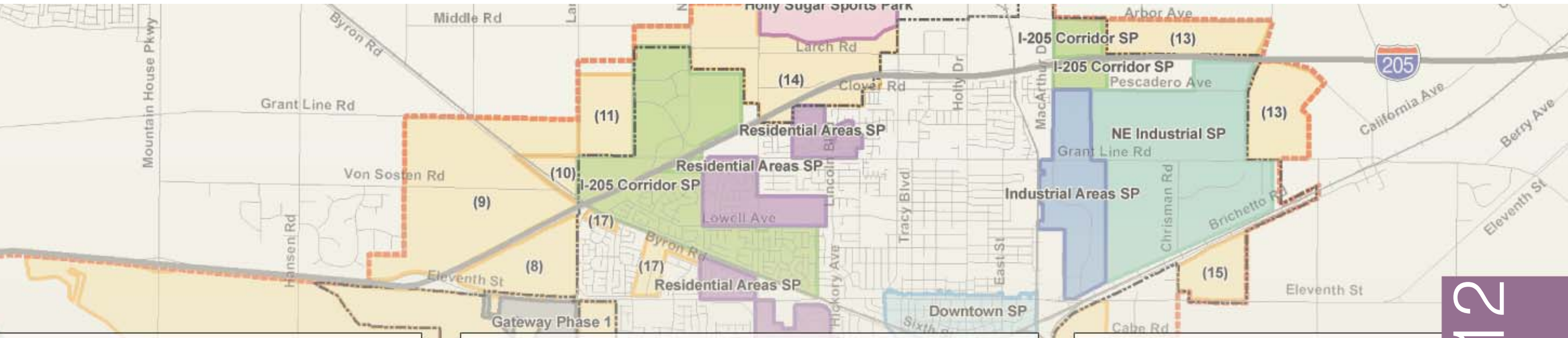

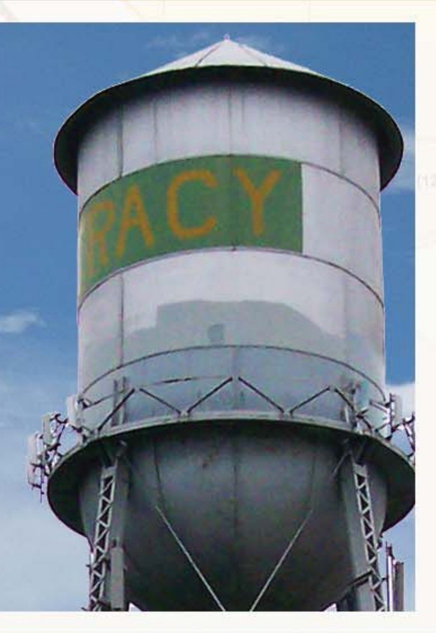

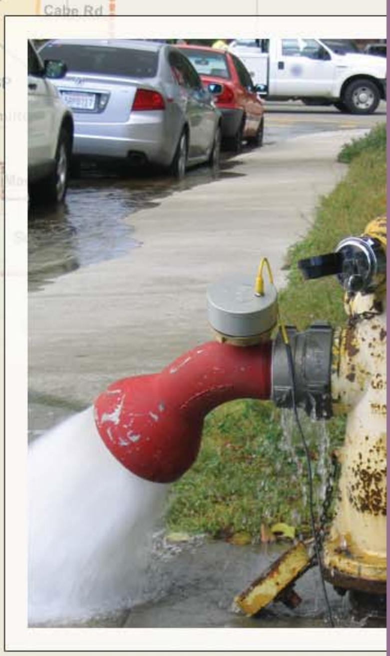

DECEMBER 2012

CITY OF TRACY

Citywide Water System Master Plan

WEST YOST ASSOCIATES

TRACY

CITYWIDE WATER SYSTEM MASTER PLAN

Prepared for

The City of Tracy

December 2012

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404-02-09-76

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Table of Contents

Table of Contents

Table of Contents

Chapter 5. Existing and Future Water Supplies

Chapter 6. System Performance and Operational Criteria

Table of Contents

Chapter 7. Existing Potable Water System Evaluation

Chapter 8. Buildout Potable Water System Evaluation

Table of Contents

List of Appendices

List of Tables

Table of Contents

List of Figures

ES.1 PURPOSE OF THE CITYWIDE WATER SYSTEM MASTER PLAN

The purpose of this Citywide Water System Master Plan for the City of Tracy (City) is to provide an evaluation of the required backbone potable and recycled water system facilities required to serve buildout of the City's General Plan. Buildout of the City's Sphere of Influence (SOI) includes existing developed land uses within the City limits, on-going development projects and infill with approved water supply and assumed future service areas located within the City's SOI. Figure ES-1 shows the City's SOI along with locations of the assumed future service areas. Chapter 3 provides a summary of the City's General Plan and projected buildout land uses assumed for purposes of this Citywide Water System Master Plan as directed by City staff.

The level of analysis for this Citywide Water System Master Plan is being referred to by the City as the "Tier 1" evaluation, in which overall planning objectives, goals and recommendations are defined, and required potable water and recycled water backbone infrastructure is identified and sized to serve buildout of the City's General Plan. A "Tier 2" evaluation, including evaluation of required "on-site" infrastructure to meet the needs of specific proposed development projects and phasing of recommended buildout improvements, will be initiated at a later date on a project-by-project basis and is not included in this Citywide Water System Master Plan.

Buildout of the City's General Plan is anticipated to take 30 years or more to complete. Over this time it is expected that development plans for on-going development projects and/or future service areas will be revised and may be different than what has been assumed in this Citywide Water System Master Plan. The "Tier 2" evaluations of specific development projects and future updates to this "Tier 1" Citywide Water System Master Plan should evaluate these changes in development plans and any associated impacts that they may have on the recommended buildout potable water and recycled water systems described in this Citywide Water System Master Plan.

ES.2 OBJECTIVES OF THE CITYWIDE WATER SYSTEM MASTER PLAN

The objectives of this Citywide Water System Master Plan are to:

- Provide recommendations to help the City meet its water system objectives and goals;
- Evaluate existing and projected future potable and recycled water demands at buildout of the City's General Plan;
- Provide an overview of the availability and reliability of the City's existing and future water supplies and their ability to meeting existing and future buildout water demands;
- Develop performance and operational criteria under which the potable and recycled water systems will be analyzed and future facilities will be formulated;
- Evaluate the need for new backbone potable water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan;

- Evaluate the need for new backbone recycled water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan; and
- Develop a capital improvement program for recommended potable and recycled water system facilities.

The achievement of each of these objectives is described in this Citywide Water System Master Plan and is summarized below.

ES.3 WATER SUPPLY AND INFRASTRUCTURE SYSTEM OBJECTIVES, GOALS AND RECOMMENDATIONS

Chapter 2 of this Citywide Water System Master Plan describes the water supply and infrastructure system objectives, goals and recommendations. These include recommendations for complying with recent legislation (including AB32, SB375, Green Building Codes and SBx7-7), water conservation and the use of recycled and non-potable water supplies. Recommendations have also been made to reduce water use by existing customers and new development.

Based on these recommendations, in November 2009, the City developed a list of principles for sustainable infrastructure for use in developing its infrastructure master plans. Principles were developed for storm drainage, water, wastewater, recycled water, and roadways and transportation. A copy of the established principles is included in Appendix A. The principles related to water infrastructure are summarized as follows:

- Energy efficient design and control systems should be used in all new facilities to minimize power consumption. Look for opportunities to use solar generation facilities.
- Promote and encourage, where feasible, the use of recycled water (Title 22 criteria) for non-potable uses in existing and future public landscaped areas.
- Establish and adopt interior and exterior water conservation requirements which are consistent with recommended State guidelines, to the degree possible.
- Require existing City customers to participate in water conservation activities that will enable the City to meet or exceed the projected ten-year water conservation requirements proposed in the "20x2020" State plan.
- Create a water rate structure that supports and provides incentives for water conservation.
- Encourage and create incentives to convert high water use on outdoor landscaping to more drought-resistant plantings to facilitate water conservation among existing water users.

As applicable, these sustainability principles have been incorporated into this Citywide Water System Master Plan.

ES.4 EXISTING AND PROJECTED FUTURE WATER DEMANDS

As described in Chapter 4, the City of Tracy currently serves a population of about 81,000 people. Total potable water production in 2009 was 16,693 acre-feet per year (af/yr), which equates to a per capita water use of about 182 gallons per capita per day (gpcd).

Future water demands for buildout of the City's General Plan were calculated based on revised unit water demand factors reflecting the use of low-flow fixtures and appliances and the use of recycled water for landscape irrigation for selected land use designations.

With buildout of the City's SOI, the City's population is projected to increase to about 134,000 people. At buildout, potable water demands are projected to be about 36,300 af/yr, while recycled water demands (for irrigation of landscaped areas) are projected to be 7,500 af/yr. The City's future use of recycled water for non-potable uses such as landscape irrigation is key to the reduction (offset) of the City's future potable water demand, and the City's ability to meet future demands using existing and future available water supplies. A summary of the projected water demands and water production at buildout is provided in Table ES-1.

Table ES-1. Summary of Projected Water Demands and Production at Buildout[a,b]

Demand Category	Potable Water, af/yr	Recycled Water, af/yr
Development Projects w/ Approved Water Supply[c]	3,800	700
Future Service Areas[c]	12,000	6,200
Future Water Demands Subtotal[c]	15,800	6,900
Unaccounted For Water (UAFW)[c]	1,300	600
Existing Demands (2007)[c,d]	19,200	0
Buildout Water Production	36,300	7,500[e]

(a) See Appendix D for detailed water demand calculations by demand category.
(b) The proposed land uses and/or number of anticipated residential dwelling units for the Ellis Specific Plan and Cordes Ranch projects have subsequently been revised in April and May 2012, respectively, as discussed in Appendix C. However, these revisions do not significantly impact the buildout water demand projections presented, which were developed prior to these revisions.
(c) Totals rounded to the nearest hundred.
(d) As described in Chapter 4, 2007 has been used as a baseline year for existing water demands.
(e) Total does not include an estimated 200 af/yr of recycled water use that was assumed for the Ellis Specific Plan. Specific recycled water use areas have not been identified within the Ellis Specific Plan, but an estimate of recycled water use was incorporated into the proposed buildout recycled water system to provide sufficient capacity to serve this development project, if possible (see Chapter 9 for additional discussion).

It should be noted that at buildout of the City's General Plan, the City's future growth will include significant new commercial and industrial land uses, and limited residential growth. This will result in a corresponding shift in water demands based on customer class. The City's residential users currently account for about 74 percent of the City's water consumption. However, at buildout, residential consumption will only account for about 63 percent of the water consumption, while the water consumption attributed to commercial and industrial land uses will increase. Also, the percentage of water consumption attributed to landscape irrigation will be reduced at buildout, primarily as a result of the use of recycled water for landscape irrigation in new developments. These shifts in water consumption patterns are demonstrated in Table ES-2.

Table ES-2. Historical and Projected Buildout Water Consumption by Customer Class

Customer Class	Historical Average Annual Consumption[(a)]	Projected Annual Consumption at Buildout[(b)]	Percent Change
Residential	74%	63%	↓ 11%
Commercial/Office	8%	11%	↑ 3%
Industrial	5%	19%	↑ 14%
Institutional	3%	3%	--
Irrigation	10%	4%	↓ 6%
Total	100%	100%	--

(a) See Chapter 4.
(b) Includes all existing and projected future water demands; see Table D-2 in Appendix D.

As described in Chapter 4, recognizing and understanding these shifts in the types of development and associated water use will be an important factor in the City's focused development and implementation of future water conservation programs and the City's implementation plan to comply with the City's adopted SBx7-7 per capita water use targets.

ES.5 EXISTING AND PROJECTED FUTURE WATER SUPPLIES

As described in Chapter 5, the City currently receives water supplies from three sources:

- Surface water from the Delta-Mendota Canal (Central Valley Project),
- Surface water from the Stanislaus River via the South County Water Supply Project (treated and delivered by the SSJID), and
- Groundwater pumped from nine groundwater wells located within the City.

Supplies from the Central Valley Project (CVP) are obtained via a 40-year Municipal and Industrial (M&I) contract between the City and the United States Bureau of Reclamation (USBR), as well as the assignment of Ag-reliability CVP supplies from the Banta Carbona Irrigation District (BCID) and the West Side Irrigation District (WSID). Deliveries of the CVP supplies are subject to reductions due to hydrologic conditions and pumping restrictions in the San Joaquin Delta. Potential reductions in allocations of the Ag-reliability CVP supplies are significantly greater than for the M&I-reliability CVP supplies. The City's CVP supplies are treated at the City's John Jones Water Treatment Plant (JJWTP).

Treated water supply deliveries from the South County Water Supply Project (SCWSP) to the City began in July 2005 and have been essentially uninterrupted since then. As part of the SCWSP, the City has been allocated up to 10,000 af/yr of water. These supplies are expected to continue to have high reliability, with the City anticipating receipt of at least 95 percent of its allocation, even during dry years.

The City's nine groundwater wells currently have a total extraction capacity of about 15 million gallons per day (mgd). The City has determined that the maximum annual groundwater extraction rate is 9,000 af/yr. This amount of groundwater is considered to be available if needed to supplement the City's surface water supplies; however, with the recent addition of the SCWSP to the City's water supply portfolio, the City plans to decrease its future groundwater use during normal years.

On June 5, 2012, the Tracy City Council approved a long-term agreement with the Semitropic Groundwater Storage District Groundwater Storage Bank (Semitropic) for 3,500 units of water storage. One unit of water storage allows for a withdrawal of up to 1 af/yr for three years; hence, the agreement would allow for withdrawal of 3,500 af/yr for three years (10,500 af total). To store water in Semitropic, the City would not withdraw its share of CVP water from the DMC, but instead allow this water to continue to move through the DMC and California Aqueduct systems for delivery to and use by Semitropic. This is called "in lieu storage." Upon request by the City, in accordance with the contract, Semitropic would pump the stored water into the California Aqueduct and a like amount of water would be made available to the City directly from the DMC. Though the City could utilize this supply in any year, it would be most valuable during drought years when the City's CVP surface water supplies are reduced. To date, the City has deposited 7,000 af of supplies in Semitropic and has withdrawn 200 af (100 af in November 2007 and 100 af in December 2008). The City's current balance is 6,100 af (as of December 2012); these supplies are available to the City for withdrawal in dry years, if needed.

In the future, the City's existing water supplies are anticipated to be supplemented by the following future water supplies:

- Additional CVP supplies,
- Future BBID pre-1914 supplies,
- Additional SCWSP supplies,
- Aquifer Storage and Recovery wells, and
- Tertiary-treated Recycled Water (for landscape irrigation and other non-potable water uses).

Based on the City's existing and anticipated future water supplies, the City appears to have adequate supplies to meet the projected water demands at buildout of the City's General Plan under all hydrologic conditions. This is summarized in Table ES-3.

Table ES-3. Existing and Future Available Potable Water Supplies vs. Potable Water Demand for Buildout of the City's General Plan

	Normal Year	Single Dry Year	Multiple Dry Year
Existing and Future Potable Water Supplies, af/yr[(a)]			
Existing CVP Entitlements and Assignments (see Table 5-3)	11,250	7,625	4,750
SSJID Supply	10,000	9,500	9,500
Groundwater	2,500	9,000	9,000
Semitropic Permanent Agreement	--	3,500	3,500
CVP Assignment from WSID (to be exercised in conjunction with Downtown Specific Plan)	1,250	375	250
Future BBID (pre-1914 rights)	4,500	4,050	4,050
CVP Assignment from BBID	5,500	1,650	1,100
Future SCWSP Supplies	3,000	2,850	2,850
Future ASR Water Banking	--	3,000	3,000
Total Available Supplies, af/yr	38,000	41,550	38,000
Potable Water Demands, af/yr[(b)]			
Existing Customers (2007)[(c)]	19,176	19,176	19,176
Development Projects with Approved Water Supply[(d)]	4,150	4,150	4,150
Future Service Areas[(d)]	12,980	12,980	12,980
Total Buildout Demand, af/yr	36,300	36,300	36,300
Potential Potable Water Supply Shortfall, af/yr	No Shortfall	No Shortfall	No Shortfall

(a) See Chapter 5 for assumed water supply availability and reliability under various hydrologic conditions.
(b) Assumes that recycled water will be used for landscape irrigation purposes for certain land use designations.
(c) Based on actual 2007 water production; includes unaccounted for water (see Chapter 4).
(d) Includes unaccounted for water (see Chapter 4).

However, as described in Chapter 5, it should be noted that supply availability and reliability, actual demands, and the City's actual use of recycled water to offset potable water demands may change in the future. As such, the City may need to acquire additional potable water supplies in the future. Potential options for additional potable water supplies are described at the end of Chapter 5 and include the following:

- WSID CVP Supply Assignment,
- Recycled Water Exchange Agreements,
- Treatment of Shallow Groundwater, and
- Storage of Wet Year Water Supplies.

ES.6 EVALUATION OF EXISTING POTABLE WATER SYSTEM

The City's existing potable water system includes the following major facilities: John Jones Water Treatment Plant (JJWTP), nine groundwater wells, clearwells and storage tanks, booster pump stations, pressure regulating stations and transmission and distribution system pipelines. The City's existing distribution system is divided into three pressure zones.

Before evaluating how the City will meet the projected buildout demands, an evaluation of the City's existing water system facilities was conducted to determine if there were any existing deficiencies. The evaluation presented in Chapter 7 included an analysis of existing surface water treatment capacity, water storage capacity, pumping capacity, and the water system's ability to meet recommended performance criteria (developed in Chapter 6) under maximum day demand plus fire flow and peak hour demand scenarios. Recommendations for the existing potable water distribution system are described below.

ES.6.1 Recommended Pipeline Improvements

The following pipeline improvements are recommended:

- Improvement #1:
  - — Replace existing 12-inch diameter pipelines located on Sixth Street and Tracy Boulevard with 18-inch diameter pipelines to reduce high pipeline velocities simulated during a peak hour demand condition.
  - — Replace existing 12-inch diameter pipeline located on Eleventh Street, east of Tracy Boulevard, with a 16-inch diameter pipeline to reduce pipeline velocity once the 18-inch diameter pipelines are installed on Sixth Street and Tracy Boulevard.
- Improvement #2:
  - — Replace existing 4-inch diameter pipeline located along Tracy Boulevard between Fourth Street and Mt. Diablo Avenue with a 12-inch diameter pipeline to improve fire flow.

Figure ES-2 illustrates the location of the recommended pipeline improvements.

As the City plans for future pipeline renewal and replacement projects, replacement of older and/or smaller diameter pipelines with upsized pipelines should be hydraulically reviewed and considered to be able to provide reliable service during high demands.

ES.6.2 Recommended SCADA System Improvements

- Install SCADA system monitoring of flows and pressures at each pressure regulating station to provide operators with additional understanding and flexibility in system operations.
- Review the system data collected from the existing SCADA system and correct any data discrepancies found to provide more accurate system operations data.

ES.7 EVALUATION OF BUILDOUT POTABLE WATER AND RECYCLED WATER SYSTEMS

The evaluation of the potable water and recycled water buildout systems identifies the additional improvements that will be required in addition to the existing system infrastructure improvements to support the City's projected buildout potable water and recycled water demands. Development of the buildout potable water and recycled water systems included an evaluation of (1) the required buildout water treatment, storage and pumping capacity, and (2) the buildout water system's ability to meet recommended performance and operational criteria.

To assist in the evaluation of the City's potable water and recycled water systems at buildout, the buildout infrastructure recommended in this Citywide Water System Master Plan includes the infrastructure required to serve the Tracy Hills development and, for consistency, is based on the adopted water use, peaking factors, and system performance criteria described in this Citywide Water System Master Plan. West Yost has included the Tracy Hills development in the buildout potable water and recycled water system evaluations because Tracy Hills will be a part of the City's overall future operations, and including the Tracy Hills development in the buildout hydraulic model evaluation ensures that the buildout systems for both potable and recycled water will be adequate to serve the entire City (including Tracy Hills) and can provide water service at acceptable system pressures and pipeline velocities.

However, it is acknowledged that the Tracy Hills development has an approved Master Plan, which is in the process of being revised, and that recommended infrastructure presented in the Tracy Hills Master Plan is different from that presented in this Citywide Water System Master Plan due to the use of slightly different water use and peaking factors. For this Citywide Water System Master Plan, the potable water and recycled water distribution systems for the Tracy Hills development have been modeled as separate (but interconnected) systems from the City main potable water and recycled water systems, with separate distinct pressure zones.

Also, because Tracy Hills is essentially a "stand-alone" development separated from the City's other water system facilities, costs for infrastructure to specifically serve the Tracy Hills development will not be included in this Citywide Water System Master Plan. Instead, costs for Tracy Hills infrastructure will be evaluated in conjunction with the revised Tracy Hills Master Plan and subsequent evaluations to be prepared for the Tracy Hills development. However, total costs for any shared facilities (*e.g.*, JJWTP expansion and recycled water transmission main from the Holly Drive WWTP, including the recycled water pipeline to the Tracy Hills recycled water storage tank and the recycled water storage tank) are included in this Citywide Water System Master Plan and a proportionate share of the costs of these shared facilities will be allocated to the Tracy Hills development. The cost allocations will be evaluated and presented in a separate memorandum.

ES.7.1 Buildout Potable Water System

Chapter 8 of this Citywide Water System Master Plan identifies the additional improvements that will be required in addition to the existing potable water system infrastructure improvements to support the City's projected buildout potable water demands. Development of the buildout potable water system includes an evaluation of the required buildout water treatment, storage and pumping capacity, and the buildout water system's ability to meet recommended water system performance and operational criteria under buildout maximum day demand plus fire flow and peak hour demand scenarios.

The recommended backbone potable water system improvements required to serve buildout potable water demands are summarized below and shown on Figure ES-3. It should be noted that these recommendations only identify facility improvements at a Master Plan level and do not necessarily include all required on-site infrastructure nor constitute design of improvements. Subsequent detailed design is required to determine the exact sizes and final locations of these proposed facility improvements.

It should also be noted that the buildout hydraulic model is not an "all pipes" model (*i.e.*, not all smaller diameter pipelines are included); therefore, the hydraulic simulations performed as discussed above may not identify all necessary water system improvements. Consequently, it is recommended that further hydraulic evaluations be performed as additional details are provided for each future development project.

ES.7.1.1 Surface Water Treatment Facilities

- JJWTP Expansion: Increase the surface water treatment capacity at JJWTP by 21 mgd to a total capacity of 51 mgd.

ES.7.1.2 Storage Facilities

- JJWTP Expansion: Install a new clearwell with a minimum active storage capacity of 2.0 MG.
- Catellus Tank: Install a new storage tank with a minimum active storage capacity of 1.0 MG.
- Gateway Zone 1 Tank: Install a new storage tank with a minimum active storage capacity of 1.5 MG.
- Gateway Zone 2 Tank: Install a new storage tank with a minimum active storage capacity of 1.5 MG.
- Patterson Pass Tank: Install a new storage tank with a minimum active storage capacity of 0.5 MG.
- Cordes Ranch Tank: Install a new storage tank with a minimum active storage capacity of 1.5 MG.
- Zone 3-Tracy Hills Tank: Install a new storage tank with a minimum active storage capacity of 5.3 MG.
- Zone 4-Tracy Hills Tank: Install a new storage tank with a minimum active storage capacity of 3.5 MG.
- Zone 5-Tracy Hills Tank: Install a new storage tank with a minimum active storage capacity of 0.6 MG.

ES.7.1.3 Groundwater Wells

- Gateway: Install a new ASR well with a minimum firm pumping capacity of 2,500 gpm.
- Cordes Ranch: Install a new ASR well with a minimum firm pumping capacity of 2,500 gpm.
- Ellis: Install a new ASR well with a minimum firm pumping capacity of 2,500 gpm.

ES.7.1.4 Booster Pumping Facilities

- JJWTP Expansion: Increase the firm treated surface water pumping capacity to meet buildout maximum day water demands.
  - Zone 2 BPS: Replace one existing small pump (design flow of 3,300 gpm) with a new pump with a design flow of 6,700 gpm (to match existing large pumps).
  - Zone 3-City-side BPS: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.
  - Zone 3-Tracy Hills BPS: Install a new booster pump station with a minimum firm pumping capacity of 2,400 gpm.
  - Zone 4-Tracy Hills BPS: Install a new booster pump station with a minimum firm pumping capacity of 1,700 gpm.
- Zone 5-Tracy Hills BPS: Install a new booster pump station with a minimum firm pumping capacity of 240 gpm.
- Catellus Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.
- Gateway Zone 1 Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.
- Gateway Zone 2 Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.
- Cordes Ranch Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.

ES.7.1.5 Potable Water Pipelines

- To serve buildout water demands, install approximately 623,360 linear feet of new pipelines ranging in diameter from 8 to 24-inches.
- To serve buildout water demands, upsize approximately 6,960 linear feet of existing pipelines.

ES.7.1.6 Interconnections

- Install the following interconnections between pressure zones to provide supply during peak demands and/or emergency conditions:
  - — PRS #6 (from Zone 2 into Zone 1)
  - — PRS #7 (from Zone 2 into Zone 1)
  - — PRS #8 (from Zone 3-City-side into Zone 2)
  - — PRS #9 (from Zone 3-City-side into Zone 2)
  - — PRS #10 (from Zone 3-City-side into Zone 2)
  - — PRS #A (from Zone 3-City-side into Zone 3-Tracy Hills)
  - — Ellis Zone 2 PRV (from Zone 3-City-side into Zone 2)
  - — Zone 3-Tracy Hills PRV (from Zone 4-Tracy Hills into Zone 3-Tracy Hills)
  - — Two (2) - Zone 4-Tracy Hills PRVs (from Zone 5-Tracy Hills into Zone 4-Tracy Hills)
- Install an individual PRV on any water service connection with a static pressure exceeding 80 psi.

ES.7.1.7 SCADA System/Backup Power

- Install SCADA system monitoring of flows and pressures at each new water supply facility to provide operators with real-time system data and flexibility in system operations.
- Install on-site backup power to any proposed buildout system pumping facility to improve supply reliability.

ES.7.2 Buildout Recycled Water System

As shown in Table ES-1, the recycled water demand at buildout is projected to be about 7,500 af/yr for landscape irrigation of parks and other landscaped areas within the City's SOI. As described in Chapter 9, the City intends to construct and operate a recycled water system to reduce treated effluent discharges to Old River and to offset potable water demands. The recommended recycled water system would serve some development projects with approved supply and all the future service areas including the proposed Tracy Hills development. The recommended recycled water system would collect and treat water at the existing Holly Drive WWTP, and then distribute the recycled water to meet water demands from irrigation.

The recommended buildout recycled water system includes the following components.

ES.7.2.1 Recycled Water Pipelines

- 325,500 linear feet of recycled water pipelines ranging from 8 to 30-inch diameter to serve the City-side recycled water system
- 59,200 linear feet of recycled water pipelines ranging from 8 to 24-inch diameter to serve the Tracy Hills recycled water system

ES.7.2.2 Pump Stations

- Zone A pump station to serve main part of City (23 mgd)
- Zone B pump station to serve main part of City (14 mgd)
- Zone C pump station to serve main part of City (4.1 mgd)
- Zone C pump station to serve Tracy Hills (6.5 mgd)
- Zone D pump station to serve Tracy Hills (4.3 mgd)

ES.7.2.3 Diurnal Storage

- Diurnal storage for Main Part of City
  - — Holly Drive WWTP (3.0 MG)
  - — Zone Storage at Zone A Hydraulic Grade (5.0 MG)
  - — Diurnal storage for Tracy Hills Zones C and D (2.0 MG)

Figure ES-4 illustrates the proposed buildout recycled water system.

ES.8 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Chapter 10 of this Citywide Water System Master Plan presents the recommended Capital Improvement Program (CIP) for the City's existing and buildout potable water systems and proposed buildout recycled water system to support the City's projected buildout potable water and recycled water demands, respectively. These costs are summarized in Table ES-4. A detailed breakdown of the costs is provided in Chapter 10.

Table ES-4. Summary of Probable Construction Costs for Recommended Potable and Recycled Water System Improvements[(a)]

Recommended Improvements	CIP Cost (includes markups)[(b,c)]
Potable Water System	
Existing Potable Water System CIP (see Table 10-1)	$1,483,000
Buildout Potable Water System CIP (see Table 10-3)	$262,970,000
Total Potable Water System CIP	$264,453,000
Recycled Water System	
Buildout Recycled Water System CIP (see Table 10-7)	$138,200,000
Total Recycled Water System CIP	$138,200,000

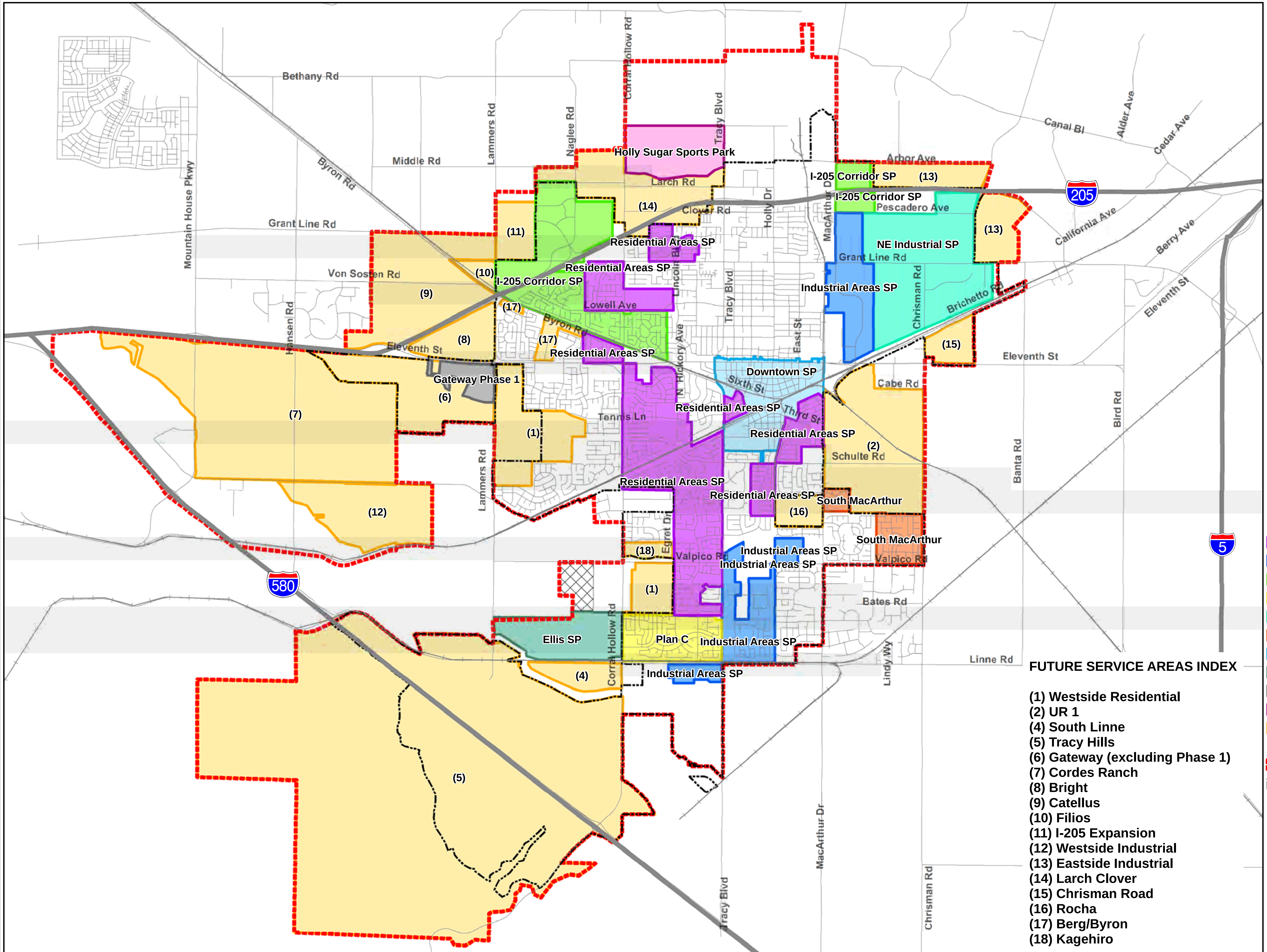
(a) Does not include costs for improvements recommended specifically for Tracy Hills.
(b) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate
(c) CIP cost includes mark-ups equal to 40 percent (General Contingency: 15 percent; Design and Planning: 10 percent; Construction Management: 10 percent; and Program Administration: 5 percent) and are based on 2012 dollars.

An additional analysis to evaluate the potential development impact fees that will be required to fund the buildout potable and recycled water system capital improvement costs, which have been allocated to new development, will be provided in a separate memorandum.

FIGURE ES-1

City of Tracy
Water System Master Plan

LOCATIONS OF PROPOSED DEVELOPMENT PROJECTS



FUTURE SERVICE AREAS INDEX

(1) Westside Residential
(2) UR 1
(4) South Linne
(5) Tracy Hills
(6) Gateway (excluding Phase 1)
(7) Cordes Ranch
(8) Bright
(9) Catellus
(10) Filios
(11) I-205 Expansion
(12) Westside Industrial
(13) Eastside Industrial
(14) Larch Clover
(15) Chrisman Road
(16) Rocha
(17) Berg/Byron
(18) Kagehiro

NOTES

1. City limits and SOI files (citylimit.shp and SOI_revised_January_09.shp) provided by DCE on 11/05/09. SOI shape file was revised based on data received from the City on 08/03/10.
2. Infill locations are not shown.
3. Project boundaries are approximate.
4. The Future Planning Area was not included in the evaluations completed for the Citywide WSMP.

LEGEND

- Residential Areas Specific Plan
- Industrial Areas Specific Plan
- I-205 Corridor Specific Plan
- Plan "C"
- Northeast Industrial Specific Plan
- South MacArthur
- Downtown Specific Plan
- Ellis Specific Plan
- Tracy Gateway - Phase 1
- Holly Sugar Sports Park
- Future Service Area (see Index)
- Future Planning Area
- SOI
- City Limits
- Highway
- Existing Street
- Railroad

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Consulting Engineers

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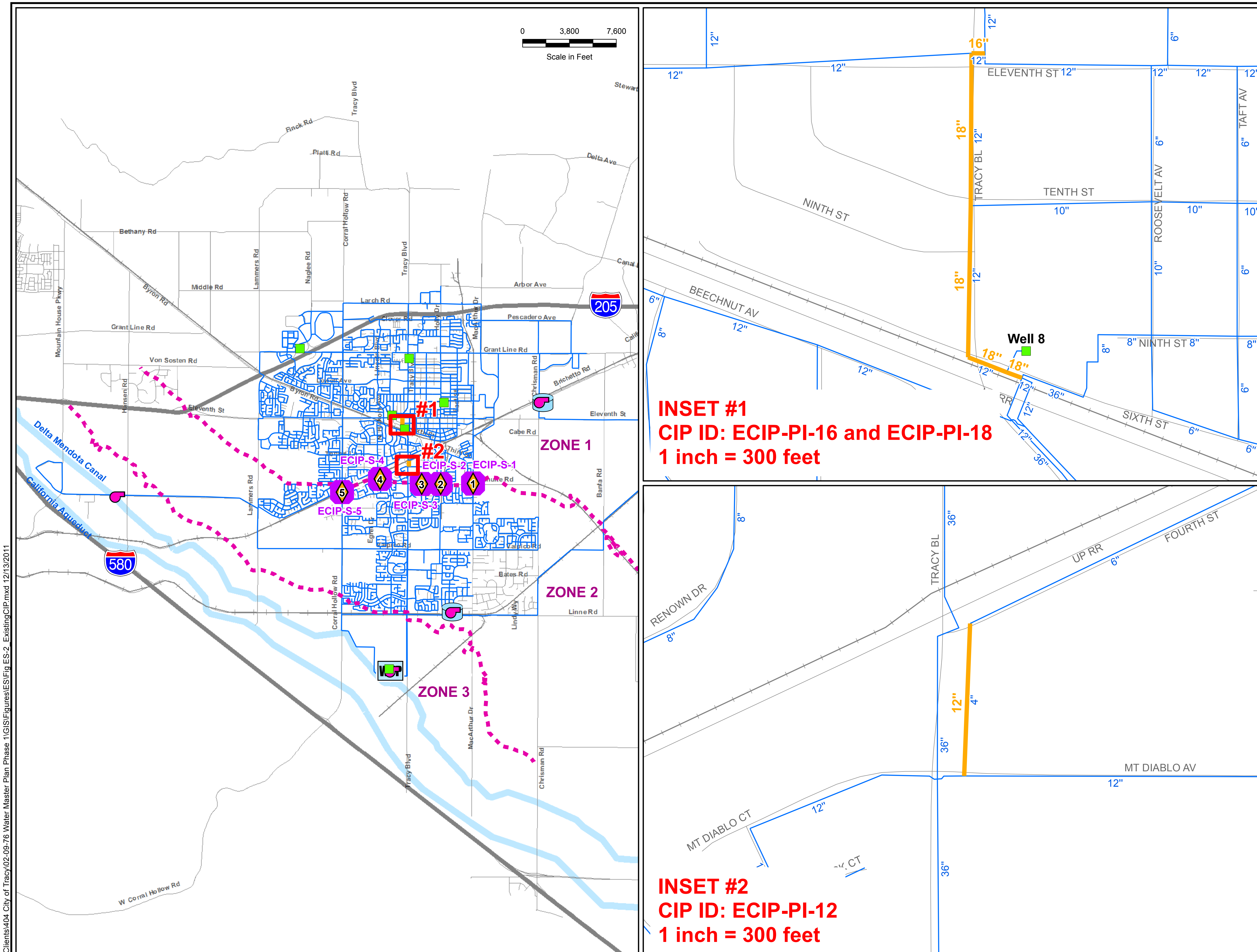
FIGURE ES-2

City of Tracy
Water System Master Plan

RECOMMENDED EXISTING POTABLE WATER SYSTEM CIP



NOTE

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.
2. Calibration of SCADA tags with data discrepancies is not shown on this figure, but is a part of the City's existing potable water system CIP (CIP ID: ECIP-S-CAL).

LEGEND

- SCADA System Improvement
- Pipeline Improvement
- Storage Tank
- Booster Pump Station
- Groundwater Well
- Pressure Regulating Station
- WTP JJWTP
- Existing Pipeline
- Highway
- Street

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Consulting Engineers

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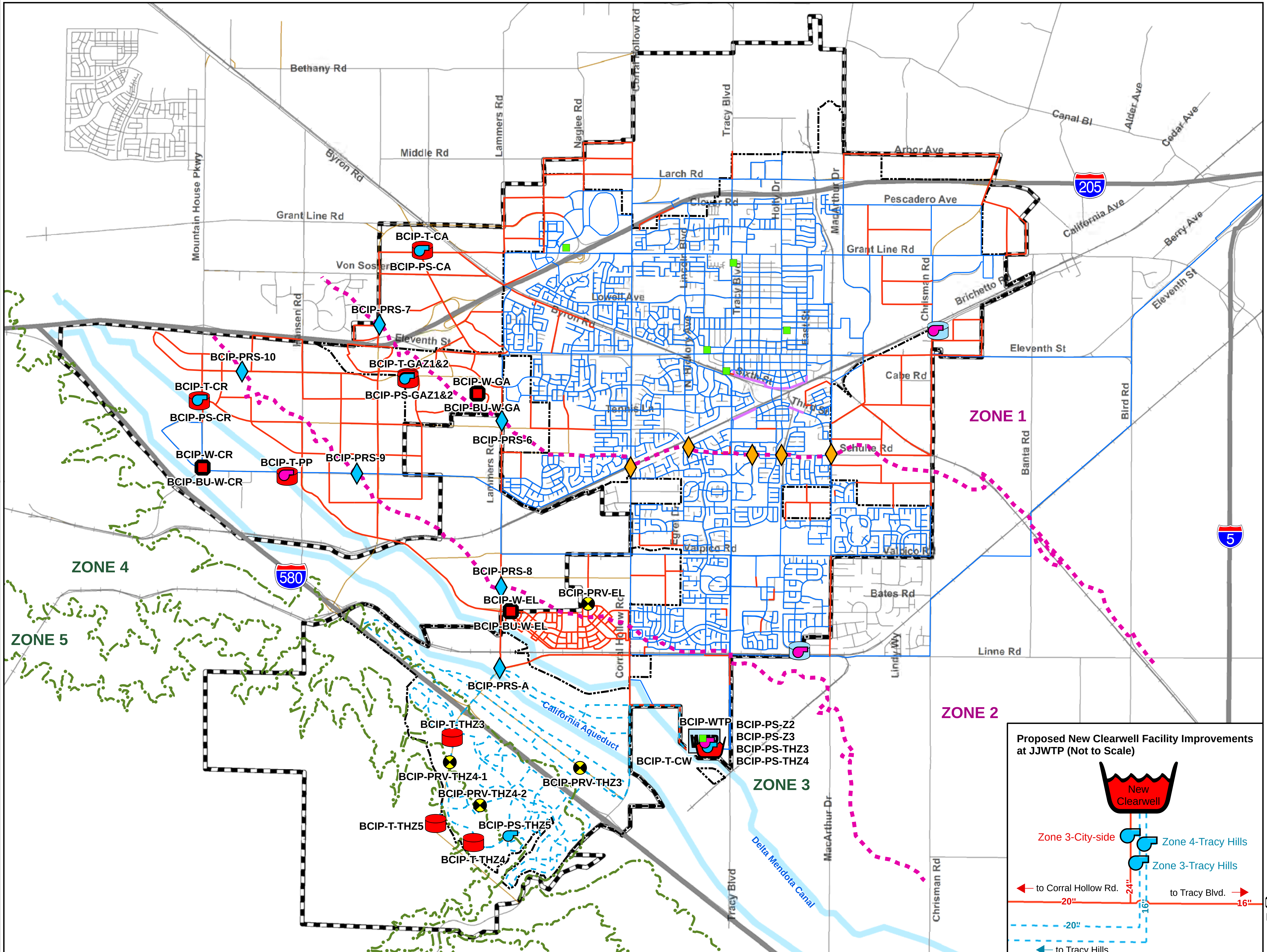
FIGURE ES-3

City of Tracy
Water System Master Plan

RECOMMENDED BUILDOUT POTABLE WATER SYSTEM CIP



NOTES

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.
2. Bore and jack pipeline projects are not shown, but is required for canal, railroad, or major highway crossings.
3. Individual PRVs on water service connections with static pressures exceeding 80 psi will be the responsibility of individual developer(s) to install.

LEGEND

- Proposed Pipeline
- Proposed Existing Pipeline Upsize
- Existing Pipeline
- Proposed Tracy Hills Pipeline
- Proposed Backup Power Generator
- Proposed Emergency PRV Connection
- Proposed Pressure Regulating Station
- Proposed ASR Groundwater Well
- Proposed Booster Pump Station
- Proposed Storage Tank
- Proposed Clearwell
- WTP JJWTP
- Existing Pressure Regulating Station
- Existing Groundwater Well
- Existing Booster Pump Station
- Existing Storage Tank
- SOI
- City Limits
- Proposed Street
- Existing Street

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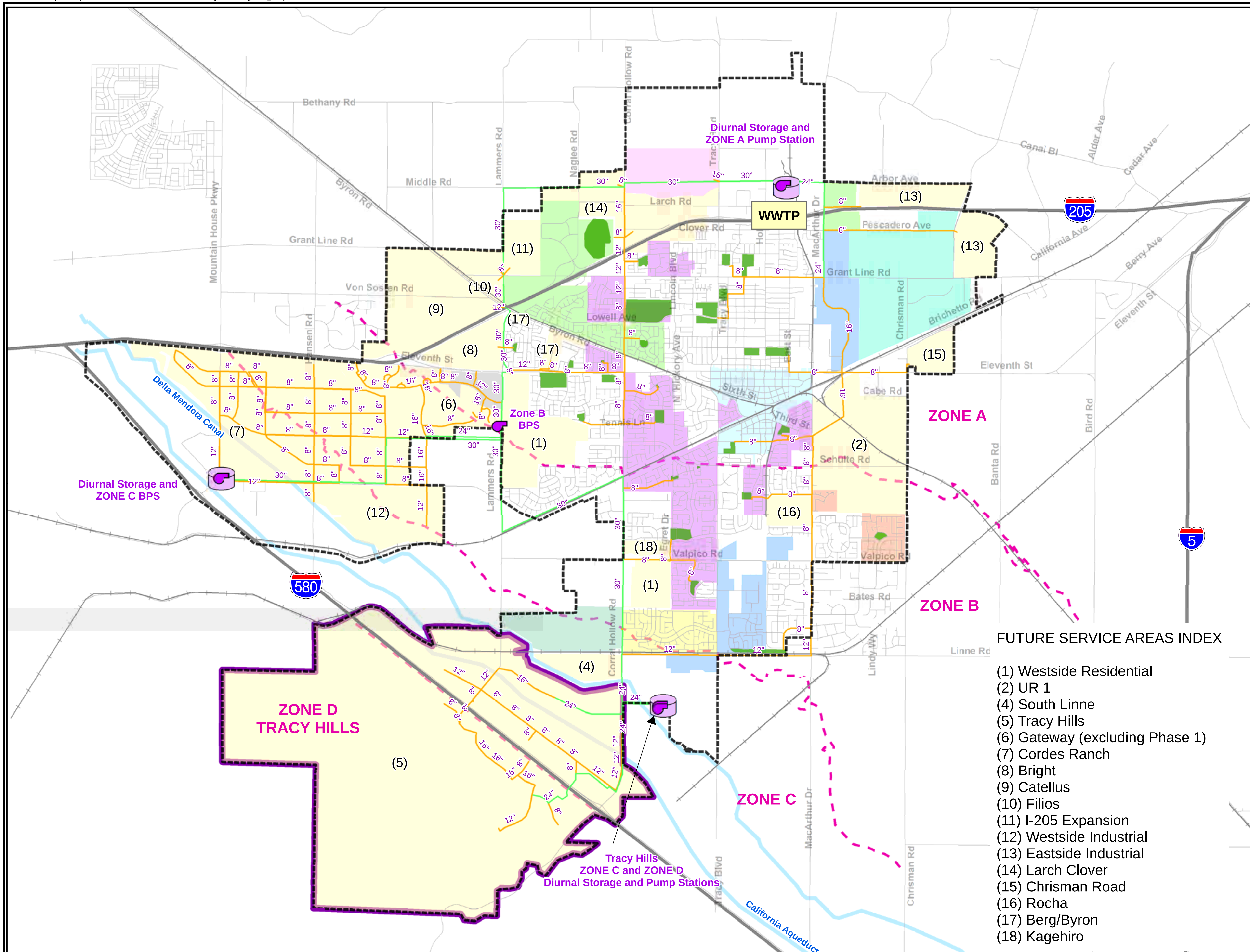
O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\ES\Fig ES-4_Recycled11x17.mxd 3/6/2012

FIGURE ES-4

City of Tracy Water System Master Plan

RECOMMENDED RECYCLED WATER SYSTEM CIP



0 2,640 5,280
Scale in Feet

NOTES:

1. Zone B BPS location is tentative. Additional piping would be required if another location is selected.

LEGEND

- Diameter ≤ 16 inches
- 16 inches < Diameter ≤ 30 inches
- Residential Areas Specific Plan
- Industrial Areas Specific Plan
- I-205 Corridor Specific Plan
- Plan "C"
- Northeast Industrial Specific Plan
- South MacArthur
- Downtown Specific Plan
- Ellis Specific Plan
- Tracy Gateway - Phase 1
- Holly Sugar Sports Park
- Future Service Area (see Index)
- Park/Irrigated Area
- SOI
- Tracy Hills WRF Service Area
- Zone Boundary
- Highway
- Existing Street
- Railroad

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 1
Introduction

1.1 CITYWIDE WATER SYSTEM MASTER PLAN PURPOSE

The purpose of this Citywide Water System Master Plan for the City of Tracy (City) is to provide an evaluation of the required backbone potable and recycled water system facilities required to serve buildout of the City's General Plan. This level of analysis is being referred to by the City as the "Tier 1" evaluation, in which overall planning objectives, goals and policies are defined and required backbone infrastructure is identified and sized to serve buildout of the City's General Plan.

A "Tier 2" evaluation, including evaluation of required "on-site" infrastructure to meet the needs of specific proposed development projects and potentially specific plan project phasing, will be initiated at a later date and is not included in this Citywide Water System Master Plan.

1.2 MASTER PLAN OBJECTIVES

The objectives of this Citywide Water System Master Plan are to:

- Provide recommendations to help the City meet its water system objectives and goals;
- Evaluate existing and projected future potable and recycled water demands at buildout of the City's General Plan;
- Provide an overview of the availability and reliability of the City's existing and future water supplies and their ability to meeting existing and future buildout water demands;
- Develop performance and operational criteria under which the potable and recycled water systems will be analyzed and future facilities will be formulated;
- Evaluate the need for new backbone potable water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan;
- Evaluate the need for new backbone recycled water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan; and
- Develop a capital improvement program for recommended potable and recycled water system facilities.

1.3 AUTHORIZATION

West Yost Associates (West Yost) was authorized to prepare this Citywide Water System Master Plan by the City on September 15, 2009.

1.4 REPORT ORGANIZATION

This Citywide Water System Master Plan is organized into the following chapters:

Chapter 1:	Introduction
Chapter 2:	Water Supply and Infrastructure System Objectives, Goals and Recommendations
Chapter 3:	General Plan Buildout Land Use Assumptions
Chapter 4:	Existing and Future Buildout Water Demands
Chapter 5:	Existing and Future Water Supplies
Chapter 6:	System Performance and Operational Criteria
Chapter 7:	Existing Potable Water System Evaluation
Chapter 8:	Buildout Potable Water System Evaluation
Chapter 9:	Buildout Recycled Water System Evaluation
Chapter 10:	Recommended Capital Improvement Program

The following appendices to this Citywide Water System Master Plan contain additional technical information, assumptions and calculations:

Appendix A:	List of Principles for Sustainable Infrastructure in the City of Tracy
Appendix B:	Preliminary Calculations Related to SBx7-7 Compliance
Appendix C:	Land Use Assumptions
Appendix D:	Water Demand Assumptions and Calculations
Appendix E:	JJWTP Expansion Project
Appendix F:	Summary of Hydraulic Model Calibration Process and Results
Appendix G:	Cost Estimating Assumptions
Appendix H:	Buildout Potable Water System Pipeline Improvements

1.5 ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations have been used throughout this Citywide Water System Master Plan to improve document clarity and readability.

AB	Assembly Bill
AC	Asbestos Cement
Af	Acre-Feet
af/ac/yr	Acre-Feet per Acre per Year
af/yr	Acre-Feet per Year
Ag	Agricultural

ASR	Aquifer Storage and Recovery
AWWA	American Water Works Association
BBID	Byron Bethany Irrigation District
BCID	Banta Carbona Irrigation District
BiOp	Biological Opinion
BMOs	Basin Management Objectives
BMPs	Best Management Practices
CALGreen	California Green Building Standards Code
CARB	California Air Resources Board
CCI	Construction Cost Index
CEQA	California Environmental Quality Act
CFC	California Fire Code
CI	Cast Iron
CII	Commercial, Industrial and Institutional
CIMIS	California Irrigation Management Information System
CIP	Capital Improvement Program
City	City of Tracy
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
DI	Ductile Iron
DMC	Delta-Mendota Canal
DPH	California Department of Public Health
Du	Dwelling Unit
DWR	Department of Water Resources
EPA	U.S. Environmental Protection Agency
EPS	Extended Period Simulation
FAR	Floor to area ratio
fps	Feet per Second
ft	Feet
ft/kft	Feet per Thousand Feet
General Plan	City of Tracy General Plan
GHG	Greenhouse Gases
GIS	Geographical Information System
GMO	Growth Management Ordinance
GMP	Groundwater Management Plan
gpcd	gallons per capita per day
gpd/ft	gallons per day per foot
gpm	Gallons per Minute
GWC	Groundwater Credit
HPR	Hydrant Pressure Recorder
JJWTP	John Jones Water Treatment Plant
K/J/C	Kennedy/Jenks/Chilton
LAFCO	Local Agency Formation Commission
LEED	Leadership in Energy and Environmental Design

M&I	Municipal and Industrial
MCLs	Maximum Contaminant Levels
MG	Million Gallons
mg/L	Milligrams per Liter
mgd	Million Gallons per Day
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PRS	Pressure Regulating Station
PRV	Pressure Reducing Valve
psi	Pounds per Square Inch
PSV	Pressure Sustaining Valve
PVC	Polyvinyl Chloride
PVWD	Plain View Water District
RGA	Residential Growth Allotment
RO	Reverse Osmosis
RWQCB	Regional Water Quality Control Board
SB610	Senate Bill 610
SBx7-7	Senate Bill x7-7
SCADA	Supervisory Control and Data Acquisition
SCS	Sustainable Community Strategy
SCWSP	South County Water Supply Project
Semitropic	Semitropic Water Storage Bank
SOI	Sphere of Influence
SRWBA	Semitropic-Rosamond Water Bank Authority
SSJID	South San Joaquin Irrigation District
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
Tracy Regional GMP	Tracy Regional Groundwater Management Plan
Tracy Sub-basin	San Joaquin Valley Groundwater Basin-Tracy Sub-basin
TRAQC	Tracy Regional Alliance for a Quality Community
TSWC	Treated Surface Water Credit
UAFW	Unaccounted-for Water
USBR	United States Bureau of Reclamation
UWMP	Urban Water Management Plan
West Yost	West Yost Associates
WRF	Water Recycling Facility
WSA	Water Supply Assessment
WSCP	Water Shortage Contingency Plan
WSID	West Side Irrigation District
WWTP	Waste Water Treatment Plant

1.6 ACKNOWLEDGEMENTS

The development of this Citywide Water System Master Plan would not have been possible without the key involvement and assistance of City staff. In particular, the following staff provided comprehensive information, significant input and important insights throughout development of this Citywide Water System Master Plan:

- Steve Bayley, Deputy Director, Public Works
- Bill Dean, Assistant Director, Development and Engineering Services
- Kul Sharma, City Engineer
- Andrew Malik, Director, Development and Engineering Services
- Carol Gorrie, Accounting Technician, Utility Billing
- Stephanie Reyna-Hiestand, Water Resources Analyst
- Bill Tapia, Facilities Maintenance Superintendent
- Dan Wengrin, Water Plant Supervisor

CHAPTER 2
Water Supply and Infrastructure System Objectives, Goals and Recommendations

2.1 INTRODUCTION

The on-going California drought conditions, environmental restrictions in the San Joaquin Delta, the recent poor economic conditions, increasing population, and limited water resources are serious problems affecting water agencies statewide. Many water agencies have adopted ordinances and taken other measures to ensure a reliable water supply for their customers. Unfortunately, the challenge of sustaining a water supply for future generations is becoming more challenging each year.

This chapter presents an overview of the City's water supply and infrastructure system objectives and goals, describes existing policies and provides recommendations for future measures to help the City meet those objectives and goals. These recommendations became the basis for a list of principles for sustainable infrastructure that will be used to develop the infrastructure master plans for the City. A complete list of the principles is included in Appendix A of this Citywide Water System Master Plan. The principles related to water infrastructure are described at the end of this chapter.

2.2 OVERALL WATER SYSTEM OBJECTIVES AND GOALS

This Citywide Water System Master Plan has been prepared based on the following overall water system objectives and goals:

- Ensure safe, adequate and reliable water supplies for the City's existing and future residents and businesses through buildout of the City's General Plan;
- Comply with existing and future water quality regulations for both potable and non-potable (recycled) water supplies;
  - — Support the City's compliance with recently adopted legislation related to reducing greenhouse gases (AB32[1] and SB375[2]) by improving the efficiency of water system facility operations when feasible;
  - — Comply with the California Green Building Standards Code[3], and other "green" building guidelines, as they relate to standards for interior and exterior water use, to promote more efficient use of the City's water supplies; and

[1] AB32 California Global Warming Solutions Act of 2006: Signed into law September 27, 2006; requires the California Air Resources Board (CARB) to develop regulations and market mechanisms that will ultimately reduce California's greenhouse gas (GHG) emissions by 25 percent (to 1990 levels) by 2020.

[2] SB375: Signed into law September 30, 2008; requires each metropolitan region to adopt a "sustainable community strategy" (SCS) in its regional transportation plans to encourage compact development that aligns with regional GHG emissions reduction targets set by the California Air Resources Board (CARB); enhances the CARB's ability to reach AB32 goals; intended to promote more environmentally-friendly communities, more sustainable developments, less time people spend in their cars, and more alternative transportation options.

[3] 2010 California Green Building Standards Code (CALGreen) (California Code of Regulations Title 24, Part 11).

- Comply with recently enacted legislation to reduce per capita water use statewide (*i.e.*, SBx7-7 “20x2020” Water Conservation) to increase the sustainability and extend the longevity of the City’s existing water supplies.

The following sections of this chapter describe the City’s existing policies and additional recommended measures for water conservation, recycled and non-potable water, and water system facility operations, to help meet these overall water system objectives and goals.

2.3 WATER CONSERVATION PROGRAMS

2.3.1 Existing Water Conservation Programs

The City has an on-going water conservation program that includes residential surveys, public and school education programs, rebates for water-efficient appliances and other specific programs. These programs have been successful in reducing water use, especially in the recent dry years. In the late 1980’s and early 1990’s, the City’s overall per capita water use was about 300 gpcd. However, since the late 1990’s, the City’s overall per capita water use has been significantly reduced. Since 2000, the City’s average overall per capita water use has been 208 gpcd. In 2009, which was a dry year and a year in which overall water demands were probably affected by poor economic conditions (*e.g.*, vacant residences due to foreclosures), the City’s per capita water use dropped to 182 gpcd.

The City also has a Water Shortage Contingency Plan (WSCP) which was originally developed in 1992. The WSCP includes triggers for implementation of various stages of the WSCP based on various water supply shortage scenarios, along with specific water use restrictions for each stage of the WSCP, which are intended to reduce the City’s water demand by up to 50 percent in the event of a water supply emergency or a drought condition. Water use restrictions in Phase I of the WSCP are voluntary, while restrictions for the later phases of the plan are mandatory and become increasingly restrictive as needed to reduce the City’s water demand. The City’s WSCP is included as an appendix to the City’s Urban Water Management Plan (UWMP).

2.3.2 Compliance with Required Statewide Reductions in Per Capita Water Use

In February 2008, Governor Arnold Schwarzenegger called for a statewide 20 percent reduction in per capita water use by 2020 and asked State and local agencies to develop a more aggressive plan of water conservation to achieve the goal. A team of State and federal agencies (the “20x2020” Agency Team) consisting of the Department of Water Resources (DWR), State Water Resources Control Board (SWRCB), California Energy Commission, Public Utilities Commission, Department of Public Health, California Air Resources Board, CALFED Program, the U.S. Bureau of Reclamation, and the California Urban Water Conservation Council (CUWCC) was formed to develop a statewide implementation plan for achieving this goal.

Then, on November 10, 2009, Governor Arnold Schwarzenegger signed Senate Bill x7-7 (SBx7-7), one of several bills passed as part of a comprehensive set of new Delta and water policy legislation. SBx7-7 requires a 20 percent reduction in urban water usage by 2020 and establishes methodologies for urban water suppliers to establish their individual, agency-specific interim (2015) and final (2020) per capita water use targets. The City’s compliance with this new legislation will require a further reduction in the City's overall per capita water use. This required reduction in per capita water use is discussed in Chapter 4 of this Citywide Water System Master Plan.

2.4 RECYCLED AND NON-POTABLE WATER RECOMMENDATIONS

2.4.1 Existing Policies

In 2002, the City adopted a Recycled and Non-Potable Water Ordinance which established the policy that recycled water may be used for non-potable uses within the City's designated recycled water use areas (as defined in the City Municipal Code in Chapter 11.30 Recycled and Non-Potable Water). Specific provisions include the following:

> *11.30.030 (a) All subdivisions for which a tentative map or parcel map is required pursuant to Government Code section 66426 and located within designated recycled water use areas shall be required to install a recycled water distribution system to provide recycled water to the common areas*[4] *of any subdivision and for any industrial cooling or processing uses in the subdivision.*

The intent of this existing City policy is to require new development to use recycled water for landscape irrigation on professionally managed and maintained landscapes located within the City, such as golf courses, parks, greenbelts, and landscaped streets and medians, and for any applicable industrial cooling or processing purposes. This applies to all land use designations within the City's General Plan including, but not limited to, residential, commercial, industrial, and institutional. The only exception is landscaped areas within residential land uses which are maintained by private homeowners (*e.g.*, private backyards or front yards which are not considered common areas); recycled water will not be required for landscape irrigation in these privately maintained areas.

2.4.2 Recommended Additional Measures

To further encourage and expand the future use of recycled and/or non-potable water within the City, the following additional measures should be considered:

- Require the use of tertiary-treated wastewater for agricultural irrigation within the City as appropriate and as allowed by Title 22 regulations.
- Require the use of recycled or non-potable water for all decorative water features and artificial lakes.

[4] "Common areas" shall include, but not be limited to, golf courses, parks, greenbelts, landscaped streets, and landscaped medians.

- Require that existing large landscaped areas currently irrigated with potable water supplies, such as City parks and sports fields, be converted to recycled or non-potable water use as opportunities for construction of recycled or non-potable water facilities to serve these existing areas occur. This may be done in conjunction with a "potable water offset" program (see further discussion under *Section 2.7 Recommendations to Reduce Water Use by New Development*).
- Require that existing facilities with evaporative cooling systems and other industrial cooling processes currently using potable water supplies be converted to recycled or non-potable water use as opportunities for construction of recycled or non-potable water facilities to serve these existing areas occur.
- Add a "Duty to Connect" requirement to Chapter 11.30 of the City's Municipal Code requiring facilities with large irrigated landscapes and/or industrial cooling systems to connect to the City's recycled water system if they are within 200 feet of a potential connection point to the City's recycled water distribution system (similar to existing "Duty to Connect" requirements for wastewater (City Code Chapter 5.24.210) and water (City Code Chapter 11.04.160)).

2.5 GREEN BUILDING CODES AND GUIDELINES

2.5.1 Compliance with California Green Building Standards Code

The 2008 California Green Building Standards Code (sometimes referred to as the CALGreen Code) was published in Part 11 of California's Title 24 Code and became effective on August 1, 2009. It included primarily voluntary green building standards for non-residential buildings, and mandatory standards for low-rise residential buildings. The 2010 California Green Building Standards Code established mandatory and voluntary CALGreen provisions for residential and non-residential construction with an effective date of July 1, 2011. The key mandatory provisions of which are as follows:

Residential Mandatory Measures:

- Reduce indoor potable water use by 20 percent by installing ultra-low-flow fixtures and appliances (*e.g.*, 2 gallons per minute (gpm) showerheads, 1.8 gpm faucets, 1.28 gallons/flush toilets, 0.8 gallons/flush urinals); and
- Provide weather- or soil moisture-based irrigation controllers for outdoor water use.

Non-Residential Mandatory Measures:

- For buildings in excess of 50,000 square feet, provide separate submeters for each individual leased, rented or other tenant space within the building projected to consume more than 100 gallons per day;
- Reduce indoor potable water use by 20 percent by installing ultra-low-flow fixtures and appliances (*e.g.*, 2 gpm showerheads, 1.8 gpm faucets, 1.28 gallons/flush toilets, and 0.8 gallons/flush urinals);

- Provide weather- or soil moisture-based irrigation controllers for outdoor water use;
- Establish landscape irrigation water budgets which conforms to the local water efficient landscaping ordinance or to the DWR Model Water Efficient Landscape Ordinance where no local ordinance is applicable; and
- Provide separate meters or submeters for indoor and outdoor potable water use.

Voluntary measures included in the 2010 CALGreen Code include further reductions in indoor water use in both residential and non-residential buildings, installation of low-water consumption irrigation systems, installation of rainwater systems, installation of graywater systems, and installation of dual plumbing systems.

2.5.2 Leadership in Energy and Environmental Design (LEED) Guidelines

LEED is an internationally recognized green building certification system developed by the U.S. Green Building Council that includes guidelines and checklists for new buildings to promote energy savings, water efficiency, CO_2 emissions reduction, and improved indoor environmental quality. The intent of LEED is to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

The LEED 2009 guidelines for new construction and major renovations require a 20 percent reduction in indoor potable water use (consistent with the CALGreen Code described above) and awards credits for the following additional measures:

- Water efficient landscaping that either reduces potable water use by 50 percent or totally eliminates potable water use for irrigation uses;
- Innovative wastewater technologies that reduce wastewater generation and potable water demand while increasing local aquifer recharge; and
- Further reductions in indoor water use beyond the required 20 percent.

2.5.3 Build It Green Guidelines

Build It Green is a membership supported non-profit organization whose mission is to promote healthy, energy- and resource-efficient homes in California. Build It Green has developed "GreenPoint Checklists" to assess how environmentally friendly or "green" a building is. Build It Green also offers a third-party home rating program called "GreenPoint Rated".

The GreenPoint Checklist for single family homes includes several items related to water use efficiency including the following:

- Use of California native plant species;
- Minimization of turf areas;
- Planting of shade trees;

- Installation of high-efficiency irrigation systems; and
- Mulching of all planting beds.

The City should consider adopting portions or all of the CALGreen Code as appropriate and/or adopting policies and guidelines recommended by the U.S Green Building Council (*e.g.*, LEED) or the "Build It Green" organization that publishes green building guidelines and checklists for new construction and remodeling projects.

2.6 RECOMMENDATIONS TO REDUCE WATER USE BY EXISTING CUSTOMERS

The following recommendations should be considered to reduce overall water use and per capita water use in the City:

- Revise existing City Municipal Code provisions to discourage water waste and encourage water conservation on a full-time basis;
- Consider Adoption of a Retrofit Upon Resale Ordinance;
- Implement a Turf Replacement Rebate ("Cash for Grass") Program; and
- Implement a Landscape Water Audit and Budget Program.

Each of these recommendations is described below.

2.6.1 Revise Existing City Municipal Code Provisions to Discourage Water Waste and Encourage Water Conservation on a Full-Time Basis

Currently, the City's Municipal Code (Chapter 11.28 Water Management) has provisions for water waste prevention and water conservation measures to be implemented in the case of drought or other emergency water shortage. The provisions are based on a four-phased Water Shortage Contingency Plan with water use restrictions becoming stricter with each phase of the plan.

Phase I of the Water Shortage Contingency Plan includes the following provisions:

> *11.28.170 Phase I water conservation measures:*
>
> *(a) No person, owner, or manager responsible for the day-to-day operation of any premises shall permit flagrant water waste or excessive runoff of water at any time during which Phase I or subsequent phases are imposed.*
>
> *(b) Proper maintenance of all plumbing and irrigation systems; installation of water-conserving plumbing or attachments; control all leaks within seventy-two (72) hours;*
>
> *(c) Residents and businesses are to practice prudent water conservation measures at all times. Examples of useful water conservation measures are as follows:*

(1) Use of a hand-held sprayer with a self-closing "trigger" handle for all outdoor uses;

(2) The voluntary planting of drought tolerant landscapes; the installation and maintenance of water-efficient irrigation systems such as drip and bubble irrigation, and the installation of sprinkler heads with a low flow rate appropriate for the landscape to prevent overwatering and runoff;

(3) Water in the morning hours during non-windy periods.

(d) All new swimming pools, hot tubs and spas installed after the effective date of the ordinance codified in this section shall have a separation tank and water recovery system installed in the filter backwash system, with a ninety (90%) percent water recovery standard. Non-permeable floating pool covers shall be required and shall provide ninety (90%) percent surface coverage on all pools, spas and hot tubs.

As currently written in the City's Municipal Code, the provisions listed above are only implemented if Phase I of the City's Water Shortage Contingency Plan is enacted by City Council. However, according to City staff, Phase I of the City's Water Shortage Contingency Plan is in effect at all times.

The City is currently in the process of updating its Water Shortage Contingency Plan. The City should revise the plan to make the Phase I water shortage provisions permanent to discourage water waste and encourage water conservation to be in effect at all times, not only during droughts or other emergency water shortages. This revised plan should then be adopted and incorporated in the City's Municipal Code.

2.6.2 Consider Adoption of a "Retrofit Upon Resale" Ordinance

In accordance with State plumbing codes, all new homes constructed after 1992 are required to have water conserving fixtures. In addition, the City offers low-flow plumbing fixtures to its customers as part of its residential water surveys and other water conservation events and educational seminars. However, in addition to these types of programs, some water agencies have implemented "Retrofit Upon Resale" ordinances which require that older, high-water-use plumbing fixtures be replaced with low-flow plumbing fixtures whenever a property is sold.

For most agencies, the ordinance requires that all buildings, prior to a change in property ownership, be certified as having water-conserving plumbing fixtures in place. Also, the ordinances apply to all residential, commercial, and industrial water customers. Generally, the seller is responsible for ensuring that the property is in compliance, and for filing a Water Conservation Certificate with the water agency prior to the close of escrow. Agencies with such an ordinance in place include: City of San Diego, City of Los Angeles, City of San Francisco, City of Santa Monica, Monterey Peninsula Water District, and North Marin Water District.

In October 2009, SB407 was passed in California which established statewide requirements for installation of water-conserving plumbing fixtures in conjunction with building improvements and property transfers. The City will need to comply with these requirements. Key dates and requirements are as follows:

- On or after January 1, 2014, for all building alterations or improvements to single family residential real property, that water-conserving plumbing fixtures replace other noncompliant plumbing fixtures as a condition for issuance of a certificate of final completion and occupancy or final permit approval by the local building department.
- On or after January 1, 2014, for all building alterations or improvements to multi-family residential real property and commercial real property, that water-conserving plumbing fixtures replace other noncompliant plumbing fixtures as a condition for issuance of a certificate of final completion and occupancy or final permit approval by the local building department.
- On or before January 1, 2017, that all noncompliant plumbing fixtures in any single family residential real property shall be replaced by the property owner with water-conserving plumbing fixtures.
- On or after January 1, 2017, that a seller or transferor of single-family residential real property, multi-family real property, or commercial real property disclose to a purchaser or transferee specified requirements for replacing plumbing fixtures, and whether the property includes noncompliant plumbing.
- On or before January 1, 2019, that all noncompliant plumbing fixtures in multi-family residential real property and commercial real property, be replaced with water-conserving plumbing fixtures.

