customer Use, gallons	Metered Customer Use, acre-feet	Metered Customer Use, mgd
2003	1,246,483,700	9,323,698,076	28,615	25.5
2004	1,243,795,400	9,303,589,592	28,554	25.5
2005	1,148,215,600	8,588,652,688	26,359	23.5
2006	1,108,611,500	8,292,414,020	25,450	22.7

^(a) Data provided by City staff (MODE Consumption Data Extract 03-07.xls) in November 2007.

^(b) Includes customer use from meters which are read in the entire water system (contiguous and outlying service areas). Does not include data for Meter No. PRE1296301 which accounts for the transfer of water from the City of Modesto to Salida.

Many of the non-residential accounts which are billed based on metered customer use are food processing facilities and other types of industries which operate primarily in the summer months when fruits and vegetables are harvested and processed. An evaluation of the monthly metered consumer use data (Figure 4), indicates that the average metered use per day is approximately

38.3 mgd during the summer months (June through September), which is over one and a half times the annual average metered use of 24.3 mgd.

Based on the metered customer use data summarized in Table 8, the City's total water production in Table 4, and assuming a system-wide unaccounted for water of 15 percent, the calculated breakdown between metered and unmetered customer water use for 2003 through 2006 is shown in Table 9.

This data, as depicted in Table 9 and Figure 5, indicates an apparent system-wide trend where metered use has decreased over the four years analyzed by approximately 11 percent [$1 - (25,450 / 28,615)$], while unmetered use has remained relatively stable.

Table 9. Comparison of Metered vs. Unmetered Customer Water Use, acre-feet (mgd)

	2003	2004	2005	2006
Total Water Production ^(a)	82,846 (74.0)	81,791 (73.0)	79,086 (70.6)	78,755 (70.3)
Unaccounted For Water (15 percent)	12,427 (11.1)	12,269 (11.0)	11,863 (10.6)	11,813 (10.5)
Total Customer Use (Total Production minus Unaccounted For Water)	70,419 (62.9)	69,522 (62.0)	67,223 (60.0)	66,942 (59.8)
Metered Customer Use ^(b)	28,615 (25.5)	28,554 (25.5)	26,359 (23.5)	25,450 (22.7)
Metered Customer Use as a Percent of Total Customer Use	41%	41%	39%	38%
Unmetered Customer Use (Total Customer Use minus Metered Customer Use)	41,804 (37.4)	40,968 (36.5)	40,864 (36.5)	41,492 (37.1)
Unmetered Customer Use as a Percent of Total Customer Use	59%	59%	61%	62%

^(a) Data taken from Table 4.

^(b) Includes customer use from meters which are read in the entire water system (contiguous and outlying service areas) and for all customer types (residential, commercial, and industrial). Does not include use for Meter No. PRE1296301, which accounts for a portion of the transfer of water from the City of Modesto to Salida.

5.1 Large Water Users

Within the City's metered water users, there are several accounts (customers) that are considered large water users. These accounts are grouped by addresses to create a list of the 50 highest water users for 2008, as shown in Table 10. The Top 50 users have an average water use of approximately 30 gpm or higher.

6.0 UNIT WATER USE FACTORS AND CALCULATED WATER DEMANDS

For this TM and the subsequent Engineer's Report, the unit water use factors per land use type, shown on Table 11, were taken from the City of Modesto 2005 Hydraulic Model Update, prepared by WYA. However, with the ongoing installation of meters throughout the City's system (with an expected reduction in future water use), it is recommended that the unit water use factors be re-evaluated during the upcoming development of the Water Master Plan.

Table 10. Top 50, 2008 Largest Water Users by Address ^(a)

Rank	Address	User Type	User Name	Customer Use, cubic feet	Customer Use, gallons	Customer Use, acre feet	Total Average Day Customer Use, mgd	Total Average Day Customer Use, gpm
1	2801 FINCH RD, MODESTO	Industrial	Signature Fruit	56,278,500	420,963,180	1,292	1.15	801
2	415 KANSAS AVE, MODESTO	Industrial	Foster Farms	33,677,700	251,909,196	773	0.69	479
3	300 12TH ST, MODESTO	Industrial		20,633,800	154,340,824	474	0.42	294
4	0 8TH & KANSAS AVE, MODESTO			20,187,000	150,998,760	463	0.41	287
5	229 12TH ST, MODESTO	Industrial		10,166,900	76,048,412	233	0.21	145
6	1700 COFFEE RD, MODESTO	Medical	Memorial Hospital	9,484,900	70,947,052	218	0.19	135
7	2201 BLUE GUM AVE, MODESTO	School	Modesto Junior College West	9,413,600	70,413,728	216	0.19	134
8	736 GARNER RD, MODESTO	Industrial	Carnation	8,451,300	63,215,724	194	0.17	120
9	600 YOSEMITE BLVD, MODESTO	Industrial	Gallo	7,297,800	54,587,544	168	0.15	104
10	214 12TH ST, MODESTO	Industrial		7,209,300	53,925,564	166	0.15	103
11	680 CLAUS RD, MODESTO	School	Johanson High School	6,829,200	51,082,416	157	0.14	97
12	1441 FLORIDA AVE, MODESTO	Medical	Doctors Medical Center	6,592,800	49,314,144	151	0.14	94
13	435 COLLEGE AVE, MODESTO	School	Modesto Junior College	5,599,900	41,887,252	129	0.11	80
14	601 ZEFF RD, MODESTO	Industrial		5,286,000	39,539,280	121	0.11	75
15	3401 DALE RD, MODESTO	Commercial	Vintage Fair Mall	4,990,400	37,328,192	115	0.10	71
16	2857 W WHITMORE AVE, MODESTO			4,744,200	35,486,616	109	0.10	68
17	1701 ROBERTSON RD, MODESTO	Apt Complex		4,724,000	35,335,520	108	0.10	67
18	705 E WHITMORE AVE, MODESTO	Industrial		4,651,300	34,791,724	107	0.10	66
19	1900 OAKDALE RD, MODESTO	Apt Complex		4,350,200	32,539,496	100	0.09	62
20	1200 W RUMBLE RD, MODESTO	School	Davis High School	3,951,000	29,553,480	91	0.08	56
21	1717 SYLVAN AVE, MODESTO	School	Beyer High School	3,949,900	29,545,252	91	0.08	56
22	501 NEECE DR, MODESTO L/S	Park (OS)	Golf Course	3,664,900	27,413,452	84	0.08	52
23	1836 LAPHAM DR, MODESTO	Industrial		3,628,400	27,140,432	83	0.07	52
24	1115 H ST, MODESTO			3,429,500	25,652,660	79	0.07	49
25	1000 COFFEE RD, MODESTO	School	Downey High School	3,407,600	25,488,848	78	0.07	48
26	3700 TULLY RD, MODESTO	Apt Complex		3,404,300	25,464,164	78	0.07	48
27	301 STANDIFORD AVE, MODESTO	Apt Complex		2,963,700	22,168,476	68	0.06	42
28	0 BEAR CUB LN L/S, MODESTO			2,933,500	21,942,580	67	0.06	42
29	1200 SUTTER AVE, MODESTO			2,886,900	21,594,012	66	0.06	41
30	1031 TIOGA DR, MODESTO			2,872,900	21,489,292	66	0.06	41
31	3001 HAHN DR, MODESTO	Apt Complex		2,764,800	20,680,704	63	0.06	39
32	2833 YOSEMITE BLVD, MODESTO	Commercial		2,714,700	20,305,956	62	0.06	39
33	2100 YOSEMITE BLVD, MODESTO			2,533,100	18,947,588	58	0.05	36
34	1401 LAKEWOOD AVE, MODESTO	Apt Complex		2,531,900	18,938,612	58	0.05	36
35	4601 DALE RD, MODESTO			2,529,600	18,921,408	58	0.05	36
36	2243 W RUMBLE RD, MODESTO			2,482,400	18,568,352	57	0.05	35
37	1200 BRIGHTON AVE L/S, MODESTO	Park (OS)	Downey Park	2,480,100	18,551,148	57	0.05	35
38	5041 TOOMES RD, SALIDA	School	Salida High School	2,377,300	17,782,204	55	0.05	34
39	2800 BRADEN DR, MODESTO	Apt Complex		2,353,200	17,601,936	54	0.05	33
40	1122 CEDAR CREEK DR, MODESTO	Apt Complex		2,326,100	17,399,228	53	0.05	33
41	1400 CELESTE DR, MODESTO	Commercial/Medical		2,325,300	17,393,244	53	0.05	33
42	3700 BEYER PARK DR L/S, MODESTO	Park (OS)	Beyer City Park	2,229,900	16,679,652	51	0.05	32
43	1037 FLOYD AVE, MODESTO			2,146,900	16,058,812	49	0.04	31
44	2000 MABLE AVE, MODESTO	Apt Complex		2,131,700	15,945,116	49	0.04	30
45	2621 PRESCOTT RD, MODESTO	Mobil Home Park		2,129,500	15,928,660	49	0.04	30
46	100 PARADISE RD L/S, MODESTO	School	Modesto High School	2,048,400	15,322,032	47	0.04	29
47	2701 KODIAK DR L/S, MODESTO			2,019,500	15,105,860	46	0.04	29
48	2200 STANDIFORD AVE, MODESTO			2,019,400	15,105,112	46	0.04	29
49	5609 SUN VALLEY CT, SALIDA			1,984,700	14,845,556	46	0.04	28
50	0 AIRPORT WAY L/S, MODESTO			1,984,700	14,845,556	46	0.04	28
Total Top 50				313,774,600	2,347,034,008	7,203	6.43	4,465
Total Metered Use								
Percent of Total Top 50 to Total Metered Use								