2.6.3 Implement a Turf Replacement Rebate ("Cash for Grass") Program

A large portion of a property's annual water use can be attributed to outdoor water uses, and turf irrigation is the largest part of outdoor water use. It is estimated that over half of a home's annual water use is used for landscape irrigation. Several water agencies in California and Nevada (North Marin Water District, City of Roseville, City of Arroyo Grande, and Southern Nevada Water Authority) have implemented turf replacement rebate programs, also known as "Cash for Grass" programs. These programs consist of rebates for existing property owners who choose to permanently replace their turf landscaping with water conserving landscaping or synthetic/artificial turf.

One such program is North Marin Water District's "Cash for Grass" program which offers a cash rebate to its residential customers in return for permanently reducing the amount of lawn area in their landscapes. The District pays $100 per 100 square feet of regularly-irrigated lawn area removed or amount of lawn area replaced with synthetic turf. The rebate is limited to $1,000 for single family residences, $200 for townhomes or condominiums, and $100 for apartments. The District will also rebate "Cash for Grass" participants 25 percent of the costs of District-approved mulch up to $100.

The City should consider implementing such a program to reduce outdoor water use.

2.6.4 Implement a Landscape Water Audit and Budget Program

This program would involve performing audits for large landscape areas to make sure that water is being applied efficiently to help reduce water use. The audit would include a "catch can" test, flow tests, an irrigation inspection and a review of the irrigation schedule. Based on the audit, a budget can be developed for each site based on the calculated area and local evapotranspiration data. The City of Redwood City has developed such a program and has developed a budget-based tiered rate schedule for their landscape irrigation connections. Sites that stay within their site-specific irrigation budget are charged at a Tier 1 rate; however, any water use above the site-specific irrigation budget is charged at a higher Tier 2 rate. The program has been very successful in getting homeowner's associations to pay attention to their irrigation water use and work closely with their landscape contractors to optimize irrigation system operations and schedules.

The City should consider implementing such a program to reduce outdoor water use.

2.7 RECOMMENDATIONS TO REDUCE WATER USE BY NEW DEVELOPMENT

2.7.1 Recommendations for New Development

To allow the City to meet its water conservation goals and maintain the long-term sustainability of its water resources, the following recommendations should be considered for new development projects in the City:

- Require all new development projects to meet a reduced overall per capita water use goal, consistent with the "20 x 2020" requirements included in SBx7-7 (see further discussion in Chapter 4).
- Require all new development projects to meet indoor water efficiency standards (in accordance with the 2010 California Green Building Standards Code).
- Reduce indoor residential and non-residential water use by 20 percent through installation of low-flow fixtures (*e.g.*, 2 gpm showerheads, 1.8 gpm faucets, and 1.28 gallons/flush toilets) and water-efficient appliances.
- Require all new development projects to meet outdoor water efficiency standards (in accordance with the 2010 California Green Building Standards Code) including development of water budgets for landscape irrigation use, and reducing or eliminating potable water use for landscape irrigation.
- Require new non-residential buildings to employ water reuse systems, such as building-scale graywater systems or connections to larger-scale recycled water systems for cooling systems and other non-potable water demands.

- Require new development projects to offset or mitigate its water demands if demands exceed those accounted for in the Citywide Water System Master Plan based on buildout of the City's adopted General Plan. The offset or mitigation may be achieved by reducing the water demands within the project (through the implementation of water conservation measures and/or incorporation of recycled water use) and/or participating in a project to reduce potable water demands in another portion of the City to offset the potable water demands of the proposed project.
- Require new subdivisions to install "purple pipe" for distribution of recycled water at the beginning of the project, even if recycled water is not immediately available (consistent with existing City Municipal Code Section 11.30.030 (a), see description above).

2.7.2 Water Efficient Landscape Ordinance

Outdoor water use for landscape irrigation makes up a significant portion of the total water use in the City. The City has "Guidelines for Water Efficient Landscape Design, Development and Maintenance" which are dated July 1, 1991. These guidelines are included as Attachment A of the City's Design Goals and Standards which were amended on April 15, 2008.

In 2006, the State enacted legislation (AB1881) requiring the update of the State Model Water Efficient Landscape Ordinance (Model Ordinance). On September 17, 2009, DWR released an updated Model Ordinance to assist local governments in reducing water waste in landscapes. All local land use agencies were required to adopt the Model Ordinance, or develop an ordinance that is at least as effective, by January 1, 2010. Key components of the Model Ordinance include requirements for the following:

- Landscape design plans (*e.g.*, plant selection, slopes, guidelines for water features, *etc*.)
- Irrigation design plans (*e.g.*, separate meters for large landscape areas, automatic irrigation controllers utilizing evapotranspiration or soil moisture sensor data, use of rain sensors, *etc*.)
- Grading design plans (*e.g.*, erosion and runoff protection)
- Irrigation scheduling and the development of a maximum applied water allowance (*e.g.*, allowable water days and times, landscape water budgets, *etc*.)
- Landscape and irrigation maintenance scheduling
- Irrigation audits, irrigation surveys and irrigation water use analysis
- Use of recycled water (*e.g.*, landscape irrigation, decorative water features)

As of January 1, 2010, the Model Ordinance from DWR is being enforced by the City as required by State law. However, the City is also working to develop its own ordinance for water efficient landscaping in accordance with the requirements established by the Model Ordinance.

2.8 RECOMMENDATIONS FOR NEW WATER SYSTEM FACILITIES AND OPERATIONS

The following recommendations should be considered by the City to make operations of the City's water facilities more efficient:

- Establish designated utility corridors within new development areas; these designated utility corridors should be within public rights-of-way to minimize or eliminate the need for utility easements within private property;
- Install solar power systems, or alternative power sources, at existing and new pump stations and other water system facilities, as feasible, to reduce electrical power consumption; and
- Increase the frequency of routine operations and maintenance (O&M) activities for existing pump stations and wells to maintain pump efficiencies and reduce power demands.

2.9 PRINCIPLES FOR SUSTAINABLE INFRASTRUCTURE IN THE CITY OF TRACY

In November 2009, based on the recommendations described in this chapter, and similar recommendations provided by the City's other infrastructure consultants, the City developed a list of principles for sustainable infrastructure for use in developing its infrastructure master plans. Principles were developed for storm drainage, water, wastewater, recycled water, and roadways and transportation. A copy of the established principles is included in Appendix A. The principles related to water infrastructure are summarized as follows:

- Energy efficient design and control systems should be used in all new facilities to minimize power consumption. Look for opportunities to use solar generation facilities.
- Promote and encourage, where feasible, the use of recycled water (Title 22 criteria) for non-potable uses in existing and future public landscaped areas.
- Establish and adopt interior and exterior water conservation requirements which are consistent with recommended State guidelines, to the degree possible.
- Require existing City customers to participate in water conservation activities that will enable the City to meet or exceed the projected ten-year water conservation requirements proposed in the "20x2020" State plan.
- Create a water rate structure that supports and provides incentives for water conservation.
- Encourage and create incentives to convert high water use on outdoor landscaping to more drought-resistant plantings to facilitate water conservation among existing water users.

As applicable, these sustainability principles will be incorporated into the Citywide Water System Master Plan as described in the following chapters.

General Plan Buildout Land Use Assumptions

3.1 OVERVIEW

The purpose of this Tier 1 Citywide Water System Master Plan is to evaluate the required potable water and recycled water infrastructure to serve buildout of the City's General Plan. Buildout of the City's General Plan includes buildout of development projects with approved water supply (including infill) and future service areas within the City's Sphere of Influence (SOI).

3.2 THE CITY'S GENERAL PLAN

The City's General Plan is the principal policy document for guiding future conservation and development of the City of Tracy, including the SOI, which is the area outside of the City limits that the City expects to annex and urbanize in the future. The General Plan was adopted by City Council on February 1, 2011 and is used as the basis for the City's Infrastructure Master Plans, including this Citywide Water System Master Plan.

3.3 THE CITY'S SPHERE OF INFLUENCE

The SOI area in the City's General Plan is about 19 square miles (existing City limits are approximately 22 square miles, for a total General Plan area of about 41 square miles). Figure 3-1 illustrates the SOI boundary and the future land uses included in the General Plan. As shown on Figure 3-1, many of the areas outside of the City limits, but within the SOI, are designated as Urban Reserve. As described below, proposed future development within these Urban Reserve areas includes a variety of land uses, including Residential, Commercial and Industrial uses. It should be noted that a large portion of these Urban Reserves are proposed to have Industrial and Commercial land uses. The impacts on the City's overall per capita water use and ability to comply with SBx7-7 "20 x 2020" requirements, is discussed in Chapter 4 of this Citywide Water System Master Plan.

3.4 BUILDOUT OF THE CITY'S SPHERE OF INFLUENCE

Buildout of the City's SOI will include several land use components. They include the following:

- Existing developed land uses within the City limits;
- Development projects with approved water supply (including infill); and
- Future service areas (also known as Urban Reserves) located within the SOI.

3.4.1 Existing Land Uses

Existing land uses within the City limits are discussed in Chapter 4. Water demands from the existing land uses will be included in the future water demand projections for buildout of the City's General Plan (see Chapter 4).

3.4.2 Development Projects with Approved Water Supply

The City has of number of development projects with approved water supply located within the City limits which are on-going. Some of these projects have defined financing for water supply, while others do not. These projects are listed and summarized in Table 3-1.

Table 3-1. Summary of Development Projects with Approved Water Supply

Project Name	Notes
Residential Areas Specific Plan	Specific Plan dated June 1987; Final EIR dated June 1987. Approved by City prior to passage of SB 610, therefore no Water Supply Assessment was required.
Industrial Areas Specific Plan (North and South)	Specific Plan dated June 1988; Final EIR dated February 1988; Final EIR Supplement dated November 1989. Approved by City prior to passage of SB 610, therefore no Water Supply Assessment was required.
I-205 Corridor Specific Plan	Specific Plan dated February 1991. Approved by City prior to passage of SB 610, therefore no Water Supply Assessment was required.
Plan “C” Residential Planning Area	Approved by City prior to passage of SB 610, therefore no Water Supply Assessment was required.
Northeast Industrial Specific Plan (Phases 1, 2 and 3)	Development Plan dated February 1996: Draft EIR dated February 1996; Final EIR dated May 1996. Approved by City prior to passage of SB 610, therefore no Water Supply Assessment was required.
South MacArthur	Approved by City prior to passage of SB 610, therefore no Water Supply Assessment was required.
Downtown Specific Plan	Draft Specific Plan dated March 2009. A Water Supply Assessment for the Downtown Specific Plan was approved by the Tracy City Council in April 2009.
Infill Projects	Infill Projects include numerous residential and commercial projects located throughout the City, including the Tracy Boulevard Assessment District, Eastgate Business Park, Tiburon Village and others. Because of their small size, the City’s infill projects are generally not subject to SB 610 requirements and do not require the preparation of a Water Supply Assessment.
Ellis Specific Plan	Ellis Specific Plan dated December 2008; Draft EIR dated April 2008; Final EIR dated December 2008. The Ellis Specific Plan project is considered to be a development project with approved water supply per the project’s Development Agreement with the City. A Water Supply Assessment for the project was approved by the Tracy City Council in December 2007.
Tracy Gateway Project (Phase 1 only)	Tracy Gateway Concept Development Plan dated October 2002; Water Supply and Infrastructure Report dated May 2007. Only the Phase 1 portion of the Gateway Project, referred to as the “First Final Map”, is considered to be a development project with approved water supply. Remaining portions of the Gateway Project are considered as a “Future Service Area”.
Holly Sugar Sports Park Specific Plan	Draft EIR August 2009; Final EIR dated June 2019. A Water Supply Assessment for the Holly Sugar Sports Park was approved by the Tracy City Council in June 2009.

Many of these development projects with approved water supply are in progress and have been partially completed, or have approved Water Supply Assessments. The City's Planning Division tracks the completion status of these on-going projects. As discussed in Chapter 4, water demands for the completed portions of these projects are included in the City's existing water demands. Anticipated additional future water demands associated with completion of these development projects have been estimated based on information provided by the City's Planning Division regarding the number of residential dwelling units and industrial, office and retail acres remaining to be developed within each of these development projects, and are included in the future water demand projections for buildout of the City's General Plan (see Chapter 4).

The locations of the development projects with approved water supply, except for Infill Projects, are shown on Figure 3-2.

3.4.3 Future Service Areas within the City and the City's SOI

In addition to the development projects with approved water supply (including infill), the City has identified a number of future service areas within the City's SOI. As described above, many of these future service areas are designated as Urban Reserve in the City's General Plan. As future developments within the City's SOI, but outside of the City limits, are approved, they will be annexed into the City and served by the City's water system.

The proposed land uses and number of anticipated residential dwelling units associated with these future service areas are summarized below and discussed further in Chapter 4[1,2]:

- 2,629 acres of Residential Development (13,719 Total Residential Dwelling Units)
  - 713 Very Low Density Residential Dwelling Units
  - 4,191 Low Density Residential Dwelling Units
  - 5,752 Medium Density Residential Dwelling Units
  - 3,063 High Density Residential Dwelling Units
- 3,379 acres of Industrial Development
- 698 acres of Office Development
- 1,233 acres of Retail Development
- 921 acres of Public Facilities and Open Space

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[1] The proposed land uses and number of anticipated residential dwelling units associated with the Tracy Gateway Phase 1 and Ellis Specific Plan projects are not included with these future service areas; they are included with development projects with approved water supply (see discussion under *Section 3.4.2 Development Projects with Approved Water Supply*).

[2] As discussed further in Appendix C, the proposed land uses and/or number of anticipated residential dwelling units for the Ellis Specific Plan and Cordes Ranch projects have subsequently been revised in April and May 2012, respectively. However, these revisions do not significantly impact the buildout water demand projections presented in this WSMP, which were developed prior to these revisions received in April and May 2012.

The locations of these future service areas are shown on Figures 3-2 and 3-3.

Some of the future service areas are currently with the City limits and have already completed specific plans, master plans, and/or water supply assessments. These include the following projects:

- Tracy Hills
  - — Specific Plan approved by City Council on June 16, 1998
  - — Water Master Plan approved by City Council in December 2000[3]
  - — Recycled Water Master Plan approved by City Council in December 2000
- Tracy Gateway (*i.e.*, the remaining parcels not included in Phase 1)
  - — General Plan Amendment and Concept Development Plan dated October 2002
  - — Water Supply and Infrastructure Report dated May 2007

Where applicable, land use assumptions used in these previous studies have been used to supplement the data from the City's Planning Division for these projects (particularly with regard to proposed non-residential land uses).

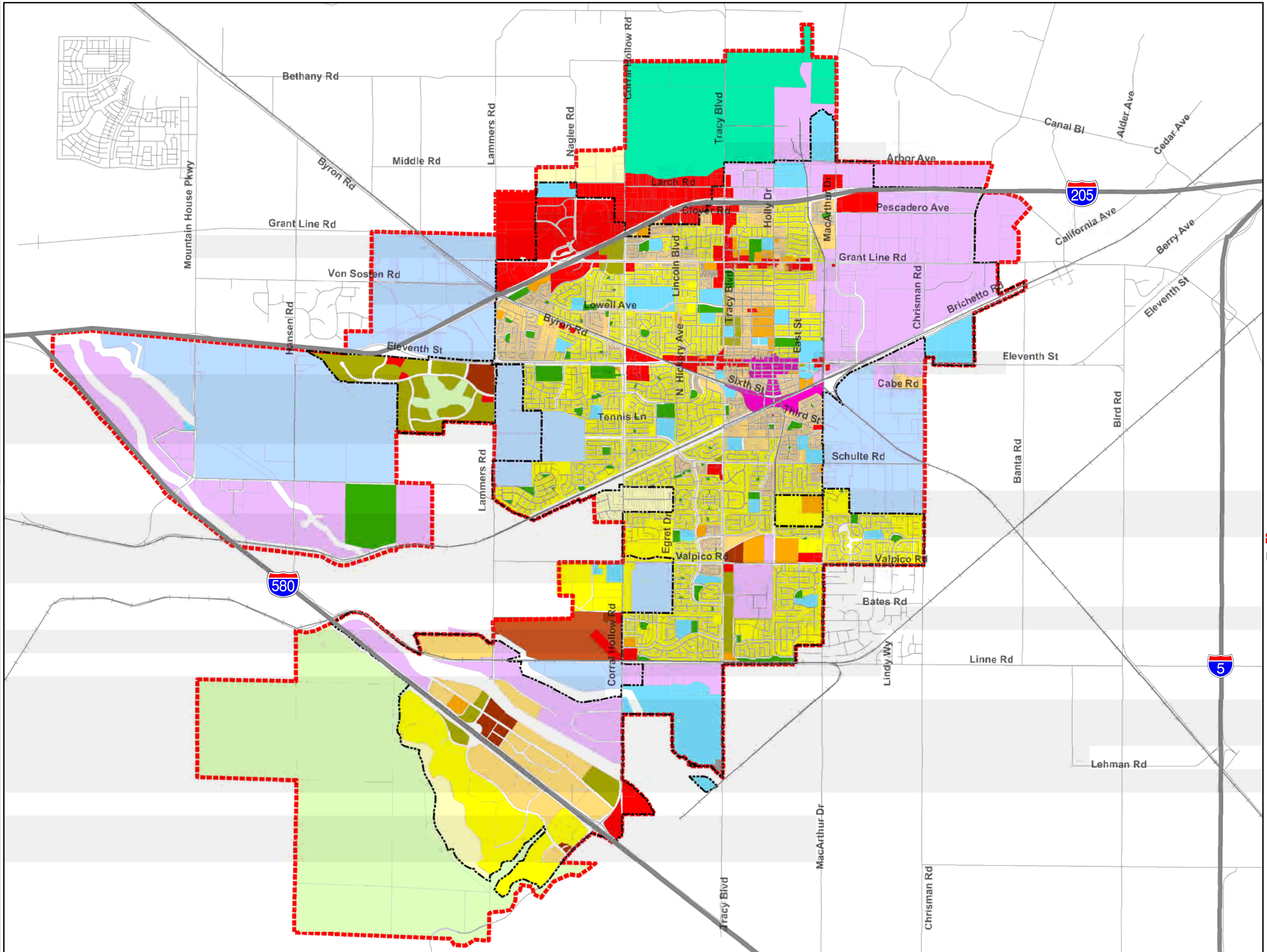
Projected water demands for these future service areas have also been included in the future water demand projections for buildout of the City's General Plan (see Chapter 4).

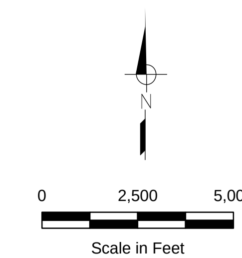
[3] The Tracy Hills Project plans to revise the Tracy Hills Water Master Plan.

FIGURE 3-1

City of Tracy
Water System Master Plan

GENERAL PLAN LAND USE





NOTES
1. General Plan land use file (GPLU_revised_January2009.shp) provided by DCE on 11/05/09.
2. City limits and SOI files (citylimit.shp and SOI_revised_January_09.shp) provided by DCE on 11/05/09. SOI shape file was revised based on data received from the City on 08/03/10.

LEGEND
- SOI
- City Limits
- Residential Very Low
- Residential Low
- Residential Medium
- Residential High
- Traditional Residential - Ellis
- Commercial
- Office
- Industrial
- Downtown
- Village Center
- Public Facilities
- Park
- Open Space
- Agriculture
- Aggregate
- Urban Reserve
- Highway
- Existing Street
- Railroad

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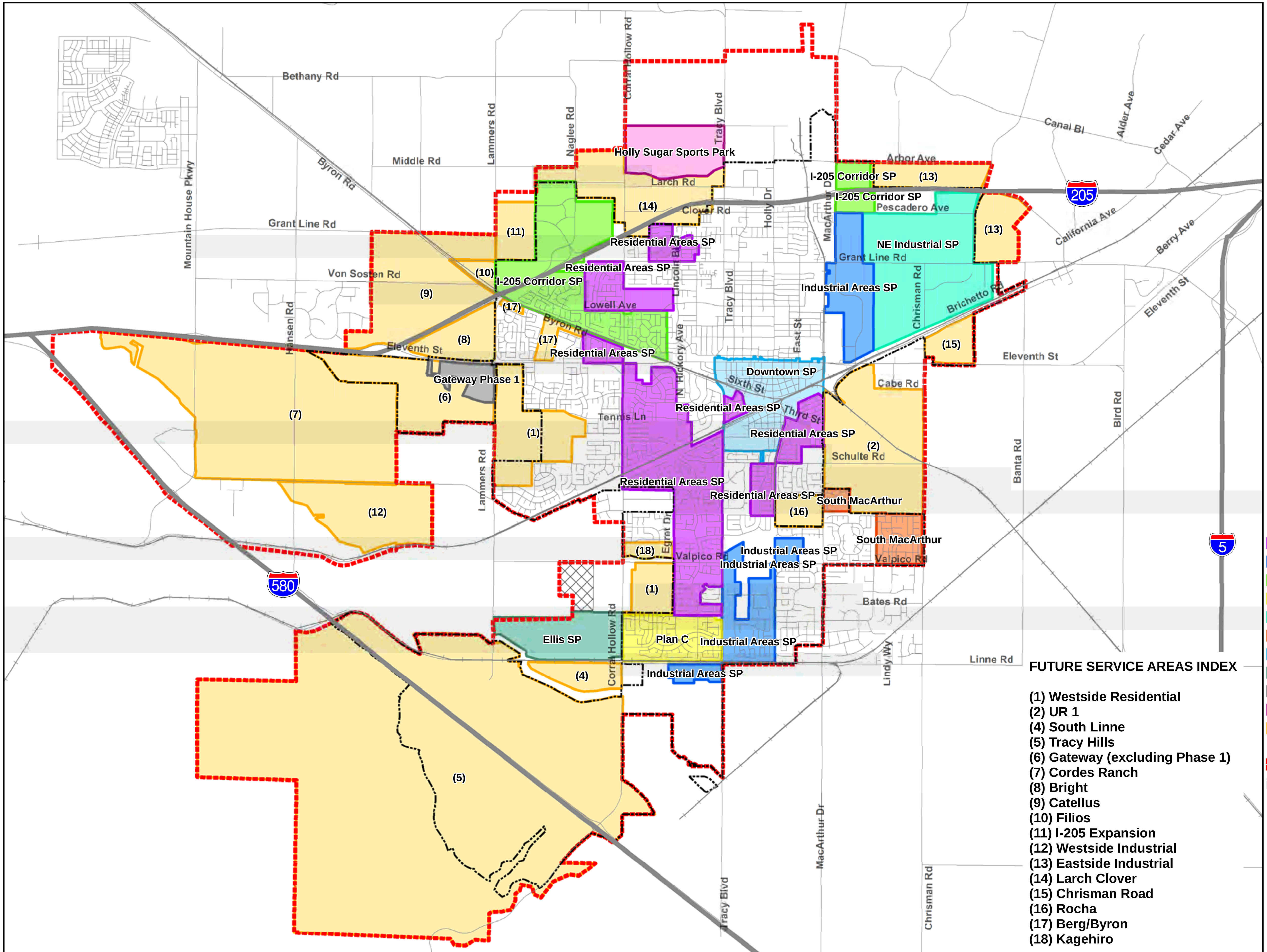
FIGURE 3-2

City of Tracy
Water System Master Plan

LOCATIONS OF PROPOSED DEVELOPMENT PROJECTS



NOTES

1. City limits and SOI files (citylimit.shp and SOI_revised_January_09.shp) provided by DCE on 11/05/09. SOI shape file was revised based on data received from the City on 08/03/10.
2. Infill locations are not shown.
3. Project boundaries are approximate.
4. The Future Planning Area was not included in the evaluations completed for the Citywide WSMP.

LEGEND

- Residential Areas Specific Plan
- Industrial Areas Specific Plan
- I-205 Corridor Specific Plan
- Plan "C"
- Northeast Industrial Specific Plan
- South MacArthur
- Downtown Specific Plan
- Ellis Specific Plan
- Tracy Gateway - Phase 1
- Holly Sugar Sports Park
- Future Service Area (see Index)
- Future Planning Area
- SOI
- City Limits
- Highway
- Existing Street
- Railroad

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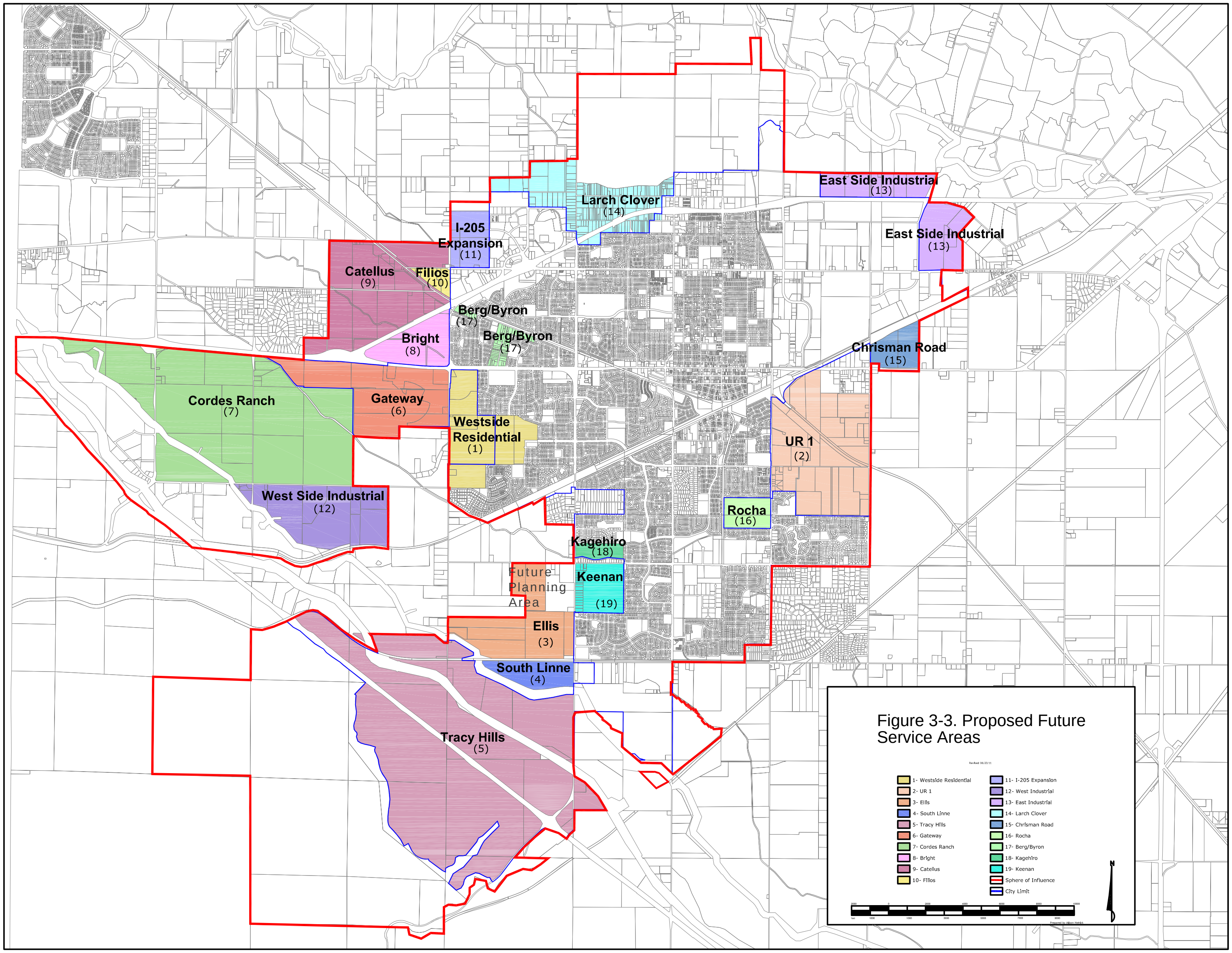

Figure 3-3. Proposed Future Service Areas

NOTES
1. Source: City of Tracy; Revised on June 23, 2011.
   Planning Area 19 (Keenan) was evaluated as a part of the Westside Residential development (Planning Area 1).
2. Per City direction, Gateway Phase 1 and Ellis are considered to be development projects with approved water supply in the Citywide Water System Master Plan (see Appendix C).

CHAPTER 4
Existing and Future Buildout Water Demands

4.1 OVERVIEW

The purpose of this chapter is to present the existing potable water demands currently served by the City and the projected potable and recycled water demands at the buildout of the City's General Plan. Only the buildout condition will be evaluated in this chapter; additional evaluations regarding the timing and phasing of future water demands will be developed as part of a separate "Tier 2" evaluation not included in this Citywide Water System Master Plan. The "Tier 2" evaluation is the project specific analysis for each proposed development area.

Accurate and detailed potable and recycled water demand data and projections are required to: (1) develop and calibrate the potable and recycled water system hydraulic models, (2) identify deficiencies in the potable and recycled water systems, and (3) assist in the assessment of the future buildout water system capacity and future buildout capital improvement program based on proposed development projects. Future water demand projections also play a key role in helping the City identify and secure sufficient water supplies to serve their customers under various hydrologic conditions.

The following sections of this chapter describe the data and methodology used to determine the City's potable and recycled water system demands at buildout:

- Existing Service Area Characteristics
- Historical Potable Water Production and Consumption
- Water Conservation
- Adopted Peaking Factors
- Future Water Demand Projection
- Projected Population Served
- Compliance with SBx7-7 at Buildout of the City's General Plan

4.2 EXISTING SERVICE AREA CHARACTERISTICS

The City is located in San Joaquin County, California, approximately 70 miles south of Sacramento and 60 miles east of San Francisco. The existing incorporated area of the City (*i.e.*, City limits) encompasses approximately 22 square miles. As described in Chapter 3, the City's SOI, as described in the General Plan, is approximately 41 square miles and is 19 square miles larger than the City limits. The SOI encompasses the area outside of and contiguous with the City limits that the City expects to annex and urbanize in the future. Figure 4-1 shows the boundaries of the existing City limits and SOI.

The City's existing water service area is generally coterminous with the City limits as shown on Figure 4-1. The City currently provides potable water service to all of its residents, including approximately 400 residents of the Larch-Clover County Services District and the unincorporated Patterson Pass Business Park[1]. Future growth potential for the City includes completion of on-going projects and infill within the City limits, and development of areas outside of the City limits within the SOI boundary.

Subsequent sections describe the existing number of services by customer class, historical population served, and existing and projected land uses within the City.

4.2.1 Existing Number of Services by Customer Class

The City has recently begun to track the number of services within its water service area by customer class. Based on water consumption and billing data provided by City staff for 2008, the City has the following number of existing potable water service connections as listed by customer class:

- Single Family Residential – 21,527 connections
- Multi-Family Residential – 505 connections
- Commercial/Industrial – 705 connections
- Other – 594 connections

The Single Family Residential customer class typically designates a service normally served by an individual meter, while the Multi-Family Residential customer class typically designates a single meter serving multiple services. The Commercial/Industrial customer class designates typical commercial and industrial uses, such as a retail store for Commercial or a manufacturing company for Industrial. The Other customer class includes all metered water uses that do not fit within the other three categories (*e.g.*, schools, parks, City Hall, *etc.*).

In summary, there were a total of 23,331 potable water service connections in 2008. Based on this data, the Residential (Single Family and Multi Family) water service connections represented approximately 94 percent of the total water service connections in 2008.

4.2.2 Historical Population Served

Approximately 81,000 people currently live in the City. Population growth has been rapid in the City, with the City growing by approximately 152 percent between 1990 and 2009. The City's population growth, at least in the near-term, is not anticipated to be as rapid as it has been historically. This is primarily due to a residential Growth Management Ordinance (GMO) adopted in 1987, which was amended in 2000 by Measure A. The objective of the GMO and

[1] Water demands from Patterson Pass Business Park are not included in the City's production totals because the water supply for this area is purchased by Patterson Pass Business Park from the Plain View Water District (now Byron Bethany Irrigation District). The City is only responsible for providing water treatment and delivery services to Patterson Pass Business Park in accordance with a "treat and wheel" agreement.

Measure A was to achieve a steady and orderly growth rate that allows for the adequate provision of services and community facilities, and includes a balance of housing opportunities. Under the adopted GMO, builders must obtain a Residential Growth Allotment (RGA) in order to secure a residential building permit.

Table 4-1 summarizes the City's historical population served between 1990 and 2009. The more recent five-year average annual population growth of approximately 2 percent indicates that the adopted GMO has slowed population growth in the recent years when compared with a historical (1990-2009) average annual growth rate of 5 percent. However, the recent poor economic conditions may also be a key factor for the slow growth that has been observed in recent years.

As shown on Figure 4-2, the population served by the City has increased at a relatively constant growth rate between 1990 and 1998 and then increased rapidly between 1999 and 2005; however, the population growth rate has slowed considerably for the more recent years (2006-2009) as discussed above. This trend of slower growth in the City is expected to be maintained with the continued enforcement of the adopted GMO.

4.2.3 Summary of Existing and Projected Buildout Land Use

A detailed discussion regarding the City's projected land use at buildout of the General Plan is presented in Chapter 3. A brief summary is provided below.

4.2.3.1 Existing Land Use

Based on the existing land use data within the City limits presented in the General Plan, approximately 29 percent of the City is vacant and 15 percent of the City is designated for Agricultural use. Consequently, this data indicates that the remaining 56 percent of the City is developed and currently has potable water use. Figure 4-3 illustrates the existing land uses within the City limits.

4.2.3.2 Future Land Use

Future development in the City includes completion of on-going projects and infill within City limits, and development of areas outside of the City limits within the SOI boundary. As discussed in Chapter 3, buildout of the City's General Plan will include undeveloped areas which consist of development projects with approved water supply (including infill) and future service areas identified by City staff and the development community. Figure 4-4 illustrates the locations of the proposed development projects, but does not include infill locations.

Figure 3-1 of Chapter 3 illustrates the allowed types of land uses within the City's General Plan. These land use designations represent the intended future use of each parcel within the City's SOI boundary; however these designations are flexible to allow for changes in economic conditions, community visions, and environmental conditions. Consequently, to provide more accurate future water demand and supply projections, buildout water demand projections will be calculated based on the following data:

Table 4-1. Historical Population Served

Year	Population	Annual Growth	Last 5-yr Average Annual Growth	Last 10-yr Average Annual Growth	Last 19-yr Average Annual Growth
1990[a]	32,450				
1991[b]	35,871	11%			5.0%
1992[b]	38,006	6%			
1993[b]	40,455	6%			
1994[b]	42,111	4%			
1995[b]	44,546	6%			
1996[b]	45,949	3%			
1997[b]	47,428	3%			
1998[b]	48,962	3%			
1999[b]	51,959	6%			
2000[b]	56,070	8%		4.7%	
2001[c]	61,112	9%			
2002[c]	66,022	8%			
2003[c]	70,037	6%			
2004[c]	74,656	7%			
2005[c]	78,157	5%	1.8%		
2006[c]	80,063	2%			
2007[c]	80,455	0%			
2008[c]	81,143	1%			
2009[c,d]	81,714	1%			

[a] Source: Department of Finance, E-4 Population Estimates for California Cities and Counties, January 1, 1981 to January 1, 1990.
[b] Source: Department of Finance, E-4 Historical Population Estimates for City, County and the State, 1991-2000, with 1990 and 2000 Census Counts, August 2007.
[c] Source: Department of Finance, E-4 Population Estimates for Cities, Counties and the State, 2001–2009, with 2000 Benchmark, May 2009.
[d] Provisional population estimate.

- Existing water demand within the City,
- Detailed land use and dwelling unit (du) information for development projects with approved water supply (including infill) provided by the City's Planning Division, and
- Detailed land use and du information for each future service area provided by the City's Planning Division.

The combination of data sources listed above accounts for all the existing development and any new development that is proposed to occur within the City's SOI boundary.

4.2.3.3 Proposed Recycled Water Use Areas

The City does not currently use recycled water, but recycled water is being considered as a source of future water supply to offset potable water demands on a project-by-project basis. For example, Phase 1 of the proposed Tracy Gateway Project plans to construct water recycling facilities that will provide recycled water for on-site landscape irrigation and for off-site landscape irrigation at the City's Presidio Park and Plasencia Field as part of the City's Water Exchange Program[2]. Several other parks and existing landscaped areas were also identified in the Tracy Gateway Project evaluation (see Figure 4-5) as potential future recycled water use areas as an expansion of the Tracy Gateway Project Water Exchange Program (for future phases of the project[3]). These potential recycled water use areas, as well as other areas in future development areas of the City, are discussed further in Chapter 9 of this Citywide Water System Master Plan.

Preliminary recycled water demand estimates have been developed based on the overall projected land use from each proposed development project, and is discussed below under *Section 4.6.4 Projected Buildout Water Demands*. Specific locations of recycled water use within the City's SOI will be evaluated in more detail as part of the City's "Tier 2" evaluations.

4.3 HISTORICAL POTABLE WATER PRODUCTION AND CONSUMPTION

The City's water production is the combined quantity of surface water purchased from the United States Bureau of Reclamation (USBR) and the South San Joaquin Irrigation District (SSJID) plus the groundwater produced by the City's wells, while water consumption is the quantity of water actually consumed or used by the City's customers. As will be discussed later, the difference between production and consumption is unaccounted-for water (UAFW).

The City currently tracks all of the surface water purchased from USBR and SSJID plus the groundwater produced by its wells. The City also meters all of its customers and categorizes their water use by customer class. Consequently, the City tracks water use in two ways: production

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[2] Table 24, 2005 Urban Water Management Plan, EKI (December 2005); per the Tracy Gateway Project Phase 1 Development Agreement.

[3] The Tracy Gateway Project plans to use the Water Exchange Program to offset all of its potable water demands for Phase 1 and through buildout of the Tracy Gateway Project.

records and meter (consumption) records. Both are discussed in more detail below, along with a discussion on UAFW and per capita water demands.

4.3.1 Historical Water Production

The City meets its customers' water demands with a combination of surface water purchased from USBR and SSJID plus groundwater pumped from municipal wells. Table 4-2 presents the historical annual water production, by source, from 1990 to 2009.

Table 4-2 indicates that since SSJID began surface water deliveries in 2005, the City has significantly increased its surface water use to meet its customers' water demands, and in return groundwater production has dramatically decreased. Surface water use in recent years (2006-2009) accounts for over 80 percent of the total annual water production whereas historical (1990-2005) surface water use averages around 60 percent of the total annual water production.

The City plans to continue maximizing surface water use because the City's groundwater is heavily mineralized (*e.g.*, high total dissolved solids (TDS)). Consequently, the resulting reduction in groundwater extraction will ultimately increase the overall quality of the City's drinking water. However, the City will continue to rely on groundwater for peaking, drought, and emergency supplies to meet water demands when surface water supplies may be limited. Detailed discussions on water supplies and their historical use and availability are presented in Chapter 5.

Figure 4-6 compares the total historical annual water production with historical average annual rainfall. This historical data indicates that annual water production has generally increased at about 3 percent per year. However, based on the data from recent years, the City's annual water production has generally decreased as shown in the five-year average annual water production, which indicates an average decrease in water production at about 2 percent per year.

This decreasing trend most likely reflects the recent poor economic conditions that resulted in vacant properties and unoccupied homes, the voluntary water conservation efforts that have been implemented by the City's water customers in the past few years due to lower than average rainfall and drought conditions, and the City's slower growth rate as shown in the City's historical population data. However, this decreasing trend in annual water production is expected to be temporary and will likely reverse as the economic conditions improve and proposed development projects are constructed. Discussions on the City's projected future water production are presented below under *Section 4.6.4 Projected Buildout Water Demands*.

Table 4-3 presents the historical monthly water production, by source, from 2005 to 2009. This data indicates that the City's highest monthly water production has historically occurred in either the month of July or August, which corresponds with the high temperatures and minimal rainfall that is experienced in the City during those summer months. The lowest monthly water production has historically occurred in either January or February. These months correspond with the shut-down of the John Jones Water Treatment Plant for maintenance, which typically occurs in the winter months (*e.g.*, December, January, and/or February). Figure 4-7 illustrates the historical monthly water production between 2005 and 2009. The average maximum month water production is approximately 785 million gallons (MG).

Table 4-2. Historical Annual Water Production by Source

Year	Surface Water, af/yr			Groundwater, af/yr	Total Production, af/yr	Total Production, MG	Percent Surface Water	Percent Groundwater
	USBR	SSJID[(a)]	Total Surface Water[(a)]					
1990[(b)]	4,968	-	4,968	5,838	10,806	3,521	46%	54%
1991[(b)]	4,995	-	4,995	4,815	9,810	3,197	51%	49%
1992[(b)]	7,148	-	7,148	4,002	11,150	3,633	64%	36%
1993[(b)]	7,800	-	7,800	4,127	11,927	3,886	65%	35%
1994[(b)]	7,788	-	7,788	4,901	12,689	4,135	61%	39%
1995[(b)]	8,387	-	8,387	4,310	12,697	4,137	66%	34%
1996[(b)]	8,817	-	8,817	4,562	13,379	4,360	66%	34%
1997[(b)]	7,539	-	7,539	5,789	13,328	4,343	57%	43%
1998[(b)]	6,282	-	6,282	4,797	11,079	3,610	57%	43%
1999[(b)]	7,551	-	7,551	5,559	13,110	4,272	58%	42%
2000[(b)]	7,785	-	7,785	6,548	14,333	4,670	54%	46%
2001[(b)]	7,302	-	7,302	7,321	14,623	4,765	50%	50%
2002[(b)]	7,878	-	7,878	7,802	15,680	5,109	50%	50%
2003[(b)]	10,118	-	10,118	6,847	16,965	5,528	60%	40%
2004[(b)]	11,187	-	11,187	7,176	18,363	5,984	61%	39%
2005[(c)]	8,920	3,146	12,066	5,826	17,892	5,830	67%	33%
2006[(c)]	6,048	8,918	14,966	3,034	18,000	5,865	83%	17%
2007[(c)]	6,374	9,130	15,504	3,672	19,176	6,249	81%	19%
2008[(c)]	6,503	8,017	14,520	2,598	17,118	5,578	85%	15%
2009[(d)]	4,965	10,401	15,366	1,327	16,693	5,439	92%	8%

[(a)] SSJID began surface water deliveries to the City in 2005.
[(b)] Source: Figure 7, WSA for the Holly Sugar Sports Park, June 2009.
[(c)] Source: *2008 PRODUCTION TOTALS.xls* received from the City on October 12, 2009.
[(d)] Source: *2009 PRODUCTION TOTALS.xls* received from the City on January 5, 2010.

Table 4-3. Historical Monthly Water Production by Source

Month	2005[a]			2006[b]			2007[c]			2008[d]			2009[e]			Average Percentage of Annual Production
	Surface Water, MG[f]	Groundwater, MG	Total, MG	Surface Water, MG[f]	Groundwater, MG	Total, MG	Surface Water, MG[f]	Groundwater, MG	Total, MG	Surface Water, MG[f]	Groundwater, MG	Total, MG	Surface Water, MG[f]	Groundwater, MG	Total, MG	
January	9.4	225.5	234.9	219.4	36.2	255.6	245.8	63.4	309.2	246.7	22.8	269.5	179.7	26.4	206.1	4.4%
February	81.5	154.2	235.7	214.1	47.5	261.6	215.0	44.8	259.8	153.2	103.5	256.7	140.9	53.5	194.4	4.2%
March	221.7	84.2	305.9	279.4	28.4	307.8	231.6	141.2	372.8	196.8	146.8	343.6	199.6	65.3	264.9	5.5%
April	292.6	124.9	417.5	252.7	20.3	273.0	266.8	270.6	537.4	420.2	113.7	533.9	322.8	34.3	357.1	7.3%
May	375.3	170.7	546.0	506.5	122.8	629.3	442.5	195.2	637.7	477.1	153.3	630.4	449.5	42.6	492.1	10.1%
June	404.2	266.5	670.7	586.6	134.7	721.3	571.4	159.8	731.2	576.7	111.9	688.6	637.9	50.0	687.9	12.1%
July	432.6	328.1	760.7	619.7	211.0	830.7	638.2	157.7	795.9	661.8	75.9	737.7	664.8	88.0	752.8	13.4%
August	528.4	283.2	811.6	628.7	139.6	768.3	697.8	74.9	772.7	647.1	49.0	696.1	693.0	26.4	719.4	13.0%
September	506.2	89.1	595.3	586.6	75.1	661.7	585.3	40.2	625.5	507.6	50.1	557.7	618.0	4.0	622.0	10.6%
October	487.0	61.5	548.5	454.0	59.6	513.6	477.5	26.4	503.9	405.8	6.1	411.9	460.0	1.7	461.7	8.4%
November	374.4	33.5	407.9	283.4	68.6	352.0	370.3	18.5	388.8	238.6	9.2	247.8	356.6	22.2	378.8	6.1%
December	218.3	77.2	295.5	245.6	45.0	290.6	309.6	3.5	313.1	199.7	4.3	204.0	284.2	18.2	302.4	4.9%
Total	3,931.6	1,898.6	5,830.2	4,876.7	988.8	5,865.5	5,051.8	1,196.2	6,248.0	4,731.3	846.6	5,577.9	5,007.0	432.6	5,439.6	100%

[a] Source: *2005 PRODUCTION TOTALS.xls* received from the City on October 12, 2009.
[b] Source: *2006 PRODUCTION TOTALS.xls* received from the City on October 12, 2009.
[c] Source: *2007 PRODUCTION TOTALS.xls* received from the City on October 12, 2009.
[d] Source: *2008 PRODUCTION TOTALS.xls* received from the City on October 12, 2009.
[e] Source: *2009 PRODUCTION TOTALS.xls* received from the City on January 5, 2010.
[f] The JJWTP is typically off-line during December, January, and/or February for maintenance.

4.3.2 Historical Water Consumption

Historical water consumed between 2000 and 2009, within each of the City's customer class, is summarized in Table 4-4. This data indicates that, on average, the Residential (Single Family and Multi Family) customer class has been the largest water user group, and on average represents approximately 74 percent of the total metered water consumption in the City. Commercial and Industrial customers represent an average of approximately 8 and 5 percent, respectively, of the total metered water consumption. Institutional water use corresponds to approximately 3 percent of the total metered water consumption, and Landscape Irrigation, on average, accounts for about 10 percent of the total metered water consumption. Projected water consumption by customer class in the future is discussed below under *Section 4.6.4 Projected Buildout Water Demands*.

Table 4-5 provides a summary of the top 15 water users in 2008 by customer classification. These top users accounted for approximately 9 percent of the total metered water consumption in 2008. The top user is an industrial food processing user, and their overall water use represents over 3 percent of the City's 2008 water consumption. The remaining large Industrial, Commercial, Institutional, Multi-Family Residential and Irrigation water users account for about 6 percent of the City's total water consumption in 2008.

4.3.3 Historical Unaccounted-for Water

UAFW within the City is the difference between the recorded water production and metered water consumption. UAFW includes a combination of various water uses that are not metered, such as water used for hydrant testing, firefighting, and system flushing or water that is lost from system leaks and water main breaks.

Historical UAFW between 2000 and 2009 is summarized in Table 4-6. As shown in Table 4-6, UAFW for years 2005 and 2008 were negative, and are likely the result of inaccurate meter readings leading to inaccurate consumption data. The UAFW percentages in 2006 and 2009 appear to be erroneous as well due to their low values.

Excluding these suspect years, Table 4-6 indicates that the UAFW within the City has averaged approximately 7.1 percent over the past 10 years. This percentage of UAFW is similar to the UAFW percentage (7.5 percent) used in previous planning studies for the City[4]. For planning purposes in this Citywide Water System Master Plan, a UAFW percentage of 7.5 percent was used to project the City's total future water production requirements. This UAFW percentage is slightly higher and more conservative than the more recent average historical records, but is consistent with previous planning studies completed by the City.

[4] Table 6, 2005 Urban Water Management Plan, EKI (December 2005).

Table 4-4. Historical Water Consumption by Customer Class, af/yr

Year	Residential	Commercial	Industrial	Institutional	Landscape Irrigation	Other	Total Consumption
2000[(a)]	9,500	1,300	1,200	200	1,100	--	13,300
2001[(a)]	9,664	1,117	668	468	1,529	--	13,446
2002[(a)]	10,494	1,206	663	478	1,983	--	14,824
2003[(a)]	11,316	1,253	690	460	1,849	--	15,568
2004[(a)]	12,662	1,279	770	532	2,043	--	17,286
2005[(b)]	14,863	1,181	737	558	1,258	24	18,621
2006[(b)]	13,709	1,247	826	594	1,540	27	17,943
2007[(c)]	13,825	1,102	775	587	1,321	25	17,635
2008[(c)]	14,027	1,339	770	662	1,805	28	18,631
2009[(d)]	11,384	1,291	772	633	2,130	14	16,224
Average	12,144	1,232	787	517	1,656	24	16,360
Average Percentage of Average Annual Consumption	74.2%	7.5%	4.8%	3.2%	10.1%	0.1%	

(a) Source: City of Tracy Urban Water Management Plan, December 2005.

(b) Source: *WUDS Usage by User Class Type 01-05 to 09-08.xls* (v3.40) received from the City on January 12, 2009.

(c) Source: *Monthly Usage User Class Type 05 to 09.xls* (v3.46) received from the City on October 26, 2009. Data from 2005 and 2006 were incomplete. Consequently, consumption data received previously was used for 2005 and 2006 [see footnote (b)].

(d) Source: *2009 Usage by User Class Type.xls* (v3.48) received from the City on February 18, 2010.

Table 4-5. Summary of Top 15 Water Users in 2008[a]

No.	Customer Class	Total Annual Consumption, ccf	Total Annual Consumption, MG	Percentage of 2008 Total Consumption
1	Industrial	271,844	203	3.3%
2	Commercial	76,005	57	0.9%
3	Institutional	65,030	49	0.8%
4	Industrial	60,731	45	0.7%
5	Multi Family Residential	41,170	31	0.5%
6	Industrial	39,223	29	0.5%
7	Multi Family Residential	28,852	22	0.4%
8	Irrigation	25,815	19	0.3%
9	Institutional	21,821	16	0.3%
10	Commercial	21,414	16	0.3%
11	Institutional	21,410	16	0.3%
12	Commercial	18,918	14	0.2%
13	Multi Family Residential	16,905	13	0.2%
14	Multi Family Residential	13,904	10	0.2%
15	Irrigation	13,439	10	0.2%
Total		736,481	550	9.1%

[a] Source: *2008 HIGH WATER CONSUMERS.xls* received from the City on October 12, 2009.

Table 4-6. Historical Unaccounted-for Water

Year	Water Production, af/yr[a]	Water Consumption, af/yr[b]	Difference, af/yr	Percentage UAFW
2000	14,333	13,300	1,033	7.2%
2001	14,623	13,446	1,177	8.0%
2002	15,680	14,824	856	5.5%
2003	16,965	15,568	1,397	8.2%
2004	18,363	17,286	1,077	5.9%
2005	17,892	18,621	(729)	-4.1%
2006	18,000	17,943	57	0.3%
2007	19,176	17,635	1,541	8.0%
2008	17,118	18,631	(1,513)	-8.8%
2009	16,693	16,224	469	2.8%
Average[c]				7.1%

[a] Source: See Table 4-2.

[b] Source: See Table 4-4.

[c] Average does not include years 2005, 2006, 2008, and 2009 because data appears to be suspect.

4.3.4 Historical Per Capita Water Demand

Historical per capita water demands were calculated by dividing the annual water production previously presented in Table 4-2 by the respective annual population previously presented in Table 4-1. Table 4-7 summarizes the historical per capita water demands for the City between 2000 and 2009. As shown in Table 4-7, the historical average per capita water demand has averaged to approximately 208 gallons per capita per day (gpcd) over the past 10 years.

Figure 4-8 compares the historical per capita water demand, historical water production, and historical population. As shown on Figure 4-8, the historical population has increased at a rapid rate between 2000 and 2005 and then slowed to a relatively stable rate from 2006 to 2009. Therefore, the majority of the variation observed in the per capita water demand is due to variations in the City's total water production, which appears to vary based on economic and hydrologic conditions.

Figure 4-8 indicates that the average overall per capita water use has been 208 gpcd; however, the per capita demand decreased significantly in 2008 to 188 gpcd. As discussed previously, this sharp decrease in 2008 is most likely due to a combination of the recent poor economic conditions resulting in an increase in unoccupied homes and the dry hydrologic conditions resulting in voluntary water conservation. Based on 2009 data, it appears that the per capita water demand continued to decrease and is now equal to 182 gpcd.

The potential implications of the recently passed SBx7-7 legislation required statewide reduction in per capita water use are discussed below in *Section 4.4 Water Conservation* and *Section 4.8 Compliance With SBx7-7 at Buildout of the City's General Plan*.

4.4 WATER CONSERVATION

As discussed in Chapter 2, the City has developed a list of principles for sustainable infrastructure to ensure a reliable water supply for future generations. A key principle that relates to the Citywide Water System Master Plan is water conservation. Water conservation will be necessary to meet requirements set by the State (*e.g.*, SBx7-7 "20 x 2020" Legislation) to reduce the City's per capita water use. Discussions regarding existing and future water conservation in the City are presented below.

4.4.1 Existing Water Conservation

The City is committed to preserving California's water resources through water conservation and efficient use of water, and currently has an on-going Water Conservation Plan that implements the CUWCC's Best Management Practices (BMPs). These BMPs include residential surveys, public and school education programs, rebates for water efficient appliances and other specific programs. These programs have been successful in reducing the City's water use, especially in the recent dry years.

Table 4-7. Historical Per Capita Water Demand					
Year	Population Served[(a)]	Water Production, af/yr[(b)]	Per Capita Water Demand, gpcd	5-yr Average Per Capita Water Demand, gpcd	10-yr Average Per Capita Water Demand, gpcd
2000	56,070	14,333	228		208
2001	61,112	14,623	214		
2002	66,022	15,680	212		
2003	70,037	16,965	216		
2004	74,656	18,363	220		
2005	78,157	17,892	204	198	
2006	80,063	18,000	201		
2007	80,455	19,176	213		
2008	81,143	17,118	188		
2009	81,714	16,693	182		

(a) Source: See Table 4-1.

(b) Source: See Table 4-2. Includes UAFW.

4.4.2 Compliance with SBx7-7 "20 x 2020" Legislation

In February 2008, Governor Arnold Schwarzenegger called for a statewide 20 percent reduction in per capita water use by 2020 and asked state and local agencies to develop a more aggressive plan of water conservation to achieve the goal. A team of State and federal agencies (the 20x2020 Agency Team) consisting of the DWR, SWRCB, California Energy Commission, Public Utilities Commission, Department of Public Health, California Air Resources Board, CALFED Program, the USBR, and the CUWCC was formed to develop a statewide implementation plan for achieving this goal.

Then, on November 10, 2009, Governor Arnold Schwarzenegger signed Senate Bill x7-7 (SBx7-7), one of several bills passed as part of a comprehensive set of new Delta and water policy legislation. SBx7-7 requires a 20 percent reduction in urban water usage by 2020 and establishes various methodologies for urban water suppliers to establish their interim (2015) and final (2020) per capita water use targets.

Four methodologies are identified in SBx7-7 for establishing per capita water use targets:

Method 1: A 20 percent reduction from historical baseline per capita water use based on a 10-year average per capita water use ending between December 31, 2004 and December 31, 2010.

Method 2: Per capita water use based on 55 gallons per capita per day water use for residential water use, landscape irrigation use based on water efficiency equivalent to the standards of the Model Water Efficient Landscape Ordinance, and a 10 percent reduction from baseline commercial, industrial and institutional (CII) water use.

Method 3: 95 percent of the hydrologic region targets established in the capita water use based on the April 2009 Draft 20x2020 Water Conservation Plan.

Method 4: A provisional approach that considers the water conservation potential from (1) indoor residential savings, (2) metering savings, (3) commercial, industrial and institutional savings, and (4) landscape and water loss savings.

A preliminary evaluation of these methods for the City is summarized below. Preliminary calculations are included in Appendix B.

Under Method 1, the City's historical baseline per capita water use is determined to be 225 gallons per capita per day based on the 10-year period from 1995 through 2004. Based on this baseline per capita water use, the interim (2015) target would be 90 percent of 225 gpcd, or 202 gpcd, and the final (2020) target would be 80 percent of 225 gpcd, or 180 gpcd.

Under Method 2, the City's target per capita water use would be 115 gpcd (55 gpcd for residential, 30 gpcd for landscape irrigation, and 30 gpcd for CII water use).

Under Method 3, the target per capita water use is based on 95 percent of the hydrologic region targets established in the April 2009 Draft 20x2020 Water Conservation Plan. The City is located in the San Joaquin River Hydrologic Region (Region 6). The per capita water use goals for the San Joaquin River Hydrologic Region (Region 6) are as follows:

- 95 percent of Interim Target (to be achieved by 2015) = 95 percent of 211 gpcd = 200 gpcd
- 95 percent of Final Target (to be achieved by 2020) = 95 percent of 174 gpcd = 165 gpcd

Method 4 was not evaluated. However, based on the first three methods, it would appear that the City's recommended interim 2015 target would be 202 gpcd, and the final recommended 2020 target would be 180 gpcd (per Method 1).

As noted above, these calculations are preliminary. Detailed calculations of baseline and target per capita water use for the City's adoption in accordance with the requirements of SBx7-7 are included in the City's 2010 UWMP[5].

The City's ability to meet these goals at buildout of the City's General Plan is discussed at the end of this chapter.

4.5 ADOPTED PEAKING FACTORS

Peaking factors are used to calculate water demands expected under high demand conditions (*i.e.*, maximum day and peak hour). The resulting water demands calculated for maximum day and peak hour conditions are then used to evaluate and size transmission/distribution pipelines and storage facilities, and to define water supply needs and capacity requirements. This section describes the methodology used to develop peaking factors for the maximum day and peak hour demand conditions within the City's potable water system and proposed recycled water system.

4.5.1 Potable Water System

Table 4-8 summarizes the historical average and maximum day demands and the corresponding peaking factors between 2005 and 2009. As shown in Table 4-8, the maximum day peaking factor for the City has ranged from a low of 1.6 in 2007 to a high of 1.8 in 2005 and 2009. The historical average maximum day peaking factor is equal to 1.7 times the average day demand.

The City currently has an adopted maximum day peaking factor of 2.2 times the average day demand (June 1994 Water Master Plan), which is higher than what has been observed in recent years. Based on the data from more recent maximum day trends, this higher peaking factor provides a very conservative estimate of the required water supply and distribution facilities to support projected water demands.

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[5] Per the City's 2010 UWMP, the City's adopted per capita water use targets are 204 gpcd (2015 target) and 182 gpcd (2020 target).

Table 4-8. Historical Maximum Day Demand Peaking Factors[(a)]

Year	Date	Maximum Day Production, mgd	Average Day Production, mgd	Maximum Day to Average Day Factor
2005	August 3	28.8	16.0	1.8
2006	August 1	27.4	16.1	1.7
2007	August 1	27.9	17.1	1.6
2008	July 8	26.5	15.3	1.7
2009	July 15	27.1	14.9	1.8
Average				1.7

(a) Source: Email from City staff on November 17, 2009.

Consequently, for planning purposes in this Citywide Water System Master Plan, a maximum day peaking factor of 2.0 was adopted. This factor provides a slightly more conservative estimate of maximum day demands when compared with the historical average maximum day peaking factor of 1.7, but will not excessively overestimate maximum day demands as compared with the City's current standard maximum day peaking factor of 2.2.

Insufficient data was available to determine a historical peak hour demand factor. However, the City's current standard peak hour peaking factor of 3.8 times the average day demand (June 1994 Water Master Plan) can be refined based on data collected from historical maximum day demands as discussed above. The adopted maximum day peaking factor of 2.0 for this Citywide Water System Master Plan is approximately a 10 percent reduction from the previously used maximum day peaking factor of 2.2. A reduction of the same percentage can also be assumed for the peak hour peaking factor, which equates to a revised peak hour peaking factor of 3.4 (0.9 x 3.8).

This peak hour peaking factor is consistent with peak hour factors observed for other West Yost clients; consequently, a peak hour peaking factor of 3.4 times the average day demand was adopted for this Citywide Water System Master Plan.

4.5.2 Recycled Water System

Peaking factors for recycled water systems are somewhat different from potable water systems, in that irrigation periods are generally limited to shorter time periods, typically during the late evenings and very early mornings (*e.g.*, 10 p.m. to 6 a.m.). For purposes of this Citywide Water System Master Plan, an irrigation period of eight (8) hours per day has been assumed.

As discussed further in *Section 4.6.5 Recycled Water Demand Timing and Seasonality,* based on 2008 data, monthly irrigation water use reaches a maximum in July with irrigation water use equal to 16.4 percent of the total annual irrigation water use. This percentage of irrigation water use during the maximum month can be converted to an average day to maximum day peaking factor equal to 5.8 times the average day irrigation demand (0.164/31 days x 365 days x [24 hours/8 hour irrigation period]).

The peak hour recycled water demand was assumed to be approximately 10 percent above the maximum day irrigation demand, which equates to a peak hour peaking factor of 6.4 (1.1 x 5.8).

Table 4-9 summarizes the maximum day and peak hour peaking factors adopted for this Citywide Water System Master Plan.

Table 4-9. Adopted Peaking Factors

Demand Condition	Potable Water System	Recycled Water System
Average Day	Annual Use divided by 365 days per year	Annual Use divided by 365 days per year
Maximum Day	2.0 times the Average Day Demand	5.8 times the Average Day Demand (assuming an 8-hour irrigation period)
Peak Hour	3.4 times the Average Day Demand	6.4 times the Average Day Demand (10% above maximum day demand)

4.6 FUTURE WATER DEMAND PROJECTION

Water demands are projected for buildout of the City's General Plan by using (1) existing water demands, (2) land use data from development projects with approved water supply (including infill), and (3) land use data from future service areas.

Existing water demands were based on the total water production from 2007. Water production data from 2007 was used instead of 2008 or 2009 data because it was more representative of actual water use within the City before the recent poor economic conditions, which resulted in numerous vacant properties and unoccupied homes. In addition, using 2007 water production as the City's baseline existing water demand provides a more conservative water demand estimate to account for typical water use patterns before the recent economic downturn.

The City's Planning Division provided a future service areas spreadsheet that included land use data and dwelling unit information for each proposed future service area. Another spreadsheet containing land use data and dwelling unit information for development projects with approved water supply (including infill) was subsequently provided[6]. Using the information presented in these spreadsheets, future water demands were then calculated using a unit water demand methodology based on the proposed land use or dwelling units assigned to each project.

Subsequent sections describe the development of the unit water demand methodology used to calculate future water demands, followed by a discussion of total projected water demands at buildout.

4.6.1 Existing Unit Water Demand Factors and Land Use Assumptions

From various planning studies that have been completed previously, the City has developed a set of unit water demand factors to estimate water demands. The City's existing unit water demand factors are summarized in Table 4-10. These factors are typically multiplied by per capita or land use area data to calculate a water demand estimate.

[6] Per discussion with City staff, the Holly Sugar Sports Park project was added to the City's list of development projects with an approved water supply.

Table 4-10. Existing Unit Water Demand Factors

Land Use Designation	Unit Water Demand Factor		
	gpcd	gpd/du	af/ac/yr[(a)]
Residential – Very Low Density[(b)]	150	450	--
Residential – Low Density[(c)]	150	450	--
Residential – Medium Density[(c)]	150	375	--
Residential – High Density[(c)]	150	300	--
Residential – Very High Density[(d)]	100	150	--
Commercial[(c)]	--	--	2.0
Office[(e)]	--	--	1.5
Industrial[(c)]	--	--	2.0
Institutional[(c)]	--	--	1.5
Parks[(c)]	--	--	4.5

(a) Unit water demand factor applies to gross acreages (*i.e.*, includes streets).
(b) Source: Water Supply Assessment for the Ellis Specific Plan, West Yost Associates (August 2007).
(c) Source: Calculation of Plan C Demands Memorandum, Kennedy/Jenks Consultants (February 6, 1996).
(d) Source: Water Supply Assessment for the Downtown Specific Plan, West Yost Associates (April 2009).
(e) Source: Water Master Plan, Kennedy/Jenks Consultants (June 1994).

In addition to these existing unit water demand factors, the City has also developed specific assumptions regarding dwelling units per acre for each residential land use type and floor to area ratios (FAR) for commercial and industrial land uses to help further refine water demand estimates from various proposed development projects that do have the additional information available. Table 4-11 summarizes the dwelling unit and FAR assumptions that the City has recommended for estimating future water demands.

Table 4-11. Proposed Dwelling Unit and Floor to Area Ratios

Land Use Designation	Range[(a)]	Future Service Areas Spreadsheet[(b)]
Residential – Very Low Density	0.1 to 2.0 du/acre	1.5 du/acre
Residential – Low Density	2.1 to 5.8 du/acre	4.35 du/acre
Residential – Medium Density	5.9 to 12.0 du/acre	9 du/acre
Residential – High Density	12.1 to 25 du/acre	18.75 du/acre
Residential – Very High Density	Up to 40 du/acre[(c)]	--
Commercial	Maximum FAR 1.0	FAR 0.3
Office	Maximum FAR 1.0	FAR 0.45
Industrial	Maximum FAR 0.5	FAR 0.5

(a) Source: General Plan, DC&E (April 22, 2009).
(b) Source: *Land Use Densities for IMPs-12.08. 09(ser).xls* received from the City on February 26, 2010.
(c) Source: Water Supply Assessment for the Downtown Specific Plan, West Yost Associates (April 2009).

In the data received from the City's Planning Division, additional assumptions regarding people per dwelling unit were also provided[7]. A summary of these are listed below, and will be used to calculate future residential water demands.

- Residential – Very Low Density: 3.3 people/du
- Residential – Low Density: 3.3 people/du
- Residential – Medium Density: 2.7 people/du
- Residential – High Density: 2.2 people/du

4.6.2 Verification of Unit Water Demand Factors

Due to possible changes in water use patterns over time, the existing unit water demand factors presented in Table 4-10 were verified to confirm if they were still representative of the City's more recent water use patterns. In addition, these factors were also reviewed to determine if they reflect the future water conservation efforts that the City plans to achieve. Unit water demand factors that are refined using more recent water use data tend to be more accurate and will help project more accurate water demands. The following sections discuss the methodologies used to "spot check" and verify existing residential and non-residential unit water demand factors.

4.6.2.1 Residential Unit Water Demand Factors

Residential unit water demand factors were refined based on assumed water conservation from future residential customers. It was assumed that exterior water use for landscape irrigation in medium and high density residential land uses will be with recycled water, which significantly decreases the corresponding unit water demand factors for potable water use. In addition, unit water demand factors for the very low and low density residential land uses were assumed to decrease by approximately 15 percent from the existing (2007) residential water use trend[8]. Table 4-12 summarizes the refined residential unit water demand factors developed for this Citywide Water System Master Plan.

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[7] Data provided in e-mail from City on November 18, 2009.

[8] Existing (2007) residential water use is approximately 153 gpcd (not including UAFW). This value is calculated using the 2007 residential water consumption shown in Table 4-4 divided by the 2007 population served shown in Table 4-1.

Table 4-12. Refined Residential Unit Water Demand Factors

Land Use Designation	Unit Water Demand Factor		
	gpcd	people/du[a]	gpd/du
Residential – Very Low Density	130[b]	3.3	429
Residential – Low Density	130[b]	3.3	429
Residential – Medium Density	115[c]	2.7	310
Residential – High Density	100[c]	2.2	220

(a) Data provided in e-mail from City on November 18, 2009.
(b) Assumes exterior water use will be with potable water, except for parks.
(c) Assumes exterior water use will be with recycled water.

The unit water demand factor for very high density residential was not refined due to insufficient data from this customer class.

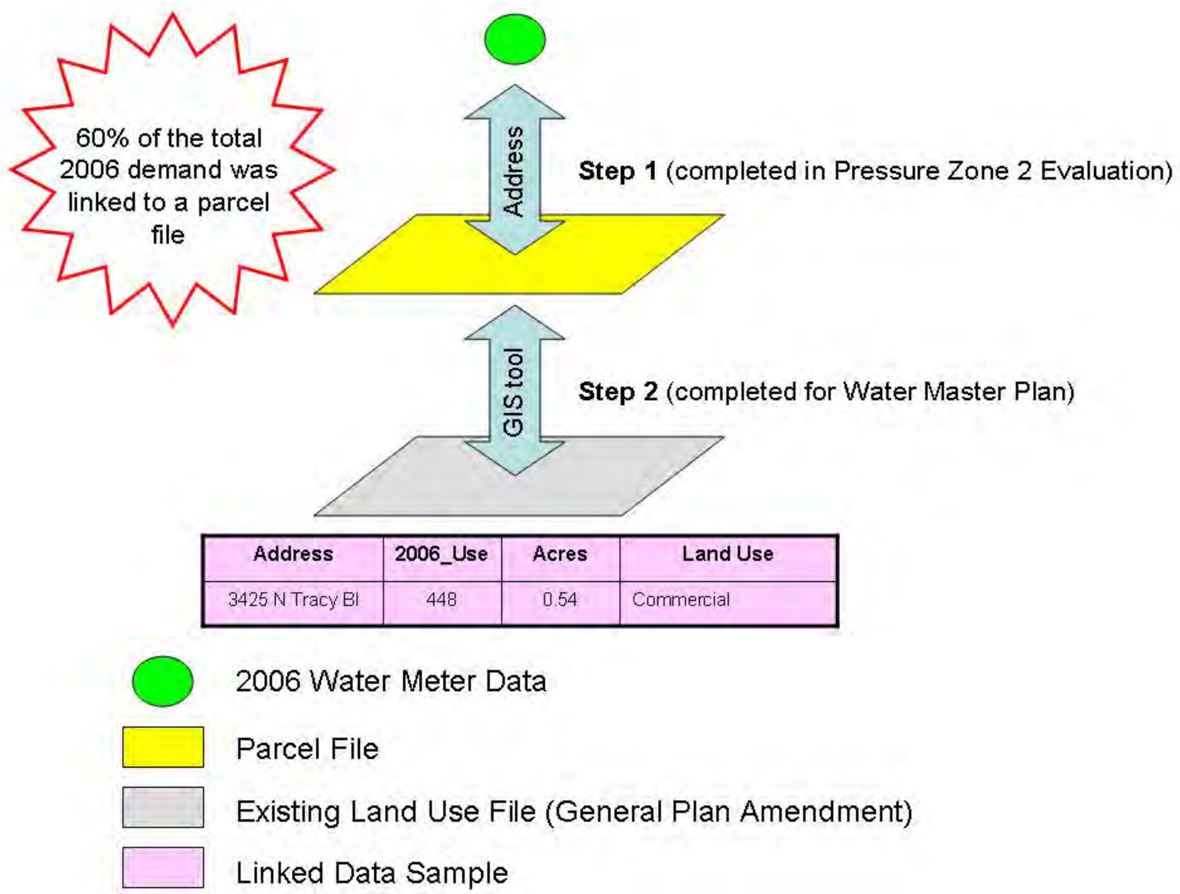
4.6.2.2 Non-Residential Unit Water Demand Factors

Non-residential unit water demand factors were verified using existing land use and parcel information in GIS format, which were correlated to existing metered water use data. Metered water use data from 2006 was previously linked to parcel data for the City's Pressure Zone 2 Evaluation competed by West Yost in July 2009. A detailed discussion regarding this process is presented in Chapter 2 of the Pressure Zone 2 Evaluation Report.

To calculate unit water demand factors by land use designation, the City's existing land use data was first added to the parcel and meter data that was previously linked for the Pressure Zone 2 Evaluation. This process was completed using tools available in GIS software. Figure 4-9 illustrates the methodology used to calculate the refined non-residential unit water demand factors.

The unit water demand factor for each non-residential land use designation was then calculated by dividing the total water use by the total parcel area for which it was linked (categorized by individual land use designation). However, the parcel area used in this initial calculation did not include streets and therefore, represented net area. Accordingly, the factors calculated were "net" unit water demand factors.

Figure 4-9. Methodology to Calculate Non-Residential Unit Water Demand Factors



Subsequently, the "net" unit water demand factors were adjusted to account for streets so they could correspond and be applied to the gross acreage information provided by City staff on development projects with approved water supply and future service areas. These "gross" unit water demand factors were then normalized to account for variation in customer water use from year to year. Table 4-13 summarizes the refined non-residential unit water demand factors developed for this Citywide Water System Master Plan.

The normalized unit water demand factors developed for the Commercial, Industrial, and Institutional land uses shown in Table 4-13 are very similar to the existing factors presented previously in Table 4-10. For Industrial land uses, the use of the 2.0 af/ac/yr factor to estimate industrial water needs (consistent with the City's existing Industrial water use factor) provides the City with the latitude to accommodate potentially higher water use type industrial customers. However, if the future industrial land uses will not be high-water-use industries, and if recycled water will be used for landscape irrigation, then the water duty for Industrial land uses can be lowered to 1.5 af/ac/yr. The existing non-residential unit water demand factors for Commercial and Institutional land uses are similar to the refined unit water demand factors do not need to be adjusted to reflect changes in more recent water use patterns.

Table 4-13. Refined Non-Residential Unit Water Demand Factors

Land Use Designation	2006 Water Use Linked, af/yr	Parcel Area Linked, acres	Net Unit Water Demand Factor, af/ac/yr	Gross Unit Water Demand Factor, af/ac/yr[(a)]	Normalized Unit Water Demand Factor, af/ac/yr[(b)]
Commercial	285	112	2.6	2.0	2.2
Industrial	1,117	541	2.1	1.7	1.8
Institutional[(c)]	258	154	1.7	1.3	1.4

(a) Assumes a net to gross area percentage of approximately 25 percent. This percentage was calculated using the total area within the City limits boundary (13,876 acres) divided by the total existing land use area of 10,872 acres, which does not include streets (General Plan Amendment, April 2009). Consequently, the parcel area linked was increased by 25 percent to account for gross acres.
(b) Assumes a normalization factor of 1.065. This factor was calculated using the maximum total annual production over the past twenty years, which was equal to 19,176 af/yr in 2007 divided by the total production from 2006 (18,000 af).
(c) Includes Medical, Public Facilities, and School land uses.
af/yr = acre feet per year
af/ac/yr = acre feet per acre per year

The Parks unit water demand factor was reduced from an existing factor of 4.5 af/ac/yr to 4.0 af/ac/yr to account for water conservation (approximately 10 percent) that is expected from parks and irrigated landscapes in the future.

4.6.3 Adopted Unit Water Demand Factors

All of the existing residential unit water demand factors were refined based on assumptions regarding water conservation from future residential water users. These assumptions account for potable water use reduction due to recycled water use, as well as more aggressive water conservation programs that will be imposed in the future.[9] As discussed above, the water use factors for Industrial land uses and Parks land uses were also refined.

Water conservation from recycled water use will be accounted for in the projected water demands as the assumed gross recycled water use acres will be subtracted out of the total gross acreage for each future service area. Due to the scattered locations and relatively small individual potential recycled water demands from the development projects with approved water supply, a conservative assumption was made to assume that these projects would not be provided with recycled water supply, and that all of their water demands would be met with potable water. Consequently, recycled water use will not be projected for the development projects with approved water supply, except for Tracy Gateway Phase 1 and Holly Sugar Sports Park where recycled water use has been specifically identified within each project area. Recycled water use areas within the Ellis Specific Plan have not been specifically identified, but an estimate of recycled water use has been included in the development of the City's recommended recycled

[9] It should be noted that the Tracy Hills Project is proposing to use alternative lower residential water use factors in their Water Master Plan Update. Use of these lower residential water use factors for the Tracy Hills Project, although not verified by actual water use data, will be based on forecasted demands in accordance with new standards for high-efficiency fixtures and appliances.

water system to provide sufficient capacity to serve this development project if it was to consider recycled water use (see Chapter 9 for more discussion). To be conservative, water demands from irrigation that could potentially be served with recycled water have not been removed from the projected potable water demands for the Ellis Specific Plan.

Table 4-14 summarizes the unit water demand factors adopted in this Citywide Water System Master Plan. Based on work completed to "spot check" and refine these adopted factors, they are appropriate for use in projecting future water demands as discussed in the following section. However, to provide individual development projects which adopt much more aggressive conservation measures with the opportunity to further reduce these adopted unit water demand factors during the specific plan process, the City will consider modest reductions to these water demand factors if:

1. The development adopts specific, more aggressive conservation measures and demonstrates to the City how these measures would further lower the adopted unit water demand factors, and
2. The development commits to a tracking or a water use verification program to document and confirm that actual project water use is less than or equal to that estimated during the project planning phase.

Table 4-14. Adopted Unit Water Demand Factors

Land Use Designation	Unit Water Demand Factor		
	gpcd	gpd/du	af/ac/yr
Residential – Very Low Density	130[a,b]	429	--
Residential – Low Density	130[a,b]	429	--
Residential – Medium Density	115[b,c]	310	--
Residential – High Density	100[b,c]	220	--
Residential – Very High Density	100	150	--
Commercial[d,e]	--	--	2.0
Office[e]	--	--	1.5
Industrial[e,f]	--	--	1.5
Institutional[d,e]	--	--	1.5
Parks[g,h]	--	--	4.0

(a) Assumes exterior water use will be with potable water, except for parks.
(b) These residential water use factors will be used to calculate the future potable demands for all residential areas including in the buildout of the City's General Plan, However, it should be noted that the Tracy Hills Project is proposing to use alternative residential water use factors in their Tracy Hills Water Master Plan Update which are significantly lower than those shown in Table 4-14. Use of lower residential water use factors for the Tracy Hills Project, although not verified by actual water use data, will be based on forecasted demands in accordance with new standards for high-efficiency fixtures and appliances.
(c) Assumes exterior water use will be with recycled water (*i.e.*, 15 percent of the total gross acres will be landscaped and irrigated with recycled water). If exterior water use will be with potable water then the adopted unit water demand factor will need to be adjusted to reflect additional potable water use for exterior water demands.
(d) Unit water demand factor was verified using water meter data; however, no adjustment was necessary.
(e) Unit water demand factor to be applied to 85 percent of the total gross acres only, assuming that 15 percent of the total gross acres will be landscaped and irrigated with recycled water.
(f) Reduced from 2.0 to 1.5 af/ac/yr based on assumed industry type (assumes that high water use industries will not be developed).
(g) Reduced from 4.5 to 4.0 af/ac/yr based on assumed conservation measures.
(h) Unit water demand factor to be applied to 15 percent of the total gross acres and/or any gross acreage that will require exterior water use.

4.6.4 Projected Buildout Water Demands

Total projected water demands for buildout of the General Plan from the development projects with approved water supply and future service areas were calculated by multiplying the adopted unit water demand factors (see Table 4-14) by the additional developed dwelling units or acreage projected to occur. As discussed above, data regarding the additional dwelling units and acreage to be developed was provided by the City's Planning Division (data was summarized in Chapter 3). Appendix C provides a copy of the land use assumption spreadsheets provided by the City's Planning Division.

The resulting future potable water demand projection from the development projects with approved water supply and future service areas were first adjusted to account for UAFW and then added to the existing (2007) water demands to provide a projection of the total potable water production at buildout. This calculation resulted in a total buildout potable water production of approximately 36,300 af/yr.

To account for recycled water use in the future, a general assumption was made to reduce the gross acreages for potable water use in the medium and high density residential plus commercial, office, industrial and institutional land uses within the future service areas by 15 percent. These acreages were then assumed to be landscaped and irrigated with recycled water. In addition, all parks land uses in the future will be irrigated using recycled water only. Based on these assumptions, recycled water production at buildout is expected to be approximately 7,500 af/yr. Table D-1 in Appendix D provides a summary of recycled water use assumptions and unit water demand factors used to project future water demands.

Table 4-15 summarizes the projected buildout potable and recycled water demands and production for the City. As shown in Table 4-15, even with the use of recycled water, the City's potable water demands are projected to almost double at buildout (from 19,200 af/yr to 36,300 af/yr). Most of the increase in water demand is associated with new development within the City's future service areas. Table D-2 in Appendix D provides detailed water demand calculations by development project and land use designation.

Table 4-15. Summary of Projected Water Demands and Production at Buildout[a,b]

Demand Category	Potable Water, af/yr	Recycled Water, af/yr
Development Projects w/ Approved Water Supply[c]	3,800	700
Future Service Areas[c]	12,000	6,200
Future Water Demands Subtotal[c]	*15,800*	*6,900*
UAFW[c]	1,300	600
Existing (2007)[c]	19,200	0
Buildout Water Production	**36,300**	**7,500[d]**

(a) See Appendix D for detailed water demand calculations by demand category.
(b) The proposed land uses and/or number of anticipated residential dwelling units for the Ellis Specific Plan and Cordes Ranch projects have subsequently been revised in April and May 2012, respectively, as discussed in Appendix C. However, these revisions do not significantly impact the buildout water demand projections presented, which were developed prior to these revisions.
(c) Totals rounded to the nearest hundred.
(d) Total does not include an estimated 200 af/yr of recycled water use that was assumed for the Ellis Specific Plan. Specific recycled water use areas have not been identified within the Ellis Specific Plan, but an estimate of recycled water use was incorporated into the proposed buildout recycled water system to provide sufficient capacity to serve this development project, if possible (see Chapter 9 for additional discussion).

The estimated buildout water production is similar to the City's previous estimate of 35,700 af/yr, as presented in the City's 2005 UWMP.

Based on the projected water demands from future development projects that will be added to the City's water system, water consumption between customer classes is expected to shift due to changes in the amount of each land use designation proposed for these future projects. Table 4-16 compares the historical average and projected buildout water consumption by customer class.

As shown in Table 4-16, the Residential customer class is expected to decrease its overall water consumption proportion as water use shifts towards increased consumption within the Industrial customer class, and to a lesser degree to the Commercial/Office customer class. This trend reflects the increase in industrial land use acreages that has been proposed in future development projects when compared to residential land uses.

Table 4-16. Historical and Projected Buildout Water Consumption by Customer Class

Customer Class	Historical Average Annual Consumption[a]	Projected Annual Consumption at Buildout[b]
Residential	74%	63%
Commercial/Office	8%	11%
Industrial	5%	19%
Institutional	3%	3%
Irrigation	10%	4%
Total	100%	100%

(a) See Table 4-4.
(b) Includes all existing and projected future demands; see Table D-2 in Appendix D.

4.6.5 Recycled Water Demand Timing and Seasonality

As described above, the estimated recycled water demand at buildout is projected to be 7,500 af/yr. This recycled water demand is anticipated to be at its maximum during the summer and fall months (particularly in July and August) when temperatures and landscape irrigation water demands are at their highest.

To estimate the future monthly recycled water use, the City's existing monthly potable water use for its dedicated landscape irrigation accounts was evaluated. Based on available metered water use data, the 2008 monthly potable water use by the City's irrigation accounts was determined to provide a representative monthly pattern of irrigation water use in the City[10]. As shown on Figure 4-10, that monthly potable irrigation water use pattern (expressed as a percent of total annual irrigation water use) was then applied to the estimated total recycled water demand at buildout to determine the monthly recycled water use at buildout. For example, 16.4 percent of the potable irrigation demand for 2008 occurred during the month of July. Therefore, recycled water demand for July at buildout is projected to be 16.4 percent of the total annual recycled water demand of 7,500 af, or 1,230 af.

As shown, the recycled water demands are projected to occur year-round, with the highest monthly demands occurring from June through October, and the lowest demands occurring in the winter and early spring months, corresponding to the City's typical rainy season.

4.7 PROJECTED POPULATION SERVED

The projected potable water demands shown in Table 4-15 were used in combination with people per dwelling unit assumptions provided by City staff to estimate the additional population to be served at buildout. Based on this data, it was estimated that the additional population to be served from future development projects will be about 53,600 people. As shown in Table 4-17, the City is projected to have a total future population of approximately 134,100 at buildout of the General Plan.

[10] Metered water use data for the City's irrigation accounts for 2007, the baseline demand year used for this demand evaluation, appeared to be inaccurate for the months of September and October.

Table 4-17. Summary of Projected Population Served at Buildout[a,b]

Population Category	Population
Development Projects w/ Approved Water Supply[c]	15,100
Future Service Areas[c]	38,500
Future Population Subtotal	*53,600*
Existing (2007) Population	80,500
Buildout Population	**134,100**

(a) Future population was calculated based on the following people per dwelling unit assumptions:
Residential – Very Low Density = 3.3 people/du
Residential – Low Density = 3.3 people/du
Residential – Medium Density = 2.7 people/du
Residential – High Density = 2.2 people/du
Residential – Very High Density = 1.5 people/du (Source: Water Supply Assessment for the Downtown Specific Plan, West Yost Associates (April 2009))
(b) Totals rounded to the nearest hundred.
(c) Based on residential dwelling unit data presented in Appendix C.

4.8 COMPLIANCE WITH SBX7-7 AT BUILDOUT OF THE CITY'S GENERAL PLAN

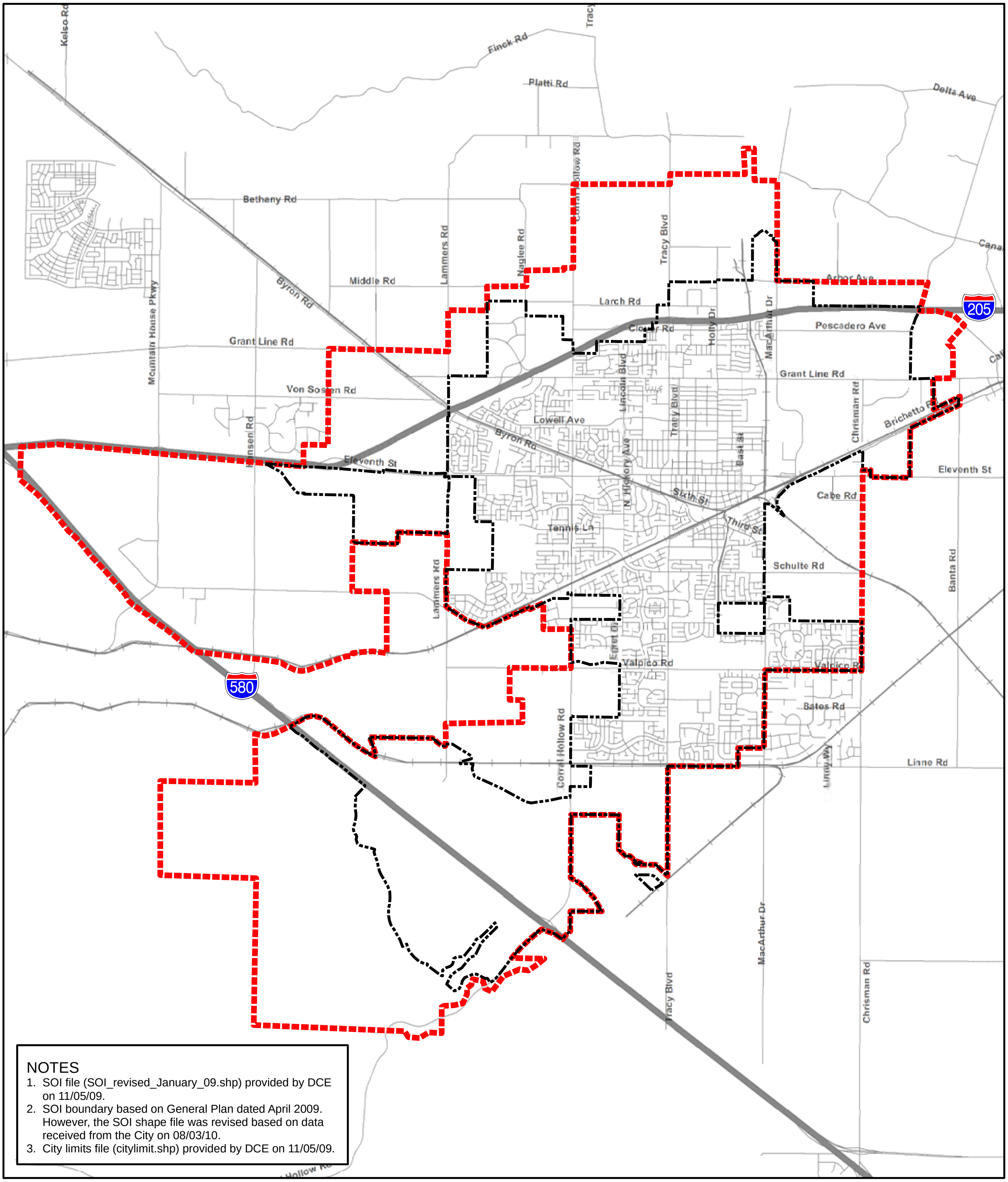
The City's ability to comply with the adopted SBx7-7 "20 x 2020" per capita water use targets discussed previously in this chapter may be impacted by the projected shift in water demands from primarily residential to more non-residential (e.g., industrial) water demands at buildout of the City's General Plan. This projected shift is due to the types of future development projects proposed within the City's SOI, which include a large amount of proposed non-residential (e.g., industrial) uses in comparison to the number of allowable new residential development units. This proposed growth trend increases the City's water demand disproportionately to the City's increase in population and therefore results in an increase to the City's per capita water use. Based on the projected future water production and population at buildout of the City's General Plan, the resulting per capita water demand could be about 242 gpcd at buildout. This value is approximately 33 percent higher than the adopted final SBx7-7 target of 182 gpcd.

The SBx7-7 legislation does include several factors which the City may consider when measuring progress toward achievement of its adopted per capita water use targets (Water Code section 10608.24(d)(1). These factors include:

- Differences in evapotranspiration and rainfall in the baseline period compared to the compliance reporting period;
- Substantial changes to commercial or industrial water use resulting from increased business output and economic development that occurred during the reporting period; and
- Substantial changes to institutional water use resulting from fire suppression services or other extraordinary events, or from new or expanded operations, that have occurred during the reporting period.

A methodology for calculating adjustments to the compliance per capita water use based on these factors is anticipated to be developed by DWR prior to 2015.

In 2011, the City's per capita water use was 180 gpcd. This per capita water use already meets the City's per capita water use targets for 2015 and 2020; however, as the economy improves water use may increase as foreclosed homes become occupied again and businesses re-open. As described in the City's 2010 UWMP, the City will continue to implement targeted water conservation measures and implement the use of recycled water to offset potable water demands to reduce per capita water use in the City.



NOTES
1. SOI file (SOI_revised_January_09.shp) provided by DCE on 11/05/09.
2. SOI boundary based on General Plan dated April 2009. However, the SOI shape file was revised based on data received from the City on 08/03/10.
3. City limits file (citylimit.shp) provided by DCE on 11/05/09.

LEGEND:

Sphere of Influence (SOI)
City Limits/Existing Water Service Area
Railroad
Highway
Existing Street

N

0 3,750 7,500
Scale in Feet

FIGURE 4-1

City of Tracy
Water System Master Plan

SERVICE AREA

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 4\Fig 4-1_ Service Area.mxd 12/6/2010

Figure 4-2. Historical Population Served (1990-2009)

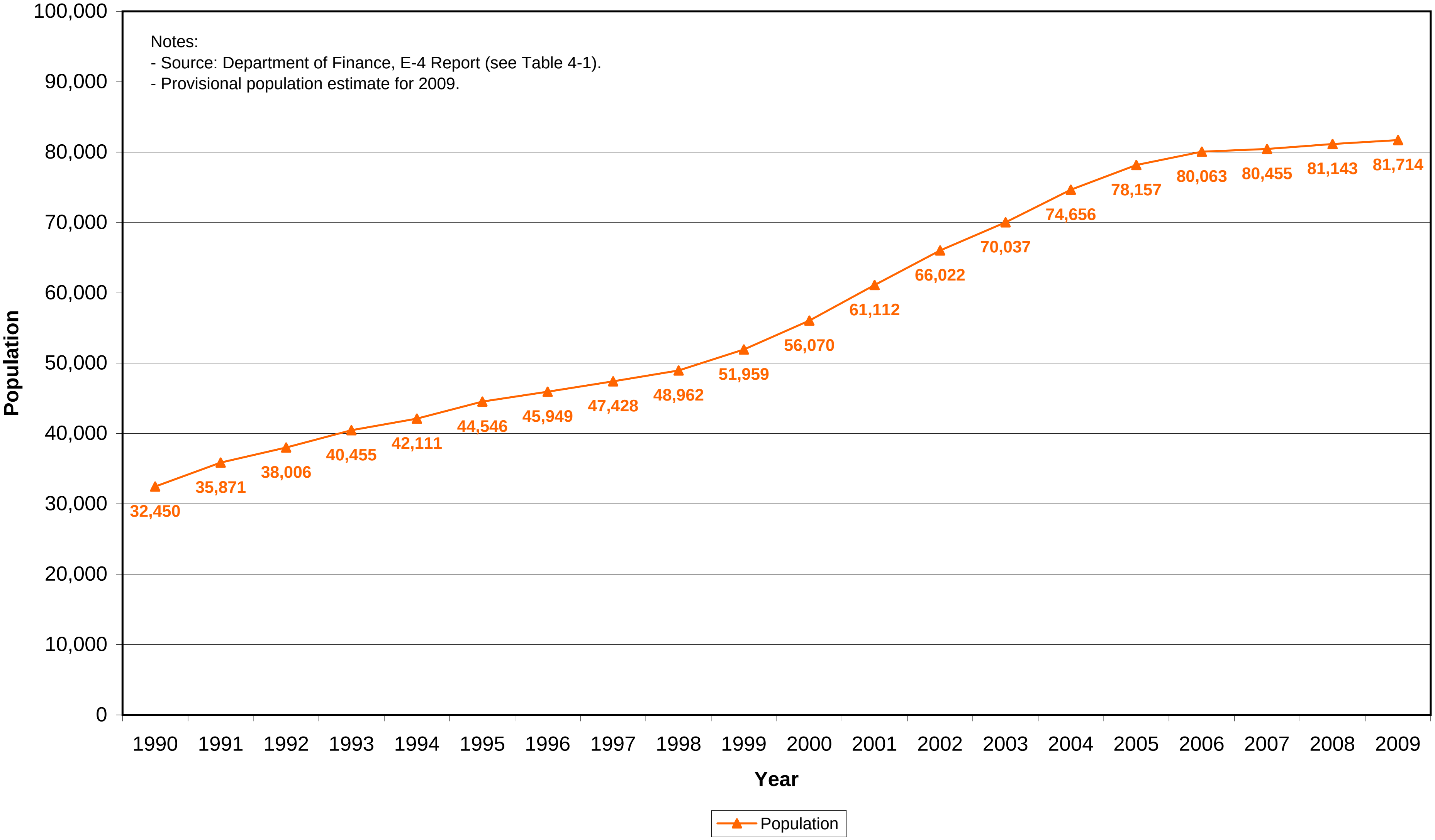
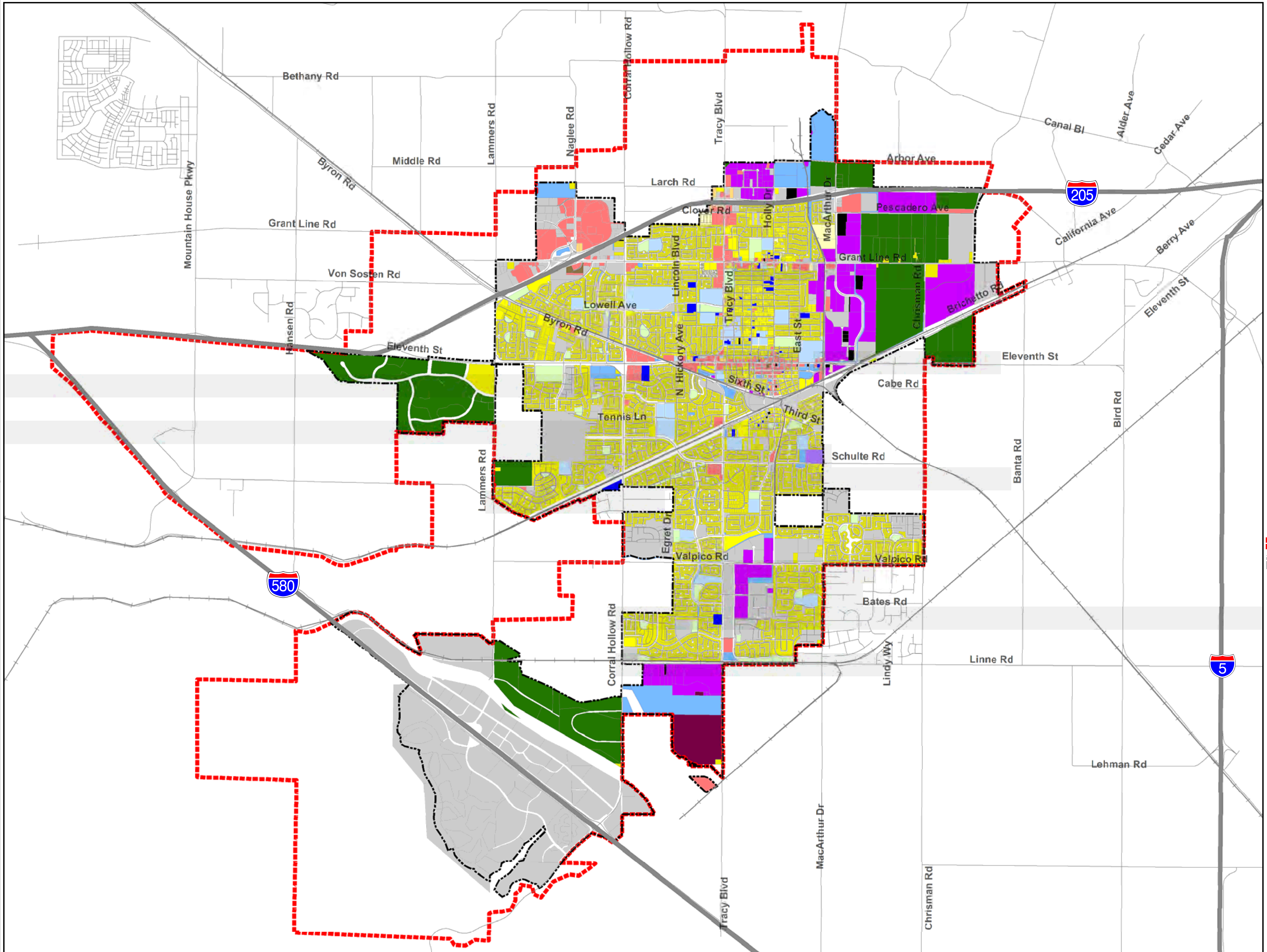


FIGURE 4-3

City of Tracy
Water System Master Plan

EXISTING LAND USE WITHIN THE CITY LIMITS



NOTES
1. Existing land use file (GPLU_revised_January2009.shp) provided by DCE on 11/05/09.
2. City limits and SOI files (citylimit.shp and SOI_revised_January_09.shp) provided by DCE on 11/05/09. SOI shape file was revised based on data received from the City on 08/03/10.

LEGEND
- SOI
- City Limits
- Residential - Single Dwelling Unit
- Residential - Two or More Dwelling Units
- Residential - Mobile Home Park
- Motel or Hotel
- Commercial
- Industrial
- Mixed Use
- Medical
- Public Facilities
- Park
- Vacant Building
- Vacant Land
- Agriculture
- School
- Airport
- Church
- Cemetery
- Highway
- Existing Street
- Railroad

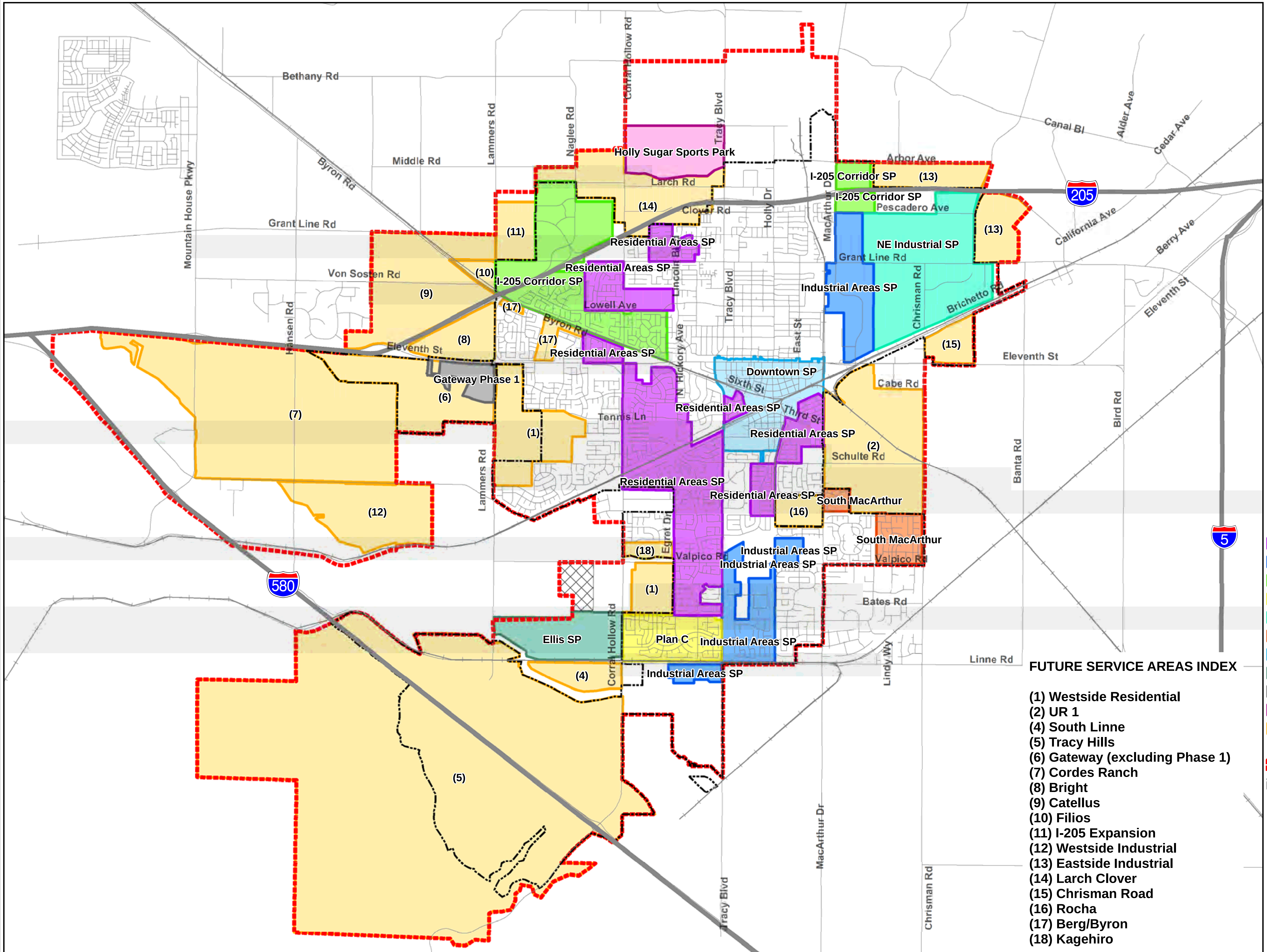
WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 4\Fig 4-3_ExistingLU_City.mxd 9/15/2010

FIGURE 4-4

City of Tracy
Water System Master Plan

LOCATIONS OF PROPOSED DEVELOPMENT PROJECTS



FUTURE SERVICE AREAS INDEX

(1) Westside Residential
(2) UR 1
(4) South Linne
(5) Tracy Hills
(6) Gateway (excluding Phase 1)
(7) Cordes Ranch
(8) Bright
(9) Catellus
(10) Filios
(11) I-205 Expansion
(12) Westside Industrial
(13) Eastside Industrial
(14) Larch Clover
(15) Chrisman Road
(16) Rocha
(17) Berg/Byron
(18) Kagehiro

NOTES

1. City limits and SOI files (citylimit.shp and SOI_revised_January_09.shp) provided by DCE on 11/05/09. SOI shape file was revised based on data received from the City on 08/03/10.
2. Infill locations are not shown.
3. Project boundaries are approximate.
4. The Future Planning Area was not inclued in the evaluations completed for the Citywide WSMP.

LEGEND

- Residential Areas Specific Plan
- Industrial Areas Specific Plan
- I-205 Corridor Specific Plan
- Plan "C"
- Northeast Industrial Specific Plan
- South MacArthur
- Downtown Specific Plan
- Ellis Specific Plan
- Tracy Gateway - Phase 1
- Holly Sugar Sports Park
- Future Service Area (see Index)
- Future Planning Area
- SOI
- City Limits
- Highway
- Existing Street
- Railroad

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 4\Fig 4-4 Future Proj Boundaries.mxd 2/21/2012

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 4\Fig 4-5_WaterEx_11x17.mxd 3/2/2012

FIGURE 4-5

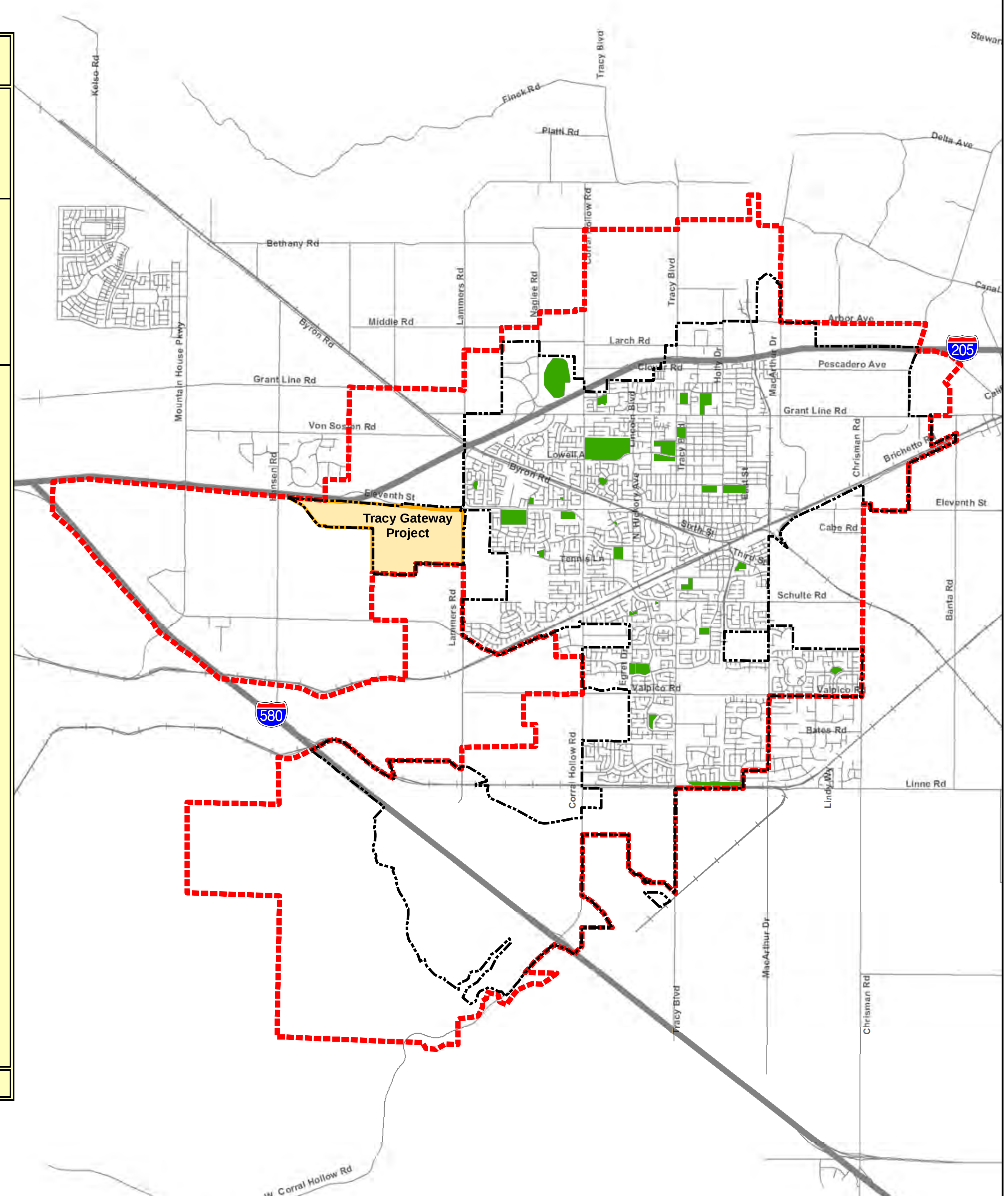
City of Tracy
Water System Master Plan

TRACY GATEWAY WATER EXCHANGE PROGRAM RECYCLED WATER USE AREAS

Potential City Parks and Other Irrigated Sites Being Considered in City's Water Exchange Program

Park Name	Total Annual Water Use, af/yr	Total Potable Water Available for Exchange, af/yr
Approved for Conversion by the City in Conjunction with Tracy Gateway First Final Map and Phase 1 Development		175
Presidio Park	119.7	
Plasencia Field	55.0	
Additional Potential Parks and Irrigated Areas for Gateway Project Phase 1 + Parcels 25, 26, and 27		51
Daniel Busch Park	13.8	
Zanussi Park	13.8	
Souza Family Park	13.8	
Verner Hanson Park	9.6	
Additional Potential Parks and Irrigated Areas Available for Water Exchange		554
Caeciliani Park	27.5	
Patzer Park	2.8	
Fabian Park	5.5	
Merrill West High School	55.0	
West Valley Mall	55.0	
Kenner Park	27.5	
Dr. Powers Park	29.2	
Tracy Park Apartments	27.5	
Monte Vista Ball Park	25.9	
Central School	9.1	
Lincoln Park	39.3	
Tracy Ball Park	31.6	
El Pescadero Park	39.9	
South School Park	27.5	
Hoyt Park	19.3	
Tracy Press Park	4.1	
Barbuda Park	5.5	
Gretchen Talley Park	13.8	
Hirsch Elementary School	20.6	
Larsen Park	13.8	
Thoming Park	13.8	
Garden Court Park	19.3	
Veterans Park	41.3	
	780	780

Source: Tracy Gateway Project Water Supply & Infrastructure Report, West Yost Associates, May 2007.



Notes
1. SOI file (SOI_revised_January_09.shp) provided by DCE on 11/05/09. This shape file was revised based on data received from the City on 08/03/10.
2. City limits file (citylimit.shp) provided by DCE on 11/05/09.

LEGEND
- City Limits
- SOI
- Park/Irrigated Area
- Railroad
- Highway
- Existing Street

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Consulting Engineers

Figure 4-6. Historical Annual Water Production (1990-2009)

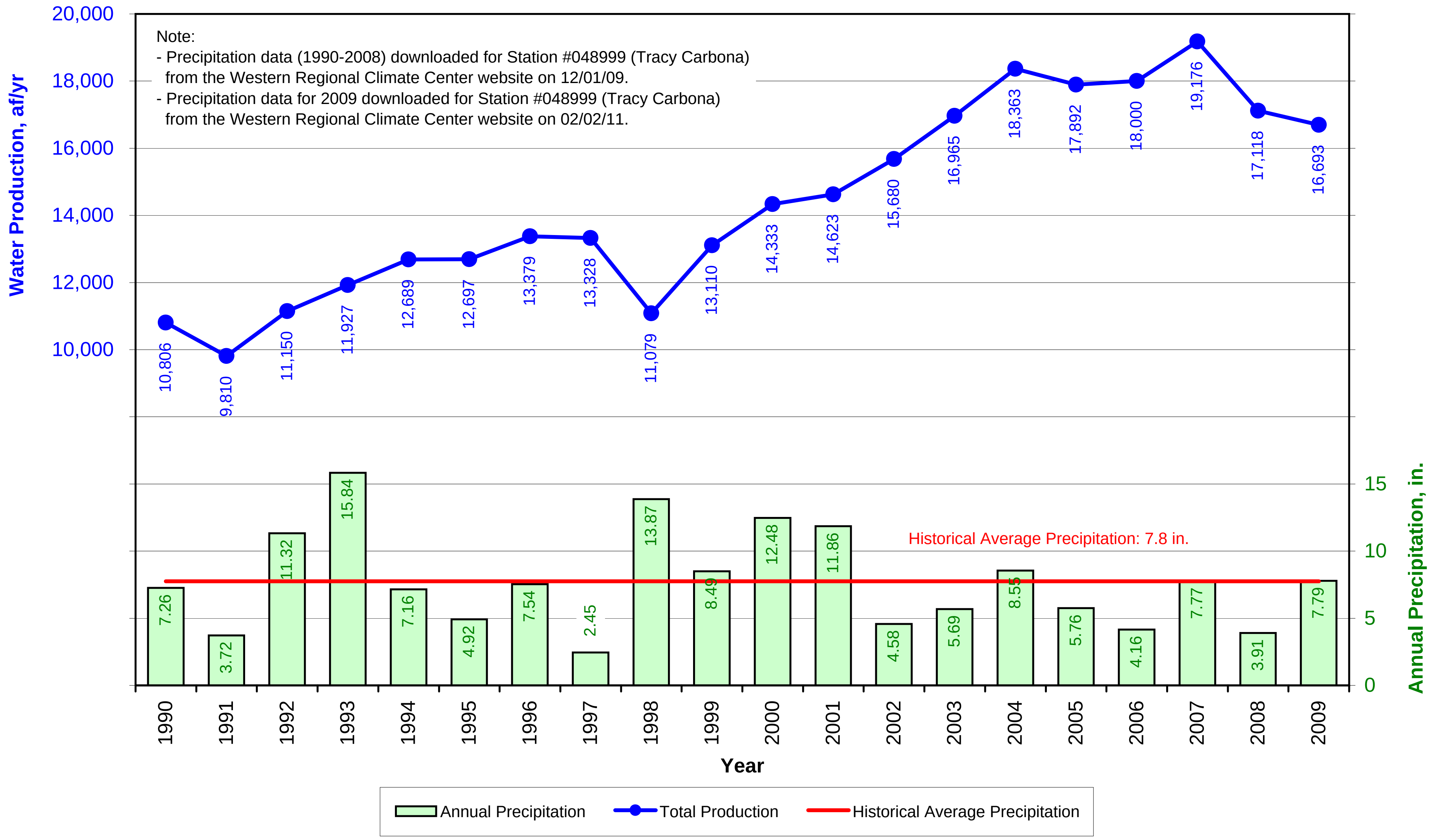


Figure 4-7. Historical Monthly Water Production (2005-2009)

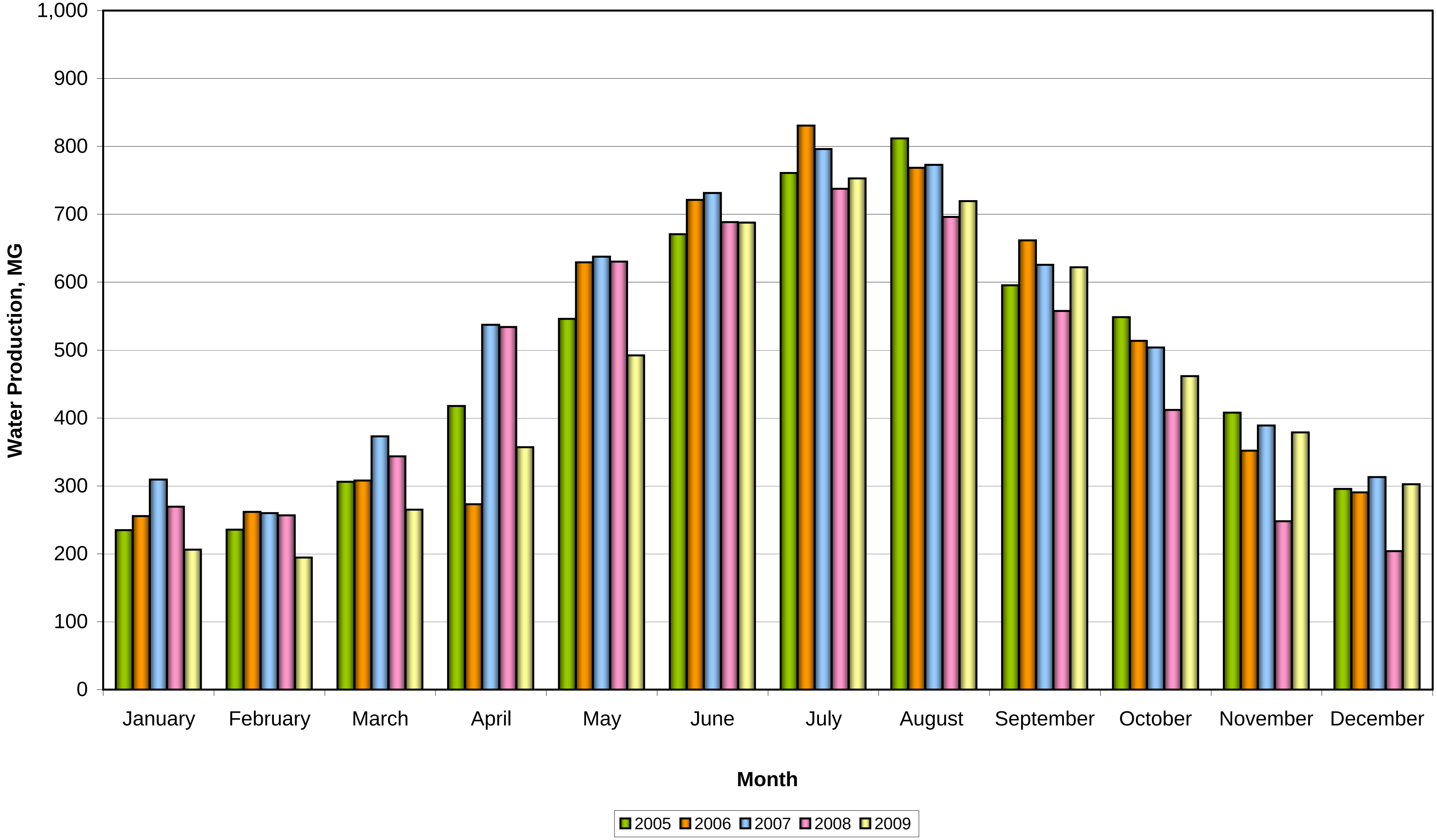


Figure 4-8. Comparison of Historical Per Capita Water Demand, Production and Population

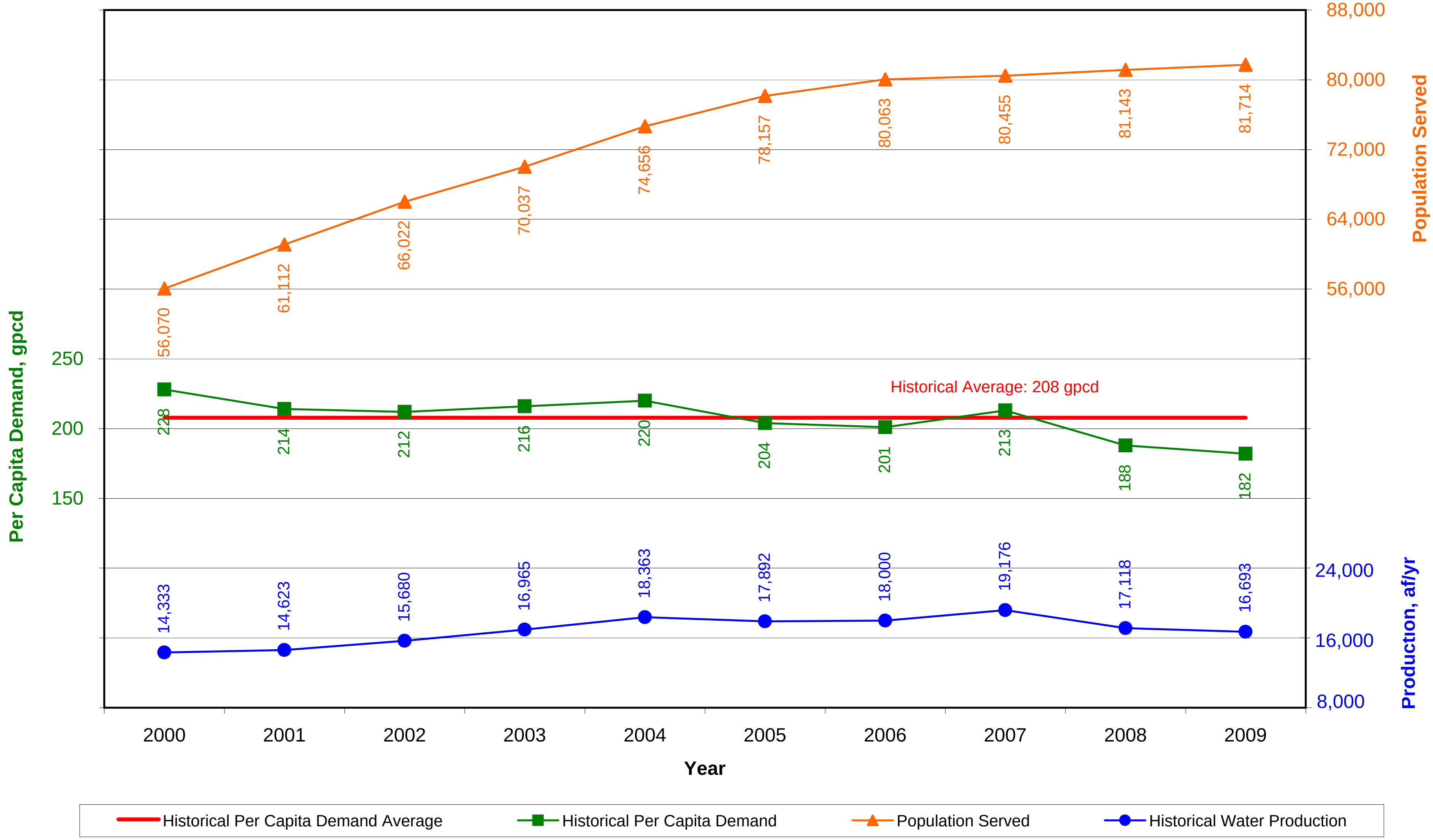
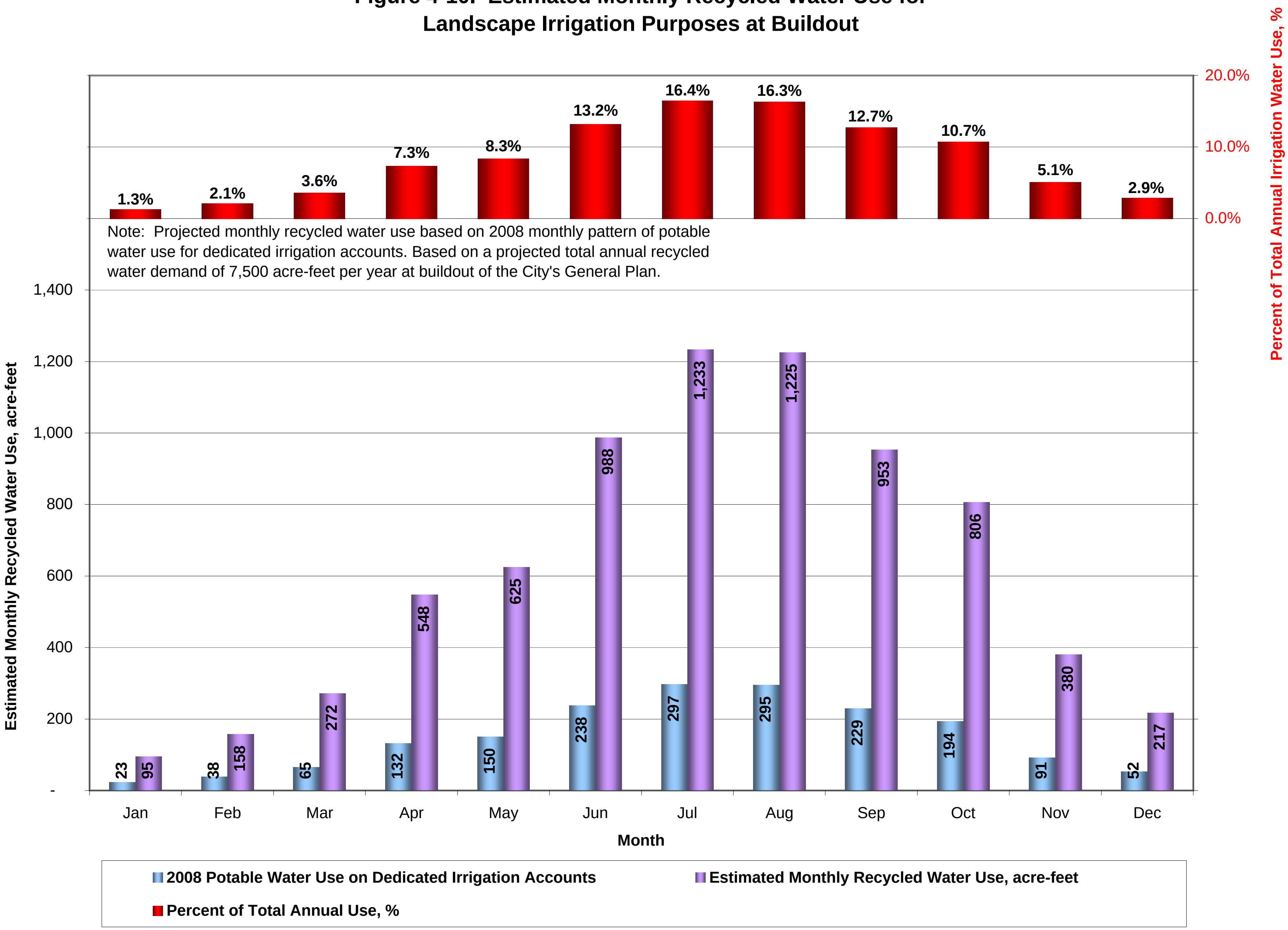


Figure 4-10. Estimated Monthly Recycled Water Use for Landscape Irrigation Purposes at Buildout



5.1 OVERVIEW

The purpose of this chapter is to provide an overview of the availability and reliability of the City's existing and additional planned future water supply sources. This chapter is not intended to provide a water supply plan for the City. The City's 2010 Urban Water Management Plan (UWMP), adopted by the City in May 2011, evaluates the City's existing and future supplies, together with the City's water conservation programs, and their ability to meet projected future demands and comply with the Water Conservation Act of 2009 (SBx7-7).

Table 5-1 provides a summary of the City's existing and additional planned future water supply agreements. A discussion of each of these water supplies and their anticipated availability and reliability is provided below.

Table 5-1. Summary of Existing and Additional Planned Future Water Supplies

Supply	Water Agreements/Contracts (Supply Quantity, af/yr)
POTABLE WATER SUPPLIES	
Existing Potable Water Supplies	
USBR CVP Contract (City Contract) (M&I Reliability)	10,000
USBR CVP (BCID assignment) (Ag Reliability)	5,000
USBR CVP (WSID assignment) (Ag Reliability)	2,500
South County Water Supply Project (SCWSP) (pre-1914 rights)	10,000
Groundwater[a]	9,000
Semitropic Water Storage Bank (Permanent Agreement)[b,c]	3,500
Additional Planned Future Potable Water Supplies	
USBR CVP (WSID Option) (Ag Reliability)[d]	2,500
USBR CVP (BBID contract) (Ag Reliability)	11,000
BBID (pre-1914)[e]	4,500
Additional Supply from SCWSP[f]	3,000
Aquifer Storage and Recovery (ASR)[c]	3,000
NON-POTABLE WATER SUPPLIES	
Existing Non-Potable Water Supplies	
Diversions of Non-Potable Surface Water from Sugar Cut[g]	Up to 1,800
Future Non-Potable Water Supplies	
Recycled Water[h]	25,000
Shallow Non-Potable Groundwater[i]	Not recommended

(a) The City is planning to decrease groundwater use to 2,500 af/yr by the year 2015. However, up to 9,000 af/yr of groundwater is available to the City to make up for shortfalls in the event of a severe drought or other water shortage.
(b) In June 2012 the Semitropic Permanent Agreement replaced the previous Pilot Agreement.
(c) Supplies from Semitropic and ASR are assumed to be dry year supplies. As such, during normal years, supplies from these sources are assumed to not be needed (0 af/yr).
(d) This option will likely be exercised by the City in conjunction with implementation of the Downtown Specific Plan to supplement existing supplies and ensure that there are adequate supplies to meet the existing and future demands under all hydrologic conditions.
(e) The future water supply anticipated from BBID (pre-1914) has been increased from 3,000 af/yr (as presented in the City's 2010 UWMP) to 4,500 af/yr based on recent agreements related to the proposed Tracy Hills project.
(f) The City is anticipating that an additional 3,000 af/yr of supply will be available from the SCWSP in the future.
(g) This existing non-potable water supply will be used to irrigate the proposed Holly Sugar Sports Park in the interim period until recycled water is available. However, continued use of this non-potable supply in the future is not anticipated.
(h) Based on the total projected recycled water production at buildout (22.4 mgd) (reference: Table C-1, Tracy Wastewater Master Plan, Draft Report, prepared by CH2MHill, May 2012).
(i) Not recommended for use due to poor water quality (see discussion in text).

5.2 EXISTING POTABLE WATER SUPPLIES

The City currently receives water supplies from the following three sources:

- Surface water from the Delta-Mendota Canal (Central Valley Project),
- Surface water from the Stanislaus River via the South County Water Supply Project (treated and delivered by the SSJID), and
- Groundwater pumped from nine groundwater wells located within the City.

Each of these existing supplies is described below. A summary table listing the City's existing and future water supplies under various hydrologic conditions is provided following the discussion of the City's future water supplies. Figure 5-1 shows the City's historical use of these water supplies.

5.2.1 Central Valley Project Water via the Delta-Mendota Canal

5.2.1.1 M&I-Reliability Supplies from the CVP

In 1974, the City entered into a 40-year contract with the USBR for an annual entitlement of 10,000 af/yr of surface water from the Central Valley Project (CVP) via the Delta-Mendota Canal (DMC). The contract is due to expire in 2014. The City has agreed with the USBR to renew this contract prior to 2014. Contract negotiations are on-going and it is the intent to renew the contract prior to 2014. In the event the contract is not renewed prior to expiration, the City and the USBR will enter into an interim renewal contract to provide water service until the long-term renewal contract is executed.

In the CVP system, in accordance with the USBR's Central Valley Project Municipal and Industrial (M&I) Draft Water Shortage Policy dated September 11, 2001, an M&I contractor is eligible for 75 percent M&I reliability applied to the contractor's historical use, with certain adjustments. This M&I reliability may be reduced when the allocation of Ag-reliability water is reduced below 25 percent of contract entitlement. Historical allocations for the M&I-reliability CVP water for the last several years are summarized below:

- 2005: 100 percent allocation
- 2006: 100 percent allocation
- 2007: 75 percent allocation
- 2008: 75 percent allocation
- 2009: 60 percent allocation
- 2010: 75 percent allocation
- 2011: 100 percent allocation
- 2012: 75 percent allocation

The City's allocations of M&I-reliability water in the last five years have averaged 77 percent of the City's contractual entitlement[1].

[1] Based on USBR CVP South of Delta M&I allocations from 2008 to 2012.

Litigation has created uncertainty regarding the reliability of water deliveries through the Bay-Delta. Most of this litigation addresses compliance with the federal and State endangered species acts (see NRDC v. Kempthorne, and Watershed Enforcers v. DWR). In August 2007, the federal court in the Kempthorne case ordered that, as an interim remedy, Delta pumping be curtailed from late December through June to protect the Delta smelt (this became known as the Wanger Decision). In December 2008, a Biological Opinion (BiOp) regarding the Delta smelt was issued by the U.S. Fish and Wildlife Service which applied Delta pumping restrictions that are similar to the August 2007 interim court remedy, and a revised BiOp related to three salmon species was issued in June 2009 which included additional pumping restrictions. After the BiOps were released, numerous parties filed suit. The court overturned the BiOps and remanded the BiOps to the fishery agencies. The final impacts of the BiOps on future SWP and CVP deliveries remain uncertain.

5.2.1.2 Ag-Reliability Supplies from the CVP

In 2004, the USBR approved the assignment of 5,000 af/yr of Ag-reliability CVP contract entitlement to the City from the Banta Carbona Irrigation District (BCID). Also in 2004, the USBR approved the assignment of another 2,500 af/yr of Ag-reliability CVP contract entitlement water to the City from the West Side Irrigation District (WSID), with the option to purchase an additional 2,500 af/yr of CVP contract entitlement from the WSID (see discussion under *Section 5.3 Additional Planned Future Potable Water Supplies*).

Deliveries of Ag-reliability water can vary significantly, and during severe water shortages supply may be reduced as much as 100 percent. Allocations for the Ag-reliability CVP water for the last several years are summarized below:

- 2005: 85 percent allocation
- 2006: 100 percent allocation
- 2007: 50 percent allocation
- 2008: 40 percent allocation
- 2009: 10 percent allocation
- 2010: 45 percent allocation
- 2011: 80 percent allocation
- 2012: 40 percent allocation

Deliveries of Ag-reliability water during the last five years have averaged 43 percent of the contractual entitlement[2].

5.2.1.3 Treatment of CVP Supplies

The City's CVP water supplies are treated at the City's John Jones Water Treatment Plant (JJWTP), which was originally constructed in 1979, expanded in 1988, and then expanded again in 2008. The JJWTP is located just north of the Delta-Mendota Canal in the southern portion of the City. With the recent plant expansion now complete, the current treatment capacity of the

[2] Based on USBR CVP South of Delta Ag allocations from 2008 to 2012.

JJWTP is 30 million gallons per day (mgd). Future additional expansion of the JJWTP is required in conjunction with buildout of the City's General Plan SOI and is described in Chapter 8.

The City also treats and serves relatively small quantities of CVP/DMC water purchased by others through a "treatment and wheeling agreement" for use at the Patterson Pass Business Park only. The Patterson Pass Business Park is now built out. In 2011, 527 acre-feet of water from the Plain View Water District (PVWD) (now part of the Byron Bethany Irrigation District (BBID)) USBR allocation was treated at the City's JJWTP and delivered to the Patterson Pass Business Park. Deliveries to the Patterson Pass Business Park in the last several years are shown below:

- 2005: 407 af
- 2006: 354 af
- 2007: 450 af
- 2008: 378 af
- 2009: 363 af
- 2010: 419 af
- 2011: 527 af

A comparable quantity of BBID CVP/DMC water is anticipated to be available for annual delivery to the Patterson Pass Business Park in the future.

5.2.2 Stanislaus River Water

The City, in partnership with the cities of Manteca, Lathrop and Escalon, and the SSJID, have constructed a surface water treatment plant near Woodward Reservoir in Stanislaus County and a transmission pipeline to deliver treated surface water to each city. The project is called the South County Water Supply Project (SCWSP). This water supply is based on SSJID's senior pre-1914 appropriative water rights to the Stanislaus River, coupled with an agreement with the USBR to store water in New Melones Reservoir. As part of the SCWSP, the City has been allocated up to 10,000 af/yr of water[3].

Treated water deliveries commenced in July 2005, and deliveries have been essentially uninterrupted since then (see Figure 5-1). In some years, SCWSP deliveries were less than the City's full project allotment; however, during these years the City did not require its full SCWSP allotment, even though the full 10,000 acre-feet was available from SCWSP. However, as shown below, since 2009 the City actually received more than its allotment. Historical deliveries from the SCWSP to the City are shown below:

- 2005: 3,146 af
- 2006: 8,918 af
- 2007: 9,130 af
- 2008: 8,017 af

[3] A small additional amount of SCWSP supplies may be available to the City on an annual basis and in the future; see further discussion at the end of this chapter.

- 2009: 10,401 af
- 2010: 10,850 af
- 2011: 11,786 af

The Draft and Final EIRs for the SCWSP analyzed the environmental impact of deliveries to the project participants of up to 44,000 af/yr (Draft EIR page 3-13). Total SCWSP deliveries to all project participants during 2006 to 2010 ranged from 16,763 af/yr in 2006 up to a maximum of 19,746 af/yr in 2009. The SCWSP is expected to have high reliability as a result of its senior pre-1914 rights. SSJID's 2010 UWMP, adopted by SSJID in September 2011, indicates that it will meet 100 percent of urban demands in normal years, 84.8 to 91.5 percent of urban demands in single dry years (the percent of urban demand met increases in the future as agricultural demands decrease), and 98 to 100 percent of urban demand in multiple dry years. For purposes of this Water System Master Plan, the City has assumed that it will be able to receive 95 percent of its allocation, even during single dry years. This increase in supply reliability is premised upon the other project participants not using their entire project allotment and that water being available to the City.

5.2.3 Groundwater

5.2.3.1 City Groundwater Wells

The City overlies a portion of the San Joaquin Valley Groundwater Basin-Tracy Sub-basin (Tracy Sub-basin). The City currently operates nine groundwater wells, with a total extraction capacity of about 15 mgd. Four wells (Production Wells 1, 2, 3 and 4) are located near the City's JJWTP and pump directly into the JJWTP clearwells, where the groundwater is blended with treated surface water. The other wells (Lincoln Well, Lewis Manor Well (Well 5), Park and Ride Well (Well 6), and Ball Park Well (Well 7) are located throughout the City and pump water directly into the distribution system after disinfection. The City's newest well, Well 8, located near the intersection of Tracy Boulevard and 6th Street, was designed as an Aquifer Storage and Recovery Well (ASR Well), but has been put into service initially as an extraction well. Figure 5-2 shows the locations of the City's wells and the Tracy Sub-basin.

5.2.3.2 Groundwater Yield

A 1990 Kennedy/Jenks/Chilton (K/J/C) study estimated a perennial groundwater yield of 6,700 af/yr in the Tracy Sub-basin within the Tracy Study Area. However, in 2001, to determine if additional groundwater resources were available in the Tracy Study Area, the City conducted an updated groundwater analysis. The Estimated Groundwater Yield Study, prepared by Bookman-Edmonston Engineering provided an evaluation of potential groundwater yield and determined that a 2,300 af/yr increase of the average annual operational groundwater yield above the groundwater yield recommended in the 1990 K/J/C study could be provided within the estimated sustainable yield of the Tracy Sub-basin in the Tracy Study Area, without adverse impact to groundwater resources or quality in the Tracy Study Area over a 50-year timeframe. This expansion of groundwater usage to 9,000 af/yr would be within the City's estimated share of the aquifer's sustainable yield of 22,000 af/yr of the 28,000 af/yr total (which includes groundwater usage within West Side Irrigation District, Naglee-Burk Irrigation District, Plain View Water District (now part of the Byron Bethany Irrigation District), and Banta-Carbona

Irrigation District). It was also estimated that this expansion of groundwater usage would result in a groundwater level drop of 10 feet, but would stabilize at this level.

5.2.3.3 Groundwater Quality

Groundwater quality in the Tracy Sub-basin varies spatially and with depth. In general, the northern part of the Tracy Sub-basin is characterized by a sodium water type, and the southern part of the Sub-basin is characterized by calcium-sodium type water. The northern part of the Tracy Sub-basin is also characterized by a wide range of anionic water types, including bicarbonate; chloride; and mixed bicarbonate-chloride. Major anions in the southern part of the Tracy Sub-basin include sulfate-chloride and bicarbonate-chloride.

There is also a difference between the water quality in the water-bearing zones above the Corcoran Clay (termed the "semi-confined aquifer") and below the Corcoran Clay (termed the "confined aquifer"). Generally, the water quality of the confined aquifer is better than that of the semi-confined aquifer. TDS concentrations in well water sampled in the semi-confined aquifer ranged between 1,000 milligrams per liter (mg/L) and 1,500 mg/L, while the measured TDS in the confined aquifer was less than 1,000 mg/L. In the vicinity of Tracy, the TDS of the confined aquifer is between 600 mg/L and 700 mg/L.

Constituents present at elevated concentrations throughout the Tracy Sub-basin in both the semi-confined and confined aquifers include chloride, nitrate, sulfate, and boron. Elevated chloride occurs in several areas near Tracy and along the San Joaquin River. Areas of elevated nitrate occur in the northwestern part of the Tracy Sub-basin and in the vicinity of Tracy. Elevated boron occurs over a large portion of the Sub-basin from south of Tracy extending to the northwest side of the Tracy Sub-basin. Sulfate concentrations of up to 500 mg/L have been detected in Tracy Sub-basin groundwater. The groundwater near Tracy is considered to be very hard.

5.2.3.4 Groundwater Management

The 1992 Groundwater Management Act, AB 3030, established provisions by which local water agencies could develop and implement groundwater management plans (GMPs). GMPs are generally designed to prevent local and regional aquifer overdrafting, which reduces available groundwater resources and which, under certain conditions, can lead to degradation of water quality and to land subsidence. As described below, the City has been, and continues to be, involved in both regional and local groundwater management efforts.