^(a) Data provided by City staff (Top 50 2006 thru 2009_v2.xls).

Table 11. Unit Water Use Factors^(a)

Land Use Designation	Unit Water Use Factor, af/ac/yr
Contiguous Service Area:	
Residential (R)	3.00
Village Residential (VR)	2.50
Redevelopment Planning District (RPD)	2.75
Commercial (C)	2.00
Regional Commercial (RC)	2.00
Industrial (I)	2.75
Mixed Use (MU)	2.75
Business Park (BP)	2.00
Open Space (OS)	0.00
Salida Community Plan (SCP) ^(b)	2.75
North Ceres (NC)	3.00
Outlying Service Areas:	
Del Rio, Ceres (Walnut Manor), Grayson, Waterford, Hickman and Turlock (an assumed factor based on land uses being primarily residential)	2.70

^(a) The unit water use factors were taken from the City of Modesto 2005 Hydraulic Model Update, prepared by WYA.

^(b) The unit water use factor for the SCP is based on the MU unit water use factor.

For this TM and Engineer’s Report, residential water use was reduced by 10 percent, to account for anticipated water use reductions as the City implements its metering program. WYA researched potential savings from conversion of flat rate customers to metered usage. Studies by the California Public Utilities Commission have shown that communities with metered water systems typically use 7 to 20 percent less water than non-metered systems. The California Urban Water Conservation Council indicates that a usage reduction of 20 percent can be assumed with a combination of conversion to metered usage, and volumetric rate charges. Actual savings will depend on a number of factors, including billings based on the volumetric rate charges compared with the flat rate service charge. In the absence of system-specific data, a savings of 10 percent was used as a conservative, but reasonable value. As noted above, once the City develops a significant residential metered use history, it will be possible to refine both residential unit water use factors to project future demand projections.

Based on the unit water use factors and the buildout land use acreages within the service areas shown in Tables 1 and 3, the total customer water demand for the future land uses for the contiguous and outlying service areas can be determined. The buildout customer water demands

are based on the various land uses within the City's total service area³ and are shown on Table 12. The table also indicates the estimated reduction in future demands due to conversion of existing flat rate residential customers to metered service. This adjustment was made by taking 10 percent of the estimated flat rate usage in 2006 (the baseline year used for the analysis) as shown in Table 9.

For projecting future water demands, a baseline Average Day demand is required. As discussed in the unaccounted for water section of this TM, there is no precise way to measure customer water use due to the City's current billing procedure of having some residential flat-fee accounts, except to set the baseline demand equal to production. Therefore, throughout this TM (and the other related TM's), by definition, the system wide baseline demand ("demand") includes both customer water use (the amount actually measured and billed) and unaccounted for water (unmeasured system losses). As a benchmark, the Average Day production of 2006 was set as the baseline demand from which future demand distributions were built. Since the baseline demand was established as equal to production, it was assumed that future projections of water demands would also equal production. A summary of the projected customer water demands and required water production to meet the projected water demands is provided in Table 13. Required production for the contiguous area, shown in the table, reflects adjustments to residential use to account for conversion from flat rate services to metered service.

7.0 FINDINGS AND CONCLUSIONS

- Based on information provided by the City, approximately 70 percent of the contiguous service area is currently developed. Excluding Open Space, approximately 9,300 acres remains to be developed within the contiguous service area.
- The City's total water production over the last few years has ranged from about 73,000 af/yr (65 mgd) to about 80,000 af/yr (71 mgd). Of this total production, about 34,000 af/yr (30 mgd) is supplied by MID surface water, while the remaining amount is supplied by the City's numerous groundwater wells.
- Production data from 2003 to 2009 shows that the City's use of MID surface water supplies fluctuates predictably throughout the year, averaging about 39 mgd during the summer months (June to September) and 24 mgd during the winter months (November to February). Use of groundwater supplies varies throughout the year, but during the summer months when demands are high, groundwater production has averaged 69 mgd in August.
- The Average Day production for the City's entire water system (contiguous and outlying service areas) in 2006 was 70.3 mgd. The Maximum Day production in 2006 was 131.4 mgd (July 25, 2006). The Peak Hour production from 8:00 to 9:00 pm on July 25, 2006 was 173.0 mgd. The resulting adopted peaking factors are as follows:

³ The buildout customer demands from the outlying service areas of Ceres (Walnut Manor) and portions of Turlock were assumed to equal existing water production minus 15 percent unaccounted for water because both outlying service areas are fully developed.

Table 12. Total Service Area Land Use at Buildout, Unit Water Factors, and Projected Customer Water Demands

CONTIGUOUS SERVICE AREA

Land Use Designation	Description (as defined in the 1995 Urban Area General Plan)	Unit Water Use Factor, af/ac/yr	BUILDOUT (2038)		
			Total Area, acres	Buildout Demand, af/yr	Buildout Demand, mgd
Residential (R)	7.5 du/acre	3.00	13,403	40,208	35.90
Village Residential (VR)	5.1 du/acre with 4% of land devoted to commercial uses	2.50	7,557	18,892	16.87
North Ceres	--	3.00	714	2,143	1.91
Residential Subtotal			21,674	61,243	54.68
Reductions due to Savings from Conversion of Existing Unmetered Customers to Metered Use ^(a)				-4,149	-3.70
Residential Subtotal	--	--	21,674	57,094	50.98
Redevelopment Planning District (RPD)	Mixed Use	2.75	1,972	5,423	4.84
Commerical (C)	0.35 sf of building area per sf of gross acreage	2.00	1,474	2,948	2.63
Regional Commercial (RC)	0.35 sf of building area per sf of gross acreage	2.00	359	718	0.64
Industrial (I)	0.30 to 0.50 sf of building area per sf of gross acreage	2.75	3,278	9,015	8.05
Mixed Use (MU)	14 du/acre with non-residential equal to 0.35 sf of building area per sf of gross acreage	2.75	3,435	9,446	8.43
Business Park (BP)	0.40 sf of building area per sf of gross acreage	2.00	2,411	4,822	4.30
Open Space (OS)	Recreational Facilities, public ownership and agriculture	0.00	2,156	0	0.00
Salida Community Plan (SCP)	Mixed Use	2.75	1,468	4,037	3.60
Non-Residential Subtotal	--	--	16,553	36,409	32.49
Total Contiguous Water Service Area			38,227	93,503	83.47

OUTLYING SERVICE AREAS

Service Area	Description	Unit Water Use Factor (based on land uses being primarily residential), af/ac/yr	BUILDOUT (2038)		
			Total Area, acres	Buildout Demand, af/yr	Buildout Demand, mgd
Del Rio	--	2.70	590	1,593	1.42
Ceres (Walnut Manor) ^(b)	--	2.70	29	25	0.02
Grayson	--	2.70	99	267	0.24
Waterford	--	2.70	950	2,565	2.29
Hickman	--	2.70	146	394	0.35
Portions of Turlock ^(b)	--	2.70	99	300	0.27
Total Outlying Service Areas			1,913	5,144	4.59

^(a) Reductions due to savings from conversion of existing unmetered customers to metered use is 10% of existing flat rate use for 2006, as reported in Table 9.

^(b) Since these outlying service areas are already builtout, the buildout customer water demand was adjusted to equal the existing production minus 15 percent unaccounted for water.

Table 13. Projected Customer Water Demands and Required Water Production at Buildout (2038)

Service Area	Projected Customer Demand, af/yr	Required Production, af/yr ^(a)	Required Average Day Production, mgd ^(a)	Required Maximum Day Production, mgd ^(a,b)	Required Peak Hour Production, mgd ^(a,b)
Buildout (2038) Condition:					
Contiguous Service Area	93,503	110,003	98.20	171.85	241.57
Outlying Service Areas:					
Del Rio	1,593	1,874	1.67	3.17	7.36
Ceres (Walnut Manor)	25	29	0.03	0.05	0.07
Grayson	267	314	0.28	0.52	1.17
Waterford	2,565	3,018	2.69	5.27	6.51
Hickman	394	464	0.41	0.93	1.55
Portions of Turlock	300	353	0.32	0.63	0.82
Outlying Service Areas Subtotal	5,144	6,052	5.40	10.57	17.49
Total	98,647	116,055	103.60	182.42	259.06

^(a) Assuming 15 percent unaccounted for water.

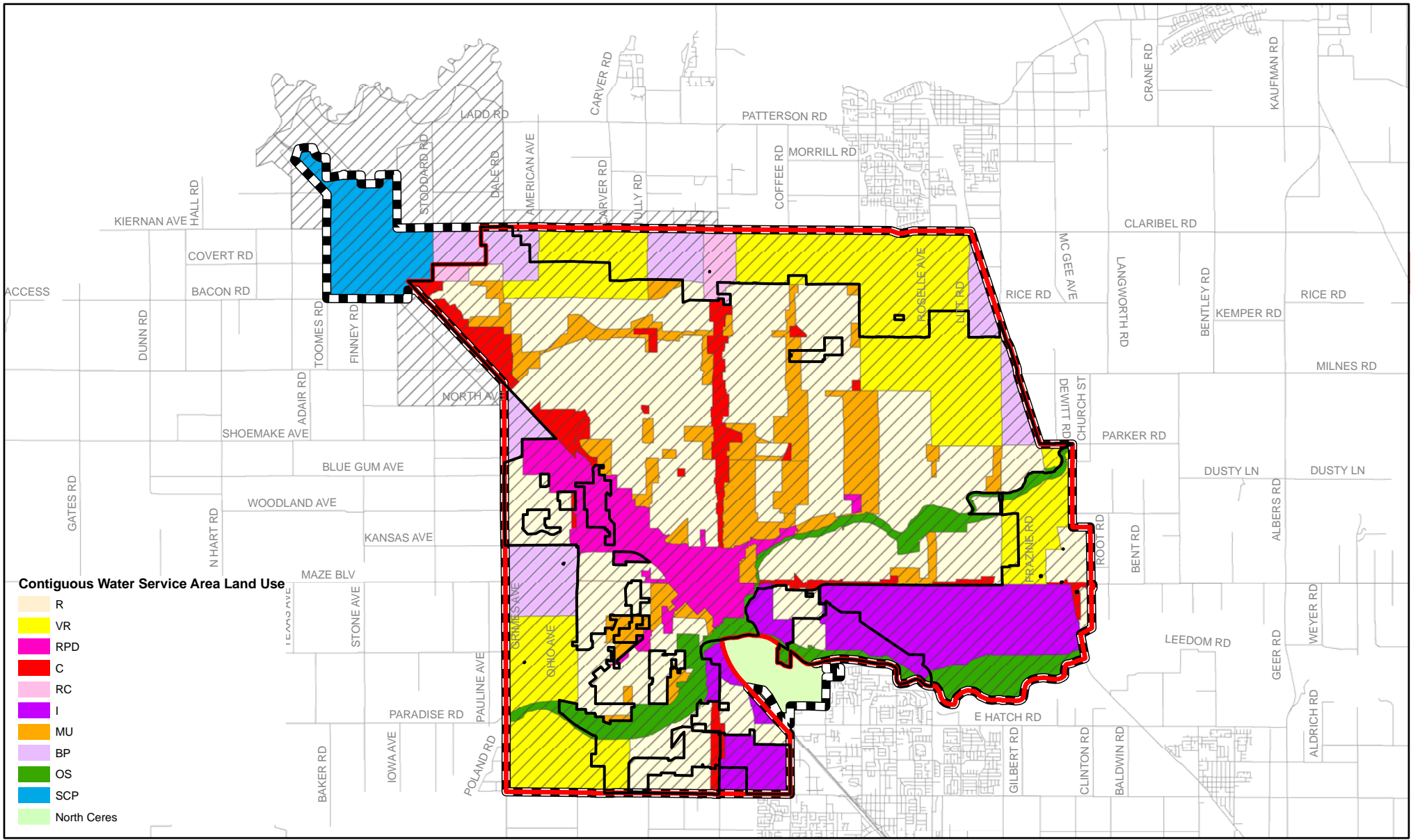
^(b) Maximum Day and Peak Hour peaking factors for the different outlying service areas are unique and are discussed in Appendices F through J of the "City of Modesto's 2008 Water System Engineer's Report".

- Maximum Day demand = 1.75 times Average Day demand (8-year average)
- Peak Hour demand = 2.46 times Average Day demand
- Unaccounted for water is estimated to be about 15 percent system-wide. This estimate was validated by the available water production and consumption data.
- Assuming the estimated 2005 population of about 264,209 within the City's entire service area (2005 UWMP), the overall use (production minus unaccounted for water losses) in 2005 equated to approximately 227 gallons per capita per day.
- For future projections of water demands, it is assumed that the projected water demands will equal production. Projected water demands incorporate a 10 percent reduction in residential water use due to anticipated savings from the City's program to meter all residential customers.

8.0 RECOMMENDATIONS

To more closely monitor water use and unaccounted for water within the water system, the City should continue to install and read meters on all customer water service connections and at key locations throughout the service area. Such meters would provide an opportunity to:

- Accurately assess unaccounted for water;
- Evaluate the transfer of water from one portion of the City's service area to another;
- Collect and evaluate actual customer use data by individual customer, by customer type, and by service area;
- Bill customers based on actual use;
- Identify and track water use by high water users;
- Provide incentives for water conservation and penalties for excessive water use;
- Measure the benefits of implemented conservation measures and other best management practices.