5.2.3.4.1 Groundwater Management Plan for the Northern Agencies in the Delta-Mendota Canal Service Area and a Portion of San Joaquin County

In 1996, the City Council adopted the Northern Delta-Mendota Canal Groundwater Management Plan pursuant to AB 3030. The plan was developed in coordination with other DMC northern agencies, including: Banta-Carbona Irrigation District, Byron-Bethany Irrigation District, Del Puerto Water District, Patterson Irrigation District, West Stanislaus Irrigation District, Westside Irrigation District, San Joaquin County, and the City of Tracy. The 1996 GMP included information on groundwater levels and quality, conjunctive management of groundwater and surface water resources, and measures to protect groundwater resources within the plan area.

In 2011, the GMP was revised to include additional information to comply with new provisions adopted by the State Legislature which included:

- The Department of Water Resources (DWR) to establish a priority schedule for monitoring groundwater basins and elevation reports as well as issuing recommendations to local entities to improve water quality;
- Permit local entities to determine best methods of groundwater monitoring to meet local demand;
- The DWR to implement groundwater monitoring if local agencies fail to do so. This will result in loss of eligibility for State grant funds.

A public hearing regarding the revised GMP was held on February 7, 2012. The revised GMP was adopted by the Tracy City Council on May 1, 2012.

5.2.3.4.2 San Joaquin County Groundwater Export Ordinance

Occasional drought conditions and on-going restrictions on Delta export pumping have reduced the imported CVP surface water supply available to entities located south of the Delta that rely on DMC/CVP water. Arrangements for water transfers between entities that receive DMC/CVP water were developed to allocate the reduced DMC/CVP supply to match demand, including pumping of groundwater into the DMC for conveyance and use in other areas. This additional groundwater extraction, for the purpose of selling it to other DMC/CVP users, raised concerns amongst Tracy Sub-basin groundwater users regarding groundwater overdraft and quality degradation. In response to these concerns, San Joaquin County enacted a Groundwater Export Ordinance in June 2000 that requires an entity to secure a permit from San Joaquin County prior to exporting groundwater out of the County (such as by pumping extracted groundwater into the DMC for conveyance to other areas).

5.2.3.4.3 City Groundwater Management Policy and Mitigated Negative Declaration for City Groundwater Production of 9,000 af/yr

On a local level, in 2001, the City adopted a Groundwater Management Policy, and prepared a Groundwater Management Policy Mitigated Negative Declaration. The Groundwater Management Policy and the Groundwater Management Policy Mitigated Negative Declaration are described below.

As discussed above, in 2001, the City anticipated that, to make up a projected temporary shortfall between supply and demand, groundwater extraction would have to increase from approximately 6,000 af/yr to a maximum of 9,000 af/yr over the three-year period from 2001 through 2004. Prior to 2001, it had been estimated that 6,700 af/yr was the City's sustainable groundwater extraction rate (K/J/C, 1990). However, the 2001 Estimated Groundwater Yield Study by Bookman-Edmonston, revised the estimated average annual operational groundwater yield to 9,000 af/yr. This operational yield, though larger than the earlier estimate, is still well under the City's estimated 22,000 to 28,000 af/yr share of the Tracy Sub-basin's sustainable yield.

Pursuant to the findings of the 2001 Bookman-Edmonston study, the Tracy City Council adopted a Groundwater Management Policy in 2001 that established the City's maximum annual groundwater extraction rate of 9,000 af/yr. To comply with CEQA and to evaluate the potential negative effects of increased groundwater extraction on water quality, water levels, and subsidence, the City also prepared a Groundwater Management Policy Mitigated Negative Declaration. The Groundwater Management Policy Mitigated Negative Declaration specifies the frequency and type of monitoring and reporting the City must conduct to evaluate the sustainability of the increased groundwater extraction rate.

Consistent with the Groundwater Management Policy Mitigated Negative Declaration, the City has maintained groundwater production rates well below the estimated sustainable yield of 9,000 af/yr. In addition, the City hired Bookman to monitor the impacts of groundwater extraction on groundwater levels, groundwater quality, and land subsidence. Bookman's most recent Mitigation Monitoring Report dated January 23, 2009 covering the period from November 2007 through November 2008 includes well production data, water quality data, hydrographs, and groundwater contour maps for the City's production and monitoring wells. As described in the report, there is no indication that pumping by the City is significantly or adversely affecting groundwater levels or water quality at this time. In fact, the report shows that groundwater levels in the City's wells have increased over the last couple of years, likely as a direct result of decreased groundwater pumpage by the City since 2005.

5.2.3.4.4 Tracy Regional Groundwater Management Plan (Regional City GMP)

In addition to participating in the development of the Tracy Sub-basin GMP, in 2005 the City was awarded a DWR grant for approximately $185,000 to prepare a Tracy Regional Groundwater Management Plan (Tracy Regional GMP) for the portion of the Tracy Sub-basin that underlies the City of Tracy. The Tracy Regional GMP was completed in March 2007. A key objective of the Tracy Regional GMP was the development of Basin Management Objectives (BMOs) for groundwater levels, groundwater quality, and land subsidence in the region.

5.2.3.5 Historical Groundwater Use

As discussed previously, the City currently operates nine groundwater extraction wells. The City's newest well, Well 8, was constructed in January 2004 and was put into service as an extraction well in September 2010. Well 8 is ultimately intended for use with the City's future Aquifer Storage and Recovery Program (see discussion under *Section 5.3 Future Potable Water Supplies*).

Locations and characteristics of the wells are listed in Table 5-2. Locations of the wells are shown on Figure 5-2.

Table 5-2. City of Tracy Groundwater Well Characteristics

Well Name/Number	Well Location/Address	Year Drilled	Total Well Depth (Casing Depth), feet	Casing Diameter, inches	Depth of Perforated Zone, feet[(a)]	Design Capacity, gpm	Production Capacity, mgd
Well 1	JJWTP	1986	1,010 (1,000)	16”	450-550 580-980	1,500	2.2
Well 2	JJWTP	1989	990 (870)	16”	420-850	2,000	2.9
Well 3	JJWTP	1989	1,020 (900)	16”	420-890	2,000	2.9
Well 4	JJWTP	1989	1,020 (950)	16”	380-940	2,000	2.9
Lincoln Well	Lincoln Park	1990	1,000 (1,000)	16”	490-980	2,500	3.6
Well 5[(b)] (Lewis Manor Well)	902 Twelfth Street (north of Eleventh Street between Tracy Boulevard and Corral Hollow Road)	2000	1,015 (1,000)	18”	410-480 601-630 650-670 805-830 900-930 965-990	2,500	3.6
Well 6 (Park & Ride Well)	2650 North Naglee Road (North of I-205 adjacent to West Valley Mall)	2001/02	1,250 (1,216)	18”	550-598 610-636 656-678 738-754 774-796 966-982 1,014-1,122 1,176-1,196	2,000	2.9
Well 7 (Ball Park Well)	2001 Bessie Avenue (east of Tracy Boulevard south of Grant Line Road)	2002	1,070 (894)	18”	550-598 570-732 850-874	2,500	3.6
Well 8[(c)]	Tracy Boulevard and Sixth Street	2004	850 (850)	18”	370-460 510-640 680-820	2,500	3.6

(a) Source: GEI Consultants, Summary of Groundwater Conditions November 2007 through November 2008, dated January 23, 2009.
(b) Data shown is for the Lewis Manor Replacement Well constructed in 2000.
(c) Well 8 went into operation in September 2010 as an extraction well. The City plans to use Well 8 as an injection/extraction well in the future as part of the City's ASR Program.

Historically, groundwater has accounted for approximately 40 to 50 percent of the City's annual water supply. Prior to 2000, groundwater extraction by the City totaled less than 6,000 af/yr. Between 2000 and 2004, to meet increased demands for water, the City began extracting additional groundwater, with annual usage up to about 7,700 af/yr. In 2005, groundwater extraction decreased to less than 6,000 af/yr primarily because: (1) the SCWSP was completed and the City began receiving Stanislaus River water; and (2) rainfall was above normal, meaning that the City received a higher percentage of its DMC/CVP contractual entitlements. The City's groundwater production over the last several years is shown below:

- 2005: 5,826 af
- 2006: 3,034 af
- 2007: 3,672 af
- 2008: 2,598 af
- 2009: 1,327 af
- 2010: 498 af
- 2011: 292 af

5.2.3.6 Projected Future Groundwater Use

5.2.3.6.1 Future Groundwater Pumpage Quantity

As discussed above, the 2001 Estimated Groundwater Yield Study indicated an average annual operational groundwater yield for the City of 9,000 af/yr. The study indicated that this increase in the City's groundwater yield was within the estimated sustainable yield of the groundwater basin within the Tracy area, and could be maintained without adverse impact to groundwater resources or quality in the Tracy area over a 50-year timeframe. However, because the hard, high-TDS groundwater is of poorer quality compared with the City's surface water sources, the City is planning to scale back its future groundwater extractions during normal years. For example, at buildout of the General Plan, groundwater production in normal years is anticipated to be approximately 2,500 af/yr. However, the City will continue to rely on groundwater for peaking, drought, and emergency supplies, and may pump up to 9,000 af/yr or more during single dry or multiple dry years, as needed, to meet demands when surface water supplies may be limited.

The City's existing groundwater wells currently have the capability of pumping 9,000 af/yr. The City has replaced a number of older wells with new wells (*e.g.*, the Tidewater Well was replaced by Well 8). Well 8, which is ultimately intended for use as part of the City's future Aquifer Storage and Recovery Program (see further discussion below), was constructed in 2004, equipped in early 2010 and put into operation as an extraction well in September 2010. In the future, the City will construct new production and emergency supply wells, as needed, to replace and supplement existing, aging production wells and provide additional supply reliability in the event of a drought or other emergency situation.

The City's potential uses of groundwater during droughts are consistent with Tracy's Groundwater Management Policy (discussed above). In the event that the City is unable to secure additional high quality surface water supplies in the future, groundwater remains a sustainable water supply up to 9,000 af/yr. However, by reducing groundwater extraction on an average annual basis to approximately 2,500 af/yr, the City will:

- Increase the overall quality of its drinking water, thus increasing customer satisfaction and reducing system maintenance and repair caused by the lower-quality groundwater;
- Recharge the underlying aquifer, effectively increasing the availability of groundwater during a drought or emergency condition (*i.e.*, the City will effectively be practicing "in-lieu groundwater banking" of its groundwater); and
- Reduce salt loading to the City's wastewater treatment plant which will help the City comply with wastewater discharge requirements (see further discussion under *Section 5.2.3.6.2 Future Groundwater Quality Issues*).

If the City decreases future groundwater extraction during normal and wet years, current groundwater levels, groundwater flow directions and gradients, and groundwater quality would be expected to change correspondingly. Further, if the City moves ahead with its proposed future ASR Program (see discussion below), changes in groundwater flow patterns associated with the introduction of treated surface water into aquifer zones may occur. In this way, a focused groundwater recharge area would be created. Groundwater quality would be expected to improve as a result of the introduction of higher quality surface water into the aquifer.

5.2.3.6.2 Future Groundwater Quality Issues

A portion of the City's potable water, after use by its customers, is discharged to the sanitary sewer collection system and treated at the City's wastewater treatment plant, with eventual discharge into Old River. Old River is part of the Delta and is included in the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (2006 Delta Plan). The Delta Plan contains standards for salinity. In 2007, the City received a renewed National Pollutant Discharge Elimination System (NPDES) wastewater discharge permit from the Regional Water Quality Control Board – Central Valley Region (RWQCB). The adopted permit contained methods by which the City could comply with the salinity standards. This permit was appealed by environmental groups to the SWRCB. The SWRCB remanded the permit back to the RWQCB with instruction to include numeric limits for salinity in the NPDES permit. The RWQCB has proposed to require the City to comply with the 2006 Delta Plan salinity standards for Electrical Conductivity of 700 µmhos/cm from April 1 through August 31, and 1,000 µmhos/cm from September 1 through March 31.

According to the City's 2011 Consumer Confidence Report, in 2011 the Specific Conductance in the City's groundwater ranged from 740 to 1,200 µmhos/cm, and averaged 917 µmhos/cm. These values exceed the proposed RWQCB limits for salinity in the City's wastewater discharge. Therefore, depending on the City's future combined use of groundwater and surface water supplies, the City may need to provide groundwater treatment to remove salts (*e.g.*, demineralization). The City's proposed reduced future use of groundwater could serve to dilute the salts in the wastewater to a concentration which does not require source water treatment to remove salt.

5.2.4 Out-of-Basin Water Banking

The Semitropic Groundwater Storage District Groundwater Storage Bank (Semitropic) is a water storage system that began operation in the early 1990s. Located in Kern County between the California Aqueduct and the Delta-Mendota Canal, Semitropic is one of eight California groundwater banking agencies. Semitropic works by having its banking partners deliver their surplus water to Semitropic for storage. Then, when requested by the banking partner, Semitropic returns the stored water to the California Aqueduct for use by its partners either by exchanging its entitlement or by reversing the intake facility (known as "pumpback"). Through "pumpback", Semitropic can deliver a maximum of 90,000 af/yr of water into the California Aqueduct. The State would then deliver the water to the banking partners.

The total storage capacity at Semitropic is 2.15 million acre-feet and, as listed below, there is still a significant amount of storage capacity which is uncommitted and available. The current Semitropic banking partners and their reserved/available storage capacities are listed below[4]:

- Original Water Bank (1.0 million acre-feet)
  - — Metropolitan Water District of Southern California: 350,000 acre-feet
  - — Santa Clara Valley Water District: 350,000 acre-feet
  - — Alameda County Water District: 150,000 acre-feet
  - — Zone 7 Water Agency: 65,000 acre-feet
  - — Newhall Land and Farming Company: 55,000 acre-feet
  - — San Diego County Water Authority: 30,000 acre-feet
- Stored Water Recovery Unit (650,000 acre-feet)
  - — Semitropic's Contribution to Semitropic-Rosamond Water Banking Authority (SRWBA): 300,000 acre-feet (see below)
  - — Semitropic Portion of Stored Water Recovery Unit (350,000 acre-feet)
    - ❖ Poso Creek Water Company: 60,000 acre-feet
    - ❖ Rampage Vineyard: 18,000 acre-feet
    - ❖ Uncommitted: 122,000 acre-feet
    - ❖ Not Available Until SRWBA is Committed: 150,000 acre-feet
- SRWBA (800,000 acre-feet)
  - — Portion Contributed by Semitropic (300,000 acre-feet)
    - ❖ San Diego County Water Authority: 15,000 acre-feet
    - ❖ Available Storage: 285,000 acre-feet
  - — Antelope Valley Water Bank (500,000 acre-feet)
    - ❖ San Diego County Water Authority: 25,000 acre-feet
    - ❖ Rosamond Community Services District: 30,000 acre-feet
    - ❖ Available Storage: 445,000 acre-feet

[4] Based on information provided on Semitropic Water Storage District website: www.semitropic.com, as of September 2010.

5.2.4.1 Pilot Agreement

In June 2006, the City entered into a pilot agreement with Semitropic for 1,000 acre-feet of water storage at Semitropic, which allowed for an annual withdrawal of up to 333 af/yr (*e.g.*, 1,000 acre-feet divided by 3). The pilot agreement was intended to establish the procedures for water deposits and withdrawals by the City of Tracy. Now that the Permanent Agreement with Semitropic has been implemented (see below), this pilot agreement has been terminated.

5.2.4.2 Permanent Agreement

On June 5, 2012 the Tracy City Council approved a long-term agreement with Semitropic for 3,500 units of water storage. One unit of water storage allows for a withdrawal of up to 1 af/yr for three years; hence, the agreement would allow for withdrawal of 3,500 af/yr for three years (10,500 af total). To store water in Semitropic, the City would not withdraw its share of CVP water from the DMC, but instead allow this water to continue to move through the DMC and California Aqueduct systems for delivery to and use by Semitropic. This is called "in lieu storage." Upon request by the City, in accordance with the contract, Semitropic would pump the stored water into the California Aqueduct and a like amount of water would be made available to the City directly from the DMC. Though the City could utilize this supply in any year, it would be most valuable during drought years when the City's CVP surface water supplies are reduced. If the City uses water from the Semitropic water bank in any given year, it would work to manage its supplies during subsequent years such that it could "refill" its water bank for future water use. By banking surplus CVP water at Semitropic, the City will increase the quantity of supplies available during drought and/or other emergency conditions, thereby increasing the reliability of its water supply.

To date, the City has deposited 7,000 acre-feet of supplies in Semitropic and has withdrawn 200 acre-feet (100 acre-feet in November 2007 and 100 acre-feet in December 2008). The City's current balance is 6,100 acre-feet; these supplies are available to the City for withdrawal in dry years, if needed.

5.3 ADDITIONAL PLANNED FUTURE POTABLE WATER SUPPLIES

The City is currently anticipating the following additional planned future potable water supplies:

- Additional surface water from the Delta-Mendota Canal (CVP);
- Surface water from BBID pre-1914 water rights;
- Additional supplies from the SCWSP; and
- Aquifer Storage and Recovery.

Each of these additional planned future potable water supplies is described below. A summary table listing the City's existing and additional planned future water supplies under various hydrologic conditions is provided at the end of this section.

5.3.1 Additional Central Valley Project Water via the Delta-Mendota Canal

5.3.1.1 Additional CVP Supplies from WSID

As previously mentioned, the City has an option for an additional assignment of 2,500 af/yr of Ag-reliability CVP contract entitlement water from the WSID. Per the agreement with WSID, the City can execute this assignment at any time before midnight on February 27, 2014. Environmental review and all other required reviews and approvals for this assignment have been completed, such that this assignment can be executed with the transfer of the required funds. The City plans to exercise this option in late 2013 or early 2014, prior to the February 27, 2014 deadline with the additional supply of 2,500 af/yr being available immediately thereafter.

5.3.1.2 Additional CVP Supplies from BBID

The area served by the former PVWD is now part of BBID. Due to on-going urbanization in portions of BBID's service area, BBID anticipates that it may have CVP contract entitlement water (with Ag-reliability) available for municipal uses in the future. The City and BBID are negotiating a phased option agreement to assign portions of BBID's CVP/DMC contract right to the City. The estimated quantity of contract entitlement water potentially subject to such an agreement is approximately 11,000 af/yr. The exact quantity of BBID CVP water entitlement is the subject of the future agreement between the City and BBID. However, previous discussions have indicated that a contract entitlement quantity of water equal to 3.4 acre-feet per year per acre of converted agricultural land may be available for M&I use.

It is estimated that an agreement between the City and BBID can be achieved within the next few years to allow for the transition of additional CVP supplies to be available to the City starting in 2015 (at 3,000 af/yr) and increasing to 11,000 af/yr by 2030. An approval will be required from the USBR and compliance with CEQA and NEPA will be required. Because the exact quantity of water available and terms of a future agreement are yet to be negotiated, the total cost and financing mechanisms for acquiring this supply have not yet been determined.

5.3.2 Surface Water from BBID Pre-1914 Water Rights

Part of the proposed Tracy Hills Specific Plan area was annexed into the BBID and is entitled to water service from BBID, using BBID's pre-1914 appropriative water rights. The City anticipates that up to 4,500 af/yr of pre-1914 water rights water could be provided by BBID on a year-round basis (via the DMC with a proposed Exchange Agreement with the USBR) to serve the proposed Tracy Hills Project in the BBID service area. This supply quantity has been increased from that presented in the City's 2010 UWMP as a result of recent agreements related to the proposed Tracy Hills Project. Because the water supply is based on pre-1914 appropriative rights, the supply is considered to be firm and well-established.

Current and future work to secure this water supply includes: finalizing agreements between the City and BBID; completion of a Water Supply Assessment and required environmental documentation; and execution of an Exchange Agreement with the USBR to provide for a year-round supply to be conveyed to the City's JJWTP via the DMC. The proposed supply will need to meet the City's reliability criteria.

Costs for obtaining the water supply from BBID and delivering the water supply to the City's JJWTP for treatment and use at the Tracy Hills Project will be paid in a manner consistent with the City's applicable fee program requiring fair share participation by the project developer. Required reviews and approvals will likely include the following entities: the City, Tracy Hills Project developer, BBID, and USBR. The City anticipates that the BBID pre-1914 water supply will be available by 2014.

5.3.3 Additional Supplies from the SCWSP

The City is anticipating that an additional 2 mgd of treatment and conveyance capacity, and 3,000 af/yr of treated water supplies will be available from the SCWSP in the future. This additional supply would have the same high reliability as the supply that the City is currently receiving from the SCWSP. Delivery of these additional supplies to the City would be through the same, existing facilities currently delivering the City's existing SCWSP supplies. Delivery of these additional supplies will be subject to approval and environmental review. The City anticipates that these additional supplies will be available starting in 2015.

5.3.4 Aquifer Storage and Recovery

The City's proposed ASR Program would allow the City to optimize conjunctive use of its water supplies through injection of surplus treated (potable) drinking water into selected aquifer zones within the groundwater Sub-basin for storage when surplus supplies are available, and recovery of that potable water from the aquifer to optimize water quality and meet seasonal peak demands during drought periods, or when emergency or disaster scenarios preclude the use of imported water supplies.

As discussed above, the City constructed a new well in January 2004 (Well 8) that was designed to allow for both injection and extraction of water supplies in conjunction with the City's proposed ASR Program. In early 2009, the City contracted to construct the above-ground well facilities (including the pump house, pump, motor, SCADA, electrical, telemetry, chemical feed systems, *etc.*) to have Well 8 operational in September 2010, initially as an extraction well, and in the future as part of the City's proposed ASR Program. In addition, the City has already installed two monitoring wells for use in the demonstration project monitoring and testing for the proposed ASR Program.

The City obtained regulatory approval from the Central Valley Regional Water Quality Control Board (RWQCB) to conduct an ASR Demonstration Testing Program. A Negative Declaration was prepared for the project in November 2010 pursuant to the provisions of CEQA (SCH No. 2010112049). The Phase 1 ASR Demonstration Testing was conducted between January 2011 and September 2011 and involved the injection of 233 acre-feet (76 million gallons) of treated SSJID potable water, storage in the confined aquifer and subsequent extraction of 340 acre-feet (111 million gallons) of water[5]. The Phase 2 ASR Testing was initiated in late December 2011 and was completed in September 2012 with injection of 700 acre-feet. The Tracy City Council

[5] Interim (Final) Status Report for Well 8 ASR Demonstration Program, Memorandum prepared for City of Tracy by Pueblo Water Resources, dated December 7, 2011.

approved and adopted a CEQA Negative Declaration for the permanent ASR Program on December 4, 2012.

The next step is to obtain approval to operate a permanent ASR Program from the RWQCB. It is estimated that as much as 685 to 915 af/yr of potable water could be injected into the aquifer, assuming a 5-month continuous injection rate of 1.5 to 2.0 mgd. Implementation of the City's ASR Program will occur incrementally (as new ASR wells are constructed) with up to 3,000 acre-feet of high-quality water ultimately (by 2025) being available in drought years to increase the reliability of the City's water supply. Approximately 1,000 af/yr of ASR supply is anticipated to be available starting in 2015 and increasing to 3,000 af/yr by 2025.

5.4 EXISTING NON-POTABLE WATER SUPPLIES

5.4.1 Diversion of Non-Potable Surface Water from Sugar Cut

As described in the June 2009 Water Supply Assessment for the Holly Sugar Sports Park, the City's Holly Sugar property has historically (since at least 1912) been irrigated using untreated surface water diverted from Sugar Cut. Over the years, the Holly Sugar property has been farmed and planted with a variety of crops, including winter wheat, corn, tomatoes, alfalfa and, when the property was owned by Holly Sugar, sugar beets. The Holly Sugar property is currently being farmed and irrigated with untreated surface water diverted from Sugar Cut. The water rights to the untreated surface water from Sugar Cut are considered to be pre-1914 appropriative rights, and may also be classified as riparian rights. Use of the water from Sugar Cut has been continuous on the Holly Sugar property for irrigation purposes since at least 1912.

The continued use of this non-potable water supply from Sugar Cut is proposed for the irrigation of the proposed Holly Sugar Sports Park (see the Holly Sugar Sports Park Water Supply Assessment dated June 2009). This use is considered a continued beneficial use of the supply for essentially the same purpose of irrigation. The use of untreated surface water from Sugar Cut for non-potable water uses for the proposed Holly Sugar Sports Park would be for the interim only, until recycled water supplies become available. Therefore, future use of this non-potable supply, beyond the interim irrigation of the proposed Holly Sugar Sports Park, is not anticipated.

5.5 ADDITIONAL PLANNED FUTURE NON-POTABLE WATER SUPPLIES

5.5.1 Recycled Water

In 2002, the City adopted a Recycled and Non-Potable Water Ordinance requiring all new subdivisions, to the extent practicable, to install the required infrastructure (such as dual-distribution pipelines) to provide recycled water to meet non-potable water demands at parks, golf courses, athletic fields, schools, median island landscapes, and industrial sites. As described in Chapter 2, one of the principles developed for sustainable infrastructure in the City is to promote and encourage the use of recycled water for non-potable uses in existing and future publicly landscaped areas in the City, where feasible.

As described in Chapter 4, at buildout of the City's General Plan, it is estimated that the recycled water demand for landscape irrigation will be approximately 7,500 af/yr. Based on the City's Citywide Wastewater System Master Plan, the quantity of recycled water supply available is up to 22.4 mgd (25,000 af/yr) at buildout, based on anticipated wastewater flows and the capacity of the City's WWTP[6]. Recycled water will be treated to a tertiary level in accordance with Title 22 requirements at the City's WWTP and will be distributed to recycled water use areas within the City's SOI. It is anticipated that adequate recycled water supplies will be available to meet the projected recycled water demands at buildout of the City's General Plan. Approvals and permits for the production, distribution and use of recycled water will be required from the RWQCB and the California Department of Public Health (DPH).

5.5.2 Shallow Non-Potable Groundwater

As discussed above, the Tracy Sub-basin underlying the City has two aquifers: semi-confined and confined. The uppermost semi-confined aquifer is primarily comprised of alluvial and flood basin formations. The underlying confined aquifer is primarily comprised of the Tulare Formation and it is overlain by the Corcoran Clay, which separates the upper semi-confined aquifer from the underlying confined aquifer. The City's production wells draw from the confined aquifer only and the average annual operational groundwater yield of 9,000 af/yr described in previous sections applies only to the confined aquifer. The City does not currently pump any groundwater from the semi-confined aquifer.

The hydraulic characteristics of the semi-confined aquifer are highly variable, based on site-specific conditions. Wells in the semi-confined aquifer produce 6 gpm to 5,300 gpm; however, pump test data are limited. The transmissivity of the semi-confined aquifer, including the recent alluvium and upper portions of the Tulare Formation, ranges between 600 to greater than 2,300 gallons per day per foot (gpd/ft). The storativity is about 0.05. Where thicker sequences of sand are present, the transmissivity may be higher.

Relatively speaking, groundwater levels in the semi-confined aquifer are significantly deeper at the south end of the City typically measuring about 48 feet below groundwater surface, whereas groundwater levels at the north end of the City are as shallow as 5 feet below ground surface. There appears to be a natural groundwater cycle where the water levels rise and then lower every few years, and are likely to fluctuate partly in response to tidal influences. Currently groundwater levels in the semi-confined aquifer appear on the rise at the northern end of the City; however, there are insufficient data in the southern portion of the City to make any conclusions in this regard. Groundwater flow in the semi-confined aquifer is generally from the southeast towards the Old River north of the City.

Groundwater recharge in the semi-confined aquifer occurs from rainfall, applied water that percolates to the water table, and seasonal infiltration by the creeks. The recharge for the shallow semi-confined aquifer is generally from the south, from the Coast Ranges, and moves to the north and west.

[6] Table C-1, Tracy Wastewater Master Plan, Draft Report, prepared by CH2MHill, May 2012.

The semi-confined aquifer is monitored by other entities at four locations within the City. Static water levels are measured on a quarterly basis and reported to the RWQCB. Groundwater quality is typically monitored just for specific contaminants of concern and does not coincide with the general parameters monitored by the City and others in the confined aquifer.

Current pumping from the semi-confined aquifer is thought to be widespread, via private wells, and used primarily for irrigation of agricultural areas. Current pumpage quantities are unknown; however, the stable groundwater level trends in the semi-confined aquifer indicate that existing pumpage is within the operational yield of the semi-confined aquifer.

Groundwater quality information is limited for the semi-confined aquifer. Most of the available water quality data for the semi-confined aquifer is from data from a 1968 basin-wide study. Groundwater extracted from the semi-confined aquifer is generally classified as being high in salts and not suitable for potable uses, but may be considered suitable for non-potable uses such as agricultural irrigation. The following provides an overview of key water quality constituents in the semi-confined aquifer:

- TDS varies greatly (ranging from 567 mg/L to 2,310 mg/L), but overall is poorer quality than the confined aquifer and exceeds recommended drinking water Maximum Contaminant Levels (MCLs)[7]. The TDS concentrations increase toward the north and to the west.
- Sulfate concentrations in the semi-confined aquifer ranged from less than 100 to over 600 mg/L[8].
- Chloride concentrations in the semi-confined aquifer range from 50 to 850 mg/L, with the lowest concentrations near the Coast Ranges, south of Tracy near the airport[9].
- Boron concentrations in the semi-confined aquifer range from 0.7 to 6.3 mg/L[10]. The lowest concentrations follow a similar pattern as the TDS, with low concentrations near the Coastal Range foothills (to the south).

The shallow groundwater is considered to be suitable for agricultural irrigation purposes. However, given the relatively poor permeability of the soils in the City, there is concern for the potential accumulation of salts in the soil, leading to soil binding. This could partially be mitigated by planting salt-tolerant turf and plant materials and providing good subsurface drainage; however, this may not be a feasible long-term solution for the City.

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[7] The recommended MCL for TDS is 500 mg/L, with an upper limit of 1,000 mg/L if it is not reasonable or feasible to supply water with lower concentrations. Short-term use is allowed for water between 1,000 and 1,500 mg/L.

[8] The recommended MCL for sulfate is 250 mg/L, with an upper limit of 500 mg/L if it is not reasonable or feasible to supply water with lower concentrations. Short-term use is allowed for water up to 600 mg/L.

[9] The recommended MCL for chloride is 250 mg/L, with an upper limit of 500 mg/L if it is not reasonable or feasible to supply water with lower concentrations. Short-term use is allowed for water up to 600 mg/L.

[10] There is no established MCL for boron. However, California DPH has established an Action Level of 1 mg/L for boron.

Therefore, due to the poor water quality associated with the shallow groundwater supply, the use of this supply to meet the non-potable demands within the City's SOI is not recommended, and is not discussed further in this Citywide Water System Master Plan.

5.6 POTABLE WATER SUPPLY RELIABILITY

The reliability of each of the City's DMC/CVP water supplies has been estimated based on hydrologic modeling work conducted by the USBR. The USBR modeling projects annual delivery quantities from the CVP taking into consideration historical hydrologic conditions, current environmental restrictions and regulatory constraints, and Delta improvements over a 71-year historical period from 1922 to 1993. As described below, these reliability estimates have been adjusted to account for recent Delta pumping restrictions and impacts due to future climate change.

Table 5-3 provides a summary of anticipated reliability and availability of the City's existing and additional planned future water supplies under various hydrologic conditions.

5.6.1 Supply Reliability in Normal Years

As described in the City's 2005 and 2010 UWMPs, based on USBR's previous modeling, during an average hydrologic year, the City could expect to receive approximately 85 percent of its M&I-reliability water supply and 58 percent of its Ag-reliability water from the USBR's allotment of CVP water via the DMC (plus the small volume of BBID water that is managed through the City's treatment and distribution system on behalf of Patterson Pass Business Park).

However, for purposes of this Citywide Water System Master Plan, due to recent environmental concerns in the Delta and potential future impacts due to climate change, it has been assumed that these normal year reliabilities will be reduced by about 10 percent, to 75 percent for M&I-reliability supplies and 50 percent for Ag-reliability supplies. These assumed reductions in reliability are consistent with reliability reductions being estimated by DWR for the State Water Project, which is subject to the same Delta environmental and climate change issues. As described below, a similar 10 percent reduction in reliability has also been assumed for the City's CVP supplies under the dry year scenarios. These changes in assumed supply reliability are also reflected in the City's 2010 UWMP.

5.6.2 Supply Reliability in Dry Years

During droughts, further cutbacks to the City's DMC/CVP supply are projected. When CVP/DMC supplies are thus reduced, the City can increase its use of SCWSP water and local groundwater. The availability of these sources is considered to be less dependent on climatic factors and is likely to be available at more consistent levels. In addition, the City will further increase the reliability of its water supply during drought years through the purchase of groundwater banking capacity in the Semitropic Water Storage Bank and potential future implementation of an ASR Program.

Table 5-3. Existing and Additional Planned Future Potable Water Supply Availability Under Various Hydrologic Conditions									
Source	Reliability	Water Agreements/ Contracts "Available Supply" af/yr	Normal Year, % of Contract	Normal Year Supply Available af/yr	Single Dry Year, % of Contract	Single Dry Year Supply Available af/yr	Multiple Dry Year, % of Contract	Multiple Dry Year Supply Available af/yr
EXISTING SUPPLIES								
CVP Supplies								
CVP Surface Water (City USBR Contract)	M&I Reliability	10,000	75%	7,500	65%	6,500	40%	4,000
CVP Surface Water (BCID USBR Assignment)	Ag Reliability	5,000	50%	2,500	15%	750	10%	500
CVP Surface Water (WSID USBR Assignment)	Ag Reliability	2,500	50%	1,250	15%	375	10%	250
Total CVP Surface Water Deliveries		17,500		11,250		7,625		4,750
SSJID (SCWSP)		10,000	100%	10,000	95%	9,500	95%	9,500
Semitropic (Permanent Agreement)		3,500	Dry Year Supply (not available in Normal Years)		100%	3,500	100%	3,500
Groundwater		9,000	100%	2,500	100%	9,000	100%	9,000
Total Existing Potable Water Supplies		**40,000**		**23,750**		**29,625**		**26,750**
ADDITIONAL PLANNED FUTURE SUPPLIES								
Future CVP Surface Water (WSID USBR Option)	Ag Reliability	2,500	50%	1,250	15%	375	10%	250
Future BBID (pre-1914 rights)		4,500	100%	4,500	90%	4,050	90%	4,050
Future CVP Surface Water (BBID USBR assignment)	Ag Reliability	11,000	50%	5,500	15%	1,650	10%	1,100
Future SCWSP Supplies		3,000	100%	3,000	95%	2,850	95%	2,850
Future ASR Water Banking		3,000	Dry Year Supply (not available in Normal Years)		100%	3,000	100%	3,000
Total Additional Planned Future Potable Water Supplies		**24,000**		**14,250**		**11,925**		**11,250**
Total Existing + Additional Planned Future Potable Water Supplies		**64,000**		**38,000**		**41,550**		**38,000**

5.6.2.1 Single Dry Years

During a single dry year, or when the DMC/CVP flows must be reduced due to environmental impacts, all of the City's existing surface water allotments are subject to some level of reduction.

The actual reductions will vary with the severity of the regional water supply shortage and climatic conditions, and the consideration of water and contract rights. For purposes of this Citywide Water System Master Plan, it is assumed that the City will receive the following water supplies during a single dry year:

- 90 percent of pre-1914 water rights water from BBID[11],
- 95 percent of SSJID SCWSP water[12],
- 65 percent of M&I reliability USBR allotment of DMC/CVP water[13], and
- 15 percent of Ag reliability USBR allotment of DMC/CVP water[14].

5.6.2.2 Multiple Dry Years

If there are multiple dry years, the City's surface water allotments, especially from the DMC/CVP, may be significantly reduced. Thus, in the event of drought, the City will have to depend more heavily on its groundwater and SCWSP supplies. As an example, in 1991, due to prolonged drought, the USBR reduced the City's DMC/CVP surface water allotment by 50 percent, such that the City's 1991 allocation was reduced to 5,000 acre-feet. As a result, the City implemented a water conservation program consistent with its Water Shortage Contingency Plan and relied on its groundwater supply to satisfy a larger portion of the City's water demand. The City now has a broader portfolio of water supplies. However, as described above, CVP supply reliabilities may be reduced even further due to on-going Delta environmental issues and future climate change. For purposes of this Citywide Water System Master Plan, it is assumed that the City will receive the following water supplies during a multiple dry year period:

- 90 percent of pre-1914 water rights water from BBID[15],
- 95 percent of SSJID SCWSP water[16],

[11] Consistent with the reliability assumed for this supply source in the City's 2005 and 2010 UWMPs.

[12] Reliability of this supply under single dry year conditions increased by 5 percent from that assumed in the City's 2005 UWMP due to the nature of the water right (increased from 90 percent to 95 percent). See further discussion in *Section 5.2.2 Stanislaus River Water*. This increased reliability is reflected in the City's 2010 UWMP.

[13] Reliability of this supply under single dry year conditions decreased by 10 percent from that assumed in the City's 2005 UWMP (decreased from 75 percent to 65 percent). This decreased reliability is reflected in the City's 2010 UWMP.

[14] Reliability of this supply under single dry year conditions decreased by 10 percent from that assumed in the City's 2005 UWMP (decreased from 25 percent to 15 percent). This decreased reliability is reflected in the City's 2010 UWMP.

[15] Consistent with the reliability assumed for this supply source in the City's 2005 and 2010 UWMPs.

- 40 percent of M&I reliability USBR allotment of DMC/CVP water[17], and
- 10 percent of Ag reliability USBR allotment of DMC/CVP water[18].

5.7 NON-POTABLE WATER SUPPLY RELIABILITY

Recycled water supplies are generally regarded as being highly reliable water supplies, even during drought conditions. This is because wastewater flows are primarily generated from interior water uses which remain about the same throughout the year and during drought conditions (reductions in water use during drought conditions are primarily the result of reduced exterior water uses which generally do not become wastewater flows). For this reason, it is assumed that recycled water supplies will be 100 percent reliable under all hydrologic conditions.

5.8 SUFFICIENCY OF THE CITY'S WATER SUPPLIES TO MEET FUTURE BUILDOUT DEMAND

5.8.1 Potable Water Supply versus Demand at Buildout

Figure 5-3 shows the anticipated availability of the City's existing and additional planned future potable water supplies under various hydrologic conditions and its ability to meet the anticipated water demands at buildout of the City's General Plan (as described in Chapter 4). Existing and additional planned future available potable water supplies and estimated buildout potable water demands are also summarized in Table 5-4.

As shown, with a total potable water supply production requirement of 36,300 af/yr for buildout of the City's General Plan (includes unaccounted for water) (see Table 4-15), the City has adequate existing and additional planned future potable water supplies to meet buildout demands under all hydrologic conditions. However, it should be noted that supply availability and reliability, and actual demands, may change in the future. As such, the City may need to acquire additional potable water supplies in the future. The City will need to closely track actual potable water demands and supply availability and reliability as future service areas are approved and developed to determine if existing and future supplies are adequate and/or if and when additional potable water supplies may be required. Potential options for additional potable water supplies are described at the end of this chapter and are evaluated in the City's 2010 UWMP.

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[16] Reliability of this supply under multiple dry year conditions increased by 5 percent from that assumed in the City's 2005 UWMP due to the nature of the water right (increased from 90 percent to 95 percent). See further discussion in *Section 5.2.2 Stanislaus River Water*. This increased reliability is reflected in the City's 2010 UWMP.

[17] Reliability of this supply under multiple dry year conditions decreased by 10 percent from that assumed in the City's 2005 UWMP (decreased from 50 percent to 40 percent). This decreased reliability is reflected in the City's 2010 UWMP.

[18] Reliability of this supply under multiple dry year conditions decreased by 15 percent from that assumed in the City's 2005 UWMP (decreased from 25 percent to 10 percent) consistent with actual 2009 CVP Ag deliveries. This decreased reliability is reflected in the City's 2010 UWMP.

Table 5-4. Existing and Additional Planned Future Potable Water Supplies vs. Potable Water Demand for Buildout of the City's General Plan

	Normal Year	Single Dry Year	Multiple Dry Year
Existing and Additional Planned Future Potable Water Supplies, af/yr[a]			
Existing CVP Entitlements and Assignments (see Table 5-3)	11,250	7,625	4,750
SSJID Supply	10,000	9,500	9,500
Groundwater	2,500	9,000	9,000
CVP Assignment from WSID (to be exercised in conjunction with Downtown Specific Plan)	1,250	375	250
Future BBID (pre-1914 rights)	4,500	4,050	4,050
CVP Assignment from BBID	5,500	1,650	1,100
Future SCWSP Supplies	3,000	2,850	2,850
Semitropic Permanent Agreement	--	3,500	3,500
Future ASR Water Banking	--	3,000	3,000
Total Available Supplies, af/yr	38,000	41,550	38,000
Potable Water Demands, af/yr			
Existing Customers (2007)[b]	19,176	19,176	19,176
Development Projects with Approved Water Supply[c]	4,150	4,150	4,150
Future Service Areas[c]	12,980	12,980	12,980
Total Buildout Demand, af/yr[d]	36,300	36,300	36,300
Potential Potable Water Supply Shortfall, af/yr	**No Shortfall**	**No Shortfall**	**No Shortfall**

(a) See Table 5-3 for assumed water supply availability under various hydrologic conditions.
(b) Based on actual 2007 water production; includes unaccounted for water (see Chapter 4).
(c) Includes unaccounted for water (see Chapter 4).
(d) Rounded to nearest hundred.

Water Supply Assessments (WSAs) should be prepared for proposed projects in accordance with the requirements of Senate Bill 610 (SB610). Per the SB610 requirements, a WSA must be prepared if a proposed project meets any of following characteristics:

- A proposed residential development of more than 500 dwelling units.
- A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space.
- A proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space.
- A proposed hotel or motel, or both, having more than 500 rooms.
- A proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area.

- A mixed-use project that includes one or more of the projects specified in this subdivision.
- A project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500-dwelling unit project.

5.8.2 Recycled Water Availability at Buildout

Based on the City's Citywide Wastewater System Master Plan, the quantity of recycled water supply available is up to 22.4 mgd (25,000 af/yr) at buildout, based on anticipated wastewater flows and the capacity of the City's WWTP[19]. Recycled water will be treated to a tertiary level in accordance with Title 22 requirements at the City's WWTP and will be distributed to recycled water use areas within the City's SOI. It is anticipated that adequate recycled water supplies will be available to meet the projected recycled water demands at buildout of the City's General Plan, including those associated with the Proposed Project.

The projected future use of recycled water supplies to meet non-potable water demands such as landscape irrigation is critical to reduce potable water demands and reserve the City's available potable water supplies for their most important uses and to ensure that the City has adequate water supplies to meet future water demands. Without this future recycled water use, the City would have inadequate potable water supplies to meet anticipated future water demands.

5.9 POTENTIAL ADDITIONAL FUTURE WATER SUPPLIES

The City will continue to evaluate new potable and non-potable water supply opportunities to ensure that adequate water supplies are available to meet the needs of the City's existing and future customers. Potential additional potable water supplies which the City may wish to consider in the future include the following:

- WSID CVP Supply Assignment. Similar to the proposed phased option agreement to assign portions of PVWD's (now BBID's) CVP/DMC contract right to the City, it may be possible to negotiate a similar agreement with the WSID to assign portions of WSID's remaining CVP contract rights (2,500 af/yr) to the City as development occurs within the WSID service area. WSID's CVP supplies have Ag-reliability as discussed above. Such an agreement between the WSID and the City would be subject to negotiation and environmental review.
- Recycled Water Exchange Agreements. Recycled water exchange agreements with adjacent irrigation districts in exchange for surface water supplies may be possible in the future. Under such an agreement, the City would provide recycled water produced at the City's WWTP (or other reclamation facility) to adjacent irrigation districts for irrigation purposes in exchange for surface water supplies (possibly assignment of CVP supplies or other surface water supplies which could be treated at the City's JJWTP). Such agreements would be subject to negotiation and environmental review.

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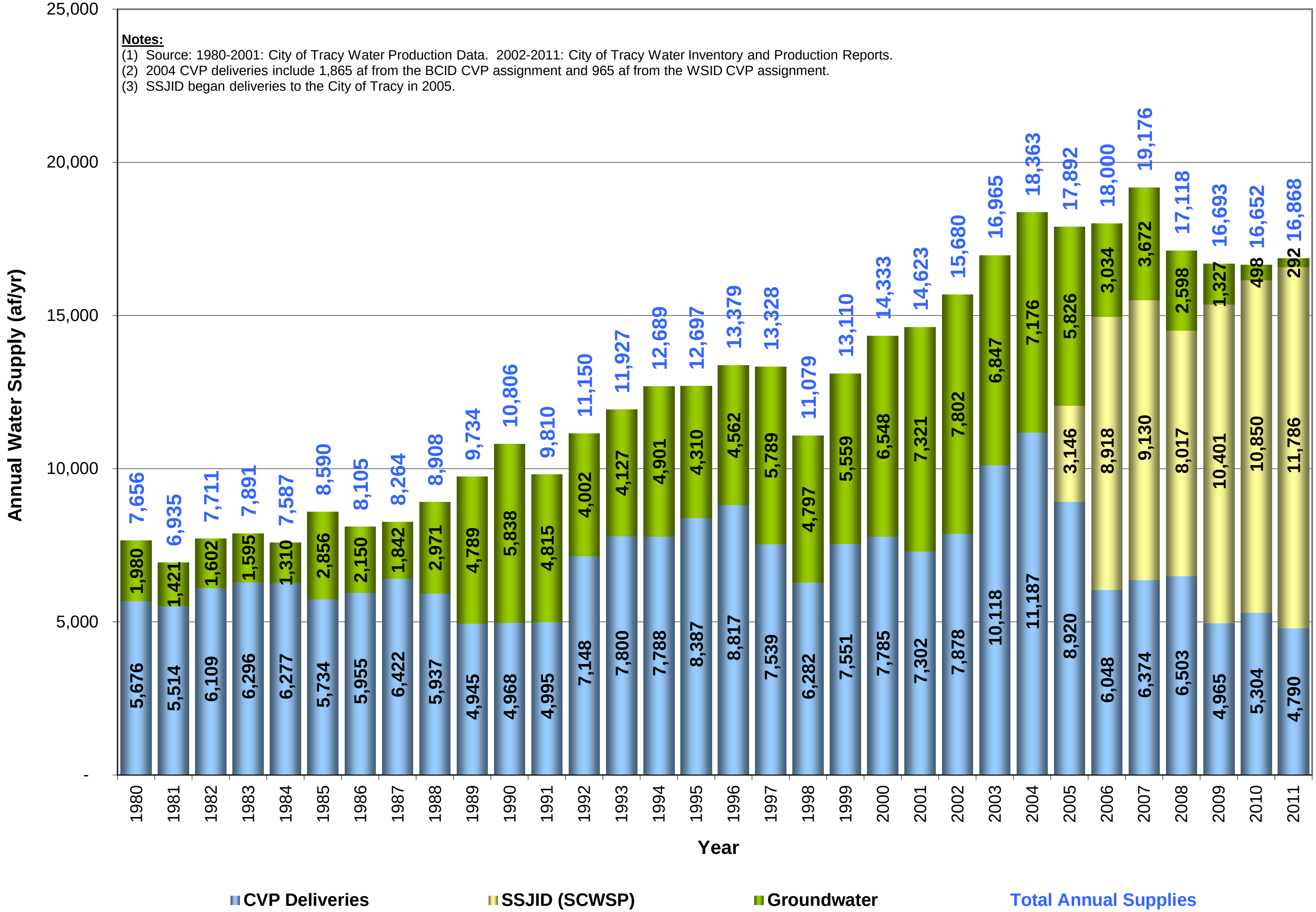
[19] Table C-1, Tracy Wastewater Master Plan, Draft Report, prepared by CH2MHill, May 2012.

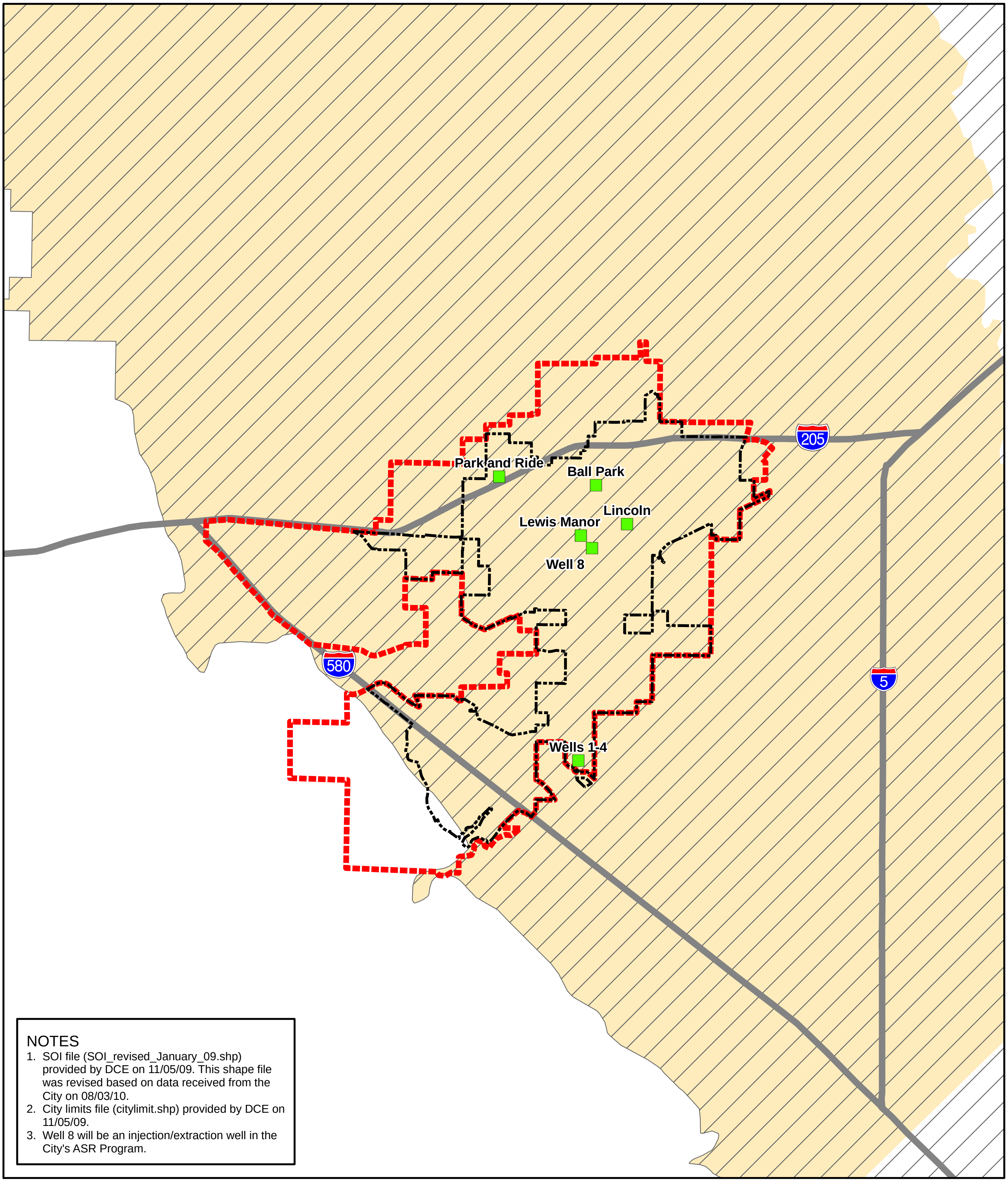
- Treatment of Shallow Groundwater. As described above, the quality of the shallow groundwater underlying the City is poor and is not suitable for direct use. However, if the shallow groundwater could be treated using a membrane treatment technology, or an alternative treatment technology, it could be suitable for potable use. The current concern with membrane treatment is the need for and cost of brine disposal (in addition to the energy costs and relatively limited membrane life). In the future, additional brine disposal technologies and alternative membrane options may be developed, making this a more cost-effective treatment option.[20]
- Storage of Wet Year Water Supplies. If the City were able to store wet year supplies in some way, the City may be able to take advantage of stored water obtained in wet years, for use in later dry years when supplies may be limited. The feasibility of such an option would need to be thoroughly evaluated and would be subject to environmental review.

Other alternative supply sources may be proposed in conjunction with future development projects. The City will carefully evaluate any proposed new water supply sources to ensure that the City's water supply reliability criteria are met.

[20] As described in *Section 5.2.3.6.2 Future Groundwater Quality Issues*, the City may also need to consider demineralization of deeper groundwater in the future to reduce salts in the groundwater pumped and used by the City to help the City comply with its wastewater discharge requirements.

Figure 5-1. City of Tracy Historical Water Supplies





NOTES
1. SOI file (SOI_revised_January_09.shp) provided by DCE on 11/05/09. This shape file was revised based on data received from the City on 08/03/10.
2. City limits file (citylimit.shp) provided by DCE on 11/05/09.
3. Well 8 will be an injection/extraction well in the City's ASR Program.

LEGEND:

- Groundwater Well
- San Joaquin Valley Basin
- Tracy Sub-basin
- SOI
- City Limits
- Highway

N

0 6,250 12,500
Scale in Feet

FIGURE 5-2

City of Tracy
Water System Master Plan

GROUNDWATER WELLS

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 5\Fig 5-2_ Wells.mxd 12/6/2010

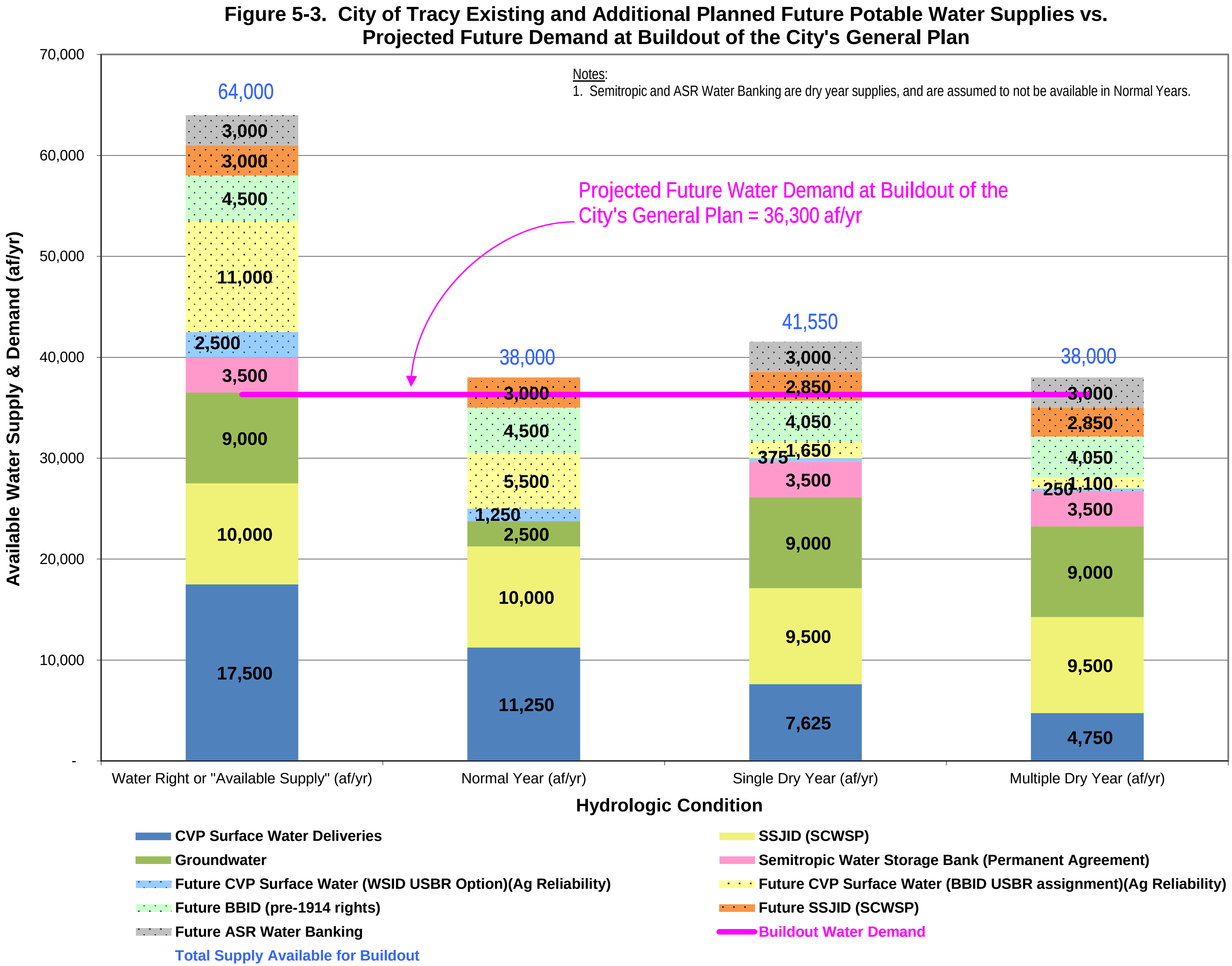


Figure 5-3. City of Tracy Existing and Additional Planned Future Potable Water Supplies vs. Projected Future Demand at Buildout of the City's General Plan
Notes:
1. Semitropic and ASR Water Banking are dry year supplies, and are assumed to not be available in Normal Years.
Projected Future Water Demand at Buildout of the City's General Plan = 36,300 af/yr
Available Water Supply & Demand (af/yr)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
64,000
3,000
3,000
4,500
11,000
2,500
3,500
9,000
10,000
17,500
38,000
3,000
4,500
5,500
1,250
2,500
10,000
11,250
41,550
3,000
2,850
4,050
375
1,650
3,500
9,000
9,500
7,625
38,000
3,000
2,850
4,050
250
1,100
3,500
9,000
9,500
4,750
Water Right or "Available Supply" (af/yr)
Normal Year (af/yr)
Single Dry Year (af/yr)
Multiple Dry Year (af/yr)
Hydrologic Condition
CVP Surface Water Deliveries
SSJID (SCWSP)
Groundwater
Semitropic Water Storage Bank (Permanent Agreement)
Future CVP Surface Water (WSID USBR Option)(Ag Reliability)
Future CVP Surface Water (BBID USBR assignment)(Ag Reliability)
Future BBID (pre-1914 rights)
Future SSJID (SCWSP)
Future ASR Water Banking
Buildout Water Demand
Total Supply Available for Buildout

CHAPTER 6
System Performance and Operational Criteria

6.1 OVERVIEW

The purpose of this chapter is to define the recommended performance and operational criteria for the City's potable and recycled water distribution systems. For the potable water system, these criteria include recommendations for the required fire flow and flow duration, definitions of "emergency events", and recommendations for surface water treatment capacity, system storage capacity (operational, fire flow, and emergency components), system pumping capacity, minimum and maximum system pressures, and maximum pipeline velocity and head loss. The recycled water system performance and operational criteria includes recommendations for system pumping capacity, system storage capacity (seasonal and operational components), minimum and maximum system pressures, and maximum pipeline velocity and head loss.

The City currently uses the City of Tracy Design Standards dated December 2008 for the planning and design of its potable water distribution system. Key water system design criteria and operational standards from this document are incorporated into this chapter; however, additional explanation and discussion have been added to further describe various system recommendations. The following sections of this chapter present the recommended performance and operational criteria for the City's potable and recycled water systems:

Potable Water System:

- General Water System Reliability and Recommendations
- Fire Flow Requirements
- Water System Capacity During High Demand Periods
- Surface Water Treatment Capacity
- Treated Water Storage Capacity
- Pumping Facility Capacity
- Critical Supply Facility
- Water Transmission and Distribution Pipeline Sizing and Recommended System Pressures

Recycled Water System:

- Recycled Water Demand Condition Evaluation
- Recycled Water Treatment Capacity
- Recycled Water Storage Capacity
- Recycled Water Pumping Facility Capacity
- Recycled Water Transmission Pipeline Sizing and Recommended System Pressures

6.2 POTABLE WATER SYSTEM

Components of the recommended performance and operational criteria for the City's potable water system are discussed below.

6.2.1 General Water System Reliability and Recommendations

Attention to enhancing the reliability of the system under all conditions is an important part of maintaining high quality water service. Water system reliability is achieved through a number of system features including (1) appropriately sized storage facilities, (2) redundant or "firm" pumping, transmission, and treatment facilities where required, and (3) alternate power supplies. Reliability and water quality are also improved by designing looped water distribution pipelines and avoiding dead-end distribution mains whenever possible. Looping pipeline configurations reduces the potential for stagnant water and the associated problems of poor taste and low chlorine residuals. In addition, proper valve placement is also necessary to maintain reliable and flexible system operation under normal and abnormal operating conditions.

6.2.1.1 Water Quality Standards

Water quality standards largely pertain to protecting public health and consistently delivering a satisfactory product to the customer. The U.S. Environmental Protection Agency (EPA) and the DPH are agencies responsible for establishing water quality standards. The EPA and DPH prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. The City, as water purveyor, is responsible for ensuring that the applicable water quality standards and regulations are met at all times.

6.2.1.2 Recommendations for New Developments

Various policies to reduce water use and comply with water efficiency standards were recommended in Chapter 2 for future service areas and new developments within the City. These policies were recommended to assist the City with achieving its water conservation goals and maintaining the long-term sustainability of its water resources. As new developments are integrated into the City's existing water system, the recommended policies discussed in Chapter 2 should be reviewed for compliance. In addition, proposed water system facilities located in the future service areas and new developments within the City should also meet the recommended system performance criteria (*e.g.*, minimum and maximum system pressures) discussed in the following sections and more specifically under *Section 6.2.8 Water Transmission and Distribution Pipeline Sizing and Recommended System Pressures.*

6.2.2 Fire Flow Requirements

The City's Public Works Department operates and maintains the water distribution system within the City, but the City's Fire Department (Fire Department) is concerned with the availability of adequate water supply for firefighting purposes. Consequently, the Fire Department establishes minimum water flows and residual system pressures during a fire fighting event, that the City is responsible for providing.

The Fire Department uses the California Fire Code (CFC) Table B150.1 *Minimum Required Fire Flow and Flow Duration for Buildings*, to assist them in establishing minimum fire flows and durations for individual structures. The recommended fire flow requirements for the City based on various land use designations are presented in Table 6-1. These fire flow requirements were developed based on discussions with the Fire Department's Fire Chief and will be used for the evaluation of the existing and future water system.

For planning purposes, the minimum fire flows identified in Table 6-1 are to be met concurrently with maximum day demand conditions while maintaining a minimum residual system pressure of 30 pounds per square inch (psi) throughout the water system. In addition, the City's water system should also have the capability to meet a system demand condition equal to the occurrence of a maximum day demand with two simultaneous fire flow events while maintaining a minimum residual system pressure of 20 psi throughout the water system. This conservative assumption of two simultaneous fire flow demands will help stress the City's water system, and determine if the water system can provide reliable service during high demand conditions. Additionally, as discussed in subsequent sections of this chapter, fire flows presented in Table 6-1 and their expected duration will also be used to establish the City's storage capacity requirements.

On March 7, 1989, the City adopted the Automatic Fire Extinguishing Ordinance, which provides guidelines for building conditions where automatic sprinkler systems are required to be installed and maintained. Any structure constructed in the future service areas and new developments within the City should conform to Section 9.06.080 of the City of Tracy Municipal Code.

6.2.3 Water System Capacity During High Demand Periods

Maximum day demand plus fire flow and peak hour demand conditions will be used to assess the adequacy of the City's potable water supply during high demand periods. Adopted peaking factors for maximum day and peak hour demands are discussed in Chapter 4. The following sections discuss the assumptions and recommended criteria for each demand condition.

6.2.3.1 Maximum Day Demand plus Fire Flow

In accordance with typical industry standards, the City's water supply system should have the capability to meet a system demand condition equal to the occurrence of a maximum day demand concurrent with either one or two simultaneous fire flow events[1] while meeting the recommended system performance criteria (*e.g.,* minimum and maximum system pressures) discussed under *Section 6.2.8 Water Transmission and Distribution Pipeline Sizing and Recommended System Pressures.*

[1] A conservative assumption of two simultaneous fire flow events is recommended for the City's water system evaluation. It is assumed that these two fire flow events will consist of one smaller single family residential fire flow combined with another larger industrial fire flow.

Table 6-1. Recommended Fire Flow Requirements[a,b]

Land Use Designation	Non-Sprinklered[c]			Sprinklered[c,d]		
	Fire Flow, gpm	Duration, hours	Recommended Storage, MG	Fire Flow, gpm	Duration, hours	Recommended Storage, MG [j]
Single Family Residential[e]	1,500	2	0.18	--	--	--
Multi Family Residential[f]	2,500	2	0.30	--	--	--
Commercial/Office[g]	6,000	4	1.44	3,500 [i]	4	0.72
Industrial	8,000	4	1.92	4,500 [i]	4	0.96
Institutional[h]	8,000	4	1.92	4,500 [i]	4	0.96

(a) Construction type and fire flow calculation area are not generally known during the development of a master plan; consequently, fire flow requirements set forth in this table are based on previous estimates for these land use types and similar communities.
(b) Unique projects or projects with alternate materials may require higher fire flows and should be reviewed by the Fire Chief on a case-by-case basis (e.g., proposed commercial/industrial areas and schools).
(c) Specific fire flows were determined from Table B105.1 of the 2007 CFC, and depend on construction type and fire flow calculation area. See Section 9.06.080 of the City of Tracy Municipal Code for automatic sprinkler system requirements.
(d) As stated in the City of Tracy Design Standards (December 2008), the Fire Chief normally allows up to a 50 percent reduction in fire flow if a building is provided with an automatic sprinkler system. However, the CFC also requires that no fire flow be less than 1,000 gpm for single family residential or 1,500 gpm for all other building types. For a more conservative fire flow estimate, Single Family and Multiple Family Residential buildings were considered non-sprinklered for this Citywide Water Master Plan.
(e) Single Family Residential includes Very Low and Low Density Residential land uses.
(f) Multi Family Residential includes Medium, High, and Very High Density Residential land uses.
(g) Commercial/Office includes Commercial, Office, Motel/Hotel and Mixed Use land uses.
(h) Institutional includes Medical, Public Facilities, Park, School, Airport, Church, and Cemetery land uses.
(i) Fire flow includes a 500 gpm demand for on-site sprinkler flow.
(j) Recommended storage volumes do not include volume associated with 500 gpm sprinkler flow.

Maximum day demand plus fire flow should be met from a combination of supply sources (*i.e.*, treated surface water from the JJWTP and SSJID supplies plus groundwater) and treated water storage reservoirs. The analysis of specific fire flow evaluations will be conducted assuming the largest booster pump at each pump station is offline (*i.e.*, firm booster pumping capacity). In addition, the City's groundwater well system (well pumps) will be assumed to pump at firm capacity (*i.e.*, firm groundwater pumping capacity) during a specific fire flow evaluation. Firm groundwater pumping capacity assumes that 20 percent of the City's groundwater wells will be out of service at any given time due to maintenance or operational issues.

These conservative assumptions ensure the reliability and flexibility of the system to provide sufficient flow during emergency fire flow conditions. It is also assumed that the pump stations with only one booster pump, or without back-up power capability (either an on-site generator or adaptor for a plug-in generator), will not be available during an emergency fire flow analysis.

6.2.3.2 Peak Hour Demand

Peak hour demand should be met from a combination of supply sources (*i.e.*, treated surface water from the JJWTP and SSJID supplies plus groundwater) and treated water storage reservoirs. Assumptions regarding firm pumping capacity will also apply during a peak hour demand condition. During a peak hour demand condition, the City's water system should be able to meet the recommended system performance criteria (*e.g.*, minimum and maximum system pressures) discussed under *Section 6.2.8 Water Transmission and Distribution Pipeline Sizing and Recommended System Pressures.*

6.2.4 Surface Water Treatment Capacity

Sufficient surface water treatment capacity from the existing and/or expanded JJWTP including the City's treated surface water supplies from SSJID should be available to meet the City's maximum day demand condition. In addition, sufficient treated surface water pumping capacity should also be available to assist in meeting a maximum day demand.

6.2.5 Treated Water Storage Capacity

The total treated water storage capacity required will be based on the following three components within each pressure zone:

- Operational Storage,
- Fire Storage, and
- Emergency Storage.

A discussion of these three storage components, along with a discussion of "credits" for groundwater supply and treated surface water supply, follows.

6.2.5.1 Operational Storage

Over any 24-hour period, water demands will vary. Typically, higher water demands will occur during the early morning hours when people are irrigating landscape and getting ready to go to work or school. Water demands will then decline to some nominal baseline level (depending on the proximity to water use patterns of adjacent commercial/industrial areas), and will then begin to increase again depending on outside water needs (and corresponding temperature), until it reaches a higher water demand in the early evening hours as people return home from work or school. Throughout the year, the peaks of this cycle will vary according to customer needs; thereby, creating maximum day and peak hour demands.

Typically, water treatment plants, supply turnouts, and/or wells are operated at a constant rate over a 24-hour period (baseline) and augmented by additional flow from storage tanks, and/or wells during high demand periods, as needed. Storage tanks are normally refilled when demands drop below the baseline water production flow rate. The storage volume used to meet these peak demand periods is called operational storage.

The operational storage requirements should be calculated based on the diurnal demand in a particular pressure zone or service area. If sufficient data is not available to develop a diurnal demand, then the recommended volume of water to be held in reserve for operational storage should be at least equal to 30 percent of the total volume of water used on a maximum day demand condition.

6.2.5.2 Fire Storage

As discussed above, fire flow requirements are identified in the CFC. These requirements are based on flow (in gpm), size of building (in square feet), and type of construction (wood frame, metal, masonry, installation of sprinklers, *etc.*). After a fire flow requirement is established, it is multiplied by the required fire flow duration to produce an estimate of the total volume of fire flow storage required. Table 6-1 presents the recommended fire flow criteria and associated required fire flow storage.

Sufficient fire flow storage should be available for the following simultaneous fire flow events:

- A Single Family Residential fire flow of 1,500 gpm for a duration of two hours. The resulting volume required for fire flow storage is 0.18 MG.
- An Industrial fire flow of 4,500 gpm for a duration of four hours (if sprinklered). The resulting volume required for fire flow storage is 0.96 MG[2].

[2] Recommended storage does not include volume associated with 500 gpm sprinkler flow (see Table 6-1). Assumes a 50 percent reduction in the required fire flow due to the installation of fire sprinklers.