Contiguous Water Service Area Land Use

- R
- VR
- RPD
- C
- RC
- I
- MU
- BP
- OS
- SCP
- North Ceres

- LEGEND:**
- City Limits
 - Sphere of Influence
 - Contiguous Service Area
 - General Plan Boundary
 - Street

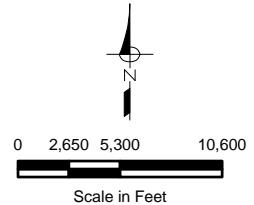


FIGURE 1

City of Modesto
LAND USES WITHIN THE
CONTIGUOUS SERVICE AREA



Figure 2. Monthly Water Production (January 2005 - December 2009)
 (Includes the contiguous and outlying service areas)

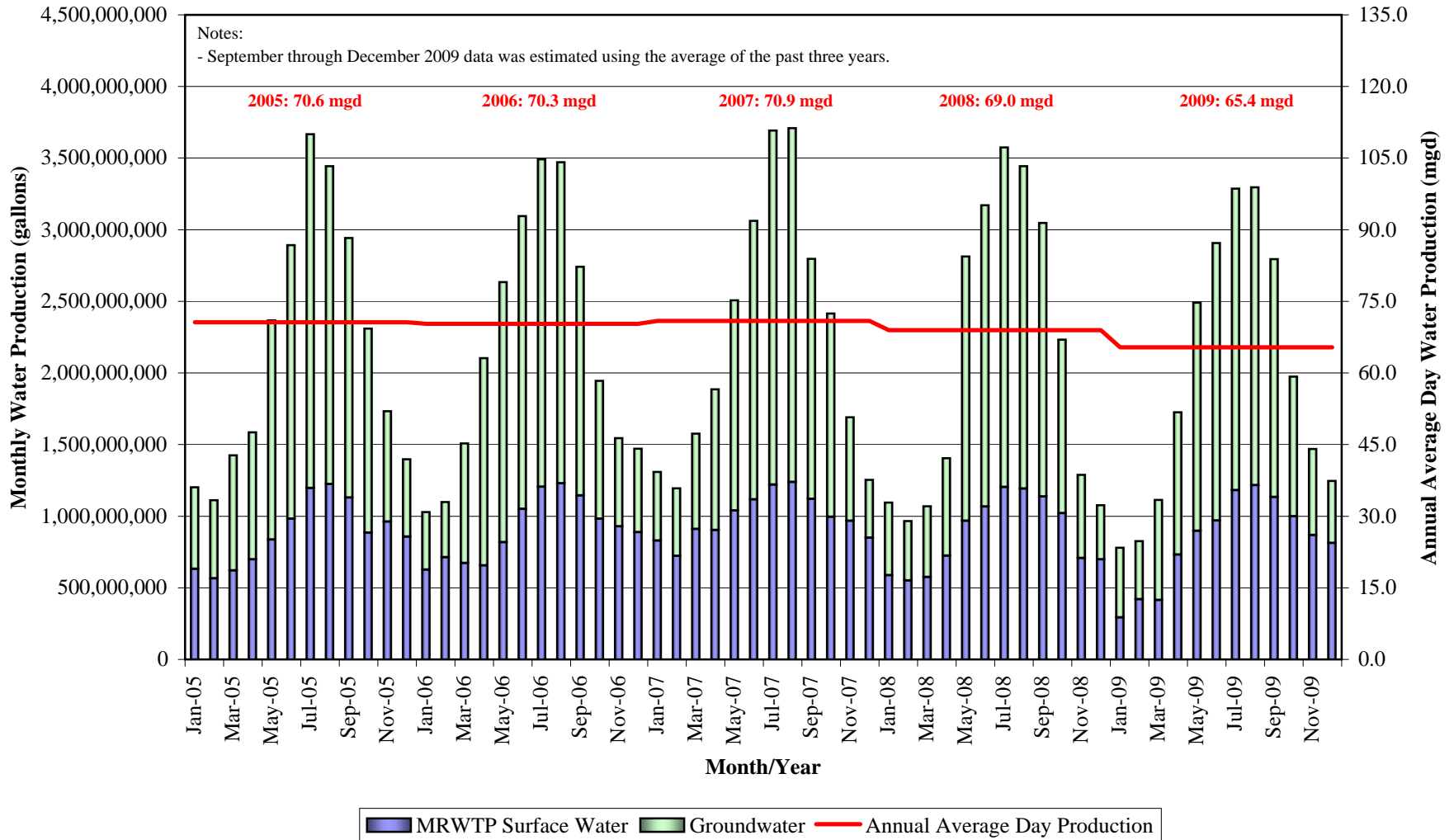


Figure 3. Hourly Water Production for July 25, 2006
 (Includes the contiguous and outlying service areas)

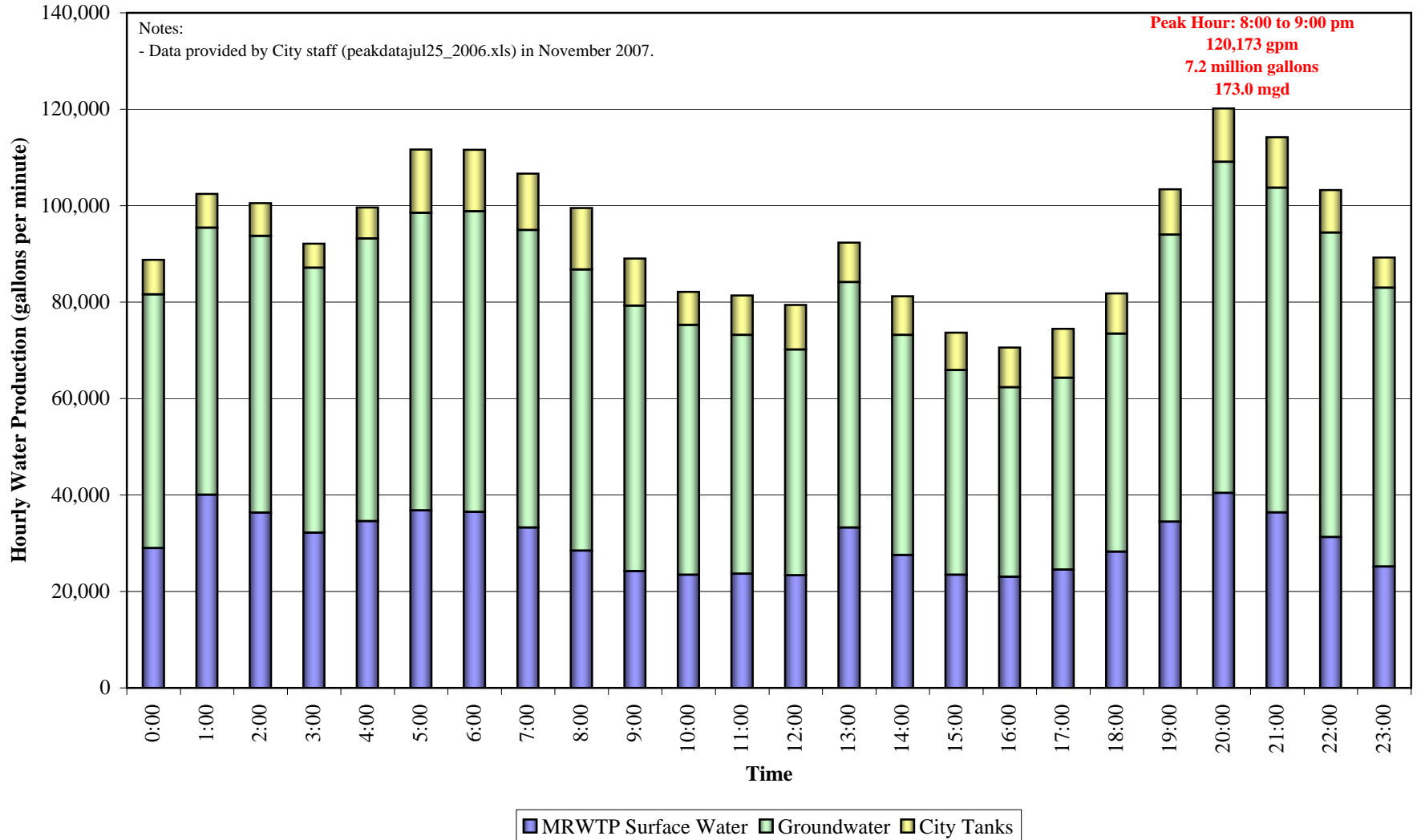
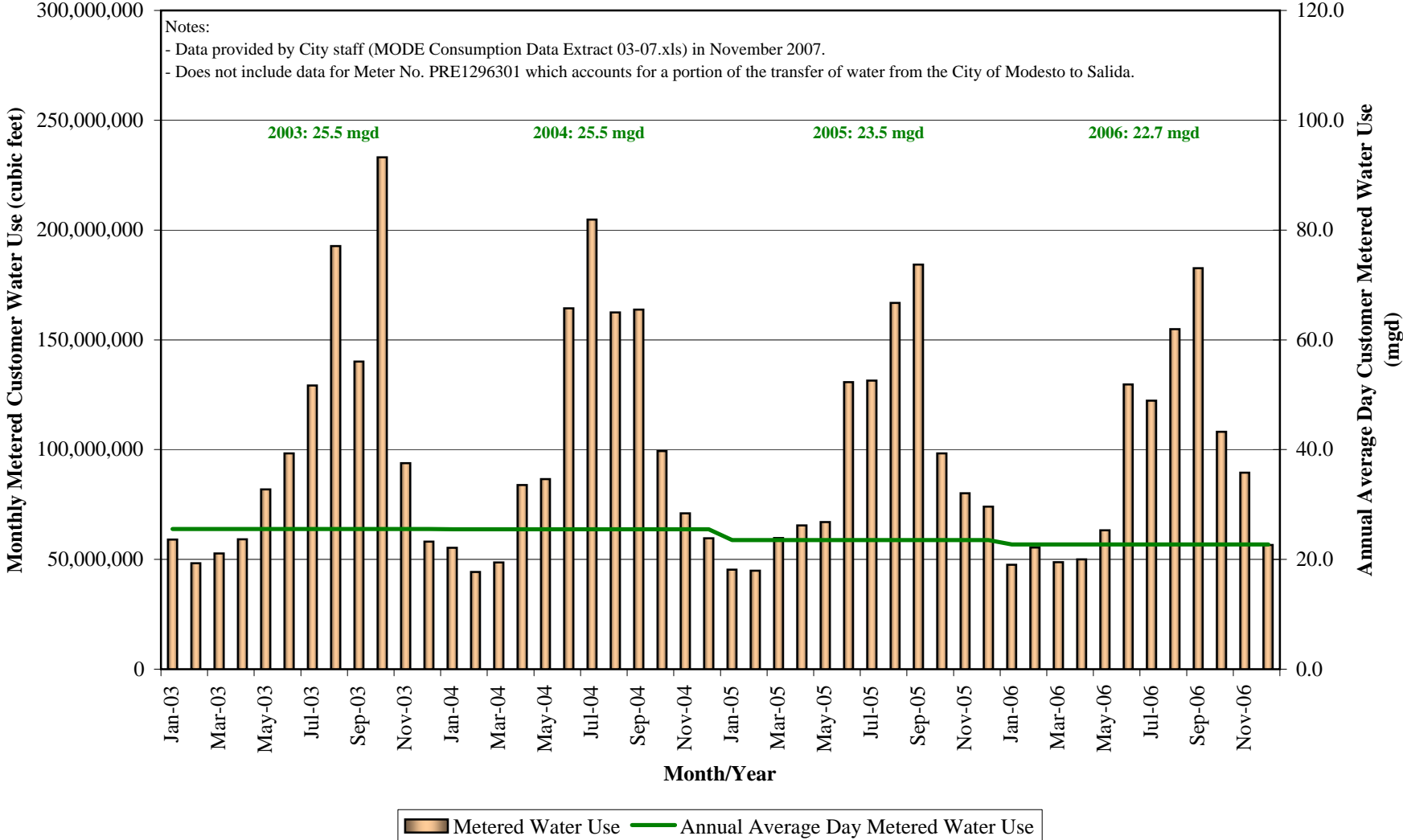
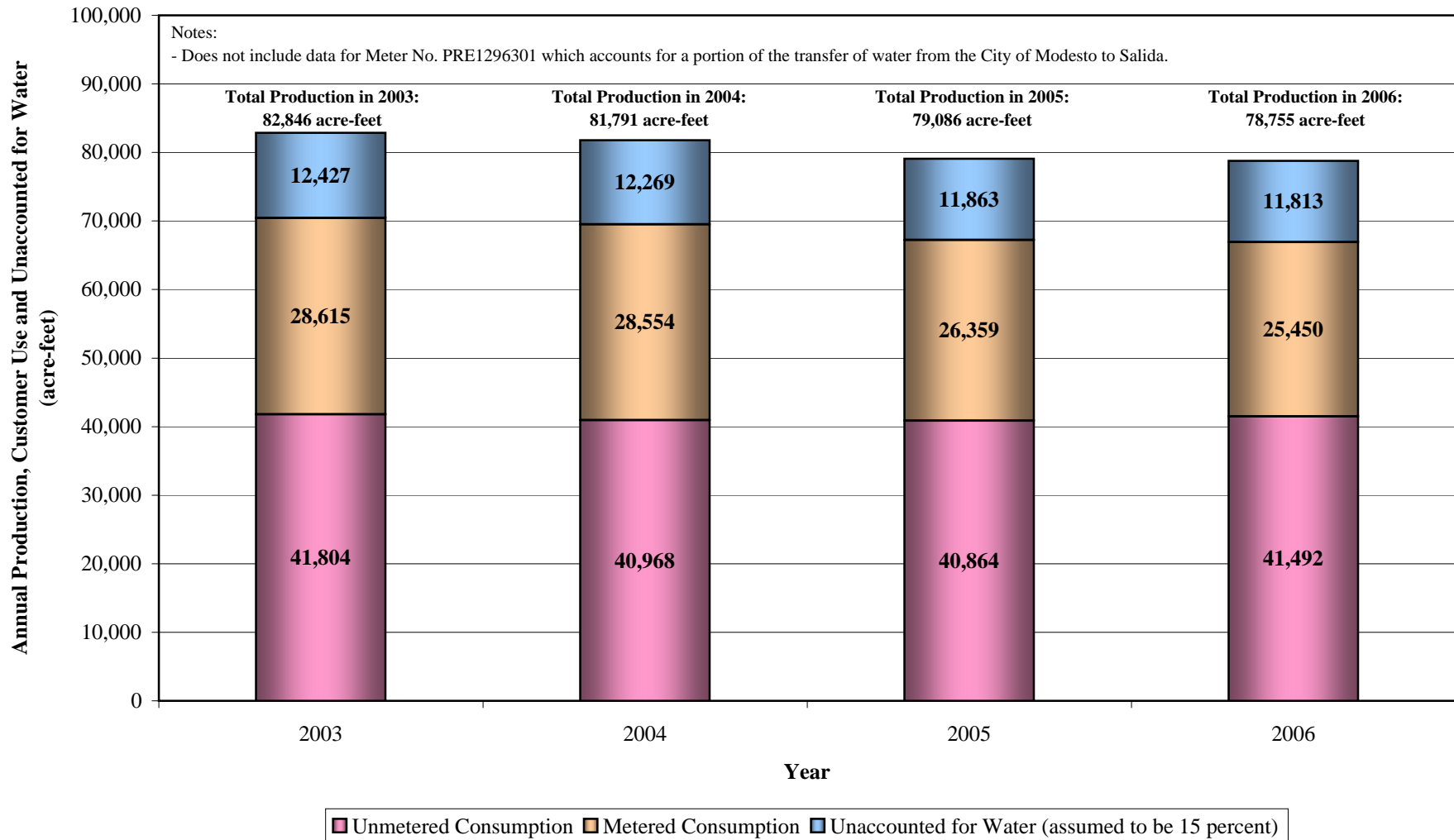