If unavailable by gravity storage, the fire flow must be supplied with a National Fire Protection Association (NFPA) rated fire pump. If an NFPA rated fire pump is not used, then a pump(s) and motor(s) combination with a backup power source of sufficient capacity to meet the required maximum fire flow and minimum residual pressure requirements, as determined by the Fire Department's Fire Chief, will be required.

6.2.5.3 Emergency Storage

A reserve of stored water is also required to meet demands during an emergency. An emergency is defined as an unforeseen or unplanned event that may degrade the quality or quantity of potable water supplies available to serve customers. There are three types of emergency events that a water utility typically prepares for:

- Minor emergency. A fairly routine, normal, or localized event that affects a few customers, such as a pipeline break, malfunctioning valve, hydrant break, or a brief power loss. Utilities plan for minor emergencies and typically have staff and materials available to correct them.
- Major emergency. A disaster that affects an entire, and/or large, portion of a water system, lowers the quantity and quality of the water, or places the health and safety of the community at risk. Examples include water treatment plant failures, raw water contamination or major power grid outages. Water utilities infrequently experience major emergencies.
- Natural disaster. A disaster caused by natural forces or events that create water utility emergencies. Examples include earthquakes, forest or brush fires, hurricanes, tornados or high winds, floods, and other severe weather conditions such as freezing or drought that damage or cause water system facilities to not be able to operate.

Determination of the required volume of emergency storage is a policy decision based on the assessment of the risk of failures and the desired degree of system reliability. The amount of required emergency storage is a function of several factors including the diversity of the supply sources, redundancy and reliability of the production facilities, and the anticipated length of the emergency outage. In developing an emergency storage requirement for the City, typical industry standards were used.

The American Water Works Association (AWWA) states that no formula exists for determining the amount of emergency storage required, and that the decision will be made by the utility based on a judgment about the perceived vulnerability of the system. For this Citywide Water System Master Plan, it has been assumed that the emergency storage requirement will be based on minor emergencies and *specific* major emergency criteria. Based on this assumption, it is recommended that the City have a minimum quantity of emergency storage volume equivalent to two times the average day demand.

6.2.5.4 Groundwater Credit

Based on the City's available groundwater wells, groundwater storage can account for a portion of the recommended emergency storage. The following must be true to use the groundwater supply to offset the need to provide surface storage:

- Groundwater supply is of potable water quality and can be reliably accessed (*i.e.*, wells are equipped with on-site emergency generators);
- Groundwater supply is not already being relied upon to meet the City's average day demand requirements; and
- Sufficient water distribution facilities are available to distribute this water to demand areas.

It will assumed that only the firm groundwater supply will be available for a groundwater credit to offset the City's emergency storage requirement (*i.e.*, 20 percent of wells could be out of service at any given time).

6.2.5.5 Treated Surface Water Supply Credit

Because the City currently has two independent sources of treated surface water supply (JJWTP and SSJID supplies), some quantity of treated surface water supply capacity can account for a portion of the City's recommended emergency storage. For this Citywide Water System Master Plan, it will be assumed that the smaller of the treated surface water supply sources (SSJID) will be available to offset a portion of the emergency storage requirement. However, the following must be true to use treated surface water supply to offset the need to provide surface storage:

- Treated surface water supply can be reliably accessed (*i.e.*, treated surface water supply facility is equipped with on-site emergency generator); and
- Sufficient treated surface water booster pumping facilities are available to distribute this water to demand areas.

6.2.5.6 Total Storage Capacity Recommended

The City's recommended potable water storage capacity should be the sum of the following components:

- Operational: Volume of water necessary to meet diurnal peaks observed throughout the day, assumed to be equivalent to at least 30 percent of the maximum day demand;
- Fire Flow: Volume of water necessary to supply two simultaneous fire flow events;
- Emergency: Volume of water necessary to provide two times an average day demand;
- Groundwater Credit: Equal to the firm groundwater supply that can be reliably accessed (facilities equipped with auxiliary power); and
- Treated Surface Water Supply Credit: Equal to the smaller of the available treated surface water supply sources (SSJID).

It should be noted that the sum of groundwater and treated surface water supply credits cannot be greater than the recommended emergency storage volume. The amount of total system storage and system peaking capacity required to meet these criteria will change over time as the City continues to grow and potable water demands increase.

6.2.6 Pumping Facility Capacity

Sufficient firm water system pumping capacity should be provided to meet the greater of the following two demand conditions within each pressure zone and any additional pressure zone(s), which are provided service from this pressure zone.

1. A maximum day demand with two simultaneous fire flow events (one smaller single family residential fire flow combined with another larger industrial fire flow) with booster pumps and well pumps assumed to operate at firm pumping capacity.
2. A peak hour demand with booster pumps and well pumps assumed to operate at firm pumping capacity.

The highest demand requirement between these two demand conditions sets the water system pumping capacity requirement. However, sufficient pumping capacity should also be provided so that the maximum day demand within each pressure zone can be supplied using firm pumping capacity with no assistance from storage reservoirs.

6.2.7 Critical Supply Facility

Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) and/or service area(s) which do not have sufficient emergency storage available (see *Section 6.2.5.3 Emergency Storage*) and that meet the following criteria:

- The largest pumping facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A pumping facility that provides water from a supply turnout; or
- A pumping facility that provides water from key groundwater supply wells (depends on capacity, quality and location).

All critical pumping facilities should be equipped with an on-site, back-up power generator. At less critical facilities, a plug-in adapter will be used to allow interconnection to a portable generator, which will be brought to the site by City staff during a prolonged power outage. In addition, portable generator booster connections will be configured at all tank/booster pump locations.

The City should also consider the following policies to make operations of the City's pumping facilities more efficient:

- Install solar power systems, or alternative power sources, at existing and new pump stations and other water system facilities, as feasible, to reduce electrical power consumption.
- Increase the frequency of routine O&M activities for existing pump stations and wells to maintain pump efficiencies and reduce power demands.

6.2.8 Water Transmission and Distribution Pipeline Sizing and Recommended System Pressures

The following criteria will be used as guidelines for sizing new transmission and distribution pipelines. However, the City's existing system will be evaluated on a case–by-case basis. For example, if an existing pipeline experiences head loss in excess of the criteria described below during a maximum day plus fire flow event, this condition, by itself, does not necessarily indicate a problem as long as the minimum system pressure criterion is satisfied.

Consequently, the City's existing system will be evaluated using pressure as the primary criterion; and secondary criteria, such as pipeline velocity, head loss, age, and material type, will be used as indicators to locate where water system improvements may be needed.

New transmission and distribution pipelines to serve the City's future service areas should be located within designated utility corridors wherever possible. These designated utility corridors should be within public rights-of-way to minimize or eliminate the need for utility easements within private property.

6.2.8.1 Water Transmission System

Transmission pipelines are generally 18 inches in diameter or larger and should be designed based on the criteria described below for average day, maximum day, and peak hour demand conditions. The criteria reflect industry standards and West Yost's experience working with the City's existing water system.

- Average Day Demand
  - Pressures should be maintained between a maximum of 100 psi[3] and a minimum of 40 psi.
  - Maximum velocity within transmission pipelines should be 3 feet per second (fps).
  - Head losses within the transmission system pipelines should be limited to 3 feet per thousand feet (ft/kft) of pipeline.

[3] A pressure reducing valve will be required on all water services with a static pressure greater than 80 psi.

- Maximum Day Demand
  - Pressures should be maintained between a maximum of 100 psi[3] and a minimum of 40 psi.
  - The maximum velocity within the transmission system pipelines should be 6 fps.
  - Head losses within the transmission system pipelines should be limited to 3 ft/kft of pipeline.
- Peak Hour Demand
  - Pressures should be maintained between a maximum of 100 psi[3] and a minimum of 40 psi.
  - The maximum velocity within the transmission system pipelines should be 6 fps.
  - Head losses within the transmission system pipelines should be limited to 3 ft/kft of pipeline.

6.2.8.2 Water Distribution System

Distribution pipelines are generally less than 18 inches in diameter and should be sized based on the criteria described below for average day, maximum day plus fire flow, and peak hour demand conditions. The criteria reflect industry standards and West Yost's experience working with the City's existing water system.

- Average Day Demand
  - Service pressures should be maintained between a maximum of 80 psi and a minimum of 40 psi.
  - The maximum velocity within the distribution system pipelines should be 6 fps.
  - Head losses within the distribution system pipelines should be limited to 7 ft/kft of pipeline.
- Maximum Day Demand plus Fire Flow
  - The minimum allowable residual pressure should be 30 psi at the flowing fire hydrant during the occurrence of a single fire flow event.
  - The minimum allowable residual pressure should be 20 psi at the flowing fire hydrants during the occurrence of two simultaneous fire flow events.
  - The maximum velocity within the distribution system pipelines should be 12 fps, or the head losses within the distribution system pipelines should be limited to 10 ft/kft of pipeline, whichever criteria is more conservative given the specific hydraulic/system condition.

- Peak Hour Demand
  - Service pressures should be maintained between a maximum of 80 psi and a minimum of 40 psi.
  - The maximum velocity within the distribution system pipelines should be 8 fps, or the head losses within the distribution system pipelines should be limited to 7 ft/kft of pipeline, whichever criteria is more conservative given the specific hydraulic/system condition.

A summary of the recommended potable water system performance and operational criteria is presented in Table 6-2 and reflect typical water system industry standards, including the California Safe Drinking Water Act and related laws, California Public Utilities Commission's General Order 103, and AWWA standards.

6.3 RECYCLED WATER SYSTEM[4]

Components of the recommended performance and operational criteria for the City's backbone recycled water system are discussed below.

6.3.1 Recycled Water Demand Condition Evaluation

A peak hour demand condition during an 8-hour irrigation period will be used to assess the adequacy of the City's recycled water system.

6.3.2 Recycled Water Treatment Capacity

Sufficient recycled water treatment capacity should be available to meet the City's maximum day recycled water demand condition.

6.3.3 Recycled Water Storage Capacity

The total recycled water storage capacity required will be based on the following components:

- Seasonal Storage, and
- Operational Storage.

A discussion of these two storage components follows.

[4] Pressure zone boundaries for the recycled water system will be determined in Chapter 9.

Table 6-2. Summary of Recommended Potable Water System Performance and Operational Criteria

Component	Criteria	Remarks / Issues
Fire Flow Requirements (flow [gpm] @ duration [hours])		
Single Family Residential	1,500 gpm @ 2 hrs	Existing development will be evaluated on case-by-case basis because of the historical varying standard.
Multi Family Residential	2,500 gpm @ 2 hrs	
Commercial/Office	3,500 gpm @ 4 hrs (with approved automatic sprinkler system)	
Industrial	4,500 gpm @ 4 hrs (with approved automatic sprinkler system)	
Institutional	4,500 gpm @ 4 hrs (with approved automatic sprinkler system)	
Water System Capacity		
Maximum Day Demand plus Fire Flow	Provide firm capacity equal to maximum day demand plus fire flow	Assume two simultaneous fire flow events.
Peak Hour Demand	Provide firm capacity equal to peak hour demand	
Surface Water Treatment Capacity		
Treated Surface Water Supply Capacity	Provide capacity equal to maximum day demand	
Treated Surface Water Pumping Capacity	Provide capacity equal to maximum day demand	
Water Storage Capacity		
Operational	30 percent of maximum day demand	
Fire	Assume one Single Family Residential fire flow concurrent with a larger Industrial fire flow	1,500 gpm @ 2 hrs = 0.18 MG 2,500 gpm @ 2 hrs = 0.30 MG 3,000 gpm @ 4 hrs = 0.72 MG 4,000 gpm @ 4 hrs = 0.96 MG
Emergency	2 x average day demand	
Groundwater Credit (GWC)	Equal to the firm groundwater supply that can be reliably accessed (facilities equipped with auxiliary power)	The maximum combined emergency storage credit is equal to the recommended emergency storage capacity.
Treated Surface Water Credit (TSWC)	Equal to the smaller of the available treated surface water supply sources	
Total Water Storage Capacity	Operational + Fire + Emergency - GWC - TSWC	If possible, total storage should be evaluated by pressure zone.
Pumping Facility Capacity		
Pumping Capacity	Provide the greater of maximum day with two concurrent fire flows or peak hour demand within each pressure zone	Assume firm pumping capacity. Sufficient pumping capacity should also be provided so that the maximum day demand can be supplied using firm pumping capacity with no assistance from storage reservoirs.
Backup Power	Equal to the firm capacity of the pumping facility	On-site generator for critical stations. [a] Plug-in portable generator for less critical stations.
Water Transmission Line Sizing		
Diameter	18-inches in diameter or larger	Locate new transmission pipelines within designated utility corridors wherever possible.
Average Day Demand Condition		Criteria based on requirements for new development, existing transmission mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Minimum Pressure [psi]	40 psi	
Maximum Pressure [psi]	100 psi	
Maximum Head loss [ft/kft]	3 ft/kft	
Maximum Velocity [fps]	3 fps	
Maximum Day Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/kft]	3 ft/kft	
Maximum Velocity [fps]	6 fps	
Peak Hour Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/kft]	3 ft/kft	
Maximum Velocity [fps]	6 fps	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Pipeline Material	Ductile Iron	For consistency in hydraulic modeling.
Water Distribution Line Sizing		
Diameter	Less than 18-inches in diameter	Must verify pipeline size with maximum day plus fire flow analysis. Locate new distribution pipelines within designated utility corridors wherever possible.
Average Day Demand Condition		Criteria based on requirements for new development, existing distribution mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Minimum Pressure [psi]	40 psi	
Maximum Pressure [psi]	80 psi	
Maximum Head loss [ft/kft]	7 ft/kft	
Maximum Velocity [fps]	6 fps	
Maximum Day w/ Fire Flow Demand Condition		
Minimum Pressure [psi] (at fire node)	30 psi for a single fire flow event; 20 psi for two simultaneous fire flow events	
Maximum Head loss [ft/kft]	10 ft/kft	
Maximum Velocity [fps]	12 fps	
Peak Hour Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/kft]	7 ft/kft	
Maximum Velocity [fps]	8 fps	
Minimum Pipeline Diameter		
General	8-inches	
Industrial	12-inches	
Distribution to cul-de-sac / dead end street	6-inches	Permanent dead end runs shall be no longer that 250 feet unless in a cul-de-sac.
Distribution to fire hydrants	8-inches	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Pipeline Material	Ductile Iron	For consistency in hydraulic modeling.
Maximum Water Service Pressure	80 psi	Install PRV if service pressure is greater than 80 psi.

[a] A pumping facility is defined as critical if it provides service to pressure zone(s) and/or service area(s) which do not have sufficient emergency storage, and that meet the following criteria:

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A facility that provides water from a supply turnout; or
- A facility that provides water from key groundwater supply wells (depends on capacity, quality and location).

6.3.3.1 Seasonal Storage

As described in Chapter 4, landscape irrigation demands are highest during the summer months, when plant evapotranspiration rates are high and very low during the winter months. Demand for recycled water supplies to meet these seasonally varying demands will also vary month to month, depending on the specific climatic conditions that are occurring. Therefore, some seasonal storage may have to be provided to store recycled wastewater generated during low irrigation demand periods for use during the high summer demand periods. The actual quantity of seasonal storage required, if any, will be determined using an annual water balance between total recycled water supply available and the total seasonal recycled water demand.

6.3.3.2 Operational Storage

Sufficient operational storage should be provided to supply the demands of an eight-hour irrigation period during a maximum summer month demand condition, with a 10 percent demand increase occurring for one hour (*i.e.*, peak hour) during the irrigation period. Due to concerns about water quality, it is recommended that this operational storage be entirely stored within an enclosed reservoir or tank system to limit exposure to potential contaminant sources after treatment, but before distribution and direct use.

6.3.3.3 Total Storage Capacity

The City's recommended recycled water storage capacity should be the sum of the following components:

- Seasonal: Volume of recycled water necessary to balance the required annual recycled water demands with the annual recycled water supply available; and
- Operational: Volume of recycled water necessary to supply the demands of an eight-hour irrigation period during a maximum summer month demand condition, with a 10 percent demand increase occurring for one hour.

The amount of total system storage and system peaking capacity required to meet these criteria will change over time as the City continues to grow and recycled water demands increase.

6.3.4 Recycled Water Pumping Facility Capacity

Sufficient pumping capacity should be provided to meet the City's peak hour recycled water demand condition within each pressure zone and any additional pressure zone(s), which are provided service from this pressure zone.

6.3.5 Recycled Water Transmission Pipeline Sizing and Recommended System Pressures

Backbone recycled water system transmission pipelines are generally 16 inches in diameter or larger and should be designed based on the criteria described below for a peak hour demand condition.

- Peak Hour Demand
  - Service pressures should be maintained between a maximum of 100 psi and a minimum of 60 psi.
  - The maximum velocity within the transmission system pipelines should be 10 fps; however, a pipeline velocity of 6 fps is desirable.

A summary of the recommended recycled water system performance and operational criteria is presented in Table 6-3.

Table 6-3. Summary of Recommended Recycled Water System Performance and Operational Criteria

Component	Criteria	Remarks / Issues
Demand Condition Evaluation		
Peak Hour Demand	Provide capacity equal to peak hour demand during an 8-hour irrigation period	
Recycled Water Treatment Capacity		
Recycled Water Treatment Capacity	Provide capacity equal to a maximum day demand	
Recycled Water Storage Capacity		
Seasonal	Equal to volume required to balance the annual demands with the annual supply available	
Operational	Equal to volume required to supply the demands of an eight-hour irrigation period during a maximum summer month with a 10 percent demand increase occurring for one hour	
Total Water Storage Capacity	Seasonal + Operational	
Pumping Facility Capacity		
Pumping Capacity	Provide capacity equal to peak hour demand	Firm pumping capacity will not be required.
Recycled Water Transmission Line Sizing		
Diameter	16-inches in diameter or larger	
Peak Hour Demand Condition		
Minimum Pressure [psi]	60 psi	
Maximum Pressure [psi]	100 psi	
Maximum Velocity [fps]	10 fps	Pipeline velocity of 6 fps is desirable.
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Pipeline Material	C-900 PVC	For consistency in hydraulic modeling.

7.1 OVERVIEW

The purpose of this chapter is to first describe the City's existing potable water distribution system, including the corresponding hydraulic model update and subsequent model calibration process. Existing water system information was obtained through the review of previous reports, maps, plans, operation records, and other available data provided to West Yost by City staff. Using this information, the City's current hydraulic model was updated (*e.g.,* adding new pipelines) to represent the existing potable water system. The updated model was then calibrated to confirm that it can accurately represent the operation of the existing potable water distribution system under varying conditions.

The remainder of the chapter presents an evaluation of the City's existing potable water distribution system and its ability to meet the City's recommended performance and operational criteria (previously described in Chapter 6) under existing water demand conditions. The evaluation includes an analysis of water storage capacity, pumping capacity, and the existing water system's ability to meet recommended water system performance and operational criteria under maximum day demand plus fire flow and peak hour demand scenarios.

Evaluations, findings, and recommendations for addressing any deficiencies identified within the existing potable water distribution system are included. Recommendations were used to develop a Capital Improvement Program (CIP), which includes an estimate of probable construction costs. The recommended existing potable water system CIP is described further in Chapter 10.

The following sections of this chapter describe the components of the City's existing potable water distribution system evaluation:

- Description of Existing Potable Water System Facilities
- Hydraulic Model Update and Calibration
- Existing Potable Water System Evaluation
- Summary of Recommended Existing Potable Water System Improvements

7.2 DESCRIPTION OF EXISTING POTABLE WATER SYSTEM FACILITIES

This section provides a summary of the City's existing potable water system facilities. The City's existing potable water system facilities are located throughout the water service area as shown on Figure 7-1. Additional details regarding each facility are presented below.

7.2.1 John Jones Water Treatment Plant

The City's JJWTP is located just north of the DMC in the southern portion of the City as shown on Figure 7-1. The JJWTP was originally constructed in 1979, expanded in 1988, and then expanded again in 2008. Currently, it has a treatment capacity of 30 mgd.

The most recent expansion added treatment through granulated activated carbon and ultraviolet light disinfection. Granulated activated carbon removes dissolved organic compounds contained in the water, and ultraviolet light disinfection provides an additional level of treatment. Several new process upgrades including new flocculation/sedimentation basins, washwater basins, and chemical addition facilities were also added during the recent expansion. The site plan, process schematic, and hydraulic profile from the JJWTP Expansion Project is provided in Appendix E.

The City operates three surface water intake pumps at the JJWTP with the capacity to pump a total of approximately 45 mgd of raw surface water from the DMC to the JJWTP for treatment. The key characteristics of the existing surface water intake pumps are summarized in Table 7-1.

Table 7-1. Summary of Existing Surface Water Intake Pumps[(a)]

Intake Pump Name	Year Installed	Production Capacity, mgd	Pump Type	Motor Horsepower	Motor Type
Pump No. 1	2008	15	Vertical Turbine	150	VFD[(b)]
Pump No. 2	2008	15	Vertical Turbine	150	VFD[(b)]
Pump No. 3	2008	15	Vertical Turbine	150	VFD[(b)]

(a) Source: JJWTP Expansion Project, Sheet G-8 (Carollo Engineers).
(b) Variable Frequency Drive.

7.2.2 South County Water Supply Project

The City, in partnership with the cities of Manteca, Lathrop and Escalon, and SSJID, constructed a new surface water treatment plant near Woodward Reservoir in Stanislaus County and new transmission pipelines to deliver treated surface water to each city. The City's treated surface water allocation from the SCWSP is 15 mgd of treatment capacity and 10,000 af/yr of water supply.

Treated surface water from the surface water treatment plant located near Woodward Reservoir is conveyed to the City through a dedicated 36-inch diameter transmission main, and is then pumped to the City by the Mossdale Pump Station located at the intersection of Manthey and Stewart Roads (see Figure 7-1). Water pumped from the Mossdale Pump Station first fills the City's Linne and NEI storage tanks through 18- and 30-inch diameter transmission mains before being pumped into the City's distribution system to serve system demands. The Mossdale Pump Station is operated by SSJID.

7.2.3 Groundwater Wells

The City currently has nine groundwater wells, which provide the City's system with groundwater supply. Currently, Well 1 and Lincoln Well are inactive due to well rehabilitation activities. The City's newest well (Well 8) was constructed in 2004 and is currently operational as of September 2010. As discussed in Chapter 5, Well 8 is ultimately intended for use with the City's ASR Program, but it will initially be used as an extraction well to serve water demands directly under normal and/or emergency conditions. The locations of these existing groundwater wells are shown on Figure 7-1. Table 7-2 presents a summary of these existing groundwater well facilities with key characteristics such as design capacity and age.

Table 7-2. Summary of Existing Groundwater Wells

Well Name/ Number	Well Location/Address	Year Drilled	Total Well Depth (Casing Depth), feet	Casing Diameter, inches	Depth of Perforated Zone, feet[a]	Design Capacity, gpm	Production Capacity, mgd
Well 1 (Currently Inactive)	JJWTP	1986	1,010 (1,000)	16"	450-550 580-980	1,500	2.2
Well 2	JJWTP	1989	990 (870)	16"	420-850	2,000	2.9
Well 3	JJWTP	1989	1,020 (900)	16"	420-890	2,000	2.9
Well 4	JJWTP	1989	1,020 (950)	16"	380-940	2,000	2.9
Lincoln Well (Currently Inactive)	Lincoln Park	1990	1,000 (1.000)	16"	490-980	2,500	3.6
Well 5[b] (Lewis Manor Well)	902 Twelfth Street (north of Eleventh Street between Tracy Boulevard and Corral Hollow Road)	2000	1,015 (1,000)	18"	410-480 601-630 650-670 805-830 900-930 965-990	2,500	3.6
Well 6 (Park & Ride Well)	2650 North Naglee Road (North of I-205 adjacent to West Valley Mall)	2001/02	1,250 (1,216)	18"	550-598 610-636 656-678 738-754 774-796 966-982 1,014-1,122 1,176-1,196	2,000	2.9
Well 7 (Ball Park Well)	2001 Bessie Avenue (east of Tracy Boulevard south of Grant Line Road)	2002	1,070 (894)	18"	550-598 570-732 850-874	2,500	3.6
Well 8[c]	Tracy Boulevard and Sixth Street	2004	850 (850)	18"	370-460 510-640 680-820	2,500	3.6

(a) Source: GEI Consultants, Summary of Groundwater Conditions November 2007 through November 2008, dated January 23, 2009.
(b) Data shown is for the Lewis Manor Replacement Well constructed in 2000.
(c) Well 8 is currently operational as an extraction well; however, the City plans to use Well 8 as an injection/extraction well in the future as part of the City's ASR Program.

The groundwater wells located at the JJWTP (Wells 1-4) pump directly into the Chlorine Contact Basin or Clearwell #2, where the groundwater is blended with the finished surface water and chlorinated prior to system distribution. Groundwater from the other remaining wells located in Zone 1 is chlorinated at each well site and pumped directly into the distribution system.

7.2.4 Potable Water Storage Facilities

The City currently operates four treated water storage reservoirs (two clearwells and two storage tanks). Table 7-3 presents a summary of these existing storage facilities with key characteristics such as storage capacity and age. As shown, the City currently has a total potable water storage capacity of 14.16 MG in its existing potable water system. However, Clearwell #1 operates as a chlorine contact basin and can no longer be counted as system storage capacity. Therefore, the total *available* potable water storage capacity is reduced to 13.5 MG. The locations of the City's two storage tanks are shown on Figure 7-1 (the two clearwells are located at the JJWTP).

Table 7-3. Summary of Existing Treated Water Storage Facilities

Storage Facility Name	Storage Type	Material	Year Constructed	Storage Capacity, MG
Clearwells				
#1[(a)]	Partially Buried Tank	--	1978	0.66
#2[(b)]	Partially Buried Tank	--	1987	4.0
Storage Tanks				
Linne	Fully Buried Tank	Concrete	2005	7.1
NEI	Partially Buried Tank	Concrete	2002	2.4
Total Storage Capacity, MG				14.16
Total Available Storage Capacity, MG				13.5[(c)]

(a) Clearwell #1 has a design capacity of 1.0 MG, but it has been reduced to 0.66 MG due to the construction of a new weir within Clearwell #1. Also known as the Chlorine Contact Basin.
(b) Clearwell #2 has a design capacity of 5.6 MG, but it has been reduced to 4.0 MG due to the construction of a new weir within Clearwell #1.
(c) Does not include Clearwell #1 as it is operated as a chlorine contact basin and can no longer be counted as system storage capacity.

7.2.5 Booster Pump Stations

The City currently has six booster pump stations. The locations of these existing booster pump stations are shown on Figure 7-1 (Zones 1, 2 and 3 booster pump stations are located at JJWTP). Table 7-4 presents a summary of the existing booster pump stations with key characteristics such as design capacity and number of booster pumps. It should be noted that, since Zone 3 has yet to be developed, the Zone 3 booster pump station is not currently operational.

The Zones 1, 2 and 3 booster pumps located at the JJWTP pump treated surface water supply (from USBR) stored in Clearwell #2 into the City's water system. The booster pumps located at the Linne and NEI storage reservoirs provide treated surface water supply (from SSJID) stored in their respective storage tanks into the City's system. These booster pumps are also used to meet peak hour demands during the morning and afternoon hours. The booster pumps located at Patterson Pass pump water to serve customers located in the Patterson Pass Business Park.

Table 7-4. Summary of Existing Booster Pump Stations

Booster Pump Station Name	Location	Year Installed	Rated Capacity[a], gpm	Firm Capacity[b], gpm	Firm Capacity[b], mgd	Number of Pumps
Zone 1[c]	JJWTP	2000	24,000	12,000	17.3	2
Zone 2[c]	JJWTP	1987	20,000	13,300	19.2	4
Zone 3	JJWTP	1987	5,700	--[d]	--[d]	4
Linne[c]	Linne Tank	2005	19,460	14,595	21.0	4
NEI[c]	NEI Tank	2001	5,600	4,200	6.0	4
Patterson Pass[c]	Schulte Road, west of Hansen Road	1991	4,000	3,000	4.3	4

(a) Maximum pumping capacity of entire pump station.
(b) Assumes that the largest booster pump at the pump station is offline.
(c) Pumps are equipped with variable frequency drives.
(d) Zone 3 booster pumps are not currently operated.

7.2.6 Pressure Regulating Stations

The City currently has five pressure regulating stations (PRS) which separate Zone 1 from Zone 2 as shown on Figure 7-1. Each station contains a valve which is used to regulate flow into Zone 1 or sustain pressure within Zone 2 depending on the system pressures within each pressure zone. Each pressure regulating station can operate in two different modes:

- Pressure Sustaining Valve (PSV) – The valve will maintain an upstream pressure between 78 and 83 psi at the bottom of Zone 2. If the pressure increases above the valve's set point, the valve will open and release water into Zone 1. This is the mode in which the existing valves typically operate.
- Pressure Reducing Valve (PRV) – The valve will allow flow into Zone 1 if the pressure at the top of Zone 1 falls below 52-56 psi. When the pressure is below the valve's set point, the valve will remain open until the pressure increases.

Although the stations can operate in two different ways, their primary function is that of a PSV. Table 7-5 presents a summary of these existing pressure regulating stations with key characteristics such as valve size and pressure setting.

Table 7-5. Summary of Existing Pressure Regulating Stations			
Pressure Regulating Station Name	Valve Size, inches	Elevation, ft	Pressure Setting (upstream/downstream), psi
1	12	63.67	83/56
2	8	66.57	79/53
3	6	71.19	78/52
4	10	64.53	80/54
5	12	68.29	79/53

7.2.7 Pressure Zone Boundaries

The City's existing potable water system consists of two interconnected pressure zones (*i.e.*, Zone 1 and Zone 2, which are isolated from each other by pressure regulating stations). A third zone (*i.e.*, Zone 3) has yet to be developed. The approximate boundaries of each pressure zone are shown on Figure 7-1.

Zone 1 extends from the northern City limits south to Schulte Road and is the most developed of the three zones. Therefore, it has more transmission pipelines to convey water throughout the zone. Zone 1 can be served from the 36-inch diameter transmission main which extends north from the JJWTP along Tracy Boulevard to Sixth Street. There are also two major water transmission mains located on the east and west sides of Zone 1 which help distribute water to the lower elevations of the zone: an 18-inch diameter transmission main along Corral Hollow Road and a 20-inch diameter transmission main along MacArthur Drive. Zone 1 can also be served from the NEI tank and booster pump station, groundwater wells, and from Zone 2 via the five pressure regulating stations.

Zone 2 extends from Schulte Road south to Linne Road and is comprised mostly of residential and light industrial land use. Water demands in Zone 2 are primarily served by the 24-inch diameter transmission main on Corral Hollow Road, which extends from the Zone 2 booster pump station at the JJWTP north towards Patterson Pass, and the Linne tank and booster pump station.

Zone 3 currently extends from Linne Road south to the JJWTP. Zone 3 has yet to be developed, but the City plans to serve future development through an existing 14-inch diameter pipeline which extends from the JJWTP to the corner of Linne Road and Tracy Boulevard. The Patterson Pass Business Park (*i.e.*, Safeway and Costco) falls into the Zone 3 service elevation ranges, but is currently served through a separate booster pump station located on Schulte Road just west of Hansen Road (*i.e.*, Patterson Pass booster pump station), which is currently supplied by Zone 2.

Table 7-6 provides a summary of the existing pressure zone boundaries with key characteristics such as service elevations and static pressure ranges.

Table 7-6. Summary of Existing Pressure Zone Boundaries

Pressure Zone	Range of Service Elevations, ft	Static Pressure Range, psi	Supply Sources
Zone 1	0-75	40-75	JJWTP via Gravity Main, NEI Tank, Wells, and Pressure Regulating Stations
Zone 2	75-150	40-85	JJWTP via Zone 2 Pumps and Linne Tank
Zone 3	Undeveloped[(a)]		

(a) Patterson Pass Business Park (*i.e.,* Safeway and Costco) is located in Zone 3, but is currently served through the Patterson Pass booster pump station supplied by Zone 2.

7.2.8 Transmission and Distribution System Pipelines

Based on the City's existing hydraulic model, there are approximately 260 miles of existing pipelines in the City's water service area.[1] Pipelines in the existing potable water distribution system range from 4 to 42 inches in diameter. Pipeline materials consist mainly of asbestos cement (AC), cast iron (CI), and ductile iron (DI). The City's existing transmission and distribution system pipeline network is shown on Figure 7-1.

7.2.9 SCADA System

The City has a SCADA (Supervisory Control and Data Acquisition) system installed to provide for remote operation and monitoring of its facilities. Most of the existing distribution facilities have SCADA installed except for the following facilities:

- Well 1,
- Well 3,
- Well 4, and
- PRS #1 through #5.

Well 8 has SCADA installed, but cannot be remotely operated by the SCADA system. Wells 1, 3, and 4, located at JJWTP, are not operated regularly so the addition of SCADA may not be necessary. However, the pressure regulating stations can provide a significant amount of water supply from Zone 2 to Zone 1 and should be monitored to provide operators with complete real-time system operations data.

The addition of SCADA system monitoring at each PRS will provide operators with the ability to operate the City's water system more efficiently between the use of the Zone 1 booster pump station and the pressure regulating stations to maintain pressures in Zone 1. The addition of SCADA system monitoring to each PRS will also provide the ability to create diurnal curves that

[1] The City's existing hydraulic model is not an all pipes model; therefore, the exact length of existing system pipelines is not known. The total length provided is an approximation.

are specific to each zone, which will help provide a better understanding of water demand patterns within each zone. Therefore, it is recommended that SCADA system monitoring of flow and pressure be installed at each PRS to provide operators with additional understanding and flexibility in system operations.

In addition, based on a review of the SCADA system data provided to develop the existing system's diurnal water demand patterns; additional data inconsistencies and SCADA system recommendations are discussed in *Section 7.3.3 Diurnal Curve Development*.

7.3 HYDRAULIC MODEL UPDATE AND CALIBRATION

A computer simulation model (hydraulic model) transforms information about the physical system into a mathematical model that solves for various demand conditions. The hydraulic model then generates information on pressure, flow, velocity and head loss that can be used to analyze system performance and identify system deficiencies. A hydraulic model can also be used to verify the adequacy of recommended or proposed system improvements.

The City currently has a hydraulic model developed to simulate its potable water system performance. As part of this Citywide Water System Master Plan, an update and calibration of the City's current potable water system hydraulic model was performed to verify that the hydraulic model can accurately reflect the existing water system conditions. This section summarizes the tasks completed to update and calibrate the City's current hydraulic model of its potable water distribution system.

7.3.1 Existing Hydraulic Model Description

The City's current hydraulic model of its existing potable water system was last updated in 2007 using Geographic Information Systems (GIS) based software developed by MWH Soft (*i.e.*, InfoWater). The 2007 update was completed by West Yost and included the following tasks[2]:

- Conversion to InfoWater modeling software
- Addition of new pipelines constructed since 2005
- Allocation of existing (2006) water demands based on spatially located meter data
- Review/fix pipeline configurations using InfoWater's *Network Review* tools
- Development of diurnal water demand pattern using SCADA system data
- Verification of Zone 2

[2] Source: Pressure Zone 2 Evaluation, West Yost Associates (July 2009).

With this Citywide Water System Master Plan (2010) update, West Yost first reviewed existing system facilities and pipelines and then incorporated any key facilities which have been constructed or replaced since the last hydraulic model update in 2007. Once the model was updated, additional work was performed to calibrate the existing potable water system hydraulic model. These tasks are discussed in more detail below.

7.3.2 Review of Existing Water System Facilities

Based on a review of the available facilities data on the existing potable water system, which was provided to West Yost by City staff, the following facilities have been added or revised in the City's current hydraulic model:

- Well 8
- Facilities from the South County Water Supply Project (Mossdale Pump Station and Transmission Pipelines)
- Various new pipeline projects
- Pipeline replacements
- Major Patterson Pass Business Park pipelines[3]
- Miscellaneous looping pipelines[4]
- Pipelines with incorrect diameters and/or C-factors

Figure 7-2 illustrates the locations of the new and revised facilities listed above that have been incorporated into the current model to accurately represent the City's existing potable water distribution system.

7.3.3 Diurnal Curve Development

A true extended period simulation (EPS) requires a realistic diurnal water demand pattern that reflects the City's actual water use trends. A typical diurnal demand pattern over a one-day period will show low water demand at night when people are asleep, increased water demands in the morning as people are awake, decreased water demands during the daytime, followed by another increase in water demand in the evening when people return home.[5] By developing and incorporating a diurnal water demand pattern, the hydraulic model can more accurately represent fluctuations in water demand over the selected time period. West Yost developed a representative 24-hour diurnal pattern for the City's existing potable water system using system data collected through the SCADA system to add the time variable to the hydraulic model.

[3] Major pipelines from the Patterson Pass Business Park were added to provide additional detail to refine the current hydraulic model because pipelines from future developments may connect to existing pipelines located within the Patterson Pass Business Park. With the addition of these pipelines, water demands within the Patterson Pass Business Park were subsequently adjusted spatially to represent the actual location of water demands.

[4] Miscellaneous looping pipelines were added to provide additional detail to refine the current hydraulic model.

[5] Source: Advanced Water Distribution Modeling and Management, Haestad Walski (2004).

To develop the 24-hour diurnal pattern, City staff provided West Yost with SCADA system data at 30- minute intervals in electronic format on the existing water system tank levels, flows, and pump discharge pressures during the period from April 22 to May 5, 2010. After a review of the half-hourly water system production data, West Yost identified May 3, 2010 as the date when recorded water system flow characteristics most accurately represented typical water system operations. As shown in Figure 7-3, the 24-hour diurnal curve developed for the City's main distribution system reflects the typical increasing and decreasing trends associated with morning, day time, evening, and night time activity.

During development of the diurnal water demand patterns, West Yost found that data collected from the following SCADA tags were inaccurate (as explained in more detail below):

- R17Flow_Discharge (NEI Booster Pump Station Flow) – Values are approximately on average 60 percent or 900 gpm lower than the calculated values, which were calculated based on NEI tank levels and SSJID inflows.
- R22Flow_West (Zone 2 Booster Pump Station Flow) – Values are approximately on average 165 percent or 6,000 gpm higher than the calculated values, which were adjusted based on flow data collected by Oratech Controls, Inc. during the Pressure Zone 2 Evaluation.[6]
- R18Reservoir_Level (Linne Tank Level) – Values are inconsistent with the calculated values, which were calculated based on Linne booster pump station flows and SSJID inflows.
- R27Pressure_Pressure (Zone 1 36-inch diameter Transmission Main Discharge Pressure) – Values are missing (*e.g.*, zero values were recorded during various periods of the SCADA data collected).

West Yost made adjustments to the collected SCADA system data from the NEI and Zone 2 booster pump stations to develop a more accurate diurnal demand pattern for the main distribution system as shown previously on Figure 7-3. However, it is recommended that City staff review the existing SCADA system and correct the discrepancies listed above to provide more accurate system operations data in the future.

7.3.4 Hydraulic Model Calibration

The City's hydraulic model was calibrated to confirm that the updated computer simulation model can accurately represent the operations of the existing water distribution system under varying conditions. This is accomplished by comparing system pressures and flows recorded in the field to model-simulated pressures and flows. Calibration of the hydraulic model used data collected from the City's water system through hydrant tests, hydrant pressure recorders, and the City's SCADA system.

[6] Source: Pressure Zone 2 Evaluation, West Yost Associates (July 2009).

A total of 13 hydrant tests were developed and 11 of those hydrant tests were performed in the field to help spot-check the pipeline roughness coefficients (C-factors) currently assigned in the hydraulic model. The locations of the developed and completed hydrant tests are shown on Figure 7-4.

To collect field pressure data, 22 hydrant pressure recorders (HPRs) were placed at strategic locations within Zone 1[7] of the City's potable water system from April 21 to May 6, 2010. Figure 7-5 shows the location of each HPR. A review of the collected data from the HPRs indicates that two of the HPRs were defective and were subsequently missing data. However, the absence of data from HPRs #9 and #10 does not compromise the verification process because data from HPRs #5 and #11, which are in the vicinity of these defective HPRs, can be used. Pressure data collected from the HPRs was used to verify that the updated model could accurately simulate conditions observed in the field during the selected time period at the various selected locations. Additional system operations data collected from the SCADA system was also used to verify the hydraulic model.

A detailed discussion regarding the results of the hydraulic model calibration process is provided in Appendix F. This appendix also includes a detailed comparison between model-simulated results and the data collected in the field from hydrant tests, HPRs, and the SCADA system. A brief discussion of the model calibration results is provided below.

7.3.5 Hydraulic Model Calibration Findings and Conclusions

In summary, the results from the hydrant test simulations indicate that the hydraulic model is well calibrated using the current pipeline C-factors assigned, and can accurately simulate a fire flow or other large demand conditions. However, based on the comparison of the collected hydrant flow test data and initial model-simulated results, three of the hydrant flow tests (Tests 5, 8, and 10) required further evaluation and adjustments because they did not initially meet the ±5 psi tolerance limit established for model calibration. Additional discussion regarding adjustments to Tests 5, 8, and 10 is provided below:

- Test 5 (8-inch DI): Initial model simulation results indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, etc.) within the area of Test 5. On May 11, 2010, City staff confirmed that there was a closed valve located on Banbury Court, southeast of Blandford Lane.[8] Simulation results from Test 5 met the ±5 psi tolerance limit once the closed valve was accurately simulated within the hydraulic model.

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[7] Zone 2 was last verified in 2007 as part of the City's Pressure Zone 2 Evaluation. Consequently, the hydraulic model verification effort for this Citywide Water System Master Plan focused on Zone 1.

[8] This closed valve has subsequently been opened by City staff.

- Test 8 (8-inch AC): Initial model simulation results indicate that there may have been an error with the residual pressure reading at observed Hydrant 8C. The difference between field-observed and model-simulated pressures for Hydrant 8C was 12 psi. However, model simulation results from observed Hydrants 8A and 8B were well within the ±5 psi tolerance limit. In addition, the C-factor for 8-inch AC pipelines was previously validated in Test 3. Therefore, it is recommended that the data from Hydrant 8C not be used.

- Test 10 (8-inch DI): Initial model simulation results indicate that there may have been an error with the residual pressure reading at observed Hydrant 10C. The difference between field-observed and model-simulated pressures for Hydrant 10C was 10 psi. However, model simulation results from observed Hydrants 10A, 10B, and 10D were within the ±5 psi tolerance limit. In addition, the C-factor for 8-inch DI pipelines was validated in Tests 2 and A1. Therefore, it is recommended that the data from Hydrant 10C not be used.

Because these three hydrant tests were able to meet the ±5 psi tolerance limit established for calibration after the removal of erroneous data and/or slight adjustments, and the remaining (8) hydrant tests were able to closely replicate field-observed pressures, these results indicate that the C-factors currently assigned in the hydraulic model are appropriate for use to represent the City's existing potable water distribution system. Additional details regarding the hydrant test simulations are provided in Appendix F.

Overall, the results from the Zone 1 verification task (*i.e.*, extended period simulation) validated the existing system configuration and demand allocation in the hydraulic model. Tank level, pump station flow rate and discharge pressure comparisons at most of the City's operated facilities trended well with the collected SCADA system data during the selected 24-hour period. Comparisons of HPR and model-simulated pressure data also trended well during the selected period. Most of the trends, though not exact, follow closely with the recorded HPR pressures. Additional details regarding the extended period simulation are provided in Appendix F.

Based on the results of the hydraulic model calibration tasks (*i.e.*, hydrant tests and extended period simulation), it can be concluded that the hydraulic model provides an accurate operational representation of the City's existing potable water distribution system, and is more than adequate for use as a planning and operational tool. However, it is recommended that the City continue to update and verify the pipeline system configurations in the hydraulic model as facilities are constructed or replaced, to maintain a hydraulic model that will continue to accurately represent the City's existing water system. The following section discusses the existing system evaluation using the newly updated and calibrated hydraulic model.

7.4 EXISTING POTABLE WATER SYSTEM EVALUATION

This section presents the evaluation of the City's existing potable water distribution system and its ability to meet the City's recommended performance and operational criteria (previously presented in Chapter 6) under existing demand conditions. This evaluation includes an analysis of existing surface water treatment capacity, water storage capacity, pumping capacity, and the water system's ability to meet recommended performance criteria under maximum day demand plus fire flow and peak hour demand scenarios. Recommended improvements for addressing any identified existing potable water distribution system deficiencies are summarized in *Section 7.5 Summary of Recommended Existing Potable Water System Improvements*.

7.4.1 Existing Potable Water Demands

The water demands currently in the City's water system model were previously allocated based on spatially-located 2006 meter data provided by City staff for the Pressure Zone 2 Evaluation.[9] These water demands currently in the model were consequently scaled up using the City's 2007 water production data to represent the existing (2007) baseline average day demand.[10] As discussed in Chapter 4, the 2007 water production data appears to more accurately represent typical City water demands, and is a little more conservative than the recently available water production data (*i.e.*, 2008 and 2009). Table 7-7 summarizes the City's existing potable water demands by pressure zone.

Table 7-7. Existing Potable Water Demands by Pressure Zone

Pressure Zone	Average Day Demand		Maximum Day Demand[a]		Peak Hour Demand[b]	
	gpm	mgd	gpm	mgd	gpm	mgd
Zone 1[c]	7,918	11.4	15,836	22.8	26,921	38.8
Zone 2[c]	3,970	5.7	7,940	11.4	13,498	19.4
Patterson Pass[d]	279	0.4	558	0.8	949	1.4
Total	12,167	17.5	24,334	35.0	41,368	59.6

(a) Maximum day demand is 2.0 times the average day demand (see Table 4-9).
(b) Peak hour demand is 3.4 times the average day demand (see Table 4-9).
(c) Average day demand is based on 2007 water production data (see Table 4-2).
(d) Patterson Pass Business Park is located in Zone 3, but is currently served through the Patterson Pass booster pump station supplied by Zone 2. Water demands from Patterson Pass Business Park are not included in the City's water production totals because the water supply for this area is purchased by Patterson Pass Business Park from the Plain View Water District (now Byron Bethany Irrigation District). However, the City is responsible for providing water treatment and delivery services to Patterson Pass Business Park. The average day demand is based on additional 2007 water production data provided by the City for the Patterson Pass Business Park (Source: *2008 PRODUCTION TOTALS.xls*).

7.4.2 Existing Water System Facilities Evaluation

To evaluate the existing potable water system, analyses addressing the following system facilities were conducted:

- Surface Water Treatment Capacity,
- Water Storage Capacity,

[9] Source: Pressure Zone 2 Evaluation, West Yost Associates (July 2009).

[10] To refine the hydraulic model, new water demands from Phase 1 Kimball High School development were added in the model before scaling current model demands to represent 2007 baseline water demands.

- Pumping Capacity, and
- Critical Supply Facilities.

The results from the existing potable water system facilities analyses are discussed below.

7.4.2.1 Surface Water Treatment Capacity

Sufficient surface water treatment capacity from the existing JJWTP and the City's treated surface water supplies from the South County Water Supply Project should be available to meet the City's existing maximum day demand condition. In addition, sufficient treated surface water pumping capacity should also be available to assist in meeting a maximum day demand. Table 7-8 compares the City's existing surface water treatment and pumping capacity with existing maximum day potable water demands.

Table 7-8. Comparison of Available and Required Surface Water Treatment and Pumping Capacity

Surface Water Capacity	JJWTP[(a)]	South County Water Supply Project[(b)]	Total Surface Water Capacity	Existing Maximum Day Demand	Surface Water Capacity Surplus or (Deficit)
Treatment Capacity, mgd	30	15	45	35	10
Pumping Capacity, gpm	20,833[(c)]	10,417[(d)]	31,250	24,334	6,916

(a) Supplied from Zone 1 36-inch diameter transmission main and Zone 2 booster pump station.
(b) Supplied from Linne Road and NEI booster pump stations.
(c) Pumping capacity is limited to the maximum available treatment capacity from the JJWTP (*i.e.,* 30 mgd).
(d) Pumping capacity is limited to the maximum available treatment capacity from the SCWSP (*i.e.,* 15 mgd).

Table 7-8 indicates that the City has sufficient surface water treatment and pumping capacity to meet existing maximum day demands.

7.4.2.2 Water Storage Capacity

The principal advantages that storage provides for the water system are the ability to equalize demands on supply sources, production facilities, and transmission mains; to provide emergency storage in case of supply failure; and to provide water to fight fires. The City's water service area has two sources of available storage: above ground storage (*i.e.*, clearwells and storage tanks) and storage available through the groundwater basin. Together, these two sources of storage must be sufficient to meet the City's operational, emergency, and fire flow storage criteria. The volumes required for each of these three storage components are listed below:

- Operational Storage: 30 percent of a maximum day demand;
- Emergency Storage: Two times an average day demand; and

- Fire Flow Storage: The required fire flow rates multiplied by their associated fire flow duration periods, as required by the City's Fire Department. Two concurrent fire flow events were assumed for the fire flow storage analysis. However, the recommended fire flow storage does not include the volume associated with sprinkler flows.

Because the City's potable water supply includes supply from groundwater wells, the groundwater basin can account for a portion of the recommended emergency storage, in the form of a groundwater credit. However, the following must be true to use the groundwater supply to offset the need to provide surface storage reservoirs:

- Groundwater supply is of potable water quality and can be reliably accessed (*i.e.*, wells are equipped with on-site emergency generators);
- Groundwater supply is not already relied upon to meet the City's average day demand requirements;
- Groundwater supply is of firm groundwater supply availability (*i.e.*, assumes 20 percent of wells will be out of service at any given time); and
- Sufficient water distribution facilities are available to distribute this water to demand areas.

In addition, the City currently has two independent sources of treated surface water supply, and some quantity of the total treated surface water supply capacity can also account for a portion of the recommended emergency storage. The treated surface water credit assumes that the smaller of the treated surface water supply sources can be available to offset a portion of the emergency storage requirement. However, the following must be true to use treated surface water supply to offset the need to provide surface storage:

- Treated surface water supply can be reliably accessed (*i.e.*, treated surface water supply facility is equipped with on-site emergency generator); and
- Sufficient treated surface water booster pumping facilities are available to distribute this water to demand areas.

In summary, the Emergency Storage Credit is equal to the sum of the groundwater and treated surface water supply credits. However, the Emergency Storage Credit can only provide a maximum storage credit equal to the City's required emergency storage volume.

The existing potable water storage facilities, in conjunction with the available Emergency Storage Credit, were evaluated to determine whether the City's existing potable water system has sufficient storage capacity to provide the required operational, emergency, and fire flow storage. Table 7-9 provides a detailed summary of the City's existing available potable water storage capacity, emergency storage credit, and required storage capacity. Table 7-10 provides a comparison between the City's available and required storage capacities, and it indicates that the City currently has a potable water storage capacity surplus of 1.8 MG.

Table 7-9. Summary of Existing Storage Facilities

[A]	[B]	[C]	[D]	[E]	[F]	[G] = [C] + [F]	[H]	[I]	[J]	[K] = [H] + [I] + [J]	[L] = [G] - [K]
		Available Storage Capacity, MG					Required Storage Capacity, MG				
			Emergency Storage Credit								
Station	Status	Reservoir Capacity	Groundwater Credit[a]	Treated Surface Water Supply Credit[b]	Total Emergency Storage Credit[c]	Total Available Storage	Operational[d]	Emergency[e]	Fire Flow[f]	Total Required Storage	Storage Surplus (Deficit), MG
NEI	Active	2.40	--	30.00	35.00	**48.50**	10.50	35.00	1.14	**46.64**	**1.8**
Lincoln Well	Inactive	--	--								
Lewis Manor Well	Active	--	7.20								
Park and Ride Well	Active	--	5.76								
Ball Park Well	Active	--	7.20								
Well 8	Active	--	--								
Linne	Active	7.10	--								
Well 1	Inactive	--	--								
Well 2	Active	--	--								
Well 3	Active	--	--								
Well 4	Active	--	--								
Clearwell #2	Active	4.00	--								

(a) Credit based on two days of pumping capacity from active groundwater wells with on-site backup power (10.1 mgd) because the required emergency storage capacity is equal to two times the average day demand. See Table 7-2 for individual well capacity.

(b) Credit based on two days of available treatment capacity (15 mgd) from the SCWSP because the required emergency storage capacity is equal to two times the average day demand.

(c) Equal to the sum of the groundwater and treated surface water supply credits; however, the maximum credit is equal to the required emergency storage capacity (35 MG).

(d) Based on 30 percent of a maximum day demand of 35.0 mgd (see Table 7-7).

(e) Based on two times the average day demand of 17.5 mgd (see Table 7-7).

(f) Based on storage required for two concurrent fire flow events; a Single Family Residential fire flow and an Industrial fire flow (see Table 6-1).

Table 7-10. Comparison of Available and Required Water Storage Capacity

Available Storage Capacity, MG			Required Storage Capacity, MG				Storage Capacity Surplus, MG[f]
Reservoir Capacity[a]	Emergency Storage Credit[b]	Total	Operational[c]	Emergency[d]	Fire Flow[e]	Total	
13.5	35.0	48.5	10.5	35.0	1.2	46.7	1.8

(a) See Table 7-3.
(b) Equal to the sum of the groundwater water and treated surface water supply credits; however, the maximum credit is equal to the required emergency storage capacity (see Columns D, E, and F of Table 7-9).
(c) Based on 30 percent of a maximum day demand of 35.0 mgd (see Table 7-7).
(d) Based on two times the average day demand of 17.5 mgd (see Table 7-7).
(e) Based on storage required for two concurrent fire flow events; a Single Family Residential fire flow and an Industrial fire flow (see Table 6-1).
(f) Equal to available storage minus required storage.

7.4.2.3 Pumping Capacity

The pumping capacity in the City's existing potable water system was evaluated to assess its ability to deliver a reliable firm capacity to the existing water service area. Firm capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. At each booster pump station, firm booster pumping capacity was defined as the total booster pump station capacity with the largest pump out of service. For groundwater well pumps, the firm groundwater pumping capacity assumed that 20 percent of the wells would be out of service at any given time.

The pumping capacity criterion for the City, described previously in Chapter 6, requires the City's potable water system to have sufficient firm pumping capacity to meet the greater of either a maximum day demand with two simultaneous fire flow events or a peak hour demand. Table 7-11 provides a detailed summary of the City's existing available pumping capacity at each pump station. Table 7-12 provides a comparison between the City's available firm pumping capacity and the existing peak hour water demand. This pumping capacity analysis indicates that the City's existing booster and groundwater pumping capacity can sufficiently meet the pumping capacity criterion for the existing water service area during the governing flow scenario of peak hour demand. The City currently has a pumping capacity surplus of 12,227 gpm during a peak hour demand scenario.

Table 7-11. Summary of Existing Pumping Facilities

Pump Station[a]	Backup Power	Status	Pump 1, gpm	Pump 2, gpm	Pump 3, gpm	Pump 4, gpm	Firm Capacity[b], gpm	Total Firm Capacity, gpm
NEI	✓	Active	1,400	1,400	1,400	1,400	4,200	53,595
Zone 1	✓	Active	12,000	12,000	--	--	12,000	
Lincoln Well	✓	Inactive	2,500	--	--	--	--	
Lewis Manor Well	✓	Active	2,500	--	--	--	2,500	
Park and Ride Well	✓	Active	2,000	--	--	--	2,000	
Ball Park Well	✓	Active	2,500	--	--	--	2,500	
Well 8		Active	2,500	--	--	--	2,500	
Linne	✓	Active	4,865	4,865	4,865	4,865	14,595	
Zone 2	✓	Active	3,300	6,700	6,700	3,300	13,300	
Well 1[c]		Inactive	1,500	--	--	--	--	
Well 2[c]		Active	2,000	--	--	--	--	
Well 3[c]		Active	2,000	--	--	--	--	
Well 4[c]		Active	2,000	--	--	--	--	

[a] Patterson Pass booster pump station is supplied from Zone 2; therefore, it does not provide additional pumping capacity to the system.

[b] Firm booster pumping capacity was defined as the total booster pump station capacity with the largest pump out of service and firm groundwater pumping capacity assumed that 20 percent of the City's wells would be out of service (i.e., approximately two wells).

[c] Wells 1-4 located at JJWTP pump directly into the Chlorine Contact Basin or Clearwell #2; therefore, these wells do not provide additional pumping capacity to the system.

Table 7-12. Comparison of Available Firm Pumping Capacity and Peak Hour Demand		
Pump Station[(a)]	Existing Firm Pumping Capacity, gpm[(b)]	Existing Peak Hour Demand, gpm[(c)]
NEI	4,200	41,368
Linne	14,595	
JJWTP	25,300	
Groundwater Wells	9,500	
Total	53,595	41,368

(a) Patterson Pass booster pump station is supplied from Zone 2; therefore, it does not provide additional pumping capacity to the system.
(b) Firm booster pumping capacity defined as the total booster pump station capacity with the largest pump out of service and firm groundwater pumping capacity assumed that 20 percent of the City's wells would be out of service (*i.e.,* approximately two wells).
(c) Peak hour demand is 3.4 times the average day demand.

7.4.2.4 Critical Supply Facilities

All critical pumping facilities should be equipped with an on-site, emergency backup power generator to provide pumping capacity during a power outage. Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) and/or service area(s) which do not have sufficient emergency storage, and that meet the following criteria:

- The largest pumping facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A pumping facility that provides water from a supply turnout; or
- A pumping facility that provides water from key groundwater supply wells (depends on capacity, quality, and location).

As shown previously in Table 7-12, most of the City's existing pumping facilities have on-site emergency backup power installed, except for Wells 1 through 4 and Well 8[11]. However, these wells do not meet the criteria listed above and are not considered critical supply facilities. Therefore, the City is currently equipped with sufficient backup power generators to provide pumping capacity during a power outage at its most critical pumping facilities.

7.4.3 Existing Water System Performance Evaluation

The performance criteria recommended for and results of the existing potable water distribution system evaluation are discussed below.

[11] Well 8 currently has a plug-in adapter installed to allow interconnection to a portable generator.

7.4.3.1 Existing Water System Performance Criteria

Steady state hydraulic analyses using the updated and calibrated hydraulic model were conducted to help identify areas of the existing potable water system that do not meet the recommended system performance criteria as presented previously in Chapter 6. The results of the existing potable water system evaluation are presented below for the following potable water demand scenarios:

- Peak Hour Demand—A peak hour flow condition was simulated for the existing water distribution facilities to evaluate their capability to meet a peak hour demand scenario. Peak hour demands are met by the combined supply from treated surface water, storage tanks, and groundwater.
- Maximum Day Demand plus Fire Flow—To evaluate the existing potable water system under the maximum day demand plus fire flow scenario, individual fire flow demands were first assigned and simulated at various locations within the City's water service area. InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow while meeting the maximum day demand plus fire flow performance criteria. Additional fire flow simulations were also performed to simulate a condition equal to a maximum day demand with two concurrent fire flow events. Maximum day plus fire flow demands are met by the combined supply from treated surface water, storage tanks, and groundwater.

The performance criteria and results for each scenario are discussed in more detail below.

7.4.3.1.1 Peak Hour Demand Scenario

As shown in Table 7-7, the peak hour demand for the existing water service area was calculated to be 41,368 gpm (59.6 mgd). This peak hour demand represents a peaking factor of 3.4 times the average day demand. During a peak hour demand scenario, a minimum pressure of 40 psi must be maintained throughout the water system. In addition, maximum head loss per thousand feet of distribution main should not exceed 7 ft/kft and maximum velocities should not exceed 8 fps. For transmission mains, maximum head loss per thousand feet of transmission main should not exceed 3 ft/kft and maximum velocities should not exceed 6 fps. Details of the system pressures and pipeline characteristics as simulated in the hydraulic model under the peak hour demand scenario are discussed below.

7.4.3.1.2 Maximum Day Demand plus Fire Flow Scenario

As shown in Table 7-7, the maximum day demand for the existing water service area was calculated to be 24,334 gpm (35.0 mgd). This maximum day demand represents a peaking factor of 2.0 times the average day demand. Fire flow demands were assigned and simulated at various locations within the City's water service area to determine if the minimum residual pressure criterion of 30 psi could be met during a maximum day demand plus fire flow scenario. Fire flow demands were assigned based on General Plan land use designations, and are summarized below in Table 7-13.

Table 7-13. Recommended Fire Flow Requirements[a]

Land Use Category	Fire Flow, gpm	Duration, hours
Single Family Residential[b]	1,500	2
Multi Family Residential[c]	2,500	2
Commercial/Office[d]	3,500[f]	4
Industrial	4,500[f]	4
Institutional[e]	4,500[f]	4

(a) Specific fire flow requirements were determined from Table B105.1 of the 2007 CFC, and depend on construction type and fire flow calculation area. Non-residential fire flow requirements are based on the assumption that an automatic sprinkler system has been installed. See Table 6-1 for further explanation of how the fire flow requirements were developed.
(b) Includes Very Low and Low Density Residential land uses.
(c) Includes Medium and High Density Residential land uses.
(d) Includes Commercial, Office, Downtown, and Village Center land uses.
(e) Includes Public Facilities and Park land uses.
(f) Fire flow includes a 500 gpm demand for on-site sprinkler flow, which is not included in the recommended fire flow storage volume.

The City's water system should also have the capability to meet a system demand condition equal to the occurrence of a maximum day demand with two concurrent fire flow events. It is assumed that the two fire flow events will consist of one smaller single family residential fire flow combined with another larger industrial fire flow. This conservative assumption of two simultaneous fire flow demands will help stress the City's water system, and determine if the existing water system can provide reliable service during high demand conditions. Consequently, two concurrent fire flow demands were simulated at various locations within the City's water service area during a maximum day demand condition to determine if the minimum residual pressure criterion of 20 psi could be met during simultaneous fire flow events.

7.4.3.2 Recommended Improvements Criteria

The performance criteria described above was used to evaluate the existing potable water system during peak hour demand and maximum day demand plus fire flow scenarios. The existing potable water system is expected to deliver peak hour flow and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria presented in Chapter 6. However, the system was evaluated using pressure as the primary criterion. If necessary, recommended improvements needed to comply with the performance criteria were added to the existing potable water system to fix any deficiencies found and are discussed below.

7.4.3.3 Existing Water System Evaluation Results

The results from the hydraulic model for the peak hour demand and maximum day demand plus fire flow analyses are presented below.

7.4.3.3.1 Peak Hour Demand Scenario

During a peak hour demand scenario, results indicate that the existing potable water system could not adequately deliver peak hour demands to meet the City's minimum pressure criterion of 40 psi as illustrated on Figure 7-6. Under this scenario, system pressures ranged from 38 to 82 psi. A small area of low pressures ranging from 38 to 39 psi was identified during the peak hour demand simulation in the southwest part of Zone 1. This area is associated with the new Phase 1 Kimball High School development. Based on the location of this area of low pressures, it appears that the low pressures are caused by higher elevations and insufficient supply sources. As discussed in more detail below, pipeline improvements recommended on Tracy Boulevard (due to high pipeline velocities simulated during a peak hour demand scenario) will alleviate the low pressures observed during the existing peak hour demand condition.

As illustrated on Figure 7-7, there are three locations within the existing system where the transmission and distribution system pipelines did not meet the corresponding maximum velocity criterion of 6 fps and 8 fps, respectively, during a peak hour demand scenario. The following list details pipelines in the existing potable water system that exceeded the maximum velocity criterion and summarizes any recommended improvements.

- Location #1: The 12-inch diameter distribution pipelines located on Sixth Street and Tracy Boulevard immediately west of the 36-inch diameter transmission main tie-in had a velocity of 10 fps. The 12-inch diameter distribution pipelines located on Sixth Street immediately east of the 36-inch diameter transmission main tie-in had a velocity of 13 fps. The 8-inch diameter distribution pipelines located on Ninth Street immediately after the 36-inch diameter transmission main tie-in had a velocity of 12 fps.

  Recommendation:

  It is recommended that the 12-inch diameter pipelines located on Sixth Street and Tracy Boulevard be replaced with 18-inch diameter pipelines to reduce high pipeline velocities caused by the large amount of water supplied from the 36-inch diameter transmission main. This improvement will also allow more supply to reach Eleventh Street to alleviate the low pressures observed at Kimball High School during a peak hour demand scenario.

  No mitigation is recommended for the 12-inch diameter pipelines located on Sixth Street immediately east of the 36-inch diameter transmission main tie-in because these pipelines currently cross the existing railroad tracks, and it would be cost-prohibitive to replace at this time.

  In addition, no mitigation is recommended for the 8-inch diameter pipelines located on Ninth Street immediately after the 36-inch diameter transmission main tie-in because pipeline velocity is a secondary criterion and no improvements for pipelines exceeding the velocity criterion in the existing potable water system are recommended unless the primary criterion (pressure) is not met.

- Location #2: The 12-inch diameter distribution pipelines located on Schulte Road, between Tracy Boulevard and Margarite Street, had a velocity of 9 fps.

  Recommendation:

  No mitigation is recommended for the 12-inch diameter pipelines located on Schulte Road, between Tracy Boulevard and Margarite Street, because pipeline velocity is a secondary criterion and no improvements for pipelines exceeding the velocity criterion in the existing potable water system are recommended unless the primary criterion (pressure) is not met.

- Location #3: The 18 and 24-inch diameter transmission pipelines located on Linne Road and Tracy Boulevard immediately west of the Linne tank had velocities of 8 and 7 fps, respectively.

  Recommendation:

  No mitigation is recommended for the 18 and 24-inch diameter pipelines located on Linne Road and Tracy Boulevard because a future 24-inch diameter pipeline on MacArthur Drive, between Valpico Road and Linne Road, is proposed to tie-in to the existing 24-inch diameter pipeline located on Linne Road. This future tie-in will allow water from the Linne tank to flow to the east and will eliminate the high velocities currently simulated on the transmission pipelines located west of the Linne tank.

7.4.3.3.2 Maximum Day Demand plus Fire Flow Scenario

Fire flow demands were assigned based on Table 7-13 and simulated at various locations within the City's water service area. Results indicate that all the fire flow junctions within the model were able to meet the minimum residual pressure criterion of 30 psi. In addition, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow (while meeting the maximum day demand plus fire flow minimum residual pressure and maximum velocity performance criteria of 30 psi and 12 fps, respectively) at each fire flow junction within the existing water system during a maximum day demand scenario.

Figure 7-8 illustrates the available fire flow while meeting the maximum day demand plus fire flow minimum residual pressure and maximum velocity performance criteria at each fire flow junction within the existing water system. As shown on Figure 7-8, results indicate that there was one fire flow junction where the available fire flow was less than the minimum required fire flow of 1,500 gpm. A review of this location indicates that the existing 4-inch diameter pipeline is undersized. Consequently, it is recommended that the existing 4-inch diameter pipeline be replaced with a new 12-inch diameter pipeline to improve the fire flow to this area.[12]

[12] Upsizing of this existing 4-inch diameter pipeline to 12-inch diameter was previously recommended in the technical memorandum titled *Hydraulic Evaluation of the Downtown Specific Plan (August 19, 2008)*, prepared by West Yost Associates.

Four additional fire flow simulations were performed within the hydraulic model to simulate a condition equal to a maximum day demand with two concurrent fire flow events. Two concurrent fire flow events were simulated during a maximum day demand condition to determine if the minimum residual pressure criterion of 20 psi could be met. Figure 7-9 illustrates the locations of the additional fire flow simulations. Locations were selected within each pressure zone based on the existing land use designations and spatial distance from supply sources to stress the City's water system. As summarized in Table 7-14, results from the hydraulic model indicate that all four of the concurrent fire flow simulations met the minimum residual pressure criterion of 20 psi.

Table 7-14. Results of Additional Fire Flow Simulations[(a)]

Pressure Zone	Location #	Fire Flow Demand, gpm[(a)]	Residual Pressure, psi
1	1	1,500	60
		4,500	38
	2	1,500	60
		4,500	52
2	3	1,500	67
		4,500	55
	4	1,500	67
		4,500	33

(a) It is assumed that the two concurrent fire flow events will consist of one smaller single family residential fire flow combined with another larger industrial fire flow.

7.5 SUMMARY OF RECOMMENDED EXISTING POTABLE WATER SYSTEM IMPROVEMENTS

The recommended improvements needed to eliminate deficiencies identified in the evaluation of the existing potable water distribution system are summarized below. It should be noted that these recommendations only identify facility improvements at a master plan level and do not necessarily include all required on-site infrastructure nor constitute design of improvements. Subsequent detailed design is required to determine the exact sizes and final locations of these proposed facility improvements.

It should also be noted that the existing hydraulic model is not an "all pipes" model (*i.e.*, not all smaller diameter pipelines are included); therefore, the hydraulic simulations performed as discussed above may not identify all necessary water system improvements. Consequently, it is recommended that City staff review older parts of the water system where smaller diameter pipelines are typically found and consider possible upsizing of these lines, as the City plans for future pipeline renewal and replacement projects. Ongoing replacement of older and/or smaller diameter pipelines will also improve the available fire flow capacity of the existing potable water system.

7.5.1 Pipelines

- Improvement #1: Replace existing 12-inch diameter pipelines located on Sixth Street and Tracy Boulevard with 18-inch diameter pipelines to reduce high pipeline velocities simulated during a peak hour demand condition. In addition, a small piece of existing 12-inch diameter pipeline located on Eleventh Street, east of Tracy Boulevard should be replaced with a 16-inch diameter pipeline to reduce pipeline velocity once the 18-inch diameter pipelines are installed. Figure 7-10 illustrates the location of Improvement #1.
- Improvement #2: Replace existing 4-inch diameter pipeline located along Tracy Boulevard between Fourth Street and Mt. Diablo Avenue with a 12-inch diameter pipeline to improve fire flow. Figure 7-10 illustrates the location of Improvement #2.
- As the City plans for future pipeline renewal and replacement projects, replacement of older and/or smaller diameter pipelines should be reviewed and considered to provide reliable service during high demands.