Figure 4. Monthly Metered Customer Water Use (January 2003 - December 2006)
 (Includes the contiguous and outlying service areas)



**Figure 5. Annual Production, Customer Use (Metered and Unmetered),
and Unaccounted for Water (2003 - 2006)**
(Includes the contiguous and outlying service areas)



ATTACHMENT A

General Plan Land Use Acreages and Area Designations

General Plan PUA Land Use Acraeges Incorporating Planned GPA's and Existing Development

Name of Comprehensive Planning District (CPD) within the Sphere of Influence	Vacant Acraeges by Land Use Designation									
	Adjusted to recognize approved General Plan Amendments and updated GIS acreage	CPD Acreage where a General Plan Amendment is Pending	Additional CPD areas already developed	Regional Commercial (RC)	Residential (R)	Village Residential (VR)	Business Park (BP)	Open Space (OS)	Mixed Use (MU)	Notes
Coffee/Claratina	25	0	0	25.3						
Coffee/Claratina	144	0	144							Reflects build-out of Coffee/Claratina SP
College West	235	0	0				235.0			
Dry Creek	497	0	0					497.0		
Empire North CPD Total	213	0	0							
Empire North (North of Dry Creek)	52	0	52							
Empire North (South of Dry Creek)	161	0	0			161.1				Reflects build-out of Empire North SP
Fairview	379	0	82			297.6				Reflects approved Galas Brother Subdivision
Hetch Hetchy	823	0	0			823.0				
Hetch Hetchy	122	0	0							
Highway 132	658	0	0	121.9			657.9			
Johansen	600	0	0			600.1				
Kierman/Carver CPD Total	1,382	0	160			566.1				Reflects build-out Carver-Bangs Specific Plan
Kierman/Carver	726	0	0				338.6			
Kierman/Carver	339	0	0							
Kierman/Carver	75	0	0	75.4						
Kierman/McHenry	370	0	0				370.2			
Kierman/McHenry	99	0	0	99.3						
North Beyer	17	0	0			26.0		0.0		
North Beyer	17	0	0					16.6		
North Beyer	148	0	148							Reflects Build out of North Beyer Specific Plan
Paradise/Carpenter *	803	0	233			570.0				Reflects Build out in County areas
Pelandale/McHenry	50	32	20		40.0			22.0		Proposed GPA increases R & OS acreages
Pelandale/McHenry	37	-32	5	0.0						Proposed GPA reduces commercial area
Pelandale/Snyder CPD Total	395	0	0							
Pelandale/Snyder	332	0	332							Reflects build-out of Pelandale/Snyder SP
Pelandale/Snyder	62	0	62						0.0	Reflects build-out of Pelandale/Snyder SP
Roselle/Claribel	259	0	0			1,290.2	259.5			
Roselle/Claribel	1,357	-67	0	67.0						Proposed GPA for new RC site
Tuolumne River	1,535	0	0					1,534.9		
Village One CPD Total	1,885	0	-1,885							
Village One	1,578	0	1,376			202.8				Reflects build-out of V-1 Specific Plan
Village One	307	0	0				306.9			
Whitmore/Carpenter	720	0	176			543.8				Reduced VR due to land fill and flood plain
Subtotal	10,497	0	388.9	40.0	5,080.7	2,168.1	2,053.9	16.6		
Total Vacant areas within Modesto SOI/PUA:										
9,748.28										

Source: Table 3, Estimated Sewer Flow Projections Memo, City of Modesto, July 27, 2006.



**CITY OF MODESTO
GENERAL PLAN PROGRAM**

**Figure II-1
GROWTH STRATEGY
DIAGRAM**

LEGEND






DESIGNATIONS

-  REDEVELOPMENT AREA
-  BASELINE DEVELOPED AREA
-  PLANNED URBANIZING AREA

BOUNDARY LINES

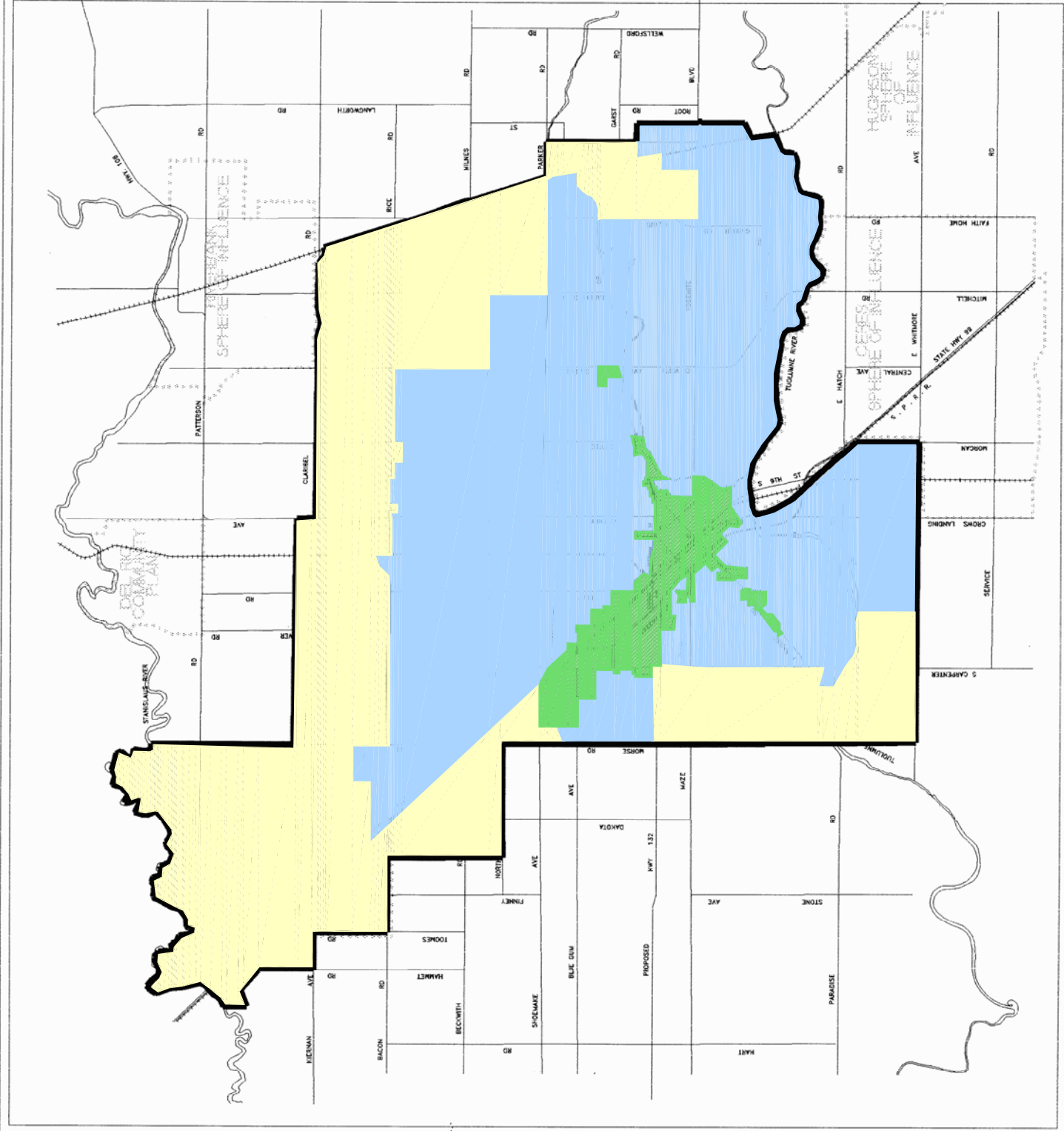
-  GENERAL PLAN BOUNDARY
-  BOUNDARY BETWEEN DESIGNATIONS

REFERENCE POINTS

-  STREETS
-  FREEWAYS
-  RAILROADS
-  RIVERS
-  ADJACENT COMMUNITY BOUNDARY



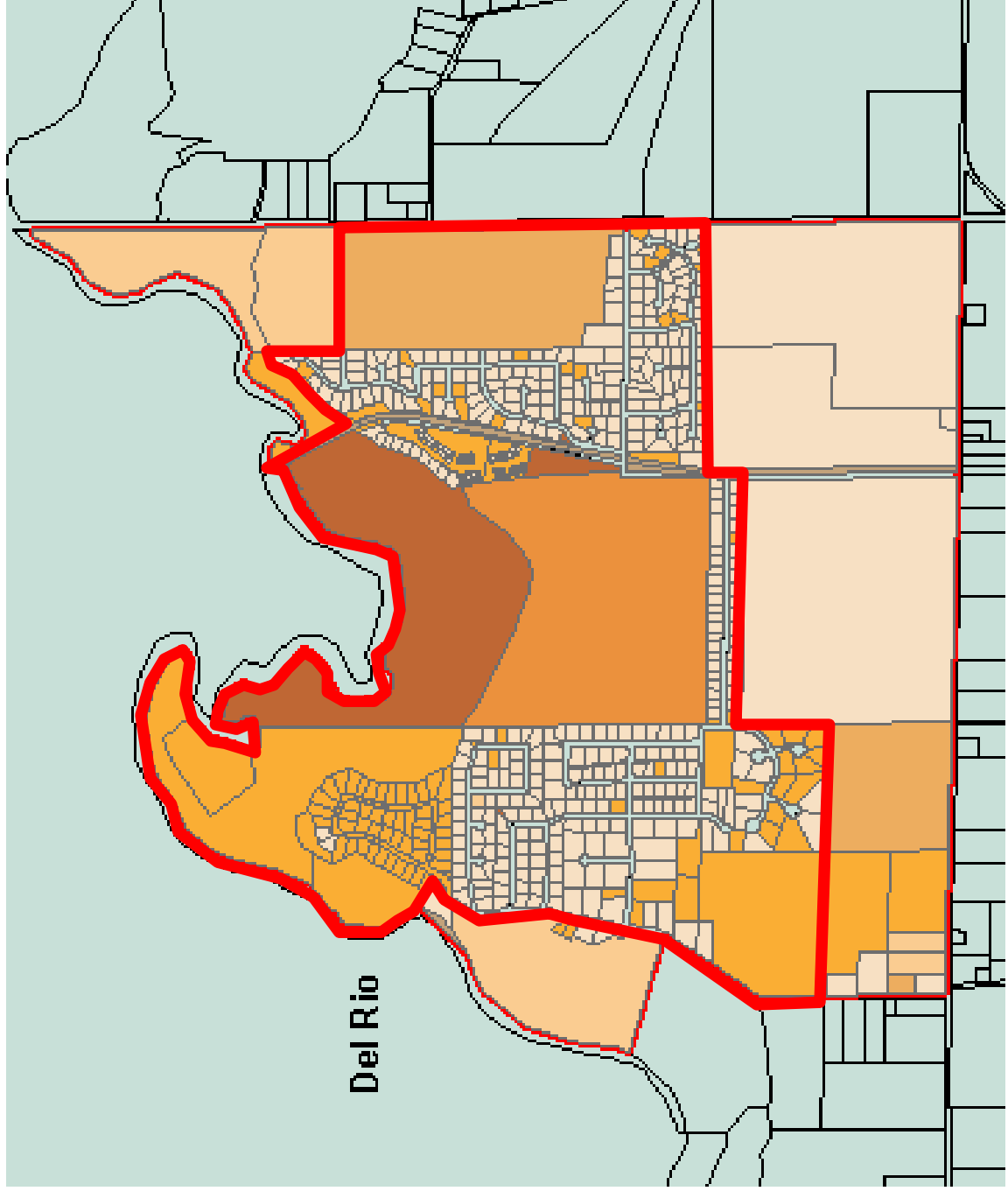
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BY: J. HARRIS