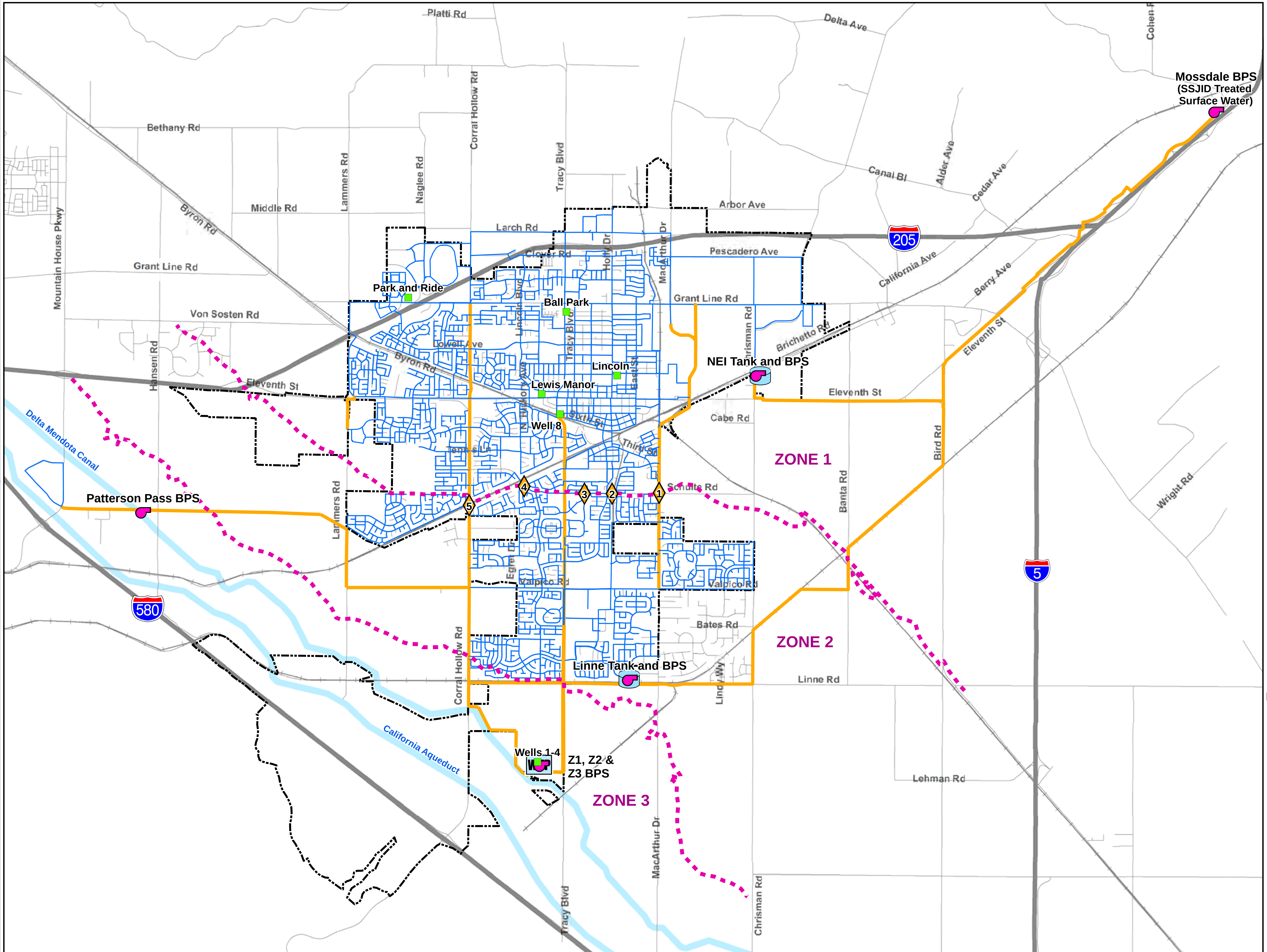
7.5.2 SCADA System

- Install SCADA system monitoring of flows and pressures at each pressure regulating station to provide operators with additional understanding and flexibility in system operations.
- Review the system data collected from the existing SCADA system and correct any data discrepancies found to provide more accurate system operations data. As discussed in *Section 7.3.3 Diurnal Curve Development*, West Yost found that data collected from the following SCADA tags were inaccurate:
  - R17Flow_Discharge (NEI Booster Pump Station Flow),
  - R22Flow_West (Zone 2 Booster Pump Station Flow),
  - R18Reservoir_Level (Linne Tank Level), and
  - R27Pressure_Pressure (Zone 1 36-inch diameter Transmission Main Discharge Pressure).

FIGURE 7-1

City of Tracy
Water System Master Plan

EXISTING POTABLE WATER SYSTEM FACILITIES



NOTES

1. City limits file (citylimit.shp) provided by DCE on 11/05/09.
2. Well 1 and Lincoln Well are currently inactive.
3. Well 8 will be an injection/extraction well in the City's ASR Program.
4. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

- Storage Tank
- Booster Pump Station
- Groundwater Well
- Pressure Regulating Station
- Pipeline Diameter < 18-inches
- Pipeline Diameter ≥ 18-inches
- WTP JJWTP
- City Limits
- Highway
- Street

WEST YOST ASSOCIATES
Consulting Engineers

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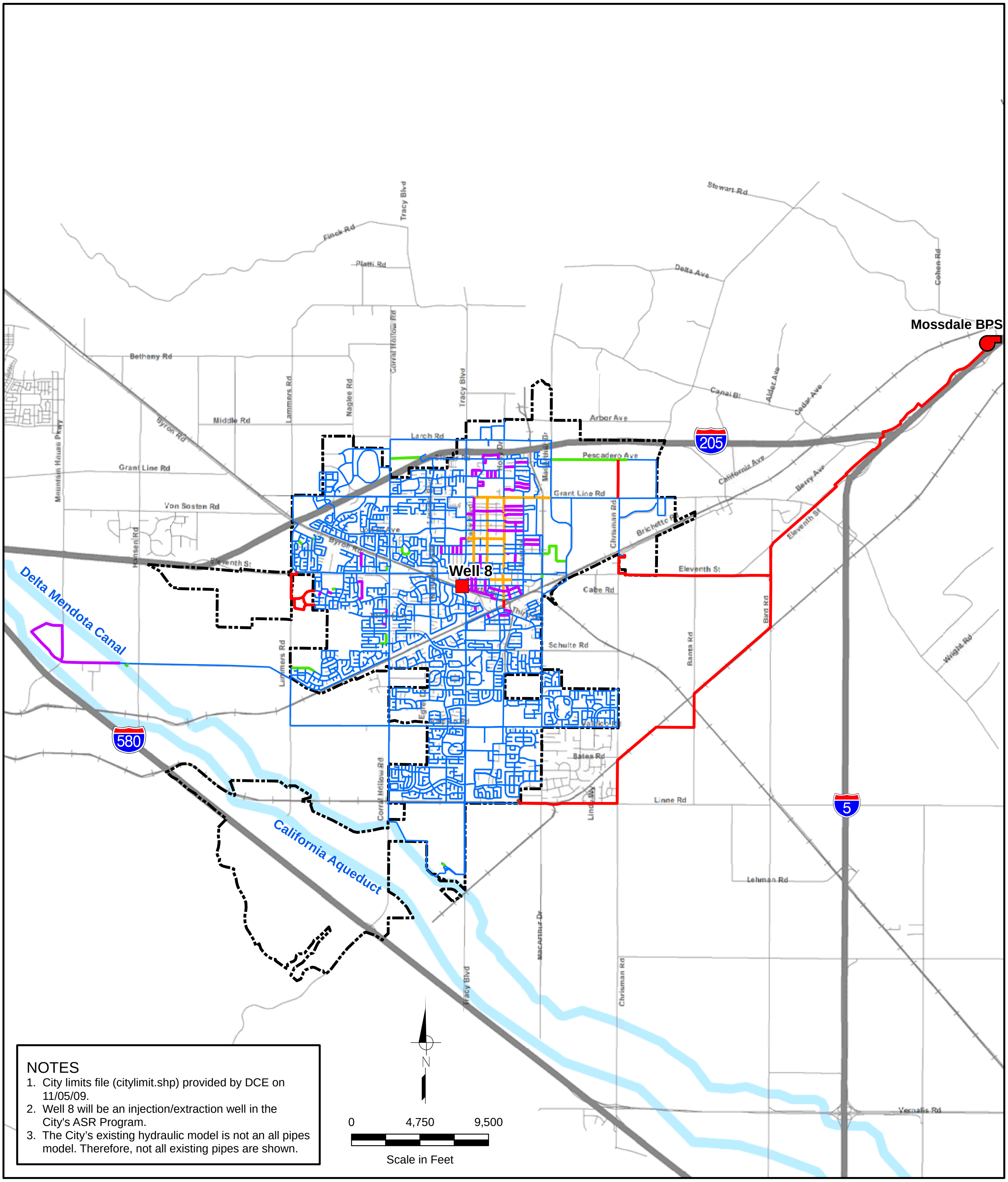

NOTES
1. City limits file (citylimit.shp) provided by DCE on 11/05/09.
2. Well 8 will be an injection/extraction well in the City's ASR Program.
3. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND:

- New Well
- New Pump Station
- Existing Pipeline
- New Pipeline
- Replaced Pipeline
- Added Pipeline (for Model Refinement)
- Updated Pipeline (for Model Refinement)
- City Limits
- Highway
- Street

FIGURE 7-2

City of Tracy
Water System Master Plan

NEW AND REVISED EXISTING SYSTEM FACILITIES

WEST YOST ASSOCIATES
Consulting Engineers

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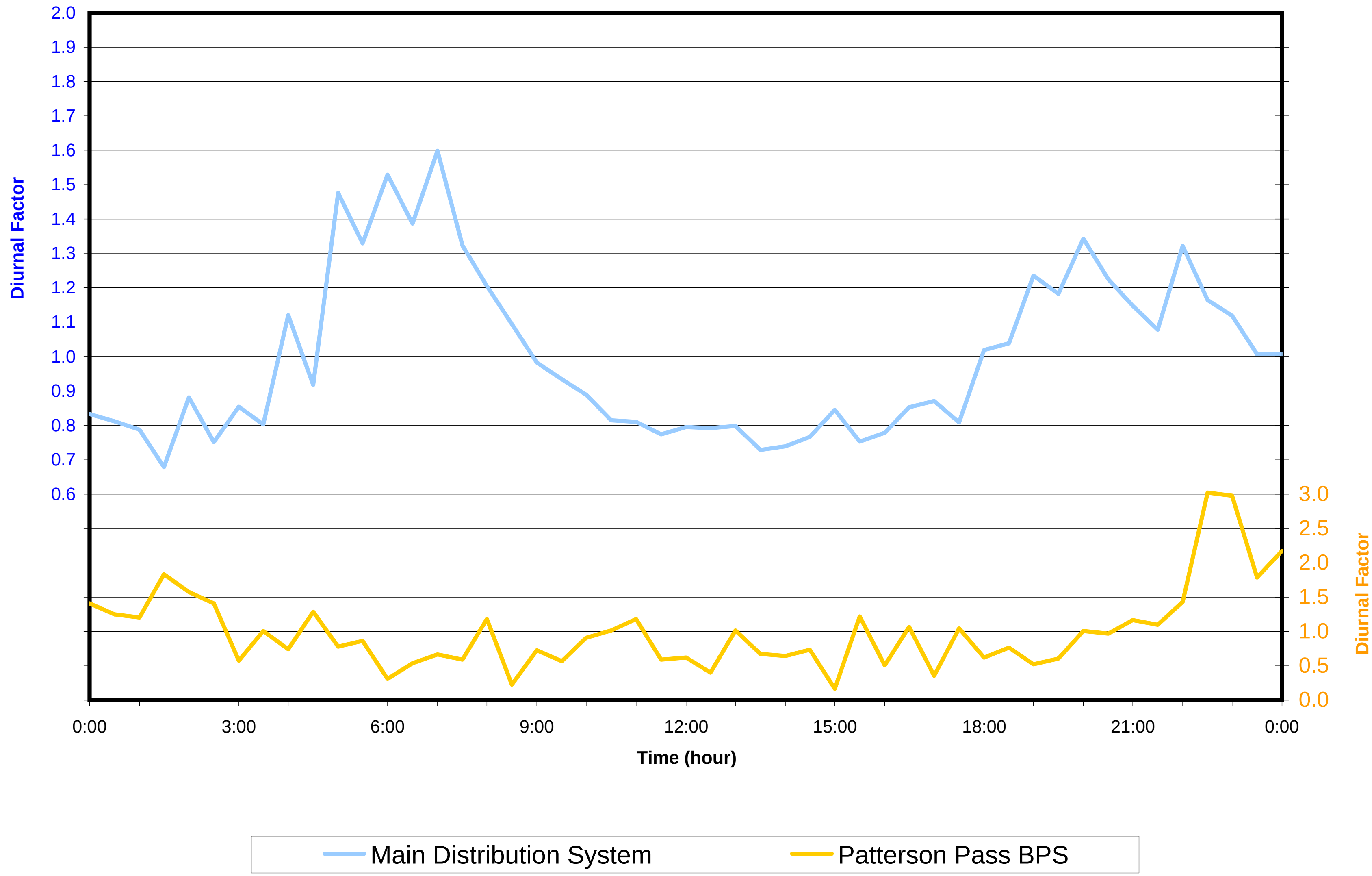
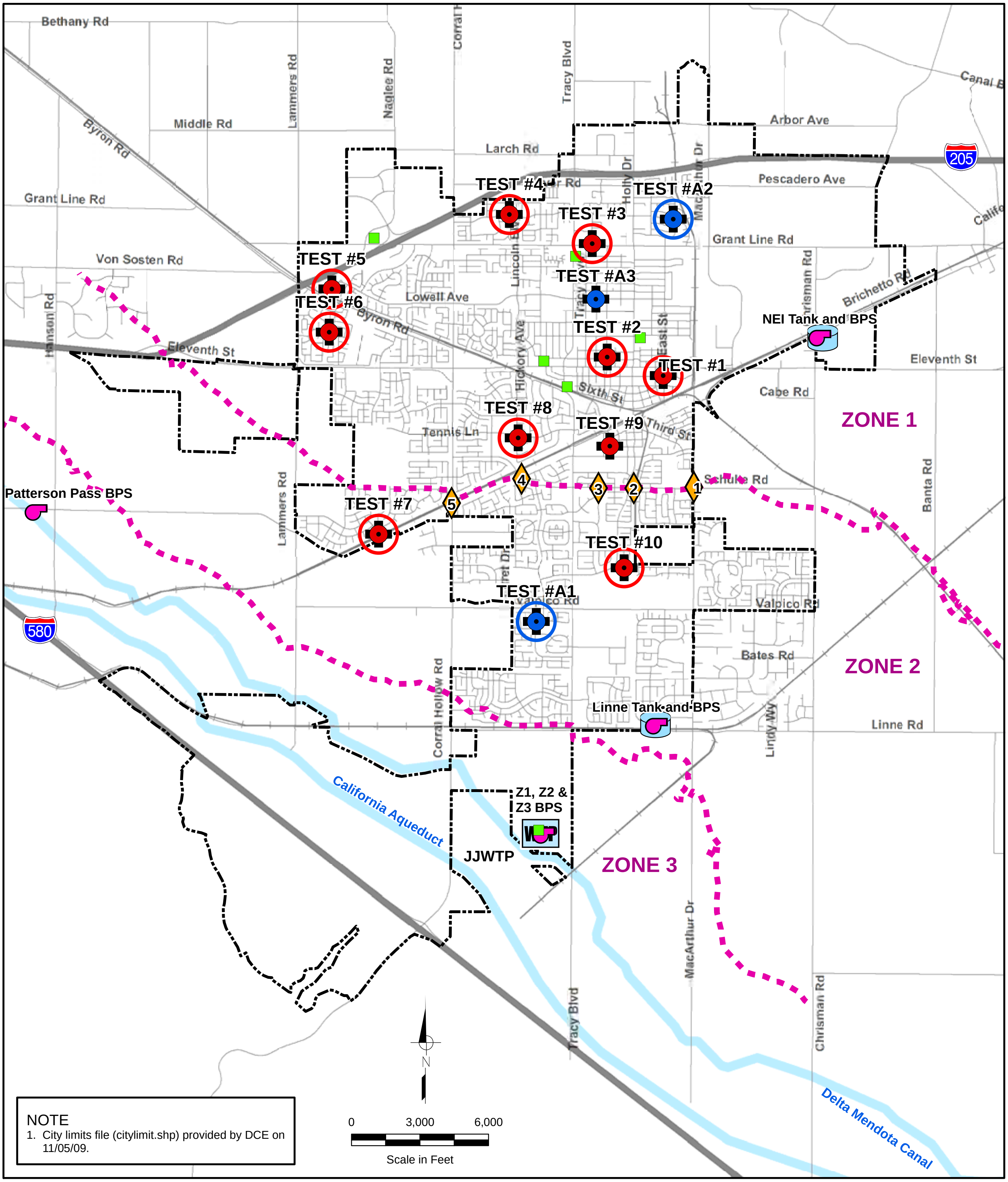
Figure 7-3. City of Tracy - Normalized Diurnal Curves
May 3, 2010





LEGEND:

- Test Location - Completed
- Test Location - Canceled
- Alternate Test Location - Completed
- Alternate Test Location
- Groundwater Well
- Pressure Regulating Station
- City Limits
- Highway
- Street

FIGURE 7-4

City of Tracy Water System Master Plan

HYDRANT TEST LOCATIONS

WEST YOST ASSOCIATES
Consulting Engineers

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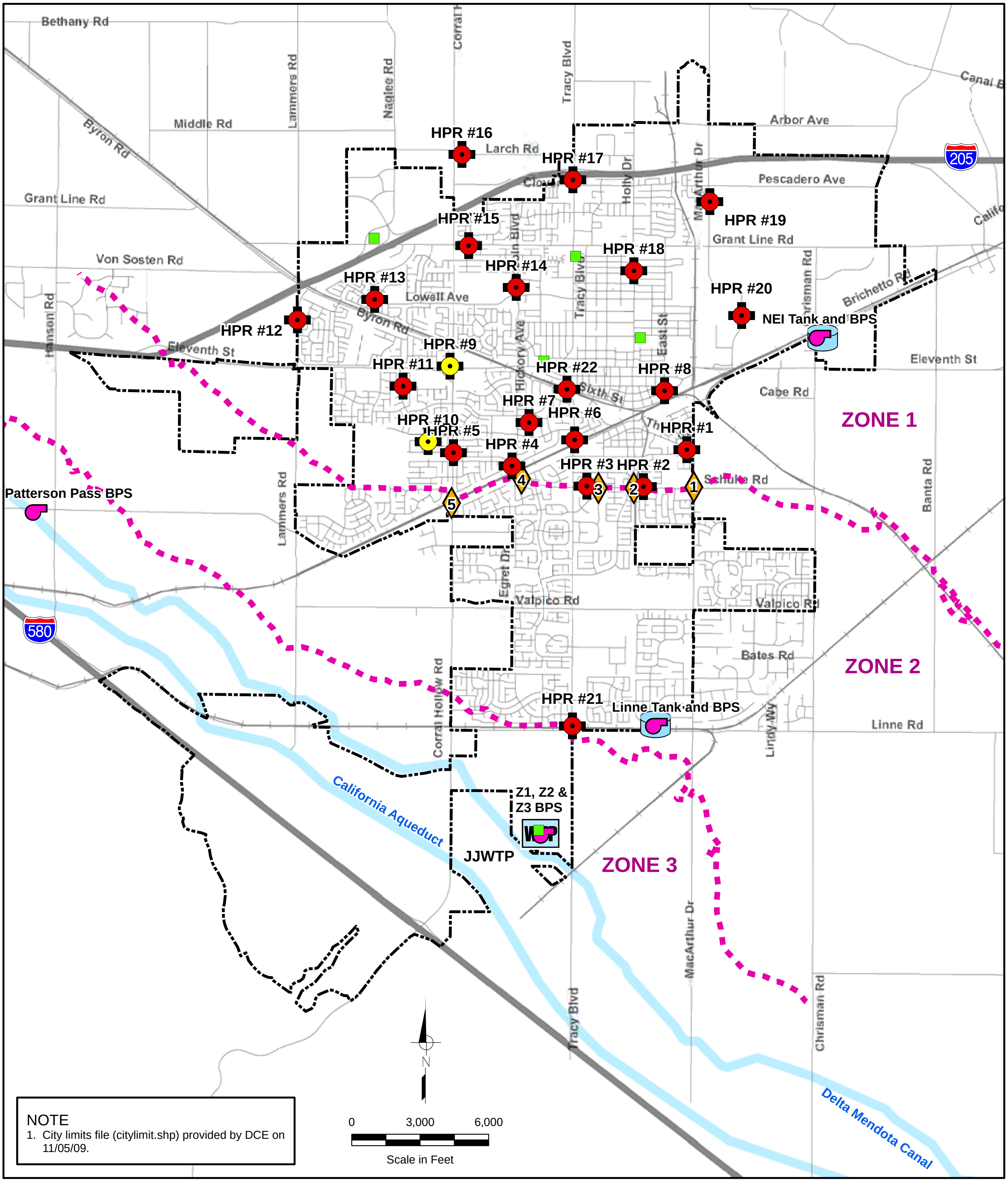

LEGEND:

- HPR Location
- HPR Location (Missing Data)
- Groundwater Well
- Pressure Regulating Station
- City Limits
- Highway
- Street

FIGURE 7-5

City of Tracy
Water System Master Plan

HPR LOCATIONS

WEST YOST ASSOCIATES
Consulting Engineers

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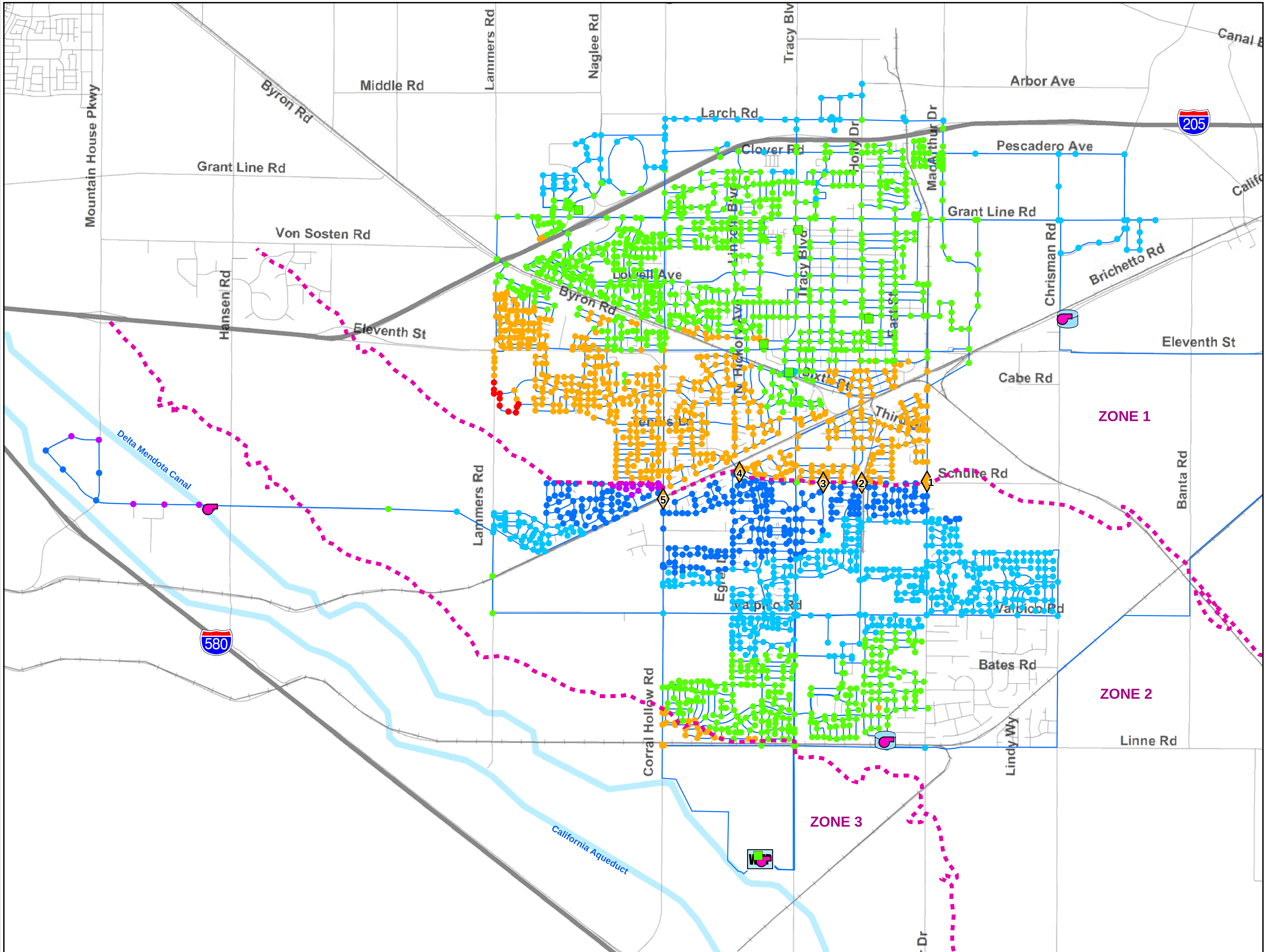

FIGURE 7-6

City of Tracy
Water System Master Plan

EXISTING SYSTEM PRESSURES - PEAK HOUR DEMAND

0 1,900 3,800
Scale in Feet

NOTE

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

- Pressure < 40 psi
- 40 psi ≤ Pressure ≤ 50 psi
- 50 psi < Pressure ≤ 60 psi
- 60 psi < Pressure ≤ 70 psi
- 70 psi < Pressure ≤ 80 psi
- Pressure > 80 psi
- Storage Tank
- Booster Pump Station
- Groundwater Well
- Pressure Regulating Station
- WTP JJWTP
- Pipeline
- Highway
- Street

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 7\Fig 7-6_PHDPressures.mxd 10/6/2010

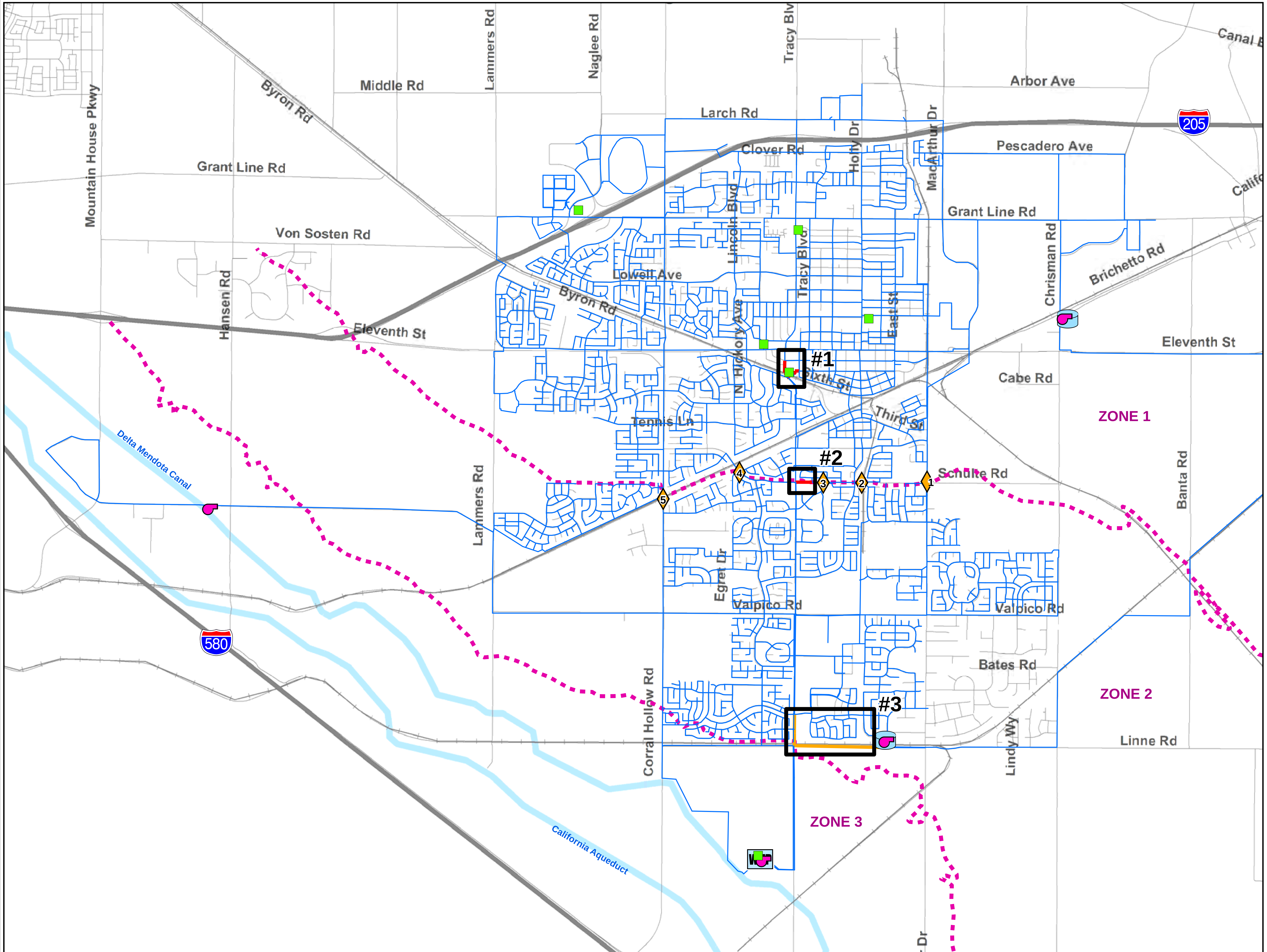

FIGURE 7-7

City of Tracy
Water System Master Plan

EXISTING PIPELINE VELOCITIES - PEAK HOUR DEMAND

0 1,900 3,800
Scale in Feet

NOTE

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

Pipeline Diameter ≥ 18-inches
- Velocity ≤ 6 fps
- Velocity > 6 fps

Pipeline Diameter < 18-inches
- Velocity ≤ 8 fps
- Velocity > 8 fps

- Storage Tank
- Booster Pump Station
- Groundwater Well
- Pressure Regulating Station
- WTP JJWTP
- Highway
- Street

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 7\Fig 7-7 PHDVelocities.mxd 10/6/2010

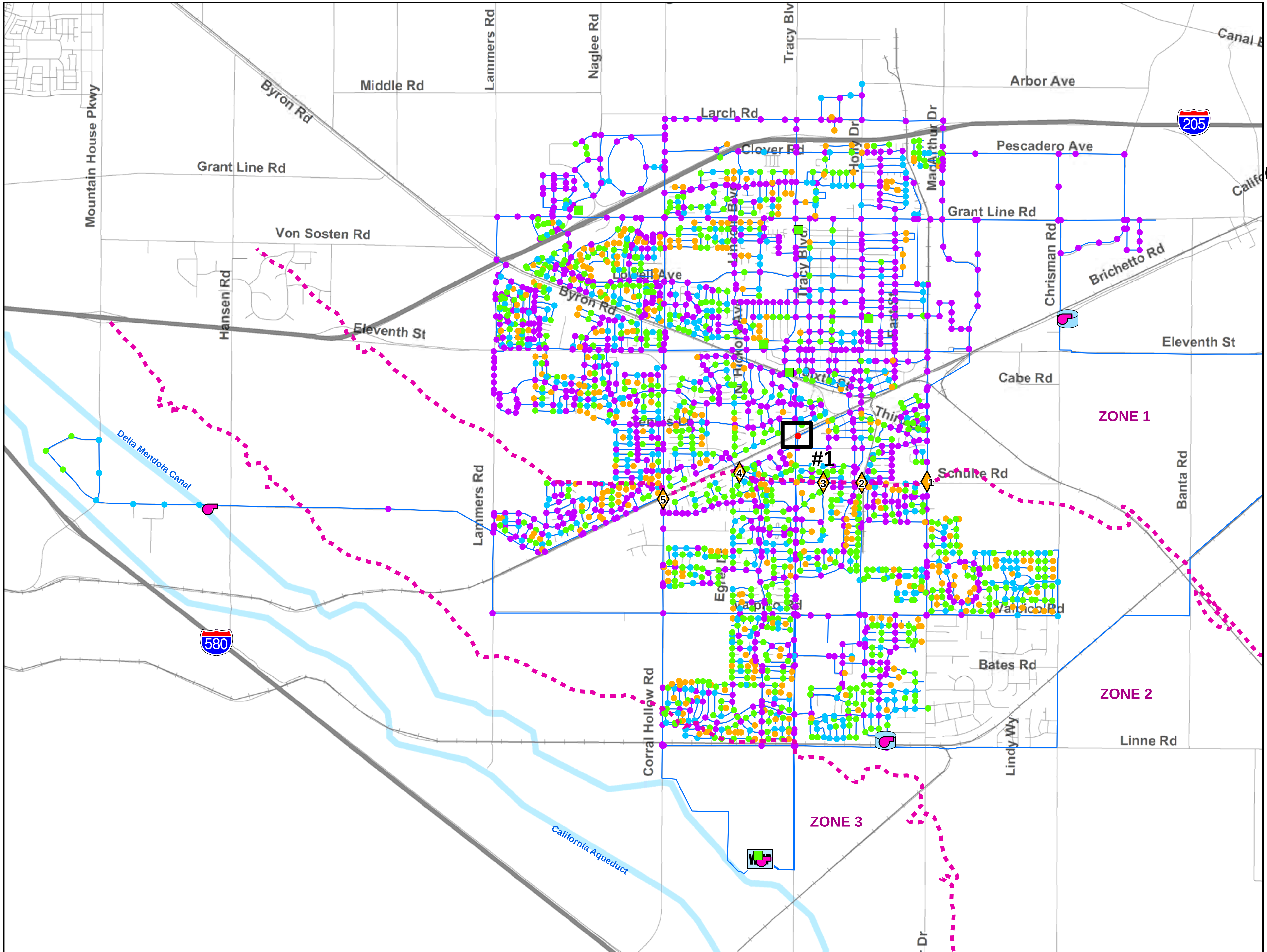

FIGURE 7-8

City of Tracy
Water System Master Plan

EXISTING SYSTEM AVAILABLE FIRE FLOW (Residual Pressure ≥ 30 psi and Velocity ≤ 12 fps)

N

0 1,900 3,800
Scale in Feet

NOTE

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

- Flow < 1,500 gpm
- 1,500 gpm ≤ Flow ≤ 2,500 gpm
- 2,500 gpm < Flow ≤ 3,500 gpm
- 3,500 gpm < Flow ≤ 4,500 gpm
- Flow > 4,500 gpm
- Storage Tank
- Booster Pump Station
- Groundwater Well
- Pressure Regulating Station
- WTP JJWTP
- Pipeline
- Highway
- Street

WEST YOST ASSOCIATES
Consulting Engineers

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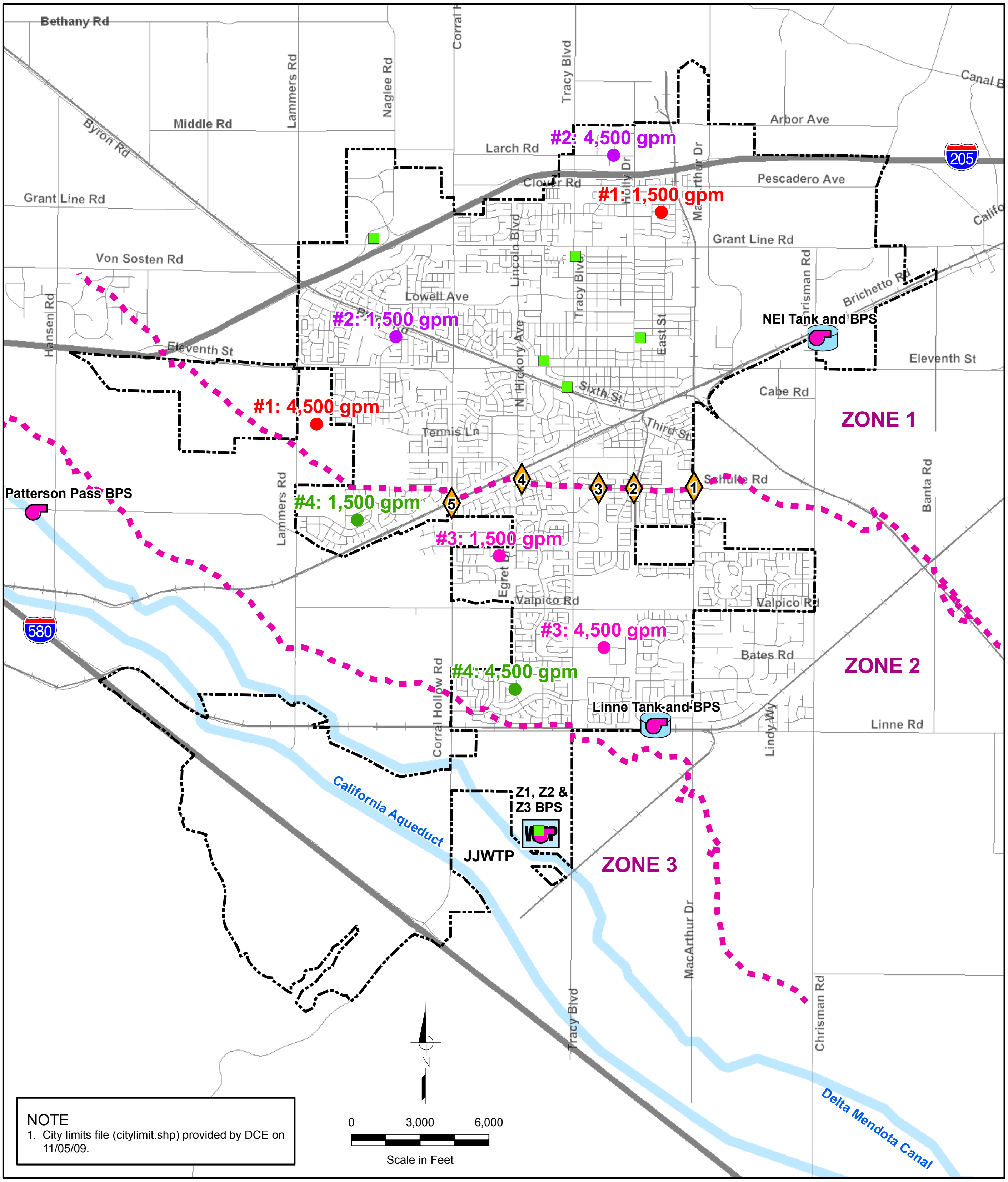

NOTE
1. City limits file (citylimit.shp) provided by DCE on 11/05/09.

LEGEND:

- Location #1
- Location #2
- Location #3
- Location #4
- Groundwater Well
- Pressure Regulating Station
- City Limits
- Highway
- Street

FIGURE 7-9

City of Tracy
Water System Master Plan

LOCATIONS OF ADDITIONAL SIMULTANEOUS FIRE FLOW SIMULATIONS

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 7\Fig 7-9_FFLocations.mxd 12/16/2010

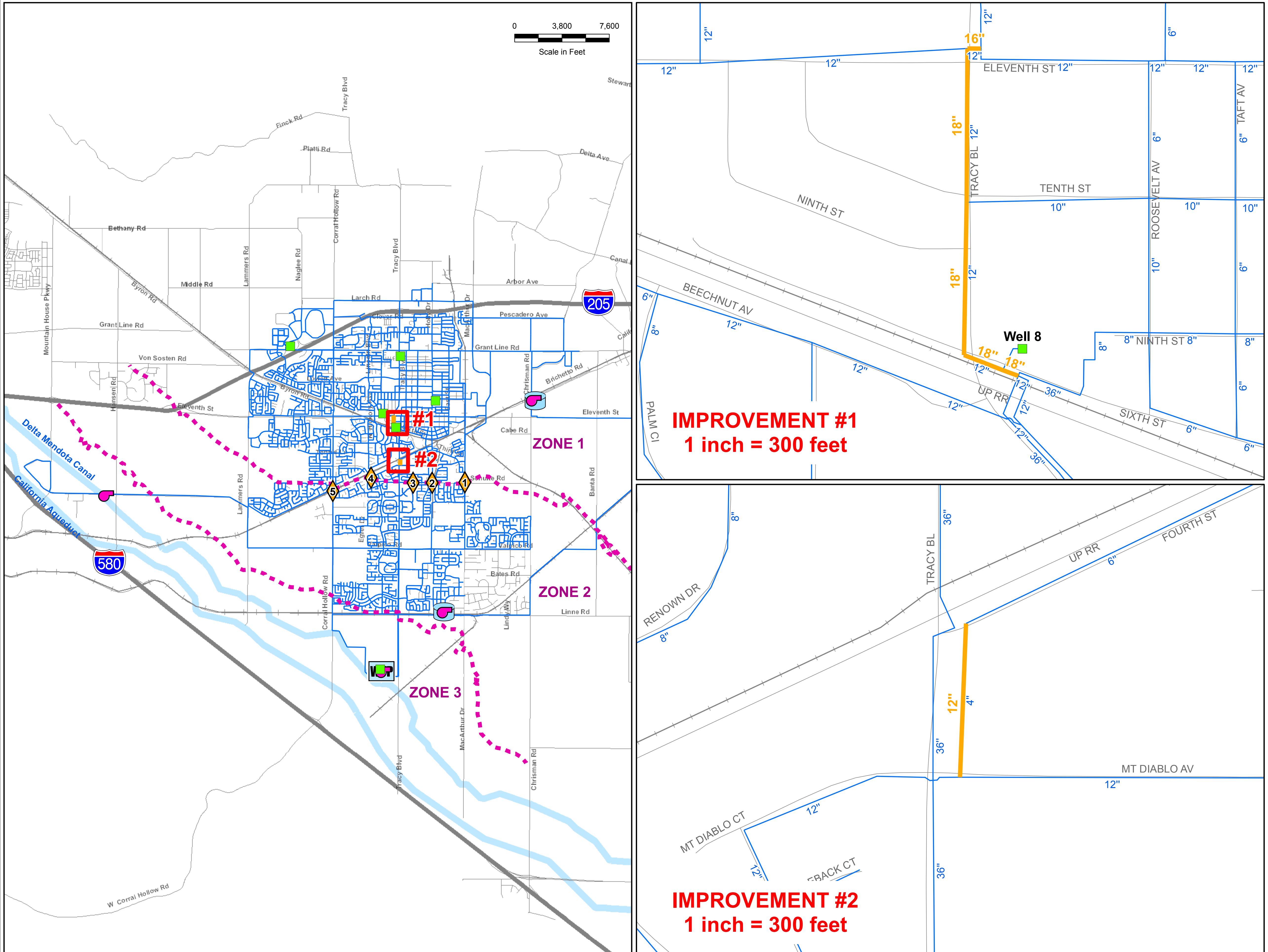

FIGURE 7-10

City of Tracy
Water System Master Plan

EXISTING SYSTEM RECOMMENDED IMPROVEMENTS

NOTE

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

- Pipeline Improvement
- Storage Tank
- Booster Pump Station
- Groundwater Well
- Pressure Regulating Station
- WTP JJWTP
- Existing Pipeline
- Highway
- Street

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 7\Fig 7-10_ExistingCIP.mxd 12/16/2010

8.1 OVERVIEW

The purpose of this chapter is to present the development and evaluation of the City's proposed buildout potable water backbone transmission and distribution system. This chapter identifies the additional improvements that will be required in addition to the existing potable water system infrastructure improvements to support the City's projected buildout potable water demands. Development of the buildout potable water system includes an evaluation of (1) the required buildout water treatment, storage and pumping capacity, and (2) the buildout water system's ability to meet recommended water system performance and operational criteria under buildout maximum day demand plus fire flow and peak hour demand scenarios.

Using the City's recommended performance and operational criteria developed in Chapter 6, preliminary sizing of major transmission pipelines and facilities required to serve future development projects was developed based on the projected buildout potable water demands presented in Chapter 4. To evaluate the suitability of these preliminary sized facilities to meet the recommended performance and operational criteria, they were subsequently incorporated into the hydraulic model of the existing potable water system (evaluated in Chapter 7). This updated hydraulic model of the buildout potable water system was then used to evaluate buildout maximum day demand plus fire flow and peak hour demand conditions to identify any deficiencies and to refine the preliminary sizing of major transmission pipelines and facilities.

Evaluations, findings, and recommendations for supporting projected buildout potable water demands and addressing any deficiencies identified within the buildout potable water backbone transmission and distribution system are included in this chapter. Recommendations were used to develop a Capital Improvement Program (CIP), which includes an estimate of probable construction costs. The recommended buildout potable water system CIP is described further in Chapter 10.

The following sections of this chapter describe the components of the City's buildout potable water backbone transmission and distribution system evaluation:

- Pressure Zone Recommendations
- Projected Buildout Potable Water Demands
- Buildout Potable Water System Facility Evaluation
- Buildout Potable Water System Performance Evaluation
- Summary of Recommended Buildout Potable Water System Improvements

To assist in the evaluation of the City's overall potable water system at buildout, the buildout infrastructure recommended in this chapter includes the infrastructure required to serve the Tracy Hills development and, for consistency, is based on the adopted water use, peaking factors, and system performance criteria described in previous chapters of this Water System Master Plan. West Yost has included the Tracy Hills development in the buildout potable water system evaluation because it will be a part of the City's overall future potable water system operations since it will be served directly from the City's JJWTP. Including the Tracy Hills development in the buildout hydraulic model evaluation ensures that the buildout potable water system will be adequate to serve potable water demands to the entire City (including Tracy Hills) and can provide water service at acceptable system pressures and pipeline velocities.

However, it is acknowledged that the Tracy Hills development has an approved Master Plan, which is in the process of being revised, and that recommended infrastructure presented in the Tracy Hills Master Plan is different from that presented in this chapter due to the use of slightly different water use and peaking factors. For this Water System Master Plan, the potable water distribution system for the Tracy Hills development has been modeled as a separate system, with separate distinct pressure zones, and with connections to the City-side system only at the JJWTP and Pressure Regulating Station (PRS) A. As described further in this chapter, PRS A will provide Tracy Hills with a looped system in the event that supply from the JJWTP is interrupted for any reason. Because Tracy Hills is essentially a "stand-alone" development separated from the City's other water system facilities, costs for infrastructure to serve the Tracy Hills development will not be included in this Citywide Water System Master Plan. Instead, costs for Tracy Hills infrastructure will be evaluated in conjunction with the revised Tracy Hills Master Plan and subsequent evaluations to be prepared for the Tracy Hills development.

8.2 PRESSURE ZONE RECOMMENDATIONS

The City's existing potable water system currently consists of two interconnected pressure zones (*i.e.*, Zones 1 and 2). In order to serve additional developments and water demands at higher elevations, the City plans to add three additional pressure zones onto the existing service area (*i.e.*, Zones 3, 4, and 5), which are located south of the existing pressure zones. As proposed, Zones 4 and 5 will be exclusive to the proposed Tracy Hills development. However, the Tracy Hills development will also encompass part of Zone 3, and the remainder of the City's future development projects will be located in Zones 1, 2, and 3. The approximate boundaries of the existing and proposed pressure zones and the locations of future development projects are shown on Figure 8-1.

Table 8-1 provides a summary of the existing and proposed pressure zone boundaries with key characteristics such as service elevations and static pressure ranges. The ranges of service elevations for Zones 3, 4, and 5 were developed based on the recommendations documented in the Tracy Hills Water Master Plan (approved December 2000) prepared by Nolte Associates, Inc. Further review of the proposed service elevations located in Zone 3 within the hydraulic model indicates that the service elevations of future development projects excluding Tracy Hills will be between the range of approximately 145 to 240 feet, and the Zone 3 service elevations for the Tracy Hills development only will be between the range of approximately 200 to 320 feet.[1]

[1] Elevations for junctions in the hydraulic model were assigned based on their spatial location and the closest corresponding elevation contour, and may not exactly match the recommended service elevation ranges shown in Table 8-1.

Table 8-1. Summary of Existing and Proposed Pressure Zone Boundaries

Pressure Zone	Status	Range of Service Elevations, ft	Static Pressure Range, psi
Zone 1	Existing	0-75	40-75
Zone 2		75-150	40-85
Zone 3[(a)]	Proposed[(b)]	150-310	40-120
Zone 4		310-470	49-120
Zone 5		470-630	49-120

(a) Patterson Pass Business Park is currently served through the Patterson Pass booster pump station supplied by Zone 2. However, in the proposed buildout water system, the Patterson Pass Business Park will be served directly from a new Zone 3 booster pump station located at the JJWTP.

(b) Developed based on the recommendations documented in the Tracy Hills Water Master Plan (approved December 2000) prepared by Nolte Associates, Inc. Static pressure ranges are based on a reservoir height of 24 feet, and operating storage is approximately 20 percent of the total storage volume. A minimum static pressure of 49 psi at the street will provide a 40 psi minimum at the pad elevation, which is a maximum of 20 feet above the street.

This observation indicates that using a shared Zone 3 booster pump station at the JJWTP to serve Zone 3 of Tracy Hills and the remainder of the City's Zone 3 future developments will cause a majority of Zone 3 to be over-pressurized due to the higher Zone 3 service elevations located within the Tracy Hills development. Therefore, it is recommended that two separate Zone 3 service areas be established; Zone 3-Tracy Hills, and Zone 3-City-side. Each Zone 3 service area will be served from a separate Zone 3 booster pump station located at the JJWTP. One of these pump stations will only serve Zone 3 of the Tracy Hills development, and the other pump station will serve Zone 3-City-side demands. This recommendation to serve Zone 3 of the Tracy Hills development with its own designated booster pump station will (1) help reduce energy costs (to meet the City's proposed principles for sustainable infrastructure detailed in Chapter 2), (2) follow City direction to consider the Tracy Hills development as a separate, independent service area, and (3) reduce the need for individual pressure reducing valves (PRVs) on water service connections in all other future development projects located in Zone 3-City-side.

The separation of Zone 3 into two distinct service areas will reduce the high pressures in the Zone 3-City-side service area, but system pressures in the Tracy Hills development will continue to remain high (up to 120 psi or more) due to the service elevation ranges proposed for Zones 3, 4, and 5 as developed in the Tracy Hills Water Master Plan. To be consistent with the approved Tracy Hills Water Master Plan, the proposed service elevation ranges for Zones 3, 4, and 5 of Tracy Hills were not adjusted for this Citywide Water System Master Plan. However, it is recommended that these proposed pressure zones for the Tracy Hills development be reviewed and redefined, if possible, to reduce the occurrence of such high system pressures. As discussed in Chapter 6, the highest recommended system pressure for the Citywide Water System Master Plan is 100 psi and any water service connection pressures exceeding 80 psi will require the installation of individual PRVs to all service connections to reduce the pressure below 80 psi.

It should also be noted that the existing Patterson Pass Business Park (*i.e.*, Safeway and Costco) falls into the Zone 3-City-side service elevation range, but is currently served through a separate booster pump station (*i.e.*, Patterson Pass booster pump station), which is supplied by Zone 2. However, in the proposed buildout water system, the Patterson Pass Business Park will no longer be served by the Patterson Pass booster pump station. Instead, the Patterson Pass Business Park service area will be integrated into the Zone 3-City-side service area and served by a separate booster pump station located at the JJWTP (*i.e.*, Zone 3-City-side BPS). As discussed in *Section 8.4 Buildout Potable Water System Facility Evaluation*, it is recommended that the existing Patterson Pass booster pump station be converted to a pumped storage facility station to help serve buildout peak hour and fire flow demands in Zone 3-City-side.

8.3 PROJECTED BUILDOUT POTABLE WATER DEMANDS

The buildout potable water demands were developed based on the additional projected buildout land use information provided by the City, and the adopted unit water demand factors as described in Chapter 4. Based on the existing and proposed pressure zone boundaries, the projected potable water demands were calculated and categorized by pressure zone. Table 8-2 summarizes the City's buildout potable water demands (including existing demands) by pressure zone. Table 8-3 provides additional detail of the projected average day water demands for each future development project by pressure zone (not including existing demands) and will be used to develop and assign future CIP costs.

Table 8-2. Summary of Buildout Potable Water Demands by Pressure Zone[(a)]

Pressure Zone	Average Day Demand		Maximum Day Demand[(b)]		Peak Hour Demand[(c)]	
	gpm	mgd	gpm	mgd	gpm	mgd
Zone 1[(d)]	12,020	17.31	24,040	34.62	40,868	58.85
Zone 2[(d)]	6,722	9.68	13,444	19.36	22,855	32.91
Zone 3–City-side[(e)]	2,044	2.94	4,088	5.88	6,950	10.00
Zone 3–Tracy Hills	1,156	1.66	2,312	3.32	3,930	5.64
Zone 4–Tracy Hills	736	1.06	1,472	2.12	2,502	3.60
Zone 5–Tracy Hills	109	0.16	218	0.32	371	0.54
Total	22,787	32.81	45,574	65.62	77,476	111.54

(a) Includes existing potable water demands.
(b) Maximum day demand is 2.0 times the average day demand.
(c) Peak hour demand is 3.4 times the average day demand.
(d) Existing (base) average day demand is based on 2007 water production data. Existing park water demands identified for the Tracy Gateway Project Water Exchange Program have been removed and replaced with the additional projected potable water demands from the Tracy Gateway project.
(e) Patterson Pass Business Park is currently served through the Patterson Pass booster pump station supplied by Zone 2. However, in the buildout water system, the Patterson Pass Business Park will be served directly from a new Zone 3-City-side booster pump station located at the JJWTP.

Table 8-3. Summary of Buildout Average Day Potable Water Demands by Development Project[a,b]

Future Development Project	Zone 1		Zone 2		Zone 3-City-side		Zone 3 - Tracy Hills		Zone 4 - Tracy Hills		Zone 5 - Tracy Hills		Total	
	gpm	percent of total	gpm	percent of total	gpm	percent of total	gpm	percent of total	gpm	percent of total	gpm	percent of total	gpm	percent of total
DEVELOPMENT PROJECTS w/ APPROVED WATER SUPPLY														
Residential Areas Specific Plan	30.38	0.68%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	30.38	0.28%
Industrial Areas Specific Plan	19.84	0.45%	283.94	10.31%	80.59	4.57%	-	0.00%	-	0.00%	-	0.00%	384.38	3.50%
I-205 Corridor Specific Plan	181.65	4.08%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	181.65	1.66%
Plan "C"	-	0.00%	49.60	1.80%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	49.60	0.45%
Northeast Industrial Specific Plan	470.55	10.57%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	470.55	4.29%
South MacArthur	-	0.00%	39.68	1.44%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	39.68	0.36%
Downtown Specific Plan	123.99	2.78%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	123.99	1.13%
Infill	303.78	6.82%	236.82	8.60%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	540.61	4.93%
Ellis Specific Plan	-	0.00%	159.33	5.79%	561.68	31.83%	-	0.00%	-	0.00%	-	0.00%	721.01	6.57%
Tracy Gateway - Phase 1	135.38	3.04%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	135.38	1.23%
Holly Sugar Sports Park	31.62	0.71%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	31.62	0.29%
FUTURE SERVICE AREAS														
Westside Residential (URs 5, 7, 8, 9)	447.61	10.05%	336.02	12.20%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	783.63	7.14%
UR 1	559.82	12.57%	269.68	9.79%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	829.51	7.56%
South Linne (UR 11)	-	0.00%	-	0.00%	102.29	5.80%	-	0.00%	-	0.00%	-	0.00%	102.29	0.93%
Tracy Hills	-	0.00%	-	0.00%	-	0.00%	1,156.85	100.00%	735.27	100.00%	108.49	100.00%	2,000.61	18.24%
Tracy Gateway (excluding Phase 1)	-	0.00%	215.82	7.84%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	215.82	1.97%
Cordes Ranch (UR 6)	-	0.00%	741.47	26.93%	755.11	42.80%	-	0.00%	-	0.00%	-	0.00%	1,496.58	13.64%
Bright (UR 4)	275.26	6.18%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	275.26	2.51%
Catellus (UR 3)	537.51	12.07%	24.80	0.90%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	562.30	5.13%
Filios (UR 2)	47.12	1.06%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	47.12	0.43%
I-205 Expansion	195.91	4.40%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	195.91	1.79%
Westside Industrial	-	0.00%	149.41	5.43%	264.72	15.00%	-	0.00%	-	0.00%	-	0.00%	414.13	3.77%
Eastside Industrial	314.32	7.06%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	314.32	2.86%
Larch Clover	567.88	12.75%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	567.88	5.18%
Chrisman Road	100.43	2.26%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	100.43	0.92%
Rocha	-	0.00%	166.15	6.03%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	166.15	1.51%
Berg/Byron	109.73	2.46%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	109.73	1.00%
Kagehiro	-	0.00%	80.59	2.93%	-	0.00%	-	0.00%	-	0.00%	-	0.00%	80.59	0.73%
TOTAL	**4,452.78**	**100%**	**2,753.32**	**100%**	**1,764.41**	**100%**	**1,156.85**	**100%**	**735.27**	**100%**	**108.49**	**100%**	**10,971.12**	**100%**

[a] Water demands shown are for new development projects only and do not include existing potable water demands.
[b] Water demands shown include UAFW.

8.4 BUILDOUT POTABLE WATER SYSTEM FACILITY EVALUATION

To develop the buildout potable water system, analyses addressing the following system facilities were conducted:

- Surface Water Treatment Capacity,
- Water Storage Capacity,
- Pumping Capacity, and
- Critical Supply Facilities.

The results from the buildout potable water system facilities analyses are discussed below. Recommendations for supporting projected buildout potable water demands and addressing any deficiencies identified within the buildout potable water backbone transmission and distribution system are summarized in *Section 8.6 Summary of Recommended Buildout Potable Water System Improvements*.

8.4.1 Surface Water Treatment Capacity

Sufficient surface water treatment capacity from the JJWTP and the City's treated surface water supplies from the South County Water Supply Project will be required to meet the City's buildout maximum day demand condition. In addition, sufficient treated surface water pumping capacity should also be available to assist in meeting a buildout maximum day demand. Table 8-4 compares the City's current surface water treatment and pumping capacity with buildout maximum day potable water demands.

Table 8-4. Comparison of Available and Required Surface Water Treatment and Pumping Capacity

Surface Water Capacity	JJWTP[(a)]	South County Water Supply Project[(b)]	Total Surface Water Capacity	Buildout Maximum Day Demand	Surface Water Capacity Surplus or (Deficit)
Treatment Capacity, mgd	30	15	45	66	(21)
Pumping Capacity, gpm	20,833[(c)]	10,417[(d)]	31,250	45,574	(14,324)

(a) Currently supplied from Zone 1 36-inch diameter transmission main and Zone 2 booster pump station.
(b) Supplied from Linne Road and NEI booster pump stations.
(c) Pumping capacity is limited to the maximum existing available treatment capacity from the JJWTP (*i.e.,* 30 mgd).
(d) Pumping capacity is limited to the maximum existing available treatment capacity from the SCWSP (*i.e.,* 15 mgd).

Table 8-4 indicates that the City does not currently have sufficient surface water treatment and pumping capacity to meet buildout maximum day demands. Based on the deficits identified in Table 8-4, the City will have to expand the surface water treatment capacity at the JJWTP by 21 mgd to meet buildout potable water demands during a maximum day demand condition.

Based on discussion with City staff, plans for a future 15 mgd expansion at the JJWTP were already envisioned and integrated into the planning process during the most recent 15 mgd expansion (from 15 to 30 mgd) completed in 2008. For this Citywide Water System Master Plan, it is assumed that the remaining required 6 mgd (21 mgd – 15 mgd) of surface water treatment and pumping capacity to meet buildout maximum day demands will also be constructed at the existing JJWTP. The City is also embarking on an ASR well program that, if successful, will enable the City to reduce the recommended expansion of 21 mgd at the JJWTP. City staff will have to consider these different alternatives to serve buildout maximum day potable water demands when the time comes to expand the JJWTP.

Based on the additional demands in Zone 3-City-side and in the Tracy Hills development at buildout, it is recommended that a new clearwell be constructed at the JJWTP during the next expansion to provide operational flexibility for the water treatment plant and to provide additional operational and emergency storage capacity to serve future developments. For this Citywide Water System Master Plan, it was assumed that the new clearwell will have a minimum active (useable) storage capacity of 2.0 MG. The actual storage capacity of the new clearwell should be evaluated and refined as plans for the next JJWTP expansion are developed.

Additional treated surface water pumping capacity will also be required at the JJWTP to serve buildout maximum day demands. The new pressure zones will require new booster pump stations to be installed at the JJWTP[2], and the existing pressure zones will require booster pump station upgrades to meet additional buildout maximum day demands. *Section 8.4.3 Pumping Capacity* provides additional discussion regarding the additional treated surface water booster pumping capacity required at the JJWTP to serve buildout maximum day demands.

8.4.2 Water Storage Capacity

The principal advantages that storage provides for the water system are the ability to equalize demands on supply sources, production facilities, and transmission mains; to provide emergency storage in case of supply failure; and to provide water to fight fires. The City's water service area has two sources of available storage: above ground storage (*i.e.*, clearwells and storage tanks) and storage available through the groundwater basin. Together, these two sources of storage must be sufficient to meet the City's operational, emergency, and fire flow storage criteria. The volumes required for each of these three storage components are listed below:

- Operational Storage: 30 percent of a maximum day demand;
- Emergency Storage: Two times an average day demand; and

[2] The existing Zone 3 booster pump station located at the JJWTP is currently connected to the existing Zone 2 booster pump station manifold and is assumed to be replaced with a new Zone 3-City-side booster pump station at buildout. The new Zone 3-City-side booster pump station will be located at the new clearwell to serve buildout Zone 3-City-side potable water demands.

- Fire Flow Storage: The required fire flow rates multiplied by their associated fire flow duration periods, as required by the City's Fire Department. Two concurrent fire flow events were assumed for the fire flow storage analysis.[3] However, the recommended fire flow storage does not include the volume associated with sprinkler flows.

Because the City's potable water supply includes supply from groundwater wells, the groundwater basin can account for a portion of the recommended emergency storage, in the form of a groundwater credit. However, the following must be true to use the groundwater supply to offset the need to provide surface storage reservoirs:

- Groundwater supply is of potable water quality and can be reliably accessed (*i.e.*, wells are equipped with on-site emergency generators);
- Groundwater supply is not already relied upon to meet the City's average day demand requirements;
- Groundwater supply is of firm groundwater supply availability (*i.e.*, assumes 20 percent of wells will be out of service at any given time); and
- Sufficient water distribution facilities are available to distribute this water to demand areas.

In addition, the City currently has two independent sources of treated surface water supply, and some quantity of the total treated surface water supply capacity can also account for a portion of the recommended emergency storage. The treated surface water credit assumes that the smaller of the treated surface water supply sources can be available to offset a portion of the emergency storage requirement. However, the following must be true to use treated surface water supply to offset the need to provide surface storage:

- Treated surface water supply can be reliably accessed (*i.e.*, treated surface water supply facility is equipped with on-site emergency generator); and
- Sufficient treated surface water booster pumping facilities are available to distribute this water to demand areas.

In summary, the Emergency Storage Credit is equal to the sum of the groundwater and treated surface water supply credits. However, the Emergency Storage Credit can only provide a maximum storage credit equal to the City's required emergency storage volume.

The existing potable water storage facilities, in conjunction with the available Emergency Storage Credit, were evaluated to determine whether the City's current potable water system has sufficient storage capacity within each pressure zone to provide the required operational, emergency, and fire flow storage at buildout. Table 8-5 provides a comparison of the City's available potable water storage capacity and emergency storage credit with the required buildout

[3] Two concurrent fire flow events were not simulated in Zones 3, 4 and 5 for the Tracy Hills development because these smaller pressure zones do not justify the use of two simultaneous fire flow events.

storage capacity. The comparison between the City's available and required storage capacities indicates that the City will have the following potable water storage capacity deficits within each pressure zone at buildout:

- Zones 1 and 2[4]: 7.7 MG;
- Zone 3 – City-side: 8.8 MG;
- Zone 3 – Tracy Hills: 5.3 MG;
- Zone 4 – Tracy Hills: 3.5 MG; and
- Zone 5 – Tracy Hills: 0.6 MG.

Based on the storage capacity deficits identified in Table 8-5, Table 8-6 summarizes the recommended facility improvements to provide additional buildout storage capacity. The proposed specific facility improvements are either based on recommendations from previous studies (*e.g.,* Tracy Gateway) or the necessity for localized operational, emergency, and fire flow storage capacity (*e.g.,* Catellus and Cordes Ranch tanks). Localized storage provides supply reliability in the chance that storage from the new JJWTP clearwell or any other storage facility is unavailable for any reason. As shown in Table 8-6, there is a proposed storage capacity surplus of approximately 1 MG in Zone 3-City-side. This storage capacity surplus is caused by the need for localized storage to meet daily operational and fire flow demands.

8.4.3 Pumping Capacity

The existing and proposed pumping capacity in the City's potable water system was evaluated to assess its ability to deliver a reliable firm capacity to serve the buildout water service area. Firm capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. At each booster pump station, firm booster pumping capacity was defined as the total booster pump station capacity with the largest pump out of service. For groundwater well pumps, the firm groundwater pumping capacity assumed that 20 percent of the wells could be out of service at any given time.

The pumping capacity criterion for the City, described previously in Chapter 6, requires the City's potable water system to have sufficient firm pumping capacity to meet the greater of either a maximum day demand with two simultaneous fire flow events[5] or a peak hour demand.

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[4] Under existing conditions, Zones 1 and 2 are interconnected through five existing pressure regulating stations (PRS). Therefore, Zones 1 and 2 were evaluated together for the buildout potable water system facility evaluation.

[5] Two concurrent fire flow events were not simulated in Zones 3, 4 and 5 for the Tracy Hills development because these smaller pressure zones do not justify the use of two simultaneous fire flow events.

Table 8-5. Comparison of Available and Required Water Storage Capacity

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H] = [D] + [G]	[I]	[J]	[K]	[L] = [I] + [J] + [K]	[M] = [H] - [L]
			Available Storage Capacity, MG					Required Storage Capacity, MG				
				Emergency Storage Credit								
Zone	Station	Status	Reservoir Capacity	Groundwater Credit[a]	Treated Surface Water Supply Credit[b]	Total Emergency Storage Credit[c]	Total Available Storage	Operational[d]	Emergency[e]	Fire Flow[f]	Total Required Storage	Storage Surplus (Deficit), MG
1/2	NEI Tank	Active	2.40	--	30.00	50.16	**63.66**	16.19	53.98	1.14	**71.31**	**(7.7)**
	Lincoln Well	Inactive	--	--								
	Lewis Manor Well	Active	--	7.20								
	Park and Ride Well	Active	--	5.76								
	Ball Park Well	Active	--	7.20								
	Well 8	Active	--	--								
	Linne Tank	Active	7.10	--								
	Well 1	Inactive	--	--								
	Well 2	Active	--	--								
	Well 3	Active	--	--								
	Well 4	Active	--	--								
	Clearwell #2	Active	4.00	--								
3-City-side	--	--	--	--	--	--	**0.00**	1.76	5.88	1.14	**8.78**	**(8.8)**
3-Tracy Hills	--	--	--	--	--	--	**0.00**	1.00	3.32	0.96	**5.28**	**(5.3)**
4-Tracy Hills	--	--	--	--	--	--	**0.00**	0.64	2.12	0.72	**3.48**	**(3.5)**
5-Tracy Hills	--	--	--	--	--	--	**0.00**	0.10	0.32	0.18	**0.60**	**(0.6)**

[a] Credit based on two days of pumping capacity from active groundwater wells with on-site backup power because the required emergency storage capacity is equal to two times the average day demand. See Table 8-7 for individual well capacity.

[b] Credit based on two days of available treatment capacity (15 mgd) from the SCWSP because the required emergency storage capacity is equal to two times the average day demand.

[c] Equal to the sum of the groundwater and treated surface water supply credits; however, the maximum credit is equal to the required emergency storage capacity.

[d] Based on 30 percent of a maximum day demand.

[e] Based on two times the average day demand.

[f] For Zones 1, 2, and 3-City-side, based on storage required for two concurrent fire flow events; a Single Family Residential fire flow and an Industrial fire flow. For Zone 3-Tracy Hills, fire flow storage is based on an Industrial fire flow. For Zone 4-Tracy Hills, fire flow storage is based on an Office fire flow. For Zone 5-Tracy Hills, fire flow storage is based on a Single Family Residential fire flow.

Table 8-6. Summary of Available, Proposed, and Required Water Storage Capacity

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H] = [D] + [G]	[I]	[J]	[K]	[L] = [I] + [J] + [K]	[M] = [H] - [L]
			Available Storage Capacity, MG					Required Storage Capacity, MG				
				Emergency Storage Credit								
Zone	Station	Status	Reservoir Capacity	Groundwater Credit[a]	Treated Surface Water Supply Credit[b]	Total Emergency Storage Credit[c]	Total Available Storage	Operational[d]	Emergency[e]	Fire Flow[f]	Total Required Storage	Storage Surplus (Deficit), MG
1/2	NEI Tank	Active	2.40	--	30.00	53.98	**71.48**	16.19	53.98	1.14	**71.31**	**0.1**
	Lincoln Well	Inactive	--	--								
	Lewis Manor Well	Active	--	7.20								
	Park and Ride Well	Active	--	5.76								
	Ball Park Well	Active	--	7.20								
	Well 8[g]	Active	--	--								
	Linne Tank	Active	7.10	--								
	Well 1	Inactive	--	--								
	Well 2	Active	--	--								
	Well 3	Active	--	--								
	Well 4	Active	--	--								
	Clearwell #2	Active	4.00	--								
	Gateway Zone 1 Tank[h]	Proposed[k]	1.50	--								
	Gateway Zone 2 Tank[h]	Proposed[k]	1.50	--								
	Gateway ASR Well[h]	Proposed	--	7.20								
	Catellus Tank	Proposed[k]	1.00	--								
3-City-side	Ellis ASR Well[i]	Proposed	--	7.20	--	5.88	**9.88**	1.76	5.88	1.14	**8.78**	**1.1**
	Cordes Ranch Tank	Proposed[k]	1.50	--								
	Cordes Ranch ASR Well	Proposed	--	7.20								
	Patterson Pass Tank	Proposed[k]	0.50	--								
	New JJWTP Clearwell	Proposed[k]	2.00	--								
3-Tracy Hills	Gravity Tank[j]	Proposed[k]	5.30	--	--	--	**5.30**	1.00	3.32	0.96	**5.28**	**0.0**
4-Tracy Hills	Gravity Tank[j]	Proposed[k]	3.50	--	--	--	**3.50**	0.64	2.12	0.72	**3.48**	**0.0**
5-Tracy Hills	Gravity Tank[j]	Proposed[k]	0.60	--	--	--	**0.60**	0.10	0.32	0.18	**0.60**	**0.0**

[a] Credit based on two days of pumping capacity from active groundwater wells with on-site backup power because the required emergency storage capacity is equal to two times the average day demand. See Table 8-7 for individual well capacity.
[b] Credit based on two days of available treatment capacity (15 mgd) from the SCWSP because the required emergency storage capacity is equal to two times the average day demand.
[c] Equal to the sum of the groundwater and treated surface water supply credits; however, the maximum credit is equal to the required emergency storage capacity.
[d] Based on 30 percent of a maximum day demand.
[e] Based on two times the average day demand.
[f] For Zones 1, 2, and 3-City-side, based on storage required for two concurrent fire flow events; a Single Family Residential fire flow and an Industrial fire flow. For Zone 3-Tracy Hills, fire flow storage is based on an Industrial fire flow. For Zone 4-Tracy Hills, fire flow storage is based on an Office fire flow. For Zone 5-Tracy Hills, fire flow storage is based on a Single Family Residential fire flow.
[g] On-site backup power was not recommended due to site constraints.
[h] Based on previous recommendations from the evaluation of the Tracy Gateway project.
[i] Based on previous recommendations from the evaluation of the Ellis Specific Plan project.
[j] Based on previous recommendations from the evaluation of the Tracy Hills project.
[k] Proposed reservoir capacity is the recommended active and useable reservoir storage capacity and does not include dead and freeboard storage, which will be determined during design.

In addition, as discussed in *Section 8.4.1 Surface Water Treatment Capacity*, sufficient firm treated surface water pumping capacity should be available to meet a maximum day demand condition. Table 8-7 provides a comparison between the City's available and proposed firm pumping capacity for the different water demand scenarios. The proposed pumping facility improvements are based on:

1. The necessity to provide treated surface water pumping capacity to meet buildout maximum day demands (*e.g.,* Zone 3-City-side BPS),
2. Recommendations from previous studies (*e.g.,* Tracy Gateway and Ellis), or
3. The necessity for localized operational, emergency, and fire flow pumped storage capacity (*e.g.,* Catellus and Cordes Ranch tanks). A localized pumping facility provides supply reliability in the chance that supply from other sources is unavailable for any reason.

The pumping capacity analysis indicates that the City's existing and proposed firm booster and groundwater pumping capacity will be sufficient to meet the pumping capacity criterion for the buildout water service area during the governing flow scenario within each pressure zone, except for the new pressure zones located within the Tracy Hills development. However, storage tanks located at higher elevations within each pressure zone of the Tracy Hills development will be able to provide water supply by gravity to meet potable water demands during maximum day plus fire flow and peak hour demand conditions. Therefore, no mitigation is required to fix the pumping capacity deficits shown in Table 8-7 for the Tracy Hills development.

As shown in Table 8-7, there is a pumping capacity surplus in Zones 1, 2, and 3-City-side ranging from approximately 7,000 to 9,000 gpm. Similar with the storage capacity surplus discussion, this pumping capacity surplus is also required to provide localized pumping capacity to meet daily operational and fire flow demands.

8.4.4 Critical Supply Facilities

All critical pumping facilities should be equipped with an on-site, emergency backup power generator to provide pumping capacity during a power outage. Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) and/or service area(s) which do not have sufficient emergency storage, and that meet the following criteria:

- The largest pumping facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A pumping facility that provides water from a supply turnout; or
- A pumping facility that provides water from key groundwater supply wells (depends on capacity, quality, and location).

Table 8-7. Comparison of Available, Proposed, and Required Pumping Facilities

Zone	Pump Station	Backup Power	Status	Pump 1, gpm	Pump 2, gpm	Pump 3, gpm	Pump 4, gpm	Firm Capacity[c], gpm	Maximum Day Demand[a]			Maximum Day Demand w/ Fire Flow[b]			Peak Hour Demand[b]		
									Total Firm Capacity, gpm	Required Firm Capacity, gpm	Firm Capacity Surplus (Deficit), gpm	Total Firm Capacity, gpm	Required Firm Capacity, gpm	Firm Capacity Surplus (Deficit), gpm	Total Firm Capacity, gpm	Required Firm Capacity, gpm	Firm Capacity Surplus (Deficit), gpm
1/2	NEI Tank	✓	Active	1,400	1,400	1,400	1,400	4,200	39,117	37,484	**1,633**	72,995	43,484	**29,511**	72,995	63,723	**9,272**
	Zone 1	✓	Active	12,000	12,000	--	--	12,000									
	Lincoln Well	✓	Inactive	2,500	--	--	--	--									
	Lewis Manor Well	✓	Active	2,500	--	--	--	2,500									
	Park and Ride Well	✓	Active	2,000	--	--	--	2,000									
	Ball Park Well	✓	Active	2,500	--	--	--	2,500									
	Well 8[d]		Active	2,500	--	--	--	2,500									
	Gateway Zone 1 Tank[e]	✓	Proposed	1,500	1,500	1,500	1,500	4,500									
	Gateway ASR Well[e]	✓	Proposed	2,500	--	--	--	2,500									
	Catellus Tank	✓	Proposed	1,500	1,500	1,500	1,500	4,500									
	Linne Tank	✓	Active	4,865	4,865	4,865	4,865	14,595									
	Zone 2[f]	✓	Active	6,700	6,700	6,700	3,300	16,700									
	Well 1[g]		Inactive	1,500	--	--	--	--									
	Well 2[g]		Active	2,000	--	--	--	--									
	Well 3[g]		Active	2,000	--	--	--	--									
	Well 4[g]		Active	2,000	--	--	--	--									
	Gateway Zone 2 Tank[e]	✓	Proposed	1,500	1,500	1,500	1,500	4,500									
3-City-side	Ellis ASR Well[h]	✓	Proposed	2,500	--	--	--	2,500	4,500	4,088	**412**	17,000	10,088	**6,912**	17,000	6,950	**10,050**
	Cordes Ranch Tank	✓	Proposed	1,500	1,500	1,500	1,500	4,500									
	Cordes Ranch ASR Well	✓	Proposed	2,500	--	--	--	2,500									
	Patterson Pass Tank[i]	✓	Active	1,000	1,000	1,000	1,000	3,000									
	Zone 3-City-side[j]	✓	Proposed	1,175	2,150	2,150	1,175	4,500									
3-Tracy Hills	Zone 3-Tracy Hills[j]	✓	Proposed	1,200	1,200	1,200	--	2,400	2,400	2,312	**88**	2,400	6,812	**(4,412)**	2,400	3,930	**(1,530)**
4-Tracy Hills	Zone 4-Tracy Hills[j,k]	✓	Proposed	850	850	850	--	1,700	1,700	1,690	**10**	1,700	5,190	**(3,490)**	1,700	2,720	**(1,020)**
5-Tracy Hills	Zone 5-Tracy Hills	✓	Proposed	120	120	120	--	240	240	218	**22**	240	1,718	**(1,478)**	240	371	**(131)**

(a) Maximum day water demands should be met through firm treated surface water pumping capacity. The firm pumping capacity available from NEI and Linne is limited to 15 mgd based on the available water supply from the SCWSP.
(b) Maximum day plus fire flow demand and peak hour demand scenarios are met by the combined supply from treated surface water and groundwater.
(c) Firm booster pumping capacity was defined as the total booster pump station capacity with the largest pump out of service, and firm groundwater pumping capacity assumed that 20 percent of the City's wells would be out of service (i.e., approximately two wells).
(d) On-site backup power was not recommended due to site constraints.
(e) Based on previous recommendations from the evaluation of the Tracy Gateway project.
(f) Replace an existing small pump with a design flow of 3,300 gpm with a new pump with a design flow of 6,700 gpm to serve additional buildout maximum day demands located in Zones 1 and 2.
(g) Wells 1 through 4 located at JJWTP pump directly into the Chlorine Contact Basin or Clearwell #2; therefore, these wells do not provide additional pumping capacity to the system.
(h) Based on previous recommendations from the evaluation of the Ellis Specific Plan project.
(i) The existing Patterson Pass BPS site will be converted to a pumped storage facility to serve Zone 3-City-side.
(j) To be located at the JJWTP.
(k) Water demands from Zone 4-Tracy Hills and Zone 5-Tracy Hills will be served from a single Zone 4-Tracy Hills BPS located at the JJWTP. Water supplied by the Zone 4-Tracy Hills BPS will be subsequently boosted by the Zone 5-Tracy Hills BPS to serve Zone 5-Tracy Hills water demands.

As shown previously in Table 8-7, most of the City's existing pumping facilities have on-site emergency backup power installed, except for Wells 1 through 4 and Well 8[6]. As shown in Table 8-6, proposed future pumping facilities for the buildout potable water system are assumed to have an on-site backup power generator installed to improve supply reliability.

8.4.5 Update of Buildout System Facilities in Hydraulic Model

Facilities recommended based on the buildout potable water system facility evaluation were incorporated into the existing hydraulic model (including existing system improvements) to evaluate the performance of the proposed buildout potable water system. Major transmission pipelines were also added to distribute water to new demand areas. Some smaller distribution pipelines were also added to provide additional detail and system looping. The preliminary locations and sizes of buildout facilities and pipelines for the following future development projects were based on previously prepared reports/technical memoranda and/or data provided by the developers:

- Tracy Hills Water Master Plan (approved December 2000) prepared by Nolte Associates, Inc.;
- Hydraulic Evaluation of the Downtown Specific Plan (August 19, 2008) prepared by West Yost Associates;
- Tracy Gateway Project–Water Supply & Infrastructure Report (May 2007) prepared by West Yost Associates;
- Tracy Gateway Project–Hydraulic Evaluation of the City's Water System Infrastructure Required to Serve Lot 24, Lot G and the remainder of Phase 1 (June 25, 2010) prepared by West Yost Associates;
- Draft Ellis Specific Plan Water System Analysis TM (October 5, 2010) prepared by West Yost Associates[7]; and
- Cordes Ranch Water Distribution Layout and Proposed Land Use Designation Map (received on October 8, 2010) provided by Kier and Wright.

The proposed locations and sizing of facilities and pipelines recommended for the development projects listed above were used as a guideline to develop the buildout potable water system model, and facility and pipeline sizes were then evaluated and in some cases refined based on the hydraulic analyses completed for this Citywide Water System Master Plan. For all other future development projects, locations of buildout facilities and pipelines were selected based on engineering judgment.

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[6] Well 8 currently has a plug-in adapter installed to allow interconnection to a portable generator. On-site backup power is not recommended due to site constraints.

[7] The City and West Yost are currently in the process of revising the Ellis Specific Plan Water System Analysis TM. Also, as noted in Chapter 3, per an October 2011 court decision, the Development Agreement and associated approvals of the Ellis Specific Plan are to be vacated and set aside (pending the City's appeal of the decision). Therefore, the potable water system infrastructure recommendations for this project are subject to change.

It should be noted that the elevations of new junctions that have been added into the hydraulic model were assigned based on their spatial location and the closest corresponding elevation contour.[8] These elevations may not accurately represent the actual elevation of water services since grading will typically occur during the construction of a new development project. However, these preliminary junction elevations are the best estimates of the proposed service elevations at this time. As future development projects are constructed, service elevations for each future development should correspond to the service elevation ranges developed for each pressure zone, as identified in Table 8-1, to meet the minimum and maximum system pressure criteria.

To provide emergency and/or peaking water supply between pressure zones, the following interconnections are recommended and were incorporated into the hydraulic model to allow for the flow of water between pressure zones[9]:

- PRS #6 – Supplies water from Zone 2 to Zone 1;
- PRS #7 – Supplies water from Zone 2 to Zone 1;
- PRS #8 – Supplies water from Zone 3-City-side to Zone 2;
- PRS #9 – Supplies water from Zone 3-City-side to Zone 2;
- PRS #10 – Supplies water from Zone 3-Cityside to Zone 2;
- PRS #A – Supplies water from Zone 3-City-side to Zone 3-Tracy Hills;
- Ellis PRV – Supplies water from Zone 3-City-side to Zone 2;
- Zone 3-Tracy Hills PRV – Supplies water from Zone 4-Tracy Hills to Zone 3-Tracy Hills; and
- Two (2) Zone 4-Tracy Hills PRVs – Supplies water from Zone 5-Tracy Hills to Zone 4-Tracy Hills.

Figure 8-2 illustrates the locations of the proposed buildout facilities and pipeline alignments. Preliminary pipeline sizes are not shown on Figure 8-2, as they will be refined based on hydraulic evaluations discussed below in *Section 8.5 Buildout Potable Water System Performance Evaluation*. Recommended pipeline sizes will be presented in *Section 8.6 Summary of Recommended Buildout Potable Water System Improvements*.

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[8] Digital topology information was extracted as a GIS shapefile using the software program TopoDepot®. TopoDepot® provides elevation contours generated from the USGS National Elevation Database Digital Elevation Model.

[9] Pressure Regulating Stations (PRS) contain a combination of one pressure sustaining valve (PSV) and one pressure reducing valve (PRV) to control the flow of water between pressure zones.

8.5 BUILDOUT POTABLE WATER SYSTEM PERFORMANCE EVALUATION

To evaluate the performance of the City's proposed buildout potable water system, additional projected potable water demands were first allocated into the updated buildout system hydraulic model (see Table 8-3). This updated hydraulic model was then used to evaluate the City's buildout potable water backbone transmission and distribution system and its ability to meet the City's recommended performance and operational criteria under buildout maximum day demand plus fire flow and peak hour demand scenarios.

The performance criteria recommended for and results of the buildout potable water backbone transmission and distribution system evaluation are discussed below. Recommendations for supporting projected buildout potable water demands and addressing any deficiencies identified within the buildout potable water backbone transmission and distribution system are summarized in *Section 8.6 Summary of Recommended Buildout Potable Water System Improvements*.

8.5.1 Buildout Water System Performance Criteria

Steady state hydraulic analyses using the updated buildout potable water system hydraulic model were conducted to help identify areas of the buildout potable water system that do not meet the recommended system performance criteria as presented previously in Chapter 6. The results of the buildout potable water system evaluation are presented below for the following potable water demand scenarios:

- Peak Hour Demand—A peak hour flow condition was simulated for the buildout water distribution facilities to evaluate their capability to meet a peak hour demand scenario. Peak hour demands are met by the combined supply from treated surface water, storage tanks, and groundwater.
- Maximum Day Demand plus Fire Flow—To evaluate the buildout potable water system under the maximum day demand plus fire flow scenario, individual fire flow demands were first assigned and simulated at various locations within the City's water service area. InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow while meeting the maximum day demand plus fire flow performance criteria. Additional fire flow simulations were also performed to simulate a condition equal to a maximum day demand with two concurrent fire flow events. Maximum day plus fire flow demands are met by the combined supply from treated surface water, storage tanks, and groundwater.

The performance criteria and results for each scenario are discussed in more detail below.

8.5.1.1 Peak Hour Demand Scenario

As shown in Table 8-2, the peak hour demand for the buildout water service area was calculated to be 77,476 gpm (111.5 mgd). This peak hour demand represents a peaking factor of 3.4 times the average day demand. During a peak hour demand scenario, a minimum pressure of 40 psi must be maintained throughout the water system. In addition, maximum head loss per thousand feet of distribution main should not exceed 7 ft/kft and maximum velocities should not exceed 8 fps. For transmission mains, maximum head loss per thousand feet of transmission main should not exceed 3 ft/kft and maximum velocities should not exceed 6 fps. Details of the system pressures and pipeline characteristics as simulated in the hydraulic model under the peak hour demand scenario are discussed below.

8.5.1.2 Maximum Day Demand plus Fire Flow Scenario

As shown in Table 8-2, the maximum day demand for the buildout water service area was calculated to be 45,574 gpm (65.6 mgd). This maximum day demand represents a peaking factor of 2.0 times the average day demand. Fire flow demands were assigned and simulated at various locations within the City's water service area to determine if the minimum residual pressure criterion of 30 psi could be met during a maximum day demand plus fire flow scenario. Fire flow demands were assigned based on proposed General Plan land use designations, and are summarized below in Table 8-8.

Table 8-8. Recommended Fire Flow Requirements[a]

Land Use Category	Fire Flow, gpm	Duration, hours
Single Family Residential[b]	1,500	2
Multi Family Residential[c]	2,500	2
Commercial/Office[d]	3,500[f]	4
Industrial	4,500[f]	4
Institutional[e]	4,500[f]	4

(a) Specific fire flow requirements were determined from Table B105.1 of the 2007 CFC, and depend on construction type and fire flow calculation area. Non-residential fire flow requirements are based on the assumption that an automatic sprinkler system has been installed. See Table 6-1 for further explanation of how the fire flow requirements were developed.
(b) Includes Very Low and Low Density Residential land uses.
(c) Includes Medium and High Density Residential land uses.
(d) Includes Commercial, Office, Downtown, and Village Center land uses.
(e) Includes Public Facilities and Park land uses.
(f) Fire flow includes a 500 gpm demand for on-site sprinkler flow, which is not included in the recommended fire flow storage volume.

The City's water system should also have the capability to meet a system demand condition equal to the occurrence of a maximum day demand with two concurrent fire flow events. It is assumed that the two fire flow events will consist of one smaller single family residential fire flow combined with another larger industrial fire flow. This conservative assumption of two simultaneous fire flow demands will help stress the City's water system, and determine if the buildout water system can provide reliable service during high demand conditions. Consequently, two concurrent fire flow demands were simulated at various locations within the City's water service area during a maximum day demand condition to determine if the minimum residual pressure criterion of 20 psi could be met during simultaneous fire flow events.

8.5.2 Recommended Improvements Criteria

The performance criteria described above was used to evaluate the buildout potable water system during peak hour demand and maximum day demand plus fire flow scenarios. The buildout potable water system is expected to deliver peak hour flow and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria presented in Chapter 6. However, the system was evaluated using pressure as the primary criterion. If necessary, recommended improvements needed to comply with the performance criteria were added to the buildout potable water system to fix any deficiencies found and are discussed below.

8.5.3 Buildout Water System Evaluation Results

The results from the hydraulic model for the peak hour demand and maximum day demand plus fire flow analyses are presented below.

8.5.3.1 Peak Hour Demand Scenario

During a peak hour demand scenario, results indicate that the buildout potable water system could adequately deliver peak hour demands to meet the City's minimum pressure criterion of 40 psi as illustrated on Figure 8-3. Under this scenario, system pressures ranged from 40 to 122 psi. It should be noted that any individual service connection pressure exceeding 80 psi will require the installation of an individual PRV. As discussed previously, new junction elevations in the hydraulic model may not accurately represent the actual elevation of water services since grading will typically occur during the construction of a new development. Therefore, the system pressures simulated by the hydraulic model are best estimates of the proposed service pressures at this time. It is recommended that as the water system infrastructure for future development projects are designed, the proposed service elevations for each future development project should correspond to the service elevation ranges developed for each pressure zone (see Table 8-1) and that additional hydraulic analyses should be performed to confirm that the recommended minimum and maximum system pressure criteria can be met.

As illustrated on Figure 8-4, there are two locations within the buildout system where the transmission and distribution system pipelines did not meet the corresponding maximum velocity criterion of 6 fps and 8 fps, respectively, during a peak hour demand scenario. The following list details pipelines in the buildout potable water system that exceeded the maximum velocity criterion and summarizes any recommended improvements.

- Location #1A: The existing 12-inch diameter distribution pipelines located on Sixth Street immediately east of the 36-inch diameter transmission main tie-in had a velocity of 10.0 fps.

  Recommendation:

  No mitigation is recommended for the existing 12-inch diameter pipelines exceeding the velocity criterion located on Sixth Street immediately east of the 36-inch diameter transmission main tie-in because these pipelines currently cross the existing railroad tracks, and it would be cost-prohibitive to replace at this time.

- Location #1B: The proposed 18-inch diameter transmission pipelines (currently 12-inch diameter pipelines; upsizing to 18-inch diameter was recommended in Chapter 7) located on Tracy Boulevard, between Sixth Street and Tenth Street, and also west of the 36-inch diameter transmission main tie-in had a velocity of 6.2 fps.

  Recommendation:

  No mitigation is recommended for the proposed 18-inch diameter pipelines located on Tracy Boulevard, between Sixth Street and Tenth Street, because the pipeline velocities during a buildout peak hour demand condition were only slightly above the maximum pipeline velocity criterion of 6 fps, and the minimum pressure criterion of 40 psi was met.

- Location #2: The existing 18-inch diameter transmission pipelines located on Tracy Boulevard, between Linne Road and Whispering Wind Drive, and also west of the Linne tank had velocities of 6.7 and 7.2 fps.

  Recommendation:

  No mitigation is recommended for the existing 18-inch diameter pipelines located on Tracy Boulevard, between Linne Road and Whispering Wind Drive, because pipeline velocity is a secondary criterion and no improvements for existing pipelines exceeding the velocity criterion are recommended unless the primary criterion (pressure) is not met.

8.5.3.2 Maximum Day Demand plus Fire Flow Scenario

Fire flow demands were assigned based on Table 8-8 and simulated at various locations within the City's buildout water service area. Results indicate that all the fire flow junctions within the model were able to meet the minimum residual pressure criterion of 30 psi. In addition, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow (while meeting the maximum day demand plus fire flow minimum residual pressure and maximum velocity performance criteria of 30 psi and 12 fps, respectively) at each fire flow junction within the buildout water system during a maximum day demand scenario.

Figure 8-5 illustrates the available fire flow while meeting the maximum day demand plus fire flow minimum residual pressure and maximum velocity performance criteria at each fire flow junction within the buildout water system. As shown, all fire flow junctions were able to supply a minimum fire flow demand requirement of 1,500 gpm.

Seven additional fire flow simulations were performed within the hydraulic model to simulate a condition equal to a maximum day demand with two concurrent fire flow events. Two concurrent fire flow events were simulated during a maximum day demand condition to determine if the minimum residual pressure criterion of 20 psi could be met. Figure 8-6 illustrates the locations of the additional fire flow simulations. Locations were selected within each pressure zone based on the existing and proposed land use designations and spatial distance from supply sources to stress the City's water system. As summarized in Table 8-9, results from the hydraulic model indicate that all seven of the concurrent fire flow simulations met the minimum residual pressure criterion of 20 psi.

Table 8-9. Results of Additional Fire Flow Simulations[a]

Pressure Zone	Location #	Fire Flow Demand, gpm[a]	Residual Pressure, psi
1	1	1,500	60
		4,500	48
	2	1,500	64
		4,500	53
	5	1,500	51
		4,500	42
2	3	1,500	69
		4,500	59
	4	1,500	67
		4,500	36
	6	1,500	61
		4,500	31
3	7	1,500	70
		4,500	47

[a] It is assumed that the two concurrent fire flow events will consist of one smaller single family residential fire flow combined with another larger industrial fire flow.

8.6 SUMMARY OF RECOMMENDED BUILDOUT POTABLE WATER SYSTEM IMPROVEMENTS

The recommended backbone potable water system improvements required to serve buildout potable water demands are summarized below and shown on Figure 8-7. It should be noted that these recommendations only identify facility improvements at a master plan level and do not necessarily include all required on-site infrastructure nor constitute design of improvements. Subsequent detailed design is required to determine the exact sizes and final locations of these proposed facility improvements.

It should also be noted that the buildout hydraulic model is not an “all pipes” model (*i.e.*, not all smaller diameter pipelines are included); therefore, the hydraulic simulations performed as discussed above may not identify all necessary water system improvements. Consequently, it is recommended that further hydraulic evaluations be performed as additional details are provided for each future development project.

8.6.1 Surface Water Treatment Facilities

- JJWTP Expansion: Increase the surface water treatment capacity at JJWTP by 21 mgd.

8.6.2 Storage Facilities

Note: Because the actual dimensions of each proposed storage facility have not been determined, the storage facility sizes below do not include dead and freeboard storage requirements, which will be determined during design.

- JJWTP Expansion: Install a new clearwell with a minimum active storage capacity of 2.0 MG.
- Catellus Tank: Install a new storage tank with a minimum active storage capacity of 1.0 MG.
- Gateway Zone 1 Tank: Install a new storage tank with a minimum active storage capacity of 1.5 MG.
- Gateway Zone 2 Tank: Install a new storage tank with a minimum active storage capacity of 1.5 MG.
- Patterson Pass Tank: Install a new storage tank with a minimum active storage capacity of 0.5 MG.
- Cordes Ranch Tank: Install a new storage tank with a minimum active storage capacity of 1.5 MG.
- Zone 3-Tracy Hills Tank: Install a new storage tank with a minimum active storage capacity of 5.3 MG.
- Zone 4-Tracy Hills Tank: Install a new storage tank with a minimum active storage capacity of 3.5 MG.
- Zone 5-Tracy Hills Tank: Install a new storage tank with a minimum active storage capacity of 0.6 MG.

8.6.3 Groundwater Wells

- Gateway: Install a new ASR well with a minimum firm pumping capacity of 2,500 gpm.
- Cordes Ranch: Install a new ASR well with a minimum firm pumping capacity of 2,500 gpm.
- Ellis: Install a new ASR well with a minimum firm pumping capacity of 2,500 gpm.

8.6.4 Booster Pumping Facilities

- JJWTP Expansion: Increase the firm treated surface water pumping capacity to meet buildout maximum day water demands.
  - — Zone 2 BPS: Replace one existing small pump (design flow of 3,300 gpm) with a new pump with a design flow of 6,700 gpm (to match existing large pumps).
  - — Zone 3-City-side BPS: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.

— Zone 3-Tracy Hills BPS: Install a new booster pump station with a minimum firm pumping capacity of 2,400 gpm.
— Zone 4-Tracy Hills BPS: Install a new booster pump station with a minimum firm pumping capacity of 1,700 gpm.

- Zone 5-Tracy Hills BPS: Install a new booster pump station with a minimum firm pumping capacity of 240 gpm.
- Catellus Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.
- Gateway Zone 1 Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.
- Gateway Zone 2 Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.
- Cordes Ranch Tank: Install a new booster pump station with a minimum firm pumping capacity of 4,500 gpm.

8.6.5 Pipelines

- To serve buildout water demands, install approximately 623,360 linear feet of new pipelines ranging in diameter from 8 to 24-inches as shown on Figure 8-7.
- To serve buildout water demands, upsize approximately 6,960 linear feet of existing pipelines as shown on Figure 8-7.

8.6.6 Interconnections

- Install the following interconnections between pressure zones to provide supply during peak demands and/or emergency conditions:

— PRS #6 (from Zone 2 into Zone 1)
— PRS #7 (from Zone 2 into Zone 1)
— PRS #8 (from Zone 3-City-side into Zone 2)
— PRS #9 (from Zone 3-City-side into Zone 2)
— PRS #10 (from Zone 3-City-side into Zone 2)
— PRS #A (from Zone 3-City-side into Zone 3-Tracy Hills)
— Ellis Zone 2 PRV (from Zone 3-City-side into Zone 2)
— Zone 3-Tracy Hills PRV (from Zone 4-Tracy Hills into Zone 3-Tracy Hills)
— Two (2) - Zone 4-Tracy Hills PRVs (from Zone 5-Tracy Hills into Zone 4-Tracy Hills)

- Install an individual PRV on any water service connection with a static pressure exceeding 80 psi.

8.6.7 SCADA System/Backup Power

- Install SCADA system monitoring of flows and pressures at each new water supply facility to provide operators with real-time system data and flexibility in system operations.
- Install on-site backup power to any proposed buildout system pumping facility to improve supply reliability.

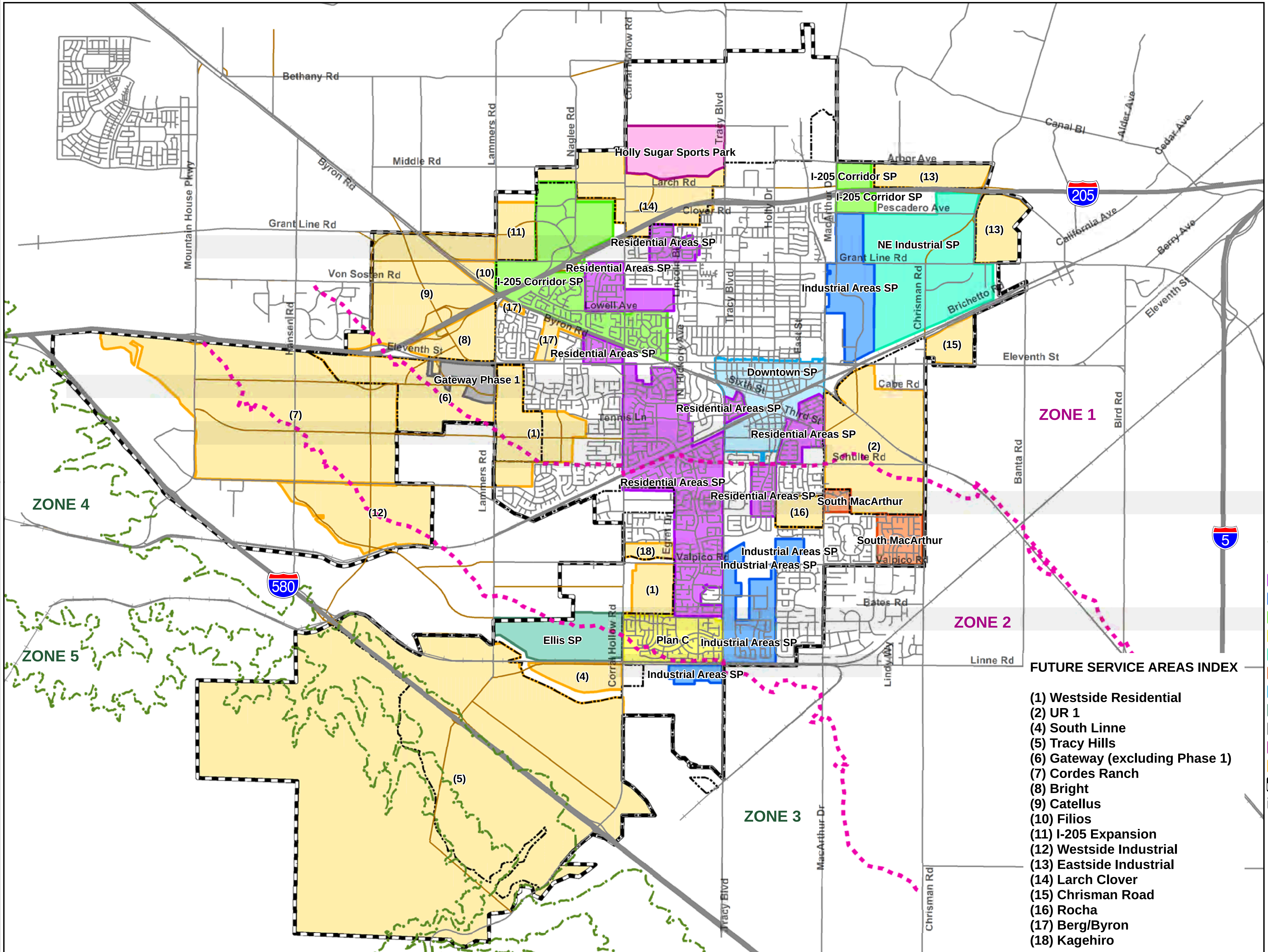

FIGURE 8-1

City of Tracy Water System Master Plan

PROPOSED DEVELOPMENT PROJECTS AND PRESSURE ZONE BOUNDARIES

0 2,500 5,000

Scale in Feet

NOTES

1. City limits and SOI files (citylimit.shp and SOI_revised_January_09.shp) provided by DCE on 11/05/09. SOI shape file was revised based on data received from the City on 08/03/10.
2. Infill locations are not shown.
3. Project boundaries are approximate.

LEGEND

- Proposed Pressure Zone Boundary
- Existing Pressure Zone Boundary
- Residential Areas Specific Plan
- Industrial Areas Specific Plan
- I-205 Corridor Specific Plan
- Plan "C"
- Northeast Industrial Specific Plan
- South MacArthur
- Downtown Specific Plan
- Ellis Specific Plan
- Tracy Gateway - Phase 1
- Holly Sugar Sports Park
- Future Service Area (see Index)
- SOI
- City Limits
- Proposed Street
- Existing Highway
- Existing Street

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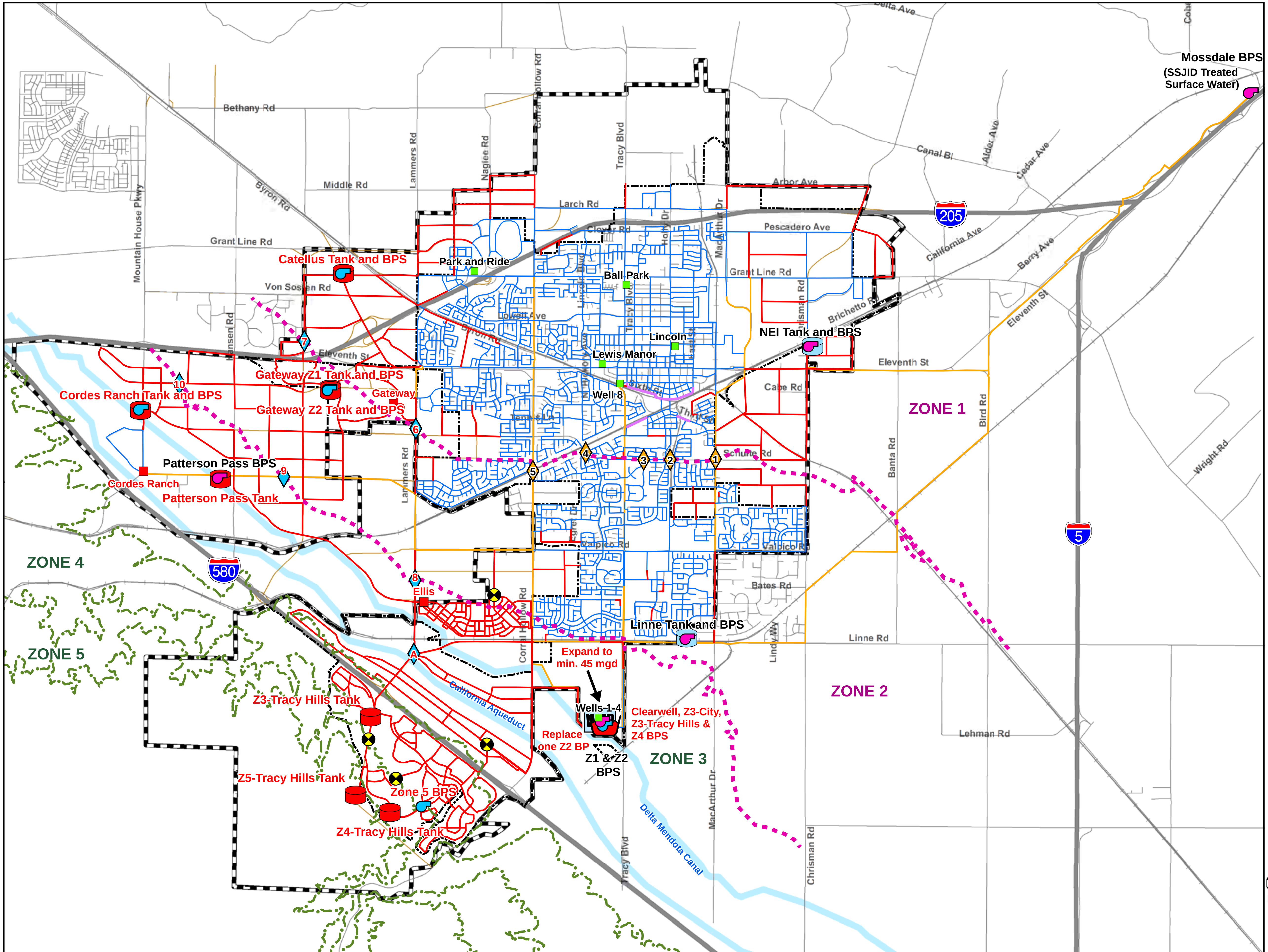

FIGURE 8-2

City of Tracy
Water System Master Plan

PROPOSED BUILDOUT POTABLE WATER SYSTEM FACILITIES

0 2,750 5,500
Scale in Feet

NOTES

1. City limits file (citylimit.shp) provided by DCE on 11/05/09.
2. Well 1 and Lincoln Well are currently inactive.
3. Well 8 will be an injection/extraction well in the City's ASR Program.
4. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

- Proposed Existing Pipeline Upsize
- Proposed Pipeline
- Proposed Emergency PRV Connection
- Proposed Pressure Regulating Station
- Proposed ASR Groundwater Well
- Proposed Booster Pump Station
- Proposed Storage Tank
- Proposed Clearwell
- WTP JJWTP
- Existing Pressure Regulating Station
- Existing Groundwater Well
- Existing Booster Pump Station
- Existing Storage Tank
- Existing Pipeline Diameter < 18-inches
- Existing Pipeline Diameter ≥ 18-inches
- SOI
- City Limits
- Proposed Street
- Existing Highway
- Existing Street

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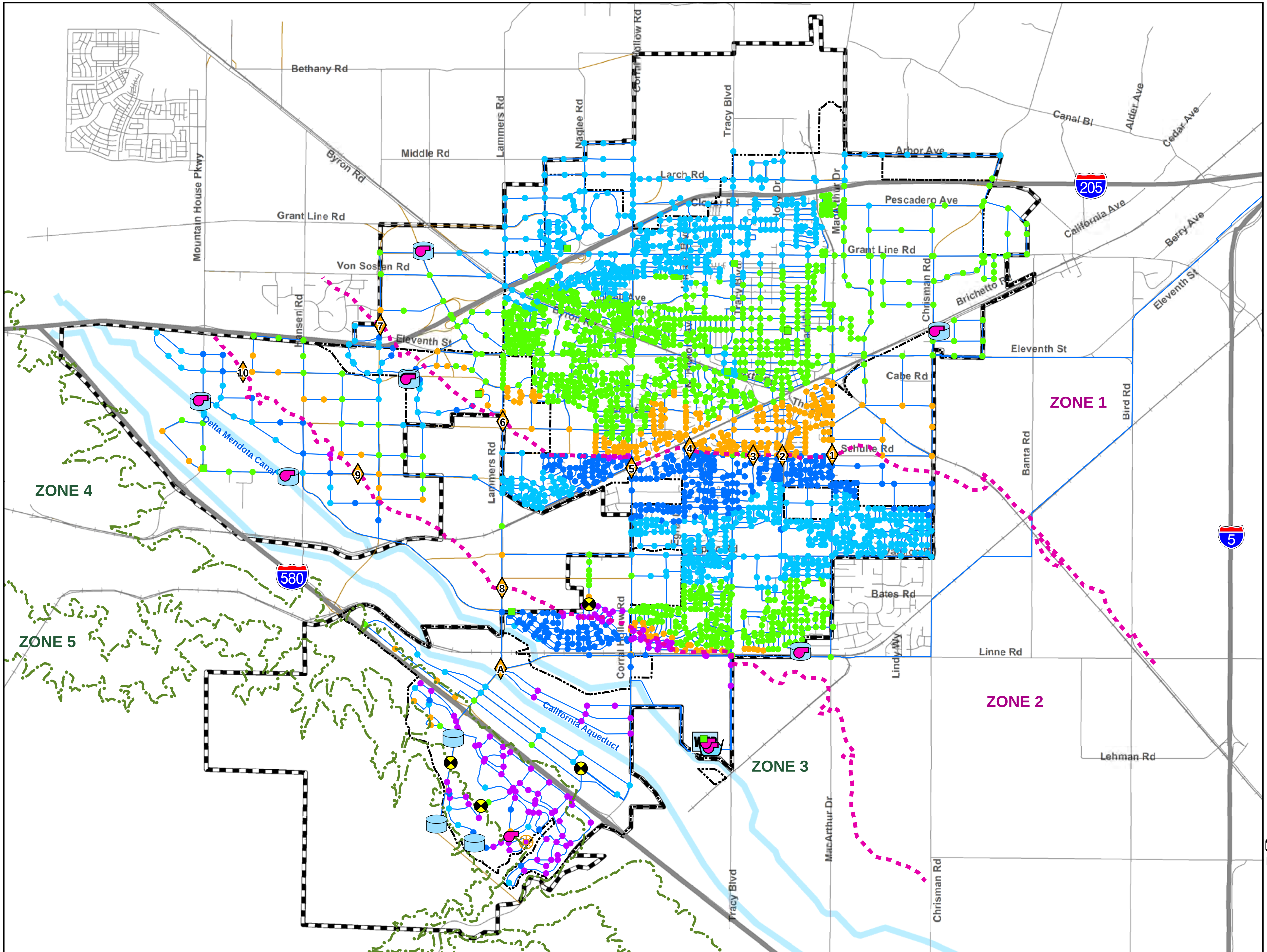
FIGURE 8-3

City of Tracy
Water System Master Plan

BUILDOUT SYSTEM PRESSURES - PEAK HOUR DEMAND



N

0 2,500 5,000

Scale in Feet

NOTES

1. City limits file (citylimit.shp) provided by DCE on 11/05/09.
2. Well 1 and Lincoln Well are currently inactive.
3. Well 8 will be an injection/extraction well in the City's ASR Program.
4. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.
5. Water service connections exceeding 80 psi will require the installation of an individual PRV.

LEGEND

- Pressure < 40 psi
- 40 psi ≤ Pressure ≤ 50 psi
- 50 psi < Pressure ≤ 60 psi
- 60 psi < Pressure ≤ 70 psi
- 70 psi < Pressure ≤ 80 psi
- Pressure > 80 psi
- Pressure > 120 psi
- Storage Tank
- Proposed Clearwell
- Booster Pump Station
- Groundwater Well
- Emergency PRV Connection
- Pressure Regulating Station
- JJWTP
- Pipeline
- SOI
- City Limits
- Proposed Street
- Existing Highway
- Existing Street

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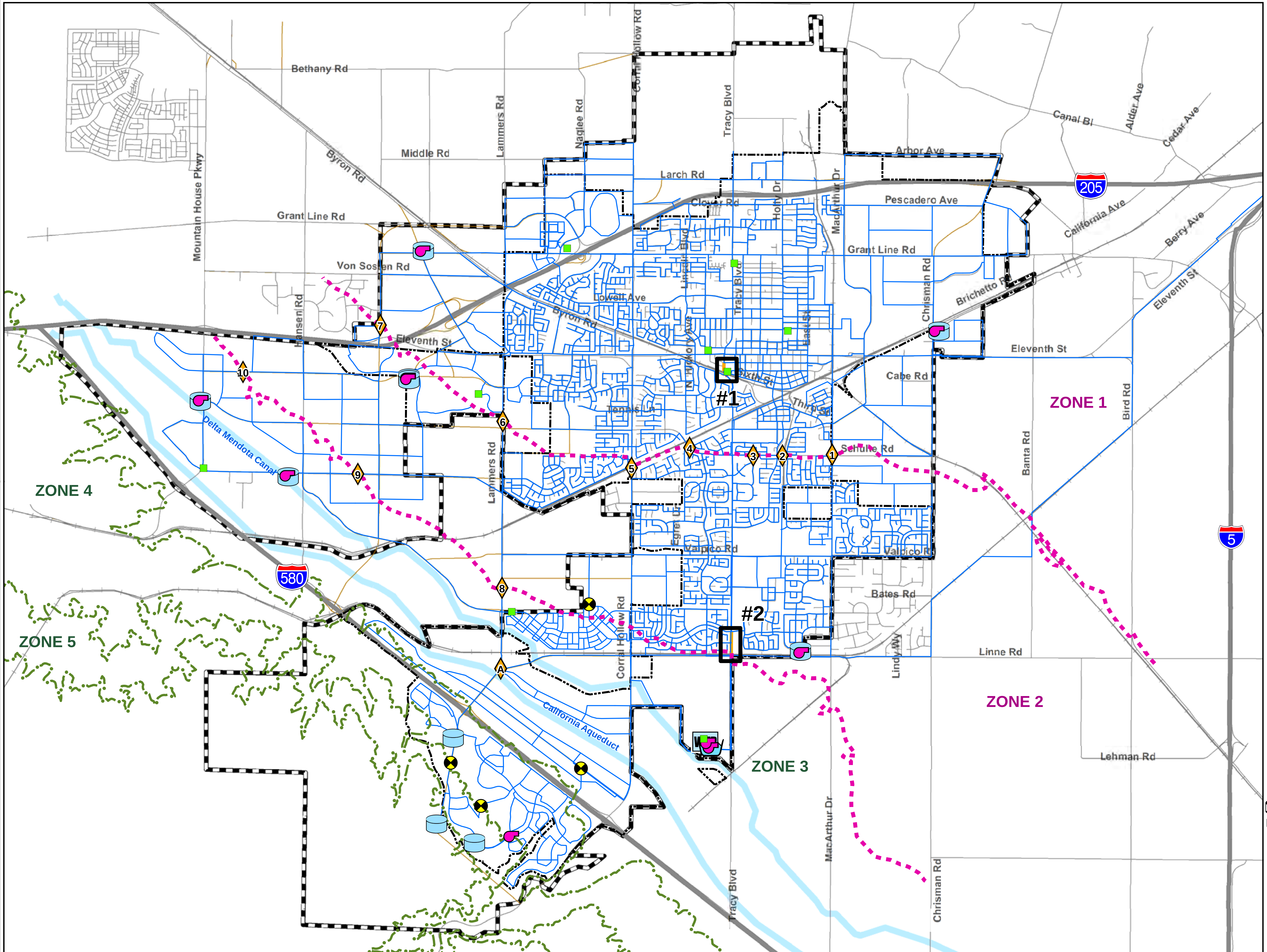
FIGURE 8-4

City of Tracy
Water System Master Plan

BUILDOUT PIPELINE VELOCITIES - PEAK HOUR DEMAND



0 2,500 5,000
Scale in Feet

NOTES

1. City limits file (citylimit.shp) provided by DCE on 11/05/09.
2. Well 1 and Lincoln Well are currently inactive.
3. Well 8 will be an injection/extraction well in the City's ASR Program.
4. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

Pipeline Diameter ≥ 18-inches
- Velocity ≤ 6 fps
- Velocity > 6 fps

Pipeline Diameter < 18-inches
- Velocity ≤ 8 fps
- Velocity > 8 fps

- Storage Tank
- Proposed Clearwell
- Booster Pump Station
- Groundwater Well
- Emergency PRV Connection
- Pressure Regulating Station
- WTP JJWTP
- SOI
- City Limits
- Proposed Street
- Existing Highway
- Existing Street

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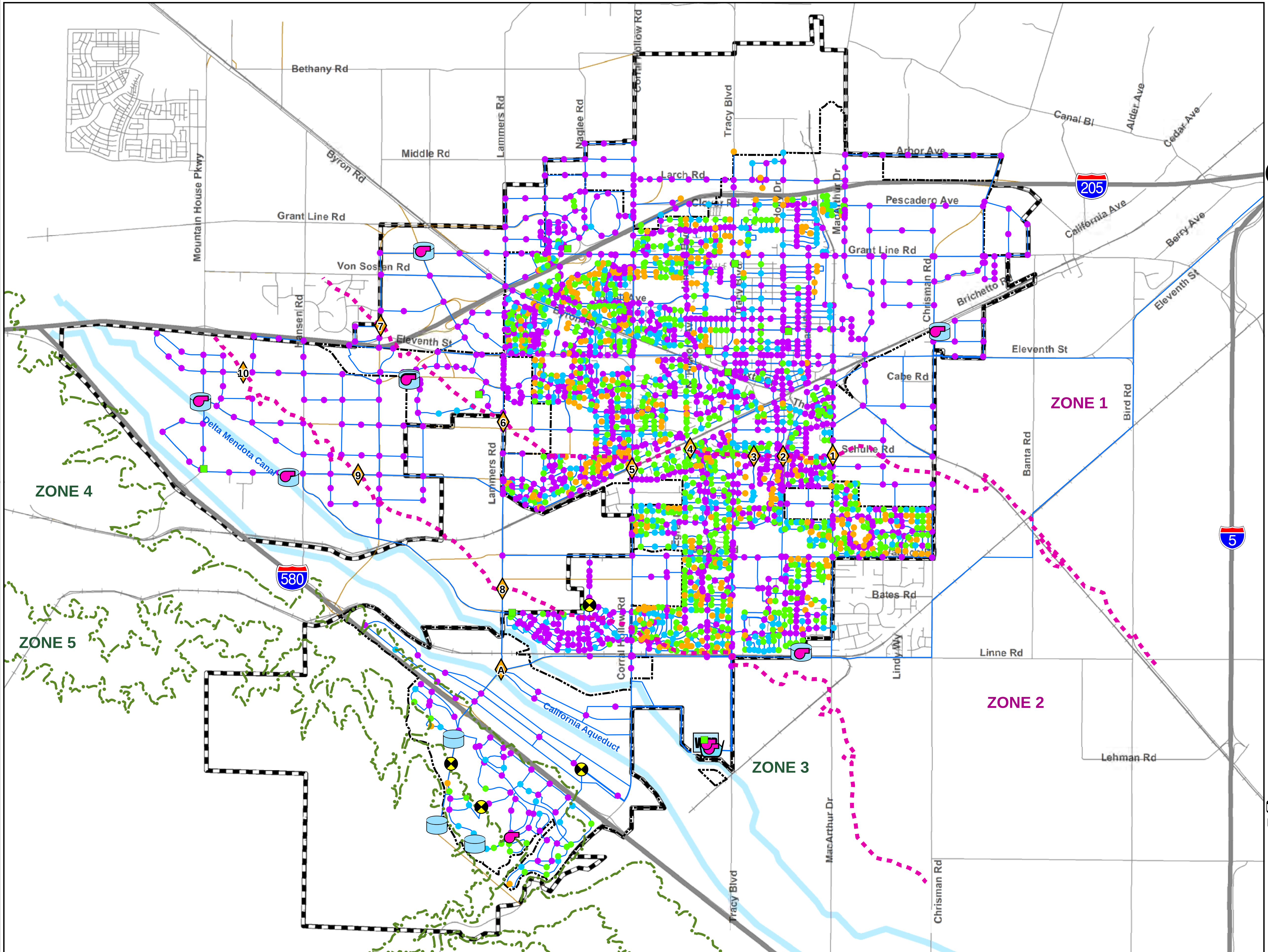
FIGURE 8-5

City of Tracy
Water System Master Plan

BUILDOUT SYSTEM AVAILABLE FIRE FLOW (Residual Pressure ≥ 30 psi and Velocity ≤ 12 fps)



0 2,500 5,000
Scale in Feet

NOTES

1. City limits file (citylimit.shp) provided by DCE on 11/05/09.
2. Well 1 and Lincoln Well are currently inactive.
3. Well 8 will be an injection/extraction well in the City's ASR Program.
4. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.

LEGEND

- Flow < 1,500 gpm
- 1,500 gpm ≤ Flow ≤ 2,500 gpm
- 2,500 gpm < Flow ≤ 3,500 gpm
- 3,500 gpm < Flow ≤ 4,500 gpm
- Flow > 4,500 gpm
- Storage Tank
- Proposed Clearwell
- Booster Pump Station
- Groundwater Well
- Emergency PRV Connection
- Pressure Regulating Station
- WTP JJWTP
- Pipeline
- SOI
- City Limits
- Proposed Street
- Existing Highway
- Existing Street

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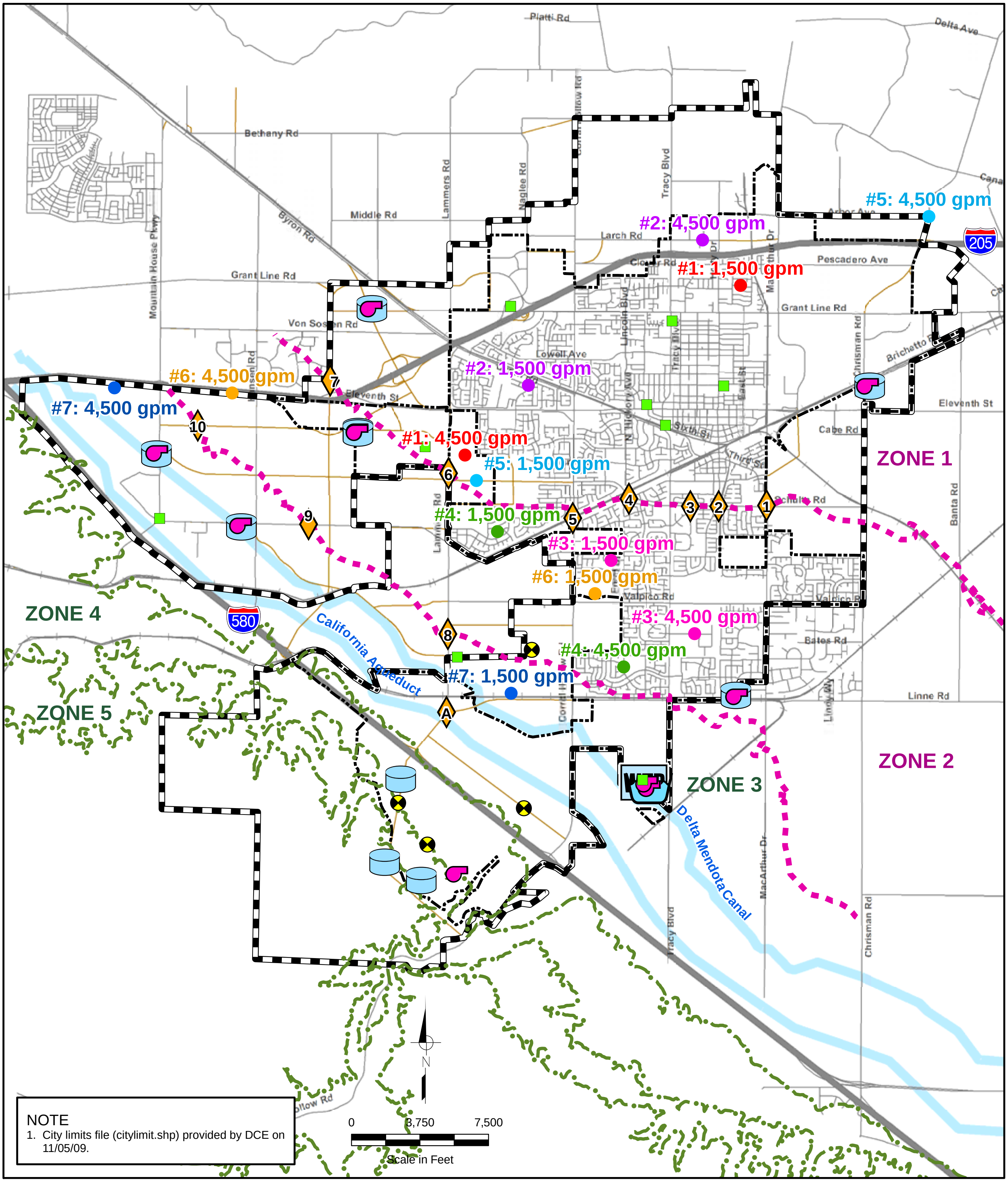

NOTE
1. City limits file (citylimit.shp) provided by DCE on 11/05/09.

LEGEND:

- Location #1
- Location #2
- Location #3
- Location #4
- Location #5
- Location #6
- Location #7
- Emergency PRV Connection
- Pressure Regulating Station
- SOI
- City Limits
- Proposed Street
- Existing Street

FIGURE 8-6

City of Tracy
Water System Master Plan

LOCATIONS OF ADDITIONAL SIMULTANEOUS FIRE FLOW SIMULATIONS

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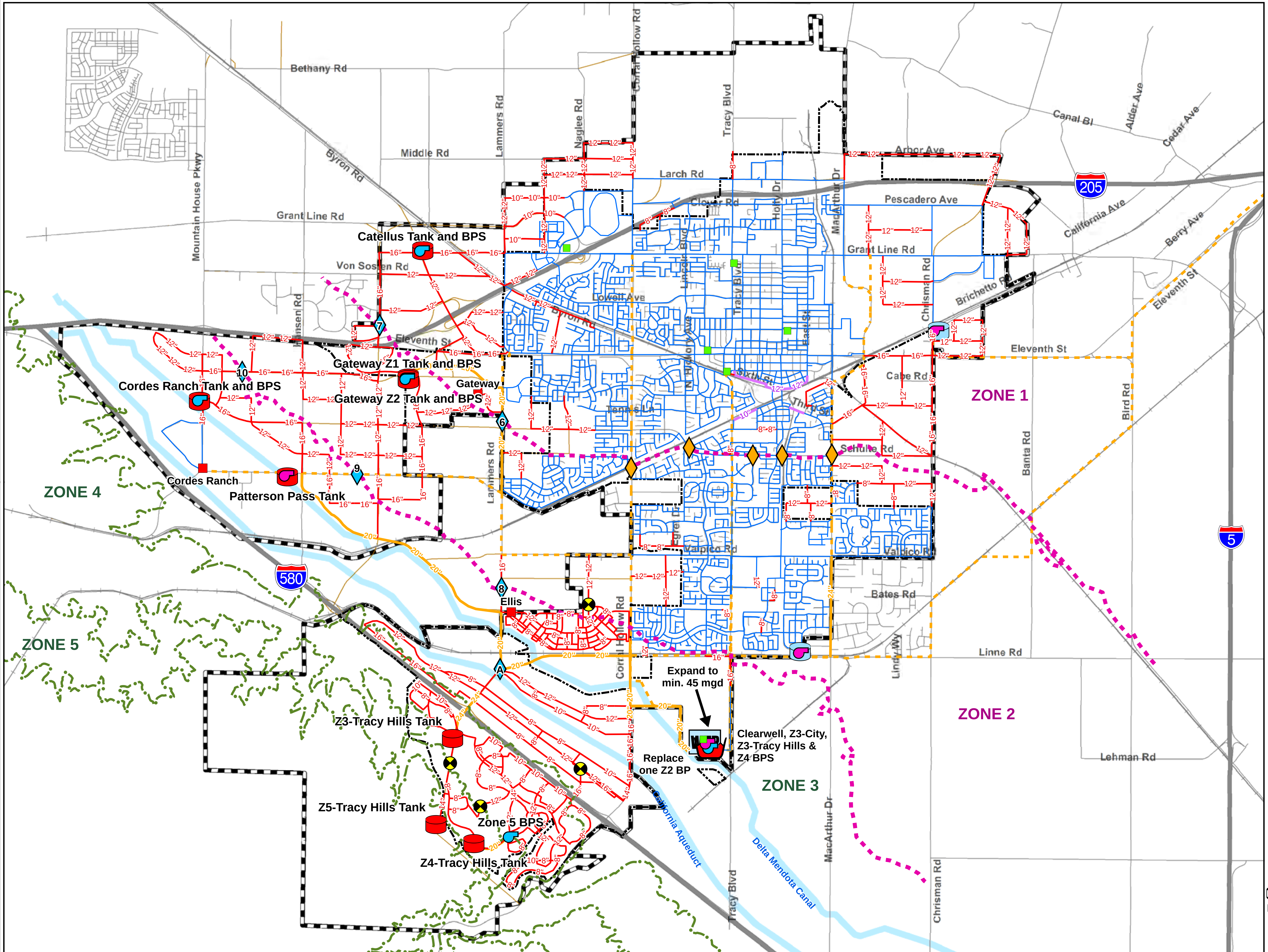
O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 8\Fig 8-6_FFLocations.mxd 3/2/2012

FIGURE 8-7

City of Tracy
Water System Master Plan

PROPOSED BUILDOUT SYSTEM RECOMMENDED IMPROVEMENTS



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0 2,500 5,000
Scale in Feet

NOTES

1. City limits file (citylimit.shp) provided by DCE on 11/05/09.
2. Well 1 and Lincoln Well are currently inactive.
3. Well 8 will be an injection/extraction well in the City's ASR Program.
4. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.
5. Install a PRV on any service connection exceeding 80 psi.
6. Install SCADA system monitoring of flows and pressures at each new facility.
7. Install on-site backup power at each new pumping facility.

LEGEND

- Proposed Existing Pipeline Upsize
- Proposed Pipeline Diameter ≥ 18-inches
- Proposed Pipeline Diameter < 18-inches
- Proposed Emergency PRV Connection
- Proposed Pressure Regulating Station
- Proposed ASR Groundwater Well
- Proposed Booster Pump Station
- Proposed Storage Tank
- Proposed Clearwell
- WTP JJWTP
- Existing Pressure Regulating Station
- Existing Groundwater Well
- Existing Booster Pump Station
- Existing Storage Tank
- Existing Pipeline Diameter < 18-inches
- Existing Pipeline Diameter ≥ 18-inches
- SOI
- City Limits
- Proposed Street
- Existing Highway
- Existing Street

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9.1 OVERVIEW

The purpose of this chapter is to describe the proposed recycled water system at buildout of the City's Sphere of Influence (SOI). The City is proposing to collect and treat wastewater at one location, the City's existing wastewater treatment plant (WWTP) on Holly Drive, treat it to a Title 22 Disinfected Tertiary standard, and distribute the recycled water to various non-potable use areas to offset existing potable water use and provide non-potable supply to meet future non-potable demands. Seasonal storage ponds will not be required to balance flow and demand, as there will be an excess amount of recycled water available from the Holly Drive WWTP in all months. However, recycled water storage tanks located out in the City's recycled water system will be required to provide for diurnal storage, as discussed in more detail below.

The topics discussed in this chapter include:

- Recycled Water Plan
- Recycled Water System Criteria
- Allocation of Recycled Water Demands
- Recommended Recycled Water System

To assist in the evaluation of the City's overall recycled water system at buildout, the recycled water infrastructure recommended in this chapter includes the infrastructure required to serve the Tracy Hills development and, for consistency, is based on the adopted water use, peaking factors, and system performance criteria described in previous chapters of this Citywide Water System Master Plan.

West Yost has included the Tracy Hills development in the buildout recycled water system evaluation because it will be a part of the City's overall future recycled water system operation, since it will be served directly from the City's existing WWTP on Holly Drive instead of from a separate wastewater treatment facility producing Title 22 Disinfected Tertiary recycled water as previously considered. Including the Tracy Hills development in the buildout hydraulic model evaluation ensures that the City's buildout recycled water system is integrated and sufficient to serve the recycled water demands of the entire City (including Tracy Hills). However, it is acknowledged that the Tracy Hills development has an approved Master Plan (2000), which is in the process of being revised (based on proposed land use changes and a revised specific plan), and that recommended infrastructure presented in the 2000 Tracy Hills Master Plan is different from that presented in this chapter due to the use of slightly different water use and peaking factors and slightly revised pipeline alignments (updated to be consistent with the City's master roadway plan alignments).

Because Tracy Hills is essentially a "stand-alone" development mostly separated from the City's other recycled water system facilities, costs for infrastructure to serve the Tracy Hills development will not be included in this Citywide Water System Master Plan. Instead, costs for Tracy Hills infrastructure will be evaluated in conjunction with the revised Tracy Hills Master Plan and subsequent evaluations to be prepared for the Tracy Hills development. However, because all recycled water will be supplied from the City's existing WWTP on Holly Drive, the main recycled water system will need to include capacity to deliver recycled water demands to the proposed Tracy Hills recycled water storage tanks. Therefore, total costs for the shared main recycled water system facilities, including the pipeline to the Tracy Hills storage tanks and the recycled water storage tank in Tracy Hills, will be included in this Citywide Water System Master Plan, and a proportionate share of the costs will be allocated to the Tracy Hills development. Additionally, Tracy Hills will be responsible for the costs of all recycled water pipelines, pump stations, and related infrastructure located within the Tracy Hills development area.

9.2 RECYCLED WATER PLAN

The City intends to construct and operate a recycled water system to serve non-potable water demands, help offset potable water demands (due to limited water supply), and reduce treated effluent discharges to Old River. As directed by the City, one integrated recycled water system is proposed and will serve and distribute recycled water throughout the entire SOI, including the proposed Tracy Hills development.

It should be noted that a second, smaller recycled water system was previously recommended as part of the October 2000 Tracy Hills Recycled Water Distribution System Master Plan (Tracy Hills Master Plan), and a new Tracy Hills Water Recycling Facility (WRF) was proposed that would have collected and treated wastewater from the Tracy Hills development as well as disposed of wastewater flow in excess of recycled water demand. This previously proposed recycled water distribution system would have seasonally stored and distributed recycled water sufficient to serve the recycled water demand of the Tracy Hills development only. However, as part of the Citywide Wastewater System Master Plan being prepared by CH2MHill, it has been determined that the construction, operation and maintenance of such a second system is cost prohibitive and, as directed by the City, this alternative was not evaluated.

Two potential recycled water demand projects that are currently in concept stage are the Mulqueeney Ranch Pumped Storage project and possible recharge of the Delta-Mendota Canal. Under the potential Mulqueeney Ranch Pumped Storage project, recycled water would be pumped into a 6,000 acre-foot reservoir where it would be used to generate electricity during daytime peak electrical demand periods and then pumped back into the reservoir during nighttime, lower electricity cost periods. Additional recycled water would be required on an annual basis to make up for evaporative and other losses. Recharging the Delta-Mendota Canal is a potential future project whereby highly treated wastewater would be pumped into the Delta-Mendota Canal and conveyed to downstream users, including the City. These two projects are still in the concept stage and the infrastructure needs of these concept projects have not been considered at this time.

9.3 RECYCLED WATER SYSTEM CRITERIA

Evaluation of the proposed Citywide recycled water distribution system utilizes criteria that are different from the criteria used to evaluate the potable water system. The proposed evaluation criteria developed for the recycled water system are described in Chapter 6. In summary, because maximum day recycled water demands typically occur during approximately an eight hour per day period between 10 pm and 6 am (instead of the typical 24-hour period of the potable water system), and peak hour demands are only slightly greater than maximum day demands as described in Chapter 4, recycled water pipeline water velocity must be lower than in potable water systems (to help reduce energy/power costs, lowering operational costs).

As described in Chapter 6, the desired recycled water system delivery pressure ranges from a minimum of 60 psi to a maximum of 100 psi, with pipeline water velocity less than 6 feet per second. Pipeline velocities greater than 6 feet per second would cause excess friction pressure loss, and would require larger pump station power requirements and greater pipeline pressure near the pump stations.

9.4 ALLOCATION OF RECYCLED WATER DEMANDS

The projected recycled water demands were previously discussed in Chapter 4. The maximum day and peak hour peaking factors were also presented previously in Chapter 4 and are summarized below in Table 9-1.

Table 9-1. Recycled Water Demand Peaking Factors

Parameter	Value
Maximum Month Demand, percent of annual demand[a]	16.4%
Maximum Day Peaking Factor[b]	5.8
Peak Hour Peaking Factor[c]	6.4

[a] See value for July recycled water use in Figure 4-10.
[b] Multiply the average day demand times the peaking factor to obtain maximum day demand. Maximum Day Demand Peaking Factor = Maximum Month Demand (percent)/ 31 days x 365 x (24/8).
[c] Multiply the average day demand times the peaking factor to obtain peak hour demand. Assumed to be 110 percent of Maximum Day Demand, see Chapter 4.

Projected recycled water annual, average day, maximum day, and peak hour demands by development area are summarized in Table 9-2. The total recycled water demand used in the model and shown in Table 9-2 is slightly greater than that shown in Appendix D because of the addition of recycled water delivery to additional City Parks (in excess of the parks identified for the required water exchange program), and the delivery of recycled water to the Gateway Ponds and the Gateway Roadways, which were not included in Appendix D.

Table 9-2. Summary of Projected Recycled Water Demand

ID	Description	Demand, af/yr	UAFW, af/yr[a]	Total Demand, af/yr	ADD, mgd	MDD, mgd	PHD, mgd	PHD, gpm
	Gateway Ponds[b]	228	19	247	0.22	1.28	1.41	976
	City Parks (Gateway Exchange Water)[c]	722	59	781	0.70	4.04	4.44	3,085
	Gateway Roadways[b]	61	5	66	0.06	0.34	0.38	261
	Subtotal	1,011	83	1,094	0.98	5.66	6.23	4,322
Development Growth Areas								
	Tracy Gateway Phase 1 (on Project site)	84	7	91	0.08	0.47	0.52	359
	Holly Sugar Sports Park	485	39	524	0.47	2.71	2.98	2,071
	Ellis Specific Plan	185	15	200	0.18	1.03	1.14	790
1	Westside Residential (URs 5, 7, 8, 9)	313	25	338	0.30	1.75	1.92	1,337
2	UR 1	396	32	428	0.38	2.21	2.44	1,691
4	South Linne (UR 11)	72	6	78	0.07	0.40	0.44	307
5	Tracy Hills	1,758	143	1,901	1.70	9.83	10.81	7,508
6	Tracy Gateway (excluding Phase 1) (on Project site)	449	36	485	0.43	2.51	2.76	1,917
7	Cordes Ranch (UR 6)	1,034	84	1,118	1.00	5.78	6.36	4,416
8	Bright (UR 4)	111	9	120	0.11	0.62	0.68	474
9	Catellus (UR 3)	388	31	419	0.37	2.17	2.39	1,657
10	Filios (UR 2)	26	2	28	0.03	0.15	0.16	111
11	I-205 Expansion	103	8	111	0.10	0.58	0.63	440
12	Westside Industrial	291	24	315	0.28	1.63	1.79	1,243
13	Eastside Industrial	221	18	239	0.21	1.24	1.36	944
14	Larch Clover	299	24	323	0.29	1.67	1.84	1,277
15	Chrisman Road	68	6	74	0.07	0.38	0.42	290
16	Rocha	46	4	50	0.04	0.26	0.28	196
17	Berg/Byron	56	5	61	0.05	0.31	0.34	239
18	Kagehiro	20	2	22	0.02	0.11	0.12	85
	Subtotal Development Growth Areas	6,405	519	6,924	6.2	35.8	39.4	27,352
	Total Recycled Water Demand[d]	7,417	601	8,018	7.2	41.5	45.6	31,674

Note: af/yr = acre-feet per year; UAFW = Unaccounted for Water; ADD = Average Day Demand; MDD = Maximum Day Demand; PHD = Peak Hour Demand; mgd = million gallons per day; gpm = gallons per minute.

(a) Unaccounted for water is assumed to be 7.5 percent of the total amount of water delivered, as discussed in Chapter 4.

(b) The previous Gateway Study included recycled water delivery to the Gateway Ponds and the Gateway Roadways. These demands may be met with non-potable raw water in the future.

(c) The conversion of existing parks using potable water for non-potable irrigation use, to a recycled water supply, is intended to provide the Gateway Project with potable water supply. The need to provide recycled water to these various City Parks has been included in the model.

(d) Because of the changes described in footnotes (b) and (c), the total projected recycled water demand at buildout is approximately 288 acre-feet greater than the projected buildout for the development areas shown in Appendix D.

(e) Recycled water demands for the Ellis Specific Plan area are tentative and will be updated as land use types within the planning area are finalized.