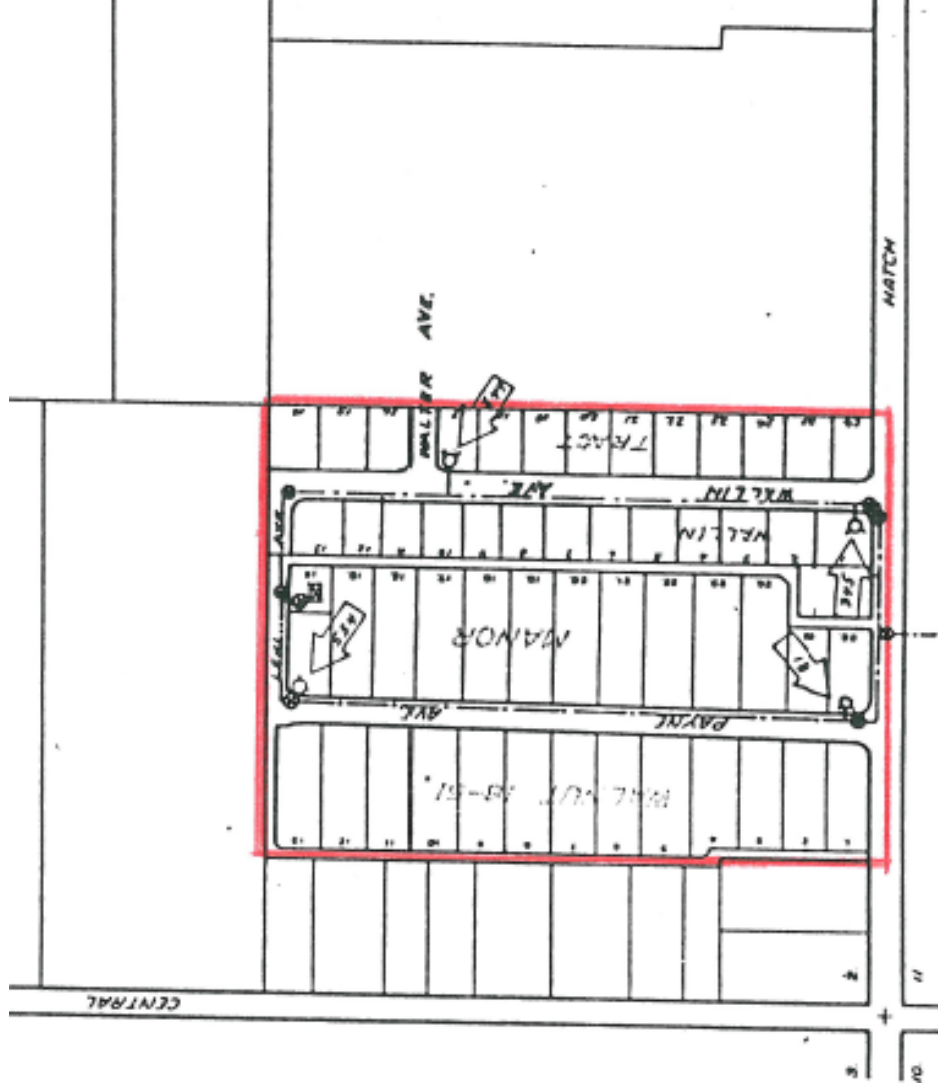
ATTACHMENT B

Outlying Service Area Boundaries

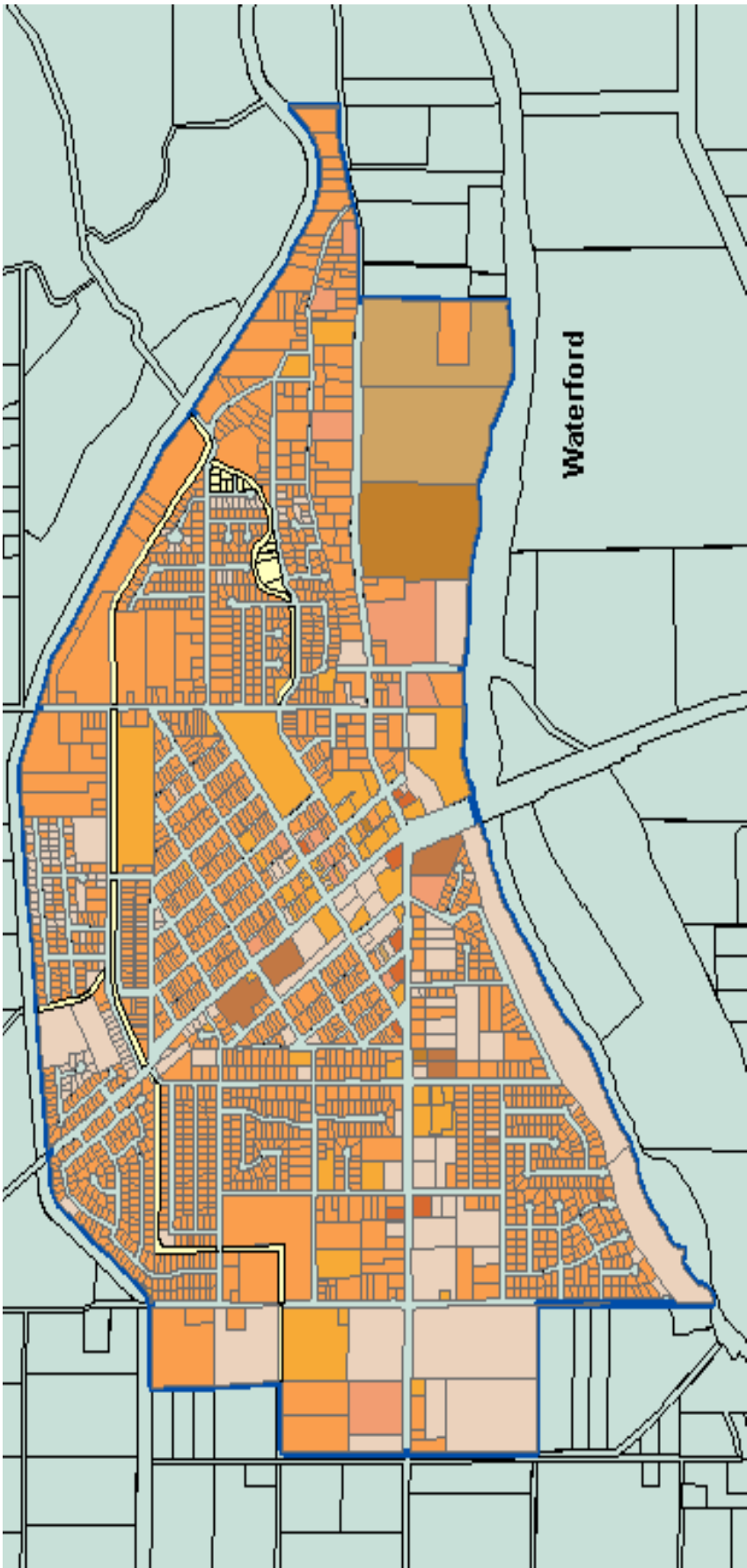
Del Rio Service Area



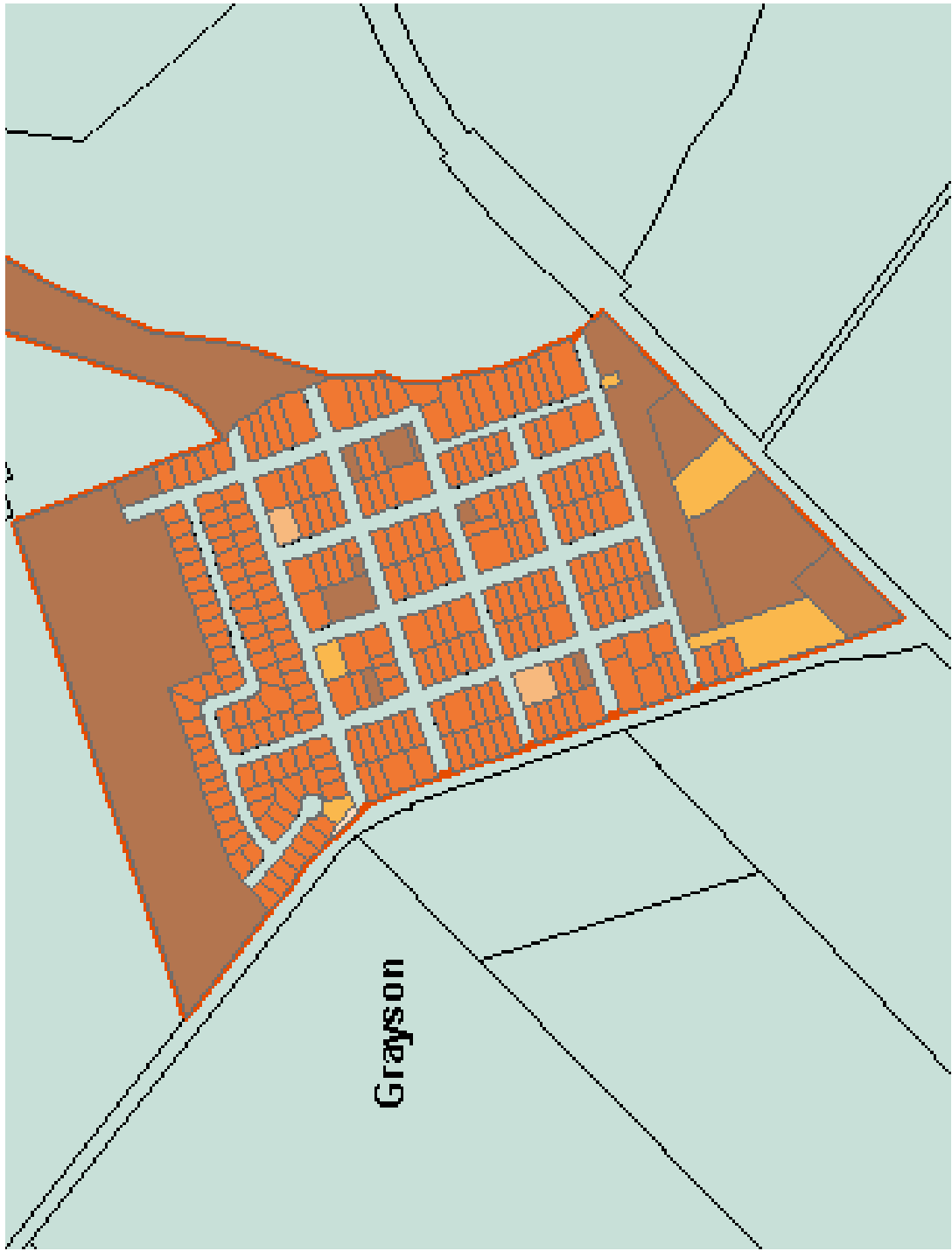
Ceres (Walnut Manor) Service Area



Waterford Service Area



Grayson Service Area



Hickman Service Area



Hickman

Turlock Service Area