9.5 RECOMMENDED RECYCLED WATER SYSTEM

Based on the recycled water system performance criteria and proposed recycled water demands, the buildout recycled water system was developed and evaluated using a hydraulic model. The development of the recommended recycled water distribution system is described below.

The proposed recycled water distribution system is assumed to begin at the Holly Drive WWTP. Diurnal storage and the main recycled water pump station would be located on or near the Holly Drive WWTP property.

9.5.1 Recycled Water Demand Areas

The demand areas to be served by the recycled water system are shown on Figure 9-1 and include all the development areas, plus the City Parks (former Gateway Exchange) areas, and the Gateway Ponds and Roadway Irrigation areas.

Proposed recycled water pressure zones were set up in the model to mimic the potable water distribution system pressure zones. The proposed ground elevation ranges, and the modeled hydraulic grade ranges for each pressure zone are presented in Table 9-3. Because the elevation and configuration of the Tracy Hills development favors a pressure zone break where Interstate 5 crosses the property, the Tracy Hills pressure zones have not been adjusted from the pressure zones recommended in the 2000 Tracy Hills Master Plan.

Table 9-3. Recycled Water Distribution Pressure Zone Ground Elevation and Hydraulic Grade

Zone Designation	Ground Elevation, feet			Hydraulic Grade, feet[(a)]
	Low	High	Difference	
A	0	77	77	215
B	70	153	83	291
C	150	223	73	361
Tracy Hills Zone C	195	290	95	430
Tracy Hills Zone D	285	390	105	530

(a) Highest elevation in zone at a minimum pressure of 60 psi.

Ground elevations and hydraulic grades were chosen to provide a system pressure range of 60 psi to 100 psi as defined in the recycled water system evaluation criteria. At the nominal hydraulic grade shown in Table 9-3, and with no water flowing through the system (static condition), the service pressure in each zone would range from 60 psi to approximately 106 psi (Tracy Hills Zone D). Because of friction losses in the distribution system during operations, system pressure near the pump stations can exceed 100 psi. The highest expected pressure in the proposed recycled water system is 102 psi on the discharge side of the Zone B Pump Station. The pressure gradient can be reduced through construction of larger diameter pipelines.

9.5.2 Recycled Water Pipeline Sizes

The proposed recycled water backbone distribution system pipelines range in size from a minimum of 8-inch diameter to a maximum of 30-inch diameter. A Hazen-Williams friction "C" factor of 130 was used in the hydraulic model. This "C" factor was used for PVC pipelines (16-inch diameter or smaller) and lined ductile iron or steel pipelines (24-inch diameter or larger). In the Tracy Hills distribution system, pipeline diameters were adjusted from the diameters presented in the 2000 Tracy Hills Master Plan to correspond with the nominal pipeline diameters used in the main distribution system.

A summary of the proposed pipeline length by diameter is shown in Table 9-4.

Table 9-4. Summary of Recycled Water System Pipeline Length by Diameter

Nominal Diameter, inches	Length, feet
8	190,800
12	50,800
16	33,500
24	39,900
30	69,700
Total	384,700

The water velocity in all pipelines larger than 8-inch diameter ranges from 1 foot per second to 6 feet per second. Because 8-inch diameter is the minimum recommended pipeline size, the velocity in some 8-inch diameter pipelines is less than 1 foot per second.

9.5.3 Recycled Water Pipeline Alignment

For the Tracy Hills development, the pipeline alignments were based on the 2000 Tracy Hills Master Plan. It was assumed that the Tracy Hills recycled water distribution system would begin at the proposed Tracy Hills recycled water storage tank, to be located immediately southwest of the Tracy Airport.

Remaining pipeline alignments were selected to minimize construction of large diameter recycled water pipelines in major City streets and to avoid difficult utility crossings. The recommended pipeline alignments are shown on Figure 9-1. The largest diameter pipelines (24-inch diameter through 30-inch diameter) would be constructed in currently sparsely developed areas at the north end of the SOI, in Lammers Road, in MacArthur Drive, generally along the southern border of the proposed Gateway and Cordes Ranch project areas, and in portions of Corral Hollow Road south of Old Schulte Road. Smaller diameter pipelines (8-inch diameter through 16-inch diameter) would be constructed in portions of Corral Hollow Road north of Old Schulte Road.

Major anticipated road and utility crossings include:

- Interstate 205 and Railroad at Lammers Road/Byron Road (30-inch diameter pipeline);
- Grant Line Road at Corral Hollow Road (12-inch diameter pipeline) and MacArthur Drive (24-inch diameter pipeline);
- 11th Street and irrigation/drainage channel at Lammers Road (30-inch diameter pipeline), Corral Hollow Road (8-inch diameter pipeline), and MacArthur Drive (16-inch diameter pipeline);
- Irrigation at Lammers Road and W. Schulte (30-inch diameter pipeline);
- Irrigation at W. Schulte Road between Lammers and Corral Hollow (30-inch diameter pipeline);
- Irrigation at Corral Hollow south of W. Schulte Road (30-inch diameter pipeline); and
- Railroad at Corral Hollow Road (8-inch diameter pipeline near Byron Road, 30-inch diameter pipeline near W. Schulte Road, and 30-inch diameter south of W. Schulte Road) and MacArthur Drive (16-inch diameter pipeline - two locations).

The above list is intended to highlight the anticipated larger utility crossings. Other utility crossings will be identified during the final design process.

9.5.4 Recycled Water Pump Station Location and Capacity

Because the source of the recycled water for all areas within the City's SOI is located at the lowest elevation of Pressure Zone A (at the existing Holly Drive WWTP facility), the recycled water must be pumped into every pressure zone. Multiple pump stations are required to move water from the Holly Drive WWTP into Pressure Zone A and then into Pressure Zone B and Pressure Zone C and the Tracy Hills Pressure Zones C and D. By conveying most of the recycled water via Lammers Road and Corral Hollow Drive, only the west Zone B and Zone C pump stations are required. Proposed pump station locations are shown on Figure 9-1.

The Tracy Hills Master Plan recommended that both the Tracy Hills Zone C and Zone D Booster Pump Stations be constructed adjacent to the Tracy Hills storage tank, instead of having the Zone D Pump Station constructed as a booster station in Zone C. West Yost concurs with this recommendation, and the logic behind this is three-fold. First, the distribution system is small enough so that the additional pipeline length is not substantial. Second, an emergency pressure reducing valve station was proposed so that some reduced flow could be delivered to Zone C through Zone D, if necessary. Third, having both pump stations at the same location makes it easier for the City to operate and maintain these pump stations.

A summary of the proposed pump station design characteristics is shown in Table 9-5.

Table 9-5. Recycled Water Distribution System Pump Station Design Criteria		
Pump Station	Design Flow Rate, gpm	Design Total Dynamic Head, feet
Zone A[(a)]	16,000	240
Zone B[(b)]	9,600	80
Zone C[(c)]	2,830	115
Tracy Hills Zone C	4,500	280
Tracy Hills Zone D	3,000	350

(a) Includes flow to all other pump stations.
(b) Includes flow to the Tracy Hills Storage Tank.
(c) Pumps directly out of Zone A Storage located within Zone C.

These proposed pump stations should supply a minimum design pressure of 60 psi in all zones to meet the design criteria described in Chapter 6.

9.5.5 Recycled Water Seasonal and Diurnal Storage

The average monthly flows are summarized in units of acre-feet in Table 9-6 and in average million gallons per day on Figure 9-2. As shown in both the table and the figure, there will be an excess amount of recycled water available from the Holly Drive WWTP in all months and therefore seasonal storage is not required.

Table 9-6. Projected Recycled Water Supply and Demand			
Month	Available Wastewater Flow[(a)], af	Recycled Water Demand, af	Remaining Amount, af
January	2,151	102	2,049
February	1,927	164	1,763
March	2,116	281	1,834
April	2,101	571	1,530
May	2,113	649	1,464
June	2,018	1,032	986
July	2,139	1,282	857
August	2,125	1,274	850
September	2,064	993	1,072
October	2,117	837	1,281
November	2,051	399	1,652
December	2,077	227	1,850
Totals	24,998	7,810	17,188

(a) From Average Day monthly flow valves received from CH2MHill by e-mails dated September 7, 2010 (Tracy Hills) and November 1, 2010 (all except Tracy Hills).

Assuming an average 8-hour pumping rate of 28,800 gpm[1], and a constant flow into diurnal storage of 9,600 gpm[2], approximately 10 million gallons of diurnal storage would be required. This value may change depending on the actual WWTP effluent diurnal flow. It is recommended that this storage be distributed throughout the system as shown in Table 9-7. Distribution of storage would allow the City to fill the tanks during the day to supply peak recycled water demands, potentially reducing the need for future infrastructure upgrades.

Table 9-7. Diurnal Storage Distribution

Pump Station	Storage Volume, million gallons
Diurnal Storage at WWTP	3.0[a]
Zone Storage at Zone A Hydraulic Grade	5.0
Tracy Hills Zone C and D	2.0
Total	10.0

(a) Volume may be reduced depending on Holly Drive WWTP effluent recycled water diurnal flow rate. May go to zero if low flow period exceeds Zone A pumping rate.

The estimated capital cost of the recommended facilities for the proposed recycled water distribution system and a proposed cost allocation between existing and future recycled water customers are presented in Chapter 10.

1 As shown in Table 9-2, the maximum day demand is 41.5 mgd which equates to 28,800 gpm,

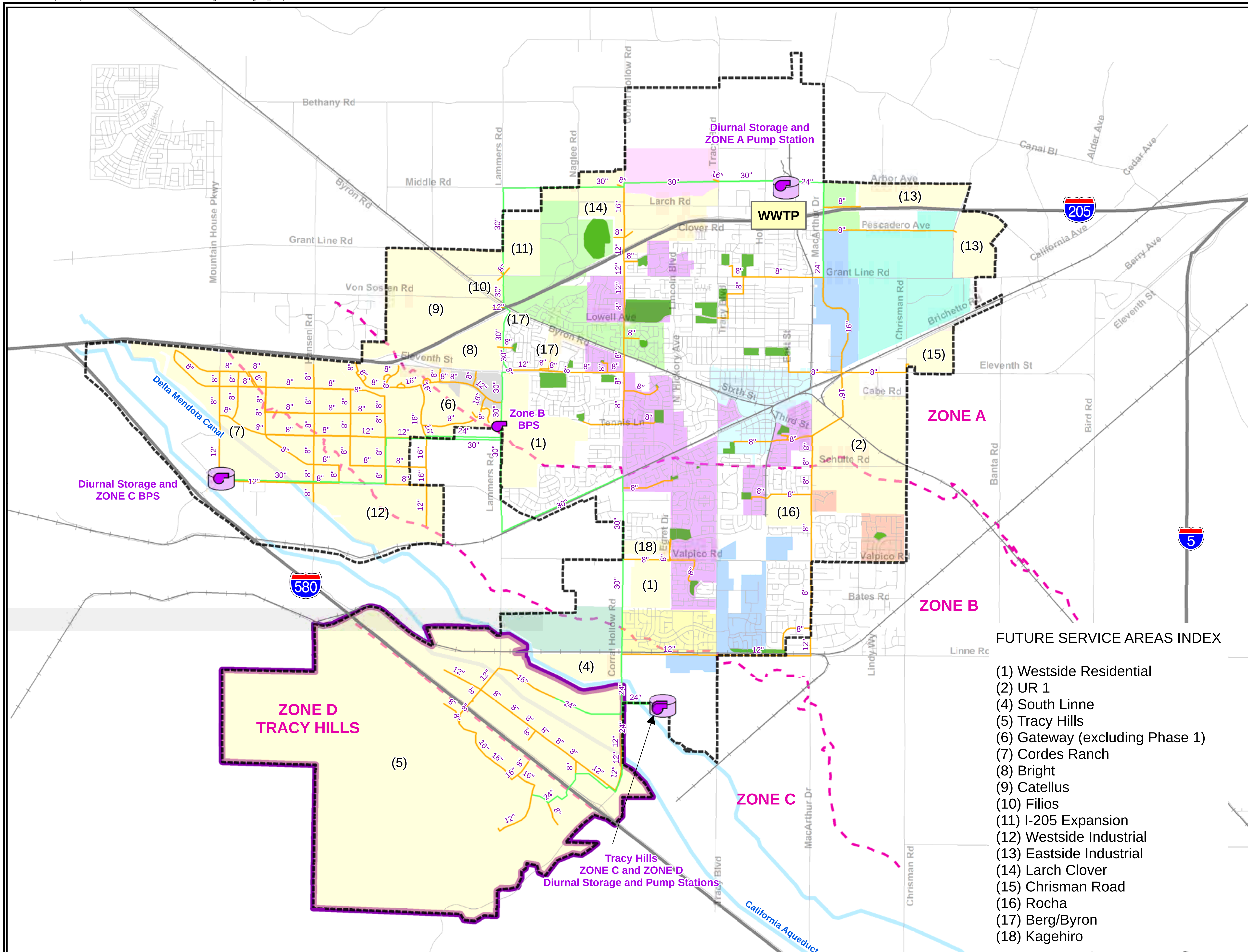
2 Equal to one-third of a maximum day demand. Flow into recycled water storage would be 9,300 gpm for 16 hours, which equals 9 million gallons prior to pumping out at 28,800 gpm. To avoid draining the recycled water storage completely every night during peak demand periods, a 10 percent safety factor was included, bringing the recommended diurnal storage to 10 million gallons.

O:\Clients\404 City of Tracy\02-09-76 Water Master Plan Phase 1\GIS\Figures\Ch 9\Fig 9-1_Recycled11x17.mxd 3/6/2012

FIGURE 9-1

City of Tracy
Water System Master Plan

PROPOSED RECYCLED WATER SYSTEM



0 2,640 5,280
Scale in Feet

NOTES:

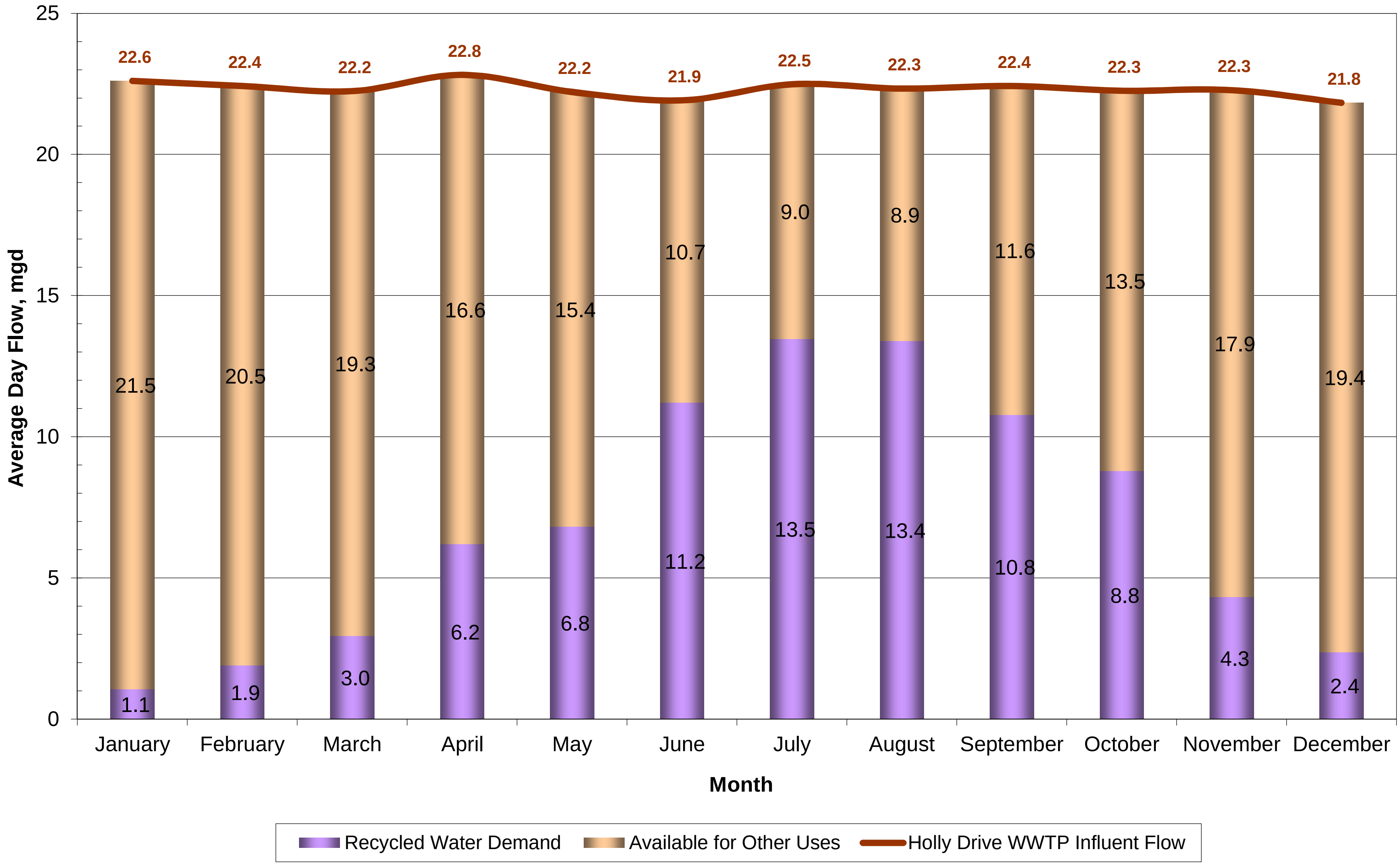
1. Zone B BPS location is tentative. Additional piping would be required if another location is selected.

LEGEND

- Diameter ≤ 16 inches
- 16 inches < Diameter ≤ 30 inches
- Residential Areas Specific Plan
- Industrial Areas Specific Plan
- I-205 Corridor Specific Plan
- Plan "C"
- Northeast Industrial Specific Plan
- South MacArthur
- Downtown Specific Plan
- Ellis Specific Plan
- Tracy Gateway - Phase 1
- Holly Sugar Sports Park
- Future Service Area (see Index)
- Park/Irrigated Area
- SOI
- Tracy Hills WRF Service Area
- Zone Boundary
- Highway
- Existing Street
- Railroad

WEST YOST ASSOCIATES
Consulting Engineers

Figure 9-2. Holly Drive WWTP Flow Balance



CHAPTER 10
Recommended Capital Improvement Program

10.1 OVERVIEW

This chapter presents the recommended capital improvement program (CIP) for the City's existing and buildout potable water systems and proposed buildout recycled water system to support the City's projected buildout potable and recycled water demands, respectively. Recommendations for improvements to the existing and buildout potable water systems were described previously in Chapters 7 and 8, respectively. In addition, infrastructure recommendations for the proposed buildout recycled water system were described previously in Chapter 9. It should be noted that the recommended CIP only identifies improvements at a Master Plan level and does not necessarily include all required on-site infrastructure or constitute design of improvements. Subsequent detailed design is required to determine the exact sizes and locations of these proposed improvements.

This chapter provides a summary of the recommended capital improvement projects, along with estimates of probable construction costs. Probable construction cost estimates will be developed individually for each proposed improvement project, and then further allocated to existing rate payers and new development based on the need for and benefit provided by the proposed improvement. For example, the cost for a pipeline improvement to increase the fire flow availability in the existing potable water system will be allocated to existing rate payers, but a new pipeline required to serve buildout potable water demands will be allocated to new development. An additional analysis to evaluate the potential development impact fees that will be required to fund the buildout potable and recycled water system capital improvement costs, which have been allocated to new development, will be provided in a separate memorandum.

Construction costs are presented in 2012 dollars and were developed based on bids from other municipal water facility design projects and standard cost estimating guides. The total CIP cost will include mark-ups equal to 40 percent of the estimated base construction costs (per City of Tracy direction) to allow for general contingency, design and planning, construction management, and program administration as listed below:

- General Contingency: 15 percent
- Design and Planning: 10 percent
- Construction Management: 10 percent
- Program Administration: 5 percent

For this Citywide Water System Master Plan, it is assumed that land for buildout potable and recycled water facilities will be acquired at $150,000 per acre. Costs for land acquisition will only be added to major facilities such as tank sites where a large parcel is required. Consequently, land acquisition costs do not include right-of-way acquisition costs for transmission and distribution mains. In addition, the proposed construction costs do not include costs for acquisition of additional surface water supplies, supply reliability, or for annual operation and maintenance. A complete description of the assumptions used in the development of the estimated probable construction costs is provided in Appendix G.

As discussed previously in Chapters 8 and 9, infrastructure to serve the Tracy Hills development was evaluated as part of the overall buildout potable and recycled water system operations; however, costs for infrastructure recommended specifically for Tracy Hills will not be included in this Citywide Water System Master Plan because Tracy Hills has an approved Master Plan and is generally viewed as a "stand-alone" development separated from the City's other system facilities. Therefore, costs for Tracy Hills infrastructure will be evaluated in conjunction with the revised Tracy Hills Master Plan and subsequent evaluations to be prepared for the Tracy Hills development. However, total costs for any shared facilities (*e.g.*, JJWTP expansion and recycled water transmission main from the City's Holly Drive WWTP) are included in this Citywide Water System Master Plan and a proportionate share of the costs of these shared facilities will be allocated to the Tracy Hills development. The cost allocations will be evaluated and presented in a separate memorandum.

The following sections of this chapter describe the components of the potable and recycled water system capital improvement program developed for this Citywide Water System Master Plan:

- Recommended Potable Water System Capital Improvement Program
- Recommended Recycled Water System Capital Improvement Program
- Capital Improvement Program Implementation

10.2 RECOMMENDED POTABLE WATER SYSTEM CAPITAL IMPROVEMENT PROGRAM

Summaries of the recommended capital improvement projects for the existing and buildout potable water systems are presented below in *Section 10.2.1 Existing Potable Water System Improvements* and *Section 10.2.2 Buildout Potable Water System Improvements*, respectively. Preliminary capital cost estimates for the recommended existing and buildout potable water system improvements are presented in *Section 10.2.3 Recommended Potable Water System CIP Costs*, which also discusses the proposed cost allocation between existing rate payers and new development.

10.2.1 Existing Potable Water System Improvements

Chapter 7 provided a summary of the evaluation of the City's existing potable water system and its ability to meet the recommended water system operational and design criteria described in Chapter 6. Based on the existing potable water system evaluation, improvements were recommended to eliminate existing system deficiencies, as listed in the following section.

- Pipeline Improvement[1]

  1a. Replace existing 12-inch diameter pipelines located on Sixth Street and Tracy Boulevard with 18-inch diameter pipelines to reduce high pipeline velocities simulated during a peak hour demand condition.

  1b. Replace existing 12-inch diameter pipeline located on Eleventh Street, east of Tracy Boulevard with a 16-inch diameter pipeline to reduce pipeline velocity once the 18-inch diameter pipelines are installed on Sixth Street and Tracy Boulevard.

  2. Replace existing 4-inch diameter pipeline located along Tracy Boulevard between Fourth Street and Mt. Diablo Avenue with a 12-inch diameter pipeline to improve fire flow availability.

- SCADA

  — Install SCADA system monitoring of flows and pressures at each pressure regulating station (PRS) to provide operators with additional understanding and flexibility in system operations.

  — Calibrate SCADA tags with data discrepancies to provide more accurate real-time system operations data.

The locations of the recommended existing potable water system improvement projects are shown on Figure 10-1. Preliminary capital cost estimates for the recommended existing potable water system improvements are presented in Table 10-1.

[1] The existing hydraulic model is not an "all pipes" model; therefore, the hydraulic simulations performed may not identify all necessary water system improvements. Consequently, it is recommended that City staff review older parts of the water system, where smaller diameter pipelines are typically found and consider possible upsizing of these pipelines, as the City plans for future pipeline renewal and replacement projects.

Table 10-1. Summary of Probable Construction Costs by Improvement for the Recommended Existing Potable Water System CIP[a]

Improvement Type	Improvement Description	CIP ID	Quantity		Estimated Construction Cost[b]	CIP Cost (includes mark-ups)[c,d]
Pipeline Improvement	Replace existing 4-inch diameter pipes on Tracy Blvd., between Fourth St. and Mt. Diablo Ave. with 12-inch diameter pipes	ECIP-PI-12	486	lf	102,060	143,000
Pipeline Improvement	Replace existing 12-inch diameter pipes on Eleventh St., east of Tracy Blvd. with 16-inch diameter pipes	ECIP-PI-16	43	lf	11,610	16,000
Pipeline Improvement	Replace existing 12-inch diameter pipes on Sixth St. and Tracy Blvd. with 18-inch diameter pipes	ECIP-PI-18	1,153	lf	345,900	484,000
SCADA	Pressure Regulating Station #1	ECIP-S-1	1	L.S.	100,000	140,000
SCADA	Pressure Regulating Station #2	ECIP-S-2	1	L.S.	100,000	140,000
SCADA	Pressure Regulating Station #3	ECIP-S-3	1	L.S.	100,000	140,000
SCADA	Pressure Regulating Station #4	ECIP-S-4	1	L.S.	100,000	140,000
SCADA	Pressure Regulating Station #5	ECIP-S-5	1	L.S.	100,000	140,000
SCADA	Calibrate SCADA tags w/ data discrepancies	ECIP-S-CAL	1	L.S.	100,000	140,000
					TOTAL	**$ 1,483,000**

[a] Costs shown are presented in 2012 dollars.

[b] Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

[c] Costs include mark-ups equal to 40 percent (General Contingency: 15 percent; Design and Planning: 10 percent; Construction Management: 10 percent; and Program Administration: 5 percent).

[d] Total rounded to nearest $1,000.

10.2.2 Buildout Potable Water System Improvements

Chapter 8 provided a summary of the evaluation of the City's buildout potable water system and its ability to meet the recommended water system operational and design criteria described in Chapter 6. Based on the buildout potable water system evaluation, backbone water system improvements were recommended to meet projected buildout potable water demands, as listed in the following section.

Note: The City and West Yost are currently in the process of revising the Ellis Specific Plan Water System Analysis TM; therefore, the potable water system infrastructure recommendations for the Ellis Specific Plan Project are subject to change.[2]

- Land Acquisition
  - To account for land acquisition costs, assume 1.5 acres will be required for each tank site.
  - To account for land acquisition costs, assume 0.25 acres will be required for each ASR well site.
- Water Treatment Plant Expansion
  - Expand the surface water treatment and intake pumping capacities at JJWTP by 21 mgd to provide additional treated surface water supply to meet buildout maximum day potable water demands.
- Storage Reservoir

  Note: Because the actual dimensions of each proposed storage tank has not been determined, the recommended storage facility sizes do not include dead and freeboard storage requirements, which will be determined during design.

  - To provide buildout water storage capacity, installation of the following storage facilities is recommended:
    - Install a new clearwell at the JJWTP with a minimum active storage capacity of 2.0 MG to provide storage for Zone 3-City-side.[3]
    - Catellus Tank - 1.0 MG.
    - Gateway Zone 1 Tank - 1.5 MG.
    - Gateway Zone 2 Tank - 1.5 MG.
    - Patterson Pass Tank - 0.5 MG.

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[2] On October 31, 2011 a Statement of Decision was issued by the Superior Court of California for the City to vacate and set aside the Development Agreement and all project approvals for the Ellis Specific Plan as a result of a lawsuit brought against the City by the Tracy Regional Alliance for a Quality Community. However, for purposes of this Water System Master Plan, the Ellis Specific Plan project has been included in the buildout potable and recycled water system evaluations. The status of the Ellis Specific Plan project is pending the City's appeal of the October 2011 decision.

[3] It was assumed that the new clearwell will have a minimum active (useable) storage capacity of 2.0 MG. The actual storage capacity of the new clearwell should be evaluated and refined as plans for the next JJWTP expansion are developed.

- ❖ Cordes Ranch Tank -1.5 MG.
- ❖ Zone 3-Tracy Hills Tank - 5.3 MG.
- ❖ Zone 4-Tracy Hills Tank - 3.5 MG.
- ❖ Zone 5-Tracy Hills Tank - 0.6 MG.

- Groundwater Well
  - — To provide emergency supply, installation of the following groundwater wells are required:
    - ❖ Gateway - ASR well with a minimum firm pumping capacity of 2,500 gpm.
    - ❖ Cordes Ranch - ASR well with a minimum firm pumping capacity of 2,500 gpm.
    - ❖ Ellis - ASR well with a minimum firm pumping capacity of 2,500 gpm.
- Booster Pump Station[4]
  - — To provide buildout water pumping capacity and to convey water from proposed partially buried storage reservoirs, installation of the following pumping facilities is recommended:
    - ❖ Zone 2 BPS (JJWTP) - Replace one existing small pump (design flow of 3,300 gpm) with a new pump with a design flow of 6,700 gpm (to match existing large pumps).
    - ❖ Zone 3-City-side BPS (JJWTP) - Booster pump station with a minimum firm pumping capacity of 4,500 gpm.
    - ❖ Zone 3-Tracy Hills BPS (JJWTP) - Booster pump station with a minimum firm pumping capacity of 2,400 gpm.
    - ❖ Zone 4-Tracy Hills BPS (JJWTP) - Booster pump station with a minimum firm pumping capacity of 1,700 gpm.
    - ❖ Zone 5-Tracy Hills BPS - Booster pump station with a minimum firm pumping capacity of 240 gpm.
    - ❖ Catellus Tank - Booster pump station with a minimum firm pumping capacity of 4,500 gpm.
    - ❖ Gateway Zone 1 Tank - Booster pump station with a minimum firm pumping capacity of 4,500 gpm.
    - ❖ Gateway Zone 2 Tank - Booster pump station with a minimum firm pumping capacity of 4,500 gpm.
    - ❖ Cordes Ranch Tank - Booster pump station with a minimum firm pumping capacity of 4,500 gpm.
- Pipeline Improvement
  - — To serve buildout potable water demands, upsize approximately 6,960 linear feet of existing pipelines within the proposed Downtown Specific Plan Project area, as listed in Table 10-2.

[4] Cost based on the firm pumping capacity required.

Table 10-2. Summary of Required Potable Water Pipeline Projects within Future Development Project Areas[a]

Future Development Project	Pipeline Improvement, lf								New Pipeline, lf[b]								Bore and Jack, lf								Total, lf
	8"	10"	12"	14"	16"	18"	20"	24"	8"	10"	12"	14"	16"	18"	20"	24"	8"	10"	12"	14"	16"	18"	20"	24"	
DEVELOPMENT PROJECTS w/ APPROVED WATER SUPPLY																									
Residential Areas Specific Plan	-	-	-	-	-	-	-	-	870	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	870
Industrial Areas Specific Plan	-	-	-	-	-	-	-	-	1,600	-	550	-	3,190	130	-	-	-	-	-	-	-	-	-	-	5,470
I-205 Corridor Specific Plan	-	-	-	-	-	-	-	-	-	2,990	9,480	-	-	-	-	-	-	-	80	-	-	-	-	-	12,550
Plan "C"	-	-	-	-	-	-	-	-	660	-	610	-	-	-	-	-	-	-	80	-	-	-	-	-	1,350
Northeast Industrial Specific Plan	-	-	-	-	-	-	-	-	-	-	13,910	-	-	-	-	-	-	-	-	-	-	-	-	-	13,910
South MacArthur	-	-	-	-	-	-	-	-	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	300
Downtown Specific Plan	870	1,360	4,730	-	-	-	-	-	1,080	-	2,580	-	220	-	-	-	80	-	-	-	-	-	-	-	10,920
Infill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ellis Specific Plan	-	-	-	-	-	-	-	-	44,420	-	15,410	-	3,010	940	-	-	-	-	-	-	-	80	-	-	63,860
Tracy Gateway - Phase 1	-	-	-	-	-	-	-	-	-	-	3,610	-	15,030	-	7,790	-	-	-	-	-	80	-	-	-	26,510
Holly Sugar Sports Park	-	-	-	-	-	-	-	-	1,490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,490
FUTURE SERVICE AREAS																									
Westside Residential (URs 5, 7, 8, 9)	-	-	-	-	-	-	-	-	-	-	14,860	-	-	-	-	-	-	-	-	-	-	-	-	-	14,860
UR 1	-	-	-	-	-	-	-	-	2,670	-	25,400	-	9,410	-	-	-	-	-	80	-	160	-	-	-	37,720
South Linne (UR 11)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tracy Hills	-	-	-	-	-	-	-	-	67,590	30,810	48,840	5,540	28,890	-	9,370	2,960	-	-	-	-	870	-	170	230	195,270
Tracy Gateway (excluding Phase 1)	-	-	-	-	-	-	-	-	-	-	7,320	-	11,620	-	3,800	-	-	-	-	-	280	-	-	-	23,020
Cordes Ranch (UR 6)	-	-	-	-	-	-	-	-	-	-	49,070	-	20,750	-	-	-	-	-	-	-	160	-	-	-	69,980
Bright (UR 4)	-	-	-	-	-	-	-	-	-	-	8,270	-	690	-	-	-	-	-	-	-	-	-	-	-	8,960
Catellus (UR 3)	-	-	-	-	-	-	-	-	-	-	17,120	-	2,770	-	-	-	-	-	-	-	230	-	-	-	20,120
Filios (UR 2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-205 Expansion	-	-	-	-	-	-	-	-	-	6,550	5,070	-	-	-	-	-	-	-	-	-	-	-	-	-	11,620
Westside Industrial	-	-	-	-	-	-	-	-	-	-	-	-	10,900	-	-	-	-	-	-	-	-	-	-	-	10,900
Eastside Industrial	-	-	-	-	-	-	-	-	-	-	16,940	-	-	-	-	-	-	-	400	-	-	-	-	-	17,340
Larch Clover	-	-	-	-	-	-	-	-	2,650	-	14,230	-	-	-	-	-	-	-	-	-	-	-	-	-	16,880
Chrisman Road	-	-	-	-	-	-	-	-	-	-	9,790	-	4,910	-	-	-	-	-	-	-	80	-	-	-	14,780
Rocha	-	-	-	-	-	-	-	-	2,920	-	2,400	-	-	-	-	-	-	-	-	-	-	-	-	-	5,320
Berg/Byron	-	-	-	-	-	-	-	-	-	-	7,550	-	-	-	-	-	-	-	-	-	-	-	-	-	7,550
Kagehiro	-	-	-	-	-	-	-	-	3,690	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,690
SHARED PIPELINES[c]																									
24-inch diameter pipeline on MacArthur Dr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,310	-	-	-	-	-	-	-	80	5,390
Zone 3-City-side BPS: 20-inch and 24-inch diameter pipelines	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32,800	30	-	-	-	-	-	-	740	-	33,570
TOTAL	870	1,360	4,730	-	-	-	-	-	129,940	40,350	273,010	5,540	111,390	1,070	53,760	8,300	80	-	640	-	1,860	80	910	310	634,200
SUBTOTAL	6,960								623,360								3,880								--

[a] Lengths shown are rounded to the nearest ten.
[b] Includes conductor pipelines for bore and jack.
[c] The total costs of these pipeline projects will be shared between various future development projects.

- New Pipeline plus Bore and Jack[5]
  - — To serve buildout potable water demands, install approximately 623,360 linear feet of new pipelines ranging in diameter from 8 to 24-inches as listed in Table 10-2.
  - — To serve buildout potable water demands, bore and jack approximately 3,880 linear feet of new pipelines as listed in Table 10-2.
- Interconnection
  - — To provide supply during peak demands and/or emergency conditions between pressure zones, installation of the following pressure zone interconnections is recommended:
    - ❖ PRS #6 (from Zone 2 into Zone 1)
    - ❖ PRS #7 (from Zone 2 into Zone 1)
    - ❖ PRS #8 (from Zone 3-City-side into Zone 2)
    - ❖ PRS #9 (from Zone 3-City-side into Zone 2)
    - ❖ PRS #10 (from Zone 3-City-side into Zone 2)
    - ❖ PRS #A (from Zone 3-City-side into Zone 3-Tracy Hills)
    - ❖ Ellis Zone 2 PRV Station (from Zone 3-City-side into Zone 2)
    - ❖ Zone 3-Tracy Hills PRV Station (from Zone 4-Tracy Hills into Zone 3-Tracy Hills)
    - ❖ Two (2) - Zone 4-Tracy Hills PRV Stations (from Zone 5-Tracy Hills into Zone 4-Tracy Hills)

  Note: The estimated probable construction costs do not include costs to install individual PRVs on water service connections with static pressures exceeding 80 psi as these will be the responsibility of individual developer(s) to install.
- Backup Generator
  - — To provide water supply in the event of a power outage, installation of an on-site backup power generator at each of the following groundwater wells is recommended:
    - ❖ Gateway ASR Well
    - ❖ Cordes Ranch ASR Well
    - ❖ Ellis ASR Well

The locations of the recommended buildout potable water system improvement projects are shown on Figure 10-2. Additional detailed maps illustrating the proposed pipeline projects for the buildout potable water system is provided in Appendix H. Preliminary capital cost estimates for the recommended buildout potable water system improvements are presented in Table 10-3. As shown in Table 10-3, recommended improvement projects for the Tracy Hills development are listed, but their respective costs have not been included, as these costs will be estimated when the revised Tracy Hills Specific Plan is developed.

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[5] The buildout hydraulic model was developed as a backbone system and is not an “all pipes” model; therefore, the hydraulic simulations performed may not identify all necessary water system improvements. Consequently, it is recommended that further hydraulic evaluations be performed as additional details are provided for each future development project.

Table 10-3. Summary of Probable Construction Costs by Improvement for the Recommended Buildout Potable Water System CIP[a]

Improvement Type	Improvement Description	CIP ID	Quantity		Estimated Construction Cost[b]	CIP Cost (includes mark-ups)[c,d]
Shared City-side Facilities						
Land Acquisition[e]	Tank Sites	BCIP-LA-T	4	sites	-	900,000
Land Acquisition[f]	ASR Well Sites	BCIP-LA-W	3	sites	-	113,000
JJWTP Expansion[g]	Expand existing JJWTP from 30 mgd to 51 mgd	BCIP-WTP	1	L.S.	63,000,000	88,200,000
Storage Reservoir[h]	2.0 MG Clearwell at JJWTP	BCIP-T-CW	1	L.S.	3,198,900	4,478,000
Storage Reservoir[h]	1.0 MG Catellus Tank	BCIP-T-CA	1	L.S.	2,422,020	3,391,000
Storage Reservoir[h]	1.5 MG Tracy Gateway Zone 1 Tank	BCIP-T-GAZ1	1	L.S.	2,810,460	3,935,000
Storage Reservoir[h]	1.5 MG Tracy Gateway Zone 2 Tank	BCIP-T-GAZ2	1	L.S.	2,810,460	3,935,000
Storage Reservoir[h]	0.5 MG Patterson Pass Tank	BCIP-T-PP	1	L.S.	2,033,580	2,847,000
Storage Reservoir[h]	1.5 MG Cordes Ranch Tank	BCIP-T-CR	1	L.S.	2,810,460	3,935,000
Groundwater Well	2,500 gpm ASR Well in Tracy Gateway	BCIP-W-GA	1	L.S.	3,100,000	4,340,000
Groundwater Well	2,500 gpm ASR Well in Cordes Ranch	BCIP-W-CR	1	L.S.	3,100,000	4,340,000
Groundwater Well	2,500 gpm ASR Well in Ellis	BCIP-W-EL	1	L.S.	3,100,000	4,340,000
Booster Pump Station[i,j]	9.65 mgd at Zone 2 BPS (JJWTP)	BCIP-PS-Z2	1	L.S.	714,290	1,000,000
Booster Pump Station[i]	6.48 mgd at Zone 3-City-side BPS (JJWTP)	BCIP-PS-Z3	1	L.S.	1,822,595	2,552,000
Booster Pump Station[i]	6.48 mgd at Catellus Tank	BCIP-PS-CA	1	L.S.	1,822,595	2,552,000
Booster Pump Station[i]	6.48 mgd at Tracy Gateway Zone 1 Tank	BCIP-PS-GAZ1	1	L.S.	1,822,595	2,552,000
Booster Pump Station[i]	6.48 mgd at Tracy Gateway Zone 2 Tank	BCIP-PS-GAZ2	1	L.S.	1,822,595	2,552,000
Booster Pump Station[i]	6.48 mgd at Cordes Ranch Tank	BCIP-PS-CR	1	L.S.	1,822,595	2,552,000
Pipeline Improvement	8-inch diameter	BCIP-PI-8	870	lf	134,850	189,000
Pipeline Improvement	10-inch diameter	BCIP-PI-10	1,360	lf	238,000	333,000
Pipeline Improvement	12-inch diameter	BCIP-PI-12	4,730	lf	993,300	1,391,000
New Pipeline (Developed Area)	8-inch diameter	BCIP-PD-8	6,000	lf	930,000	1,302,000
New Pipeline (Developed Area)	10-inch diameter	BCIP-PD-10	2,990	lf	523,250	733,000
New Pipeline (Developed Area)	12-inch diameter	BCIP-PD-12	20,770	lf	4,361,700	6,106,000
New Pipeline (Developed Area)	14-inch diameter	BCIP-PD-14	-	lf	-	-
New Pipeline (Developed Area)	16-inch diameter	BCIP-PD-16	3,410	lf	920,700	1,289,000
New Pipeline (Developed Area)	18-inch diameter	BCIP-PD-18	130	lf	39,000	55,000
New Pipeline (Developed Area)	20-inch diameter	BCIP-PD-20	-	lf	-	-
New Pipeline (Developed Area)	24-inch diameter	BCIP-PD-24	5,310	lf	1,991,250	2,788,000
New Pipeline (Undeveloped Area)	8-inch diameter	BCIP-PU-8	56,350	lf	7,325,500	10,256,000
New Pipeline (Undeveloped Area)	10-inch diameter	BCIP-PU-10	6,550	lf	982,500	1,376,000
New Pipeline (Undeveloped Area)	12-inch diameter	BCIP-PU-12	203,400	lf	36,612,000	51,257,000
New Pipeline (Undeveloped Area)	14-inch diameter	BCIP-PU-14	-	lf	-	-
New Pipeline (Undeveloped Area)	16-inch diameter	BCIP-PU-16	79,090	lf	18,190,700	25,467,000
New Pipeline (Undeveloped Area)	18-inch diameter	BCIP-PU-18	940	lf	239,700	336,000
New Pipeline (Undeveloped Area)	20-inch diameter	BCIP-PU-20	44,390	lf	12,207,250	17,090,000
New Pipeline (Undeveloped Area)	24-inch diameter	BCIP-PU-24	30	lf	9,600	13,000
Bore and Jack	8-inch diameter (16-inch casing)	BCIP-BJ-8	80	lf	33,600	47,000
Bore and Jack	12-inch diameter (21-inch casing)	BCIP-BJ-12	640	lf	307,200	430,000
Bore and Jack	16-inch diameter (24-inch casing)	BCIP-BJ-16	990	lf	549,450	769,000
Bore and Jack	18-inch diameter (24-inch casing)	BCIP-BJ-18	80	lf	44,400	62,000
Bore and Jack	20-inch diameter (30-inch casing)	BCIP-BJ-20	740	lf	506,900	710,000
Bore and Jack	24-inch diameter (30-inch casing)	BCIP-BJ-24	80	lf	54,800	77,000
Interconnection	Pressure Regulating Station #6 (12-inch)	BCIP-PRS-6	1	L.S.	200,000	280,000
Interconnection	Pressure Regulating Station #7 (12-inch)	BCIP-PRS-7	1	L.S.	200,000	280,000
Interconnection	Pressure Regulating Station #8 (12-inch)	BCIP-PRS-8	1	L.S.	200,000	280,000
Interconnection	Pressure Regulating Station #9 (12-inch)	BCIP-PRS-9	1	L.S.	200,000	280,000
Interconnection	Pressure Regulating Station #10 (12-inch)	BCIP-PRS-10	1	L.S.	200,000	280,000
Interconnection	Ellis Zone 2 PRV (12-inch)	BCIP-PRV-EL	1	L.S.	100,000	140,000
Backup Generator	ASR Well in Tracy Gateway	BCIP-BU-W-GA	1	L.S.	200,000	280,000
Backup Generator	ASR Well in Cordes Ranch	BCIP-BU-W-CR	1	L.S.	200,000	280,000
Backup Generator	ASR Well in Ellis	BCIP-BU-W-EL	1	L.S.	200,000	280,000
					SUBTOTAL	*262,970,000*
Specific Facilities for Tracy Hills[k]						
Land Acquisition	Tank Sites	BCIP-LA-THT	1	L.S.	-[l]	-[l]
Storage Reservoir[h]	5.3 MG Zone 3-Tracy Hills Tank	BCIP-T-THZ3	1	L.S.	-[l]	-[l]
Storage Reservoir[h]	3.5 MG Zone 4-Tracy Hills Tank	BCIP-T-THZ4	1	L.S.	-[l]	-[l]
Storage Reservoir[h]	0.6 MG Zone 5-Tracy Hills Tank	BCIP-T-THZ5	1	L.S.	-[l]	-[l]
Booster Pump Station[i]	3.46 mgd at Zone 3-Tracy Hills BPS (JJWTP)	BCIP-PS-THZ3	1	L.S.	-[l]	-[l]
Booster Pump Station[i]	2.45 mgd at Zone 4-Tracy Hills BPS (JJWTP)	BCIP-PS-THZ4	1	L.S.	-[l]	-[l]
Booster Pump Station[i]	0.35 mgd at Zone 5-Tracy Hills BPS	BCIP-PS-THZ5	1	L.S.	-[l]	-[l]
New Pipeline (Undeveloped Area)	8-inch diameter	BCIP-PU-8	67,590	lf	-[l]	-[l]
New Pipeline (Undeveloped Area)	10-inch diameter	BCIP-PU-10	30,810	lf	-[l]	-[l]
New Pipeline (Undeveloped Area)	12-inch diameter	BCIP-PU-12	48,840	lf	-[l]	-[l]
New Pipeline (Undeveloped Area)	14-inch diameter	BCIP-PU-14	5,540	lf	-[l]	-[l]
New Pipeline (Undeveloped Area)	16-inch diameter	BCIP-PU-16	28,890	lf	-[l]	-[l]
New Pipeline (Undeveloped Area)	20-inch diameter	BCIP-PU-20	9,370	lf	-[l]	-[l]
New Pipeline (Undeveloped Area)	24-inch diameter	BCIP-PU-24	2,960	lf	-[l]	-[l]
Bore and Jack	16-inch diameter (24-inch casing)	BCIP-BJ-16	870	lf	-[l]	-[l]
Bore and Jack	20-inch diameter (30-inch casing)	BCIP-BJ-20	170	lf	-[l]	-[l]
Bore and Jack	24-inch diameter (30-inch casing)	BCIP-BJ-24	230	lf	-[l]	-[l]
Interconnection	Pressure Regulating Station #A (12-inch)	BCIP-PRS-A	1	L.S.	-[l]	-[l]
Interconnection	Zone 3-Tracy Hills PRV (12-inch)	BCIP-PRV-THZ3	1	L.S.	-[l]	-[l]
Interconnection	Zone 4-Tracy Hills PRV 1 (12-inch)	BCIP-PRV-THZ4-1	1	L.S.	-[l]	-[l]
Interconnection	Zone 4-Tracy Hills PRV 2 (12-inch)	BCIP-PRV-THZ4-2	1	L.S.	-[l]	-[l]
					SUBTOTAL	-
					TOTAL[l]	**$ 262,970,000**

[a] Costs shown are presented in 2012 dollars.
[b] Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.
[c] Costs include mark-ups equal to 40 percent (General Contingency: 15 percent; Design and Planning: 10 percent; Construction Management: 10 percent; and Program Administration: 5 percent).
[d] Total rounded to nearest $1,000.
[e] Assumes each tank site is 1.5 acres. Cost includes Catellus, Tracy Gateway Zone 1 and 2, and Cordes Ranch Tank sites.
[f] Assumes each ASR well site is 0.25 acres. Cost includes Tracy Gateway, Cordes Ranch and Ellis ASR Well sites.
[g] Cost does not include purchase price of additional water supplies, supply reliability, or intake structure.
[h] Recommended volume based on active volume. Cost assumes the construction of a partially buried prestressed concrete tank.
[i] Recommended capacity based on firm pumping capacity.
[j] Cost is only for the materials and installation of the new booster pump, and does not include related sitework such as pump house, backup power, etc. since this is an existing pump station.
[k] A proportionate share of the JJWTP Expansion cost will be allocated to the Tracy Hills development.
[l] No water system infrastructure costs are provided for the Tracy Hills development, as these costs will be estimated when the revised Tracy Hills Specific Plan is developed.

10.2.3 Recommended Potable Water System CIP Costs

Preliminary capital cost estimates for the recommended existing and buildout potable water system improvements are presented in Tables 10-1 and 10-3, respectively. As shown, the total existing potable water system CIP cost is estimated to be $1.5 million, and the total buildout potable water system CIP cost (excluding infrastructure recommended specifically for the Tracy Hills development) is estimated to be $263.0 million. The total CIP costs should be appropriately allocated to existing rate payers and new development as shown in Tables 10-1 and 10-3, respectively.

The total preliminary cost of potable water system improvements to support the City's existing and buildout potable water demands (excluding the Tracy Hills development) is estimated to be approximately $264.5 million. As discussed previously, an additional analysis to evaluate the potential development impact fees that will be required to fund the buildout potable and recycled water system capital improvement program will be provided in a separate memorandum.

10.3 RECOMMENDED RECYCLED WATER SYSTEM CAPITAL IMPROVEMENT PROGRAM

A summary of the recommended capital improvement projects for buildout of the recycled water system is presented below in *Section 10.3.1 Buildout Recycled Water System Improvements*. Preliminary capital cost estimates for the recommended buildout recycled water system improvements are presented in *Section 10.3.2 Recommended Recycled Water System CIP Costs*.

10.3.1 Buildout Recycled Water System Improvements

As discussed in Chapter 9, the buildout recycled water system is expected to consist of one system that encompasses the entire SOI. The buildout recycled water evaluation includes the Tracy Hills development because it will be a part of the City's overall future recycled water system operations since it will be served directly from the City's existing WWTP on Holly Drive. Including Tracy Hills will assist in the evaluation of the City's overall recycled water system at buildout. However, as discussed above, costs for recycled water system infrastructure recommended specifically for Tracy Hills will not be included in this Citywide Water System Master Plan. A summary of the recommended recycled water system components is presented below.

10.3.1.1 Recycled Water System Components

The recycled water system will consist of pipelines, pump stations, and diurnal storage facilities. Seasonal storage of recycled water is not required. The recommended pipelines, by development area, are summarized in Table 10-4. The recycled water model includes transmission pipelines that will be shared by all recycled water system users, distribution pipelines for the Gateway and Cordes Ranch future service areas (Future Service Areas 6 and 7 on Figure 10-3), and distribution pipelines for Tracy Hills.

Table 10-4. Summary of Recommended Recycled Water System Pipeline Length by Diameter

Nominal Diameter, inches	Length of Pipeline, feet				
	Cordes Ranch Pipelines[a]	Gateway Pipelines[a]	Tracy Hills Pipelines[a]	Shared Transmission Pipelines[b]	Total[c]
8	64,600	15,600	14,400	96,200	190,800
12	5,400	3,300	14,000	28,100	50,800
16	2,600	6,300	10,400	14,200	33,500
24	—	—	20,400	19,500	39,900
30	—	—	—	69,700	69,700
Total	72,600	25,200	59,200	227,700	384,700

(a) Cordes Ranch, Gateway, and Tracy Hills are proposing to use significant quantities of recycled water; therefore, required recycled water pipelines to be constructed within their respective project areas are shown here separately.
(b) Shared recycled water transmission pipelines are intended to deliver recycled water supplies to various developments located throughout the City.
(c) See Table 9-4.

A summary of the proposed recycled water booster pump stations is shown in Table 10-5.

Table 10-5. Recycled Water Distribution System Pump Station Design Criteria[a]

Pump Station	Area Served[b]	Design Flow Rate, gpm
Zone A[c]	All Recycled Water Distribution System	16,000
Zone B[d]	50% of Gateway, all of Cordes Ranch, all of Westside Industrial, 50% of Westside Residential, all of Tracy Hills, 25% of UR 1, South Linne, Rocha, Kagehiro, some City Parks	9,600
Zone C	50% of Cordes Ranch, 50% of Westside Industrial	2,830
Tracy Hills Zone C	60% of Tracy Hills	4,500
Tracy Hills Zone D	40% of Tracy Hills	3,000

(a) See Table 9-5.
(b) Indicates how much of each major future service area will be served by each pump station.
(c) Includes flow to all other pump stations.
(d) Includes flow to Zone C booster pump station and Tracy Hills.

Recycled water diurnal storage facilities are recommended at the booster pump station sites summarized in Table 10-5. A summary of the recycled water system proposed distribution storage tanks is shown in Table 10-6.

Table 10-6. Recycled Water Distribution System Storage[a]

Storage Tank	Area Served[b]	Storage Volume, million gallons
Holly Drive WWTP	All Zone A Developments and City Parks	3.0
Zone Storage at Zone A Hydraulic Grade	50% of Gateway, 50% of Cordes Ranch, 50% of Westside Industrial, 50% of Westside Residential, 25% of UR 1, South Linne, Rocha, Kagehiro, some City Parks	5.0
Tracy Hills	All of Tracy Hills	2.0
	Total	10.0

[a] See Table 9-7.
[b] Indicates how much of each major future service area will be served by each storage tank.

10.3.2 Recommended Recycled Water System CIP Costs

Preliminary capital cost estimates for the recommended buildout City-side recycled water system are presented in Table 10-7. These improvements include all the recommended recycled water facilities shown on Figure 10-3, except for infrastructure that has been recommended for Tracy Hills. Cost allocation between the various participating entities for the improvements shown in Table 10-7 will be discussed in a separate memorandum.

As discussed in Appendix G, unit construction costs for pipelines, booster pump stations, and storage tanks are essentially the same as for the potable water system. However, unit construction costs for recycled water system pipelines 8-inches and 12-inches in diameter are slightly less than for potable water pipelines because the 8-inch and 12-inch diameter recycled water pipelines are assumed to be constructed from PVC instead of ductile iron.

10.4 CAPITAL IMPROVEMENT PROGRAM IMPLEMENTATION

The construction of the capital improvements for the buildout potable and recycled water systems should be coordinated with the proposed schedules of new development to ensure that the required infrastructure will be in place to serve future customers when needed.

Table 10-7. Probable Construction Costs of Recycled Water System[a]

Pump Station	Size/Capacity	CIP Cost, $M[b,c]
Pipelines	Lineal Feet	
8-inch Diameter	176,400	31.9
12-inch Diameter	36,800	10.2
16-inch Diameter	23,100	8.2
24-inch Diameter	19,500	10.2
30-inch Diameter	69,700	44.4
Utility Crossings (Jack and Bore)	Lineal Feet	
8-inch Diameter (11th and Irrigation at Corral Hollow Road)	500	0.3
8-inch Diameter (Railroad at Corral Hollow)	200	0.1
16-inch Diameter (Railroad and Irrigation at MacArthur)	500	0.4
16-inch Diameter (Railroad at MacArthur Extension)	200	0.2
30-inch Diameter (11th and Irrigation at Lammers)	200	0.3
30-inch Diameter (Railroad and I-205 at Lammers/Byron)	200	0.3
30-inch Diameter (Irrigation at Lammers/W. Schulte)	200	0.3
30-inch Diameter (Irrigation at W. Schulte)	200	0.3
30-inch Diameter (Railroad at Corral Hollow/W. Schulte)	200	0.3
30-inch Diameter (Irrigation at Corral Hollow)	200	0.3
30-inch Diameter (Railroad at Corral Hollow/W. Linne)	200	0.3
Pump Stations[d]	mgd	
Zone A	23	7.3
Zone B	14	4.5
Zone C	4.1	2.4
Diurnal Storage[d]	MG	
Holly Drive WWTP	3.0	4.1
Zone Storage at Zone A Hydraulic Grade	5.0	6.2
Zone Storage in Tracy Hills	2.0	3.4
Other Cost Items	No. of Parks	
Cost of Converting City Parks to Recycled Water	29	2.3
Total CIP Cost	—	138.2

[a] Infrastructure recommended specifically for Tracy Hills is not included in this summary table. As discussed above, costs for Tracy Hills infrastructure will be evaluated in conjunction with the revised Tracy Hills Master Plan and subsequent evaluations to be prepared for the Tracy Hills development. However, shared infrastructure to convey recycled water from the Holly Drive WWTP to the Tracy Hills recycled water storage tanks is included in this summary table.
[b] Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.
[c] CIP costs include mark-ups equal to 40 percent (General Contingency: 15 percent; Design and Planning: 10 percent; Construction Management: 10 percent; and Program Administration: 5 percent) and are based on 2012 dollars.
[d] Property costs were included for the three storage tank/booster pump stations sites based on 2.0 acres for the Zone Storage at Zone A Hydraulic Grade. It is assumed that the Holly Drive WWTP tank and booster pump station will be on City property at the Holly Drive WWTP.

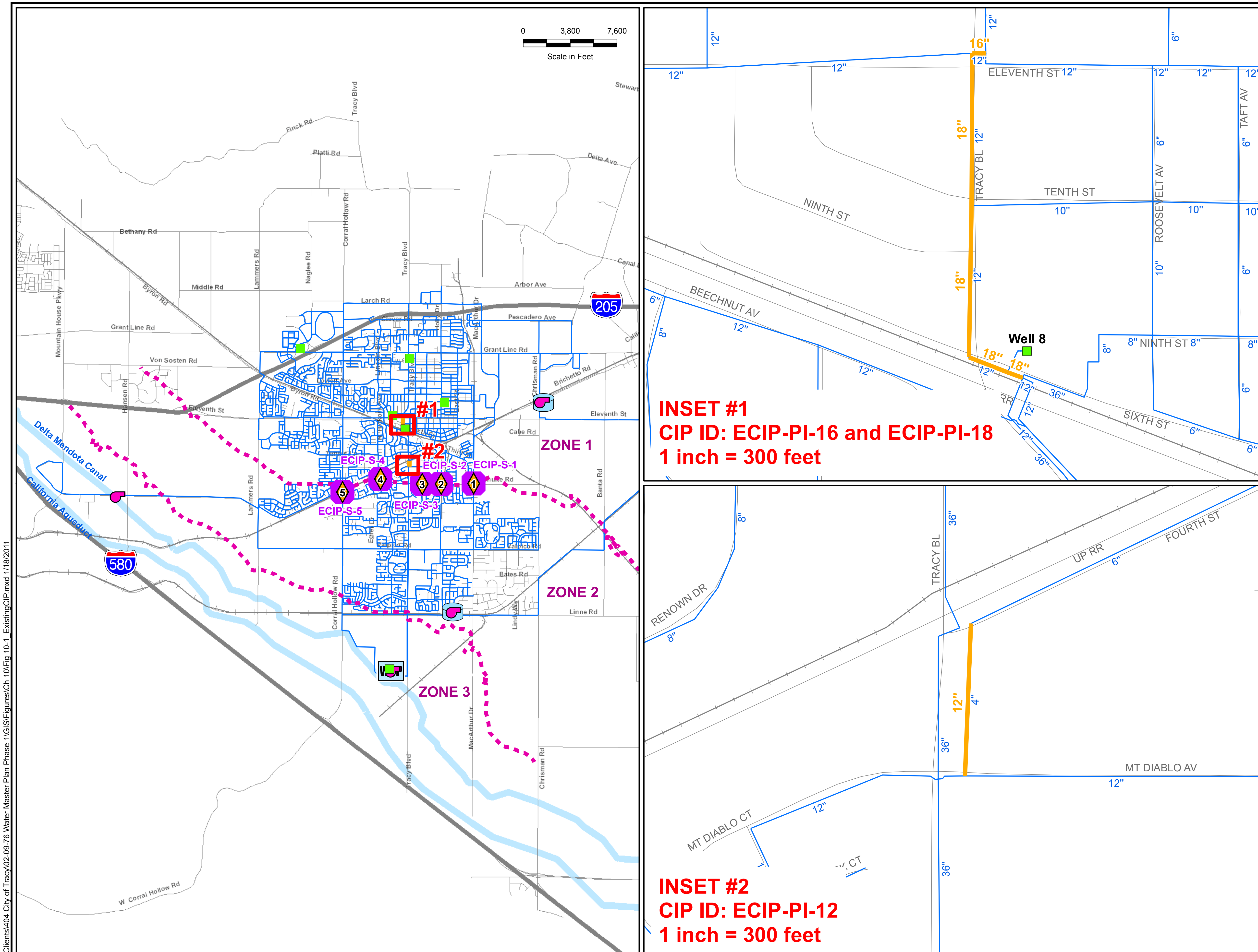

FIGURE 10-1

City of Tracy
Water System Master Plan

RECOMMENDED EXISTING POTABLE WATER SYSTEM CIP

NOTE

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.
2. Calibration of SCADA tags with data discrepancies is not shown on this figure, but is a part of the City's existing potable water system CIP (CIP ID: ECIP-S-CAL).

LEGEND

- SCADA System Improvement
- Pipeline Improvement
- Storage Tank
- Booster Pump Station
- Groundwater Well
- Pressure Regulating Station
- JJWTP
- Existing Pipeline
- Highway
- Street

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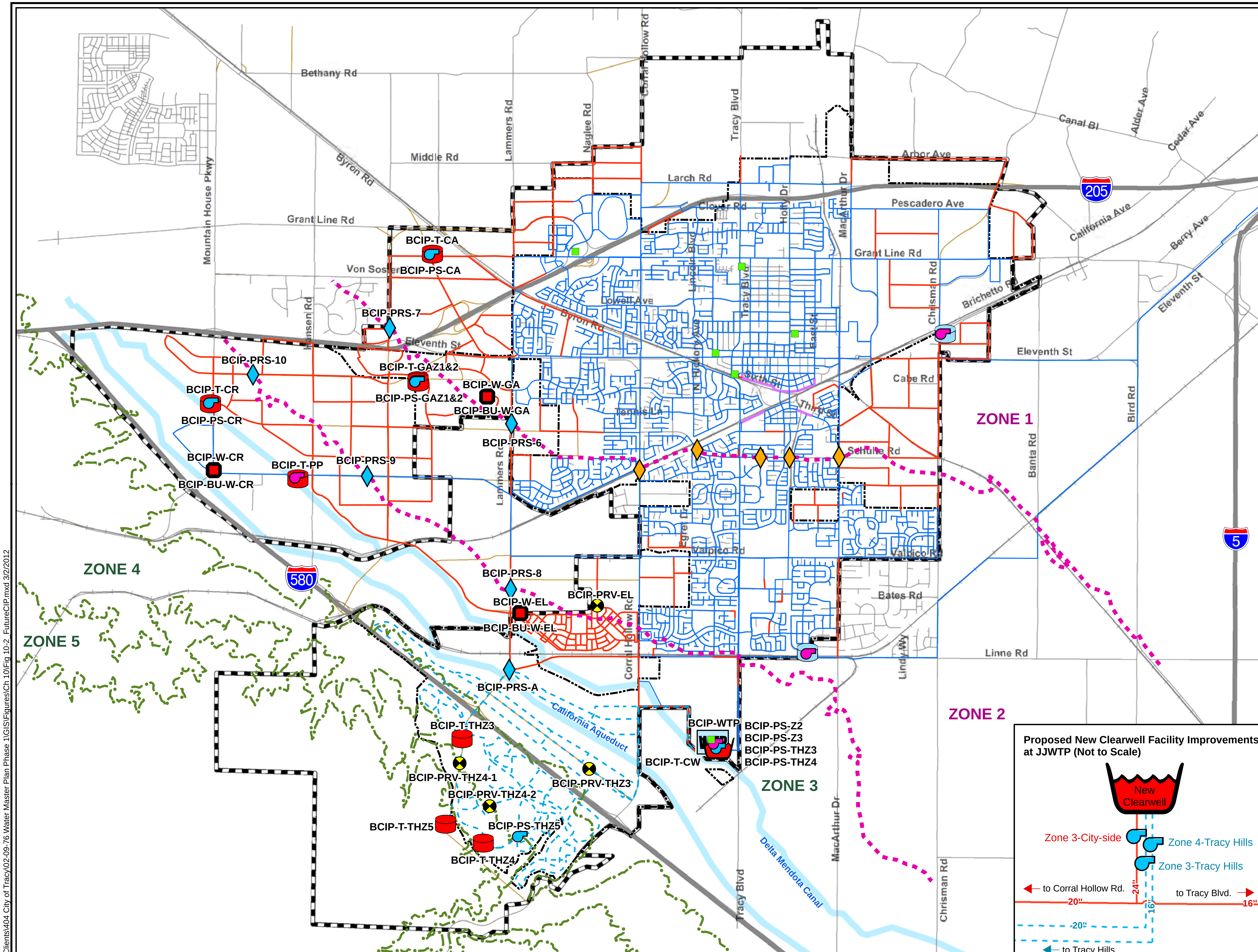
FIGURE 10-2

City of Tracy
Water System Master Plan

RECOMMENDED BUILDOUT POTABLE WATER SYSTEM CIP



NOTES

1. The City's existing hydraulic model is not an all pipes model. Therefore, not all existing pipes are shown.
2. Bore and jack pipeline projects are not shown, but is required for canal, railroad, or major highway crossings.
3. Individual PRVs on water service connections with static pressures exceeding 80 psi will be the responsibility of individual developer(s) to install.

LEGEND

- Proposed Pipeline
- Proposed Existing Pipeline Upsize
- Existing Pipeline
- Proposed Tracy Hills Pipeline
- Proposed Backup Power Generator
- Proposed Emergency PRV Connection
- Proposed Pressure Regulating Station
- Proposed ASR Groundwater Well
- Proposed Booster Pump Station
- Proposed Storage Tank
- Proposed Clearwell
- WTP JJWTP
- Existing Pressure Regulating Station
- Existing Groundwater Well
- Existing Booster Pump Station
- Existing Storage Tank
- SOI
- City Limits
- Proposed Street
- Existing Street

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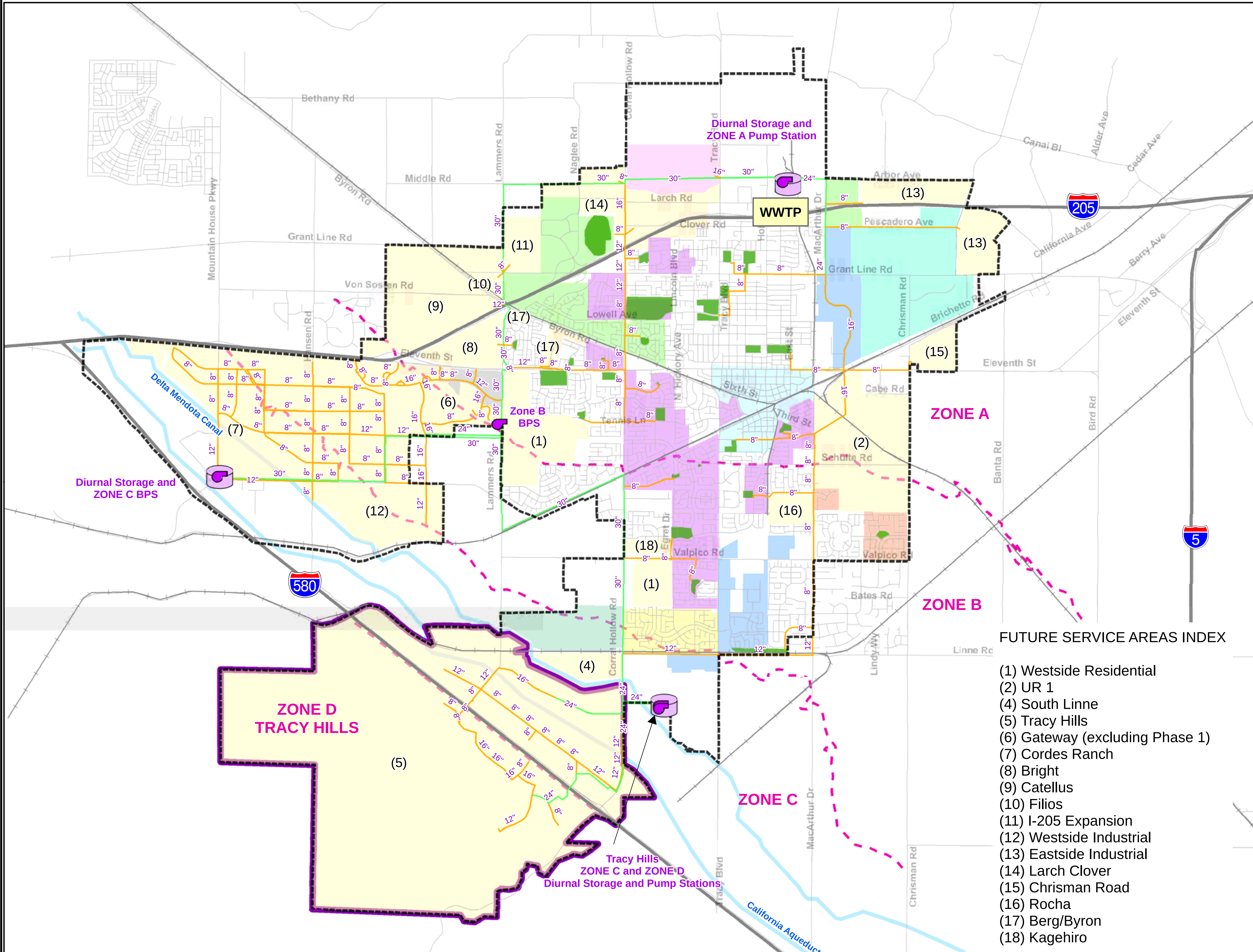
FIGURE 10-3

City of Tracy
Water System Master Plan

RECOMMENDED RECYCLED WATER SYSTEM CIP



0 2,640 5,280
Scale in Feet

NOTES:

1. Zone B BPS location is tentative. Additional piping would be required if another location is selected.

LEGEND

- Diameter ≤ 16 inches
- 16 inches < Diameter ≤ 30 inches
- Residential Areas Specific Plan
- Industrial Areas Specific Plan
- I-205 Corridor Specific Plan
- Plan "C"
- Northeast Industrial Specific Plan
- South MacArthur
- Downtown Specific Plan
- Ellis Specific Plan
- Tracy Gateway - Phase 1
- Holly Sugar Sports Park
- Future Service Area (see Index)
- Park/Irrigated Area
- SOI
- Tracy Hills WRF Service Area
- Zone Boundary
- Highway
- Existing Street
- Railroad

WEST YOST ASSOCIATES
Consulting Engineers