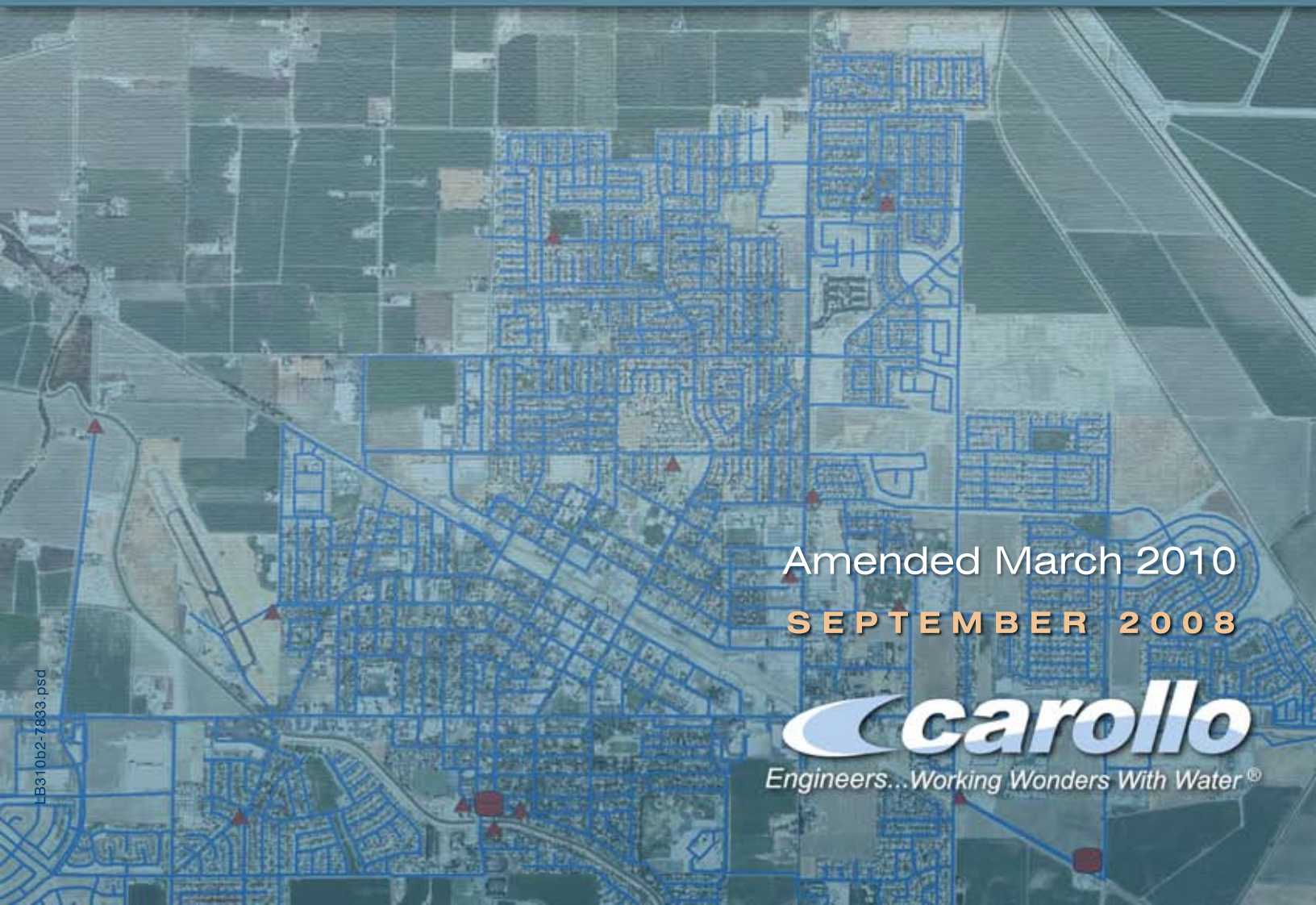
Final Report

MASTER PLAN FOR

City of Los Banos
At the Crossroads of California

Water Distribution System



Amended March 2010

SEPTEMBER 2008

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March 31, 2010
7833A03

City of Los Banos
411 Madison Avenue
Los Banos, California 93635

Attention: Mr. Mark Fachin, P.E.

Subject: City of Los Banos Final Water Distribution System Master Plan
Amended March 2010

Dear Mr. Fachin:

We are pleased to submit 10 copies of the amended final report for the City of Los Banos (City) Water Distribution System Master Plan (Master Plan). The Master Plan includes: planning assumptions, the distribution system evaluation, and recommended improvements to correct existing deficiencies and to serve future customers. This amended report incorporates the recent changes to land use assumptions and planning boundaries described in the City's 2030 General Plan Update.

Adjustments to the phasing of recommended improvements have also been included to account for the recent slowdown in development and current economic conditions. If economic, development and/or funding conditions change, then the City should revisit the phasing assumptions and consider implementing the recommended improvements at an earlier date, in particular, those that mitigate existing deficiencies.

We would like to extend our thanks to you, Mr. Gary Hutsell, Assistant Public Works Director; and other City staff whose courtesy and cooperation were valuable components in ensuring that this document will assist the City in planning infrastructure improvements to serve its customers.

Sincerely,

CAROLLO ENGINEERS, P.C.

David L. Stringfield, P.E.

Jose L. Gutierrez, P.E.

DLS:JLG:asw

Enclosures: Amended Final Water Distribution System Master Plan (10)

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City of Los Banos

WATER DISTRIBUTION SYSTEM MASTER PLAN

Amended March 2010
September 2008

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City of Los Banos

WATER DISTRIBUTION SYSTEM MASTER PLAN

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WATER DISTRIBUTION SYSTEM MASTER PLAN

ES.1 INTRODUCTION

The City of Los Banos (City) is located in western Merced County (County), in the northern portion of the San Joaquin Valley. The City is located near the junction of California State Route (SR)-152 and Interstate 5. Los Banos is the second largest city in the County.

The City owns, maintains, and operates water supply wells, storage tanks, and water lines throughout the City. The City oversees over 142 miles of water lines spanning 4- to 30-inches in diameter, 13 wells, one water tower, and one above ground water storage tank. In addition to these major facilities, the City also maintains thousands of water valves and hydrants throughout the City. The City pumps, stores, and delivers water to its residential, commercial, institutional, and industrial customers within its service area.

The City currently relies on groundwater from the Delta-Mendota groundwater subbasin to provide water to its users. Surface water and recycled water sources are not currently utilized by the City. The Delta-Mendota Subbasin is bounded on the west by the Coast Ranges, and on the north by the Stanislaus/San Joaquin County line[1]. The eastern boundary follows the San Joaquin River.

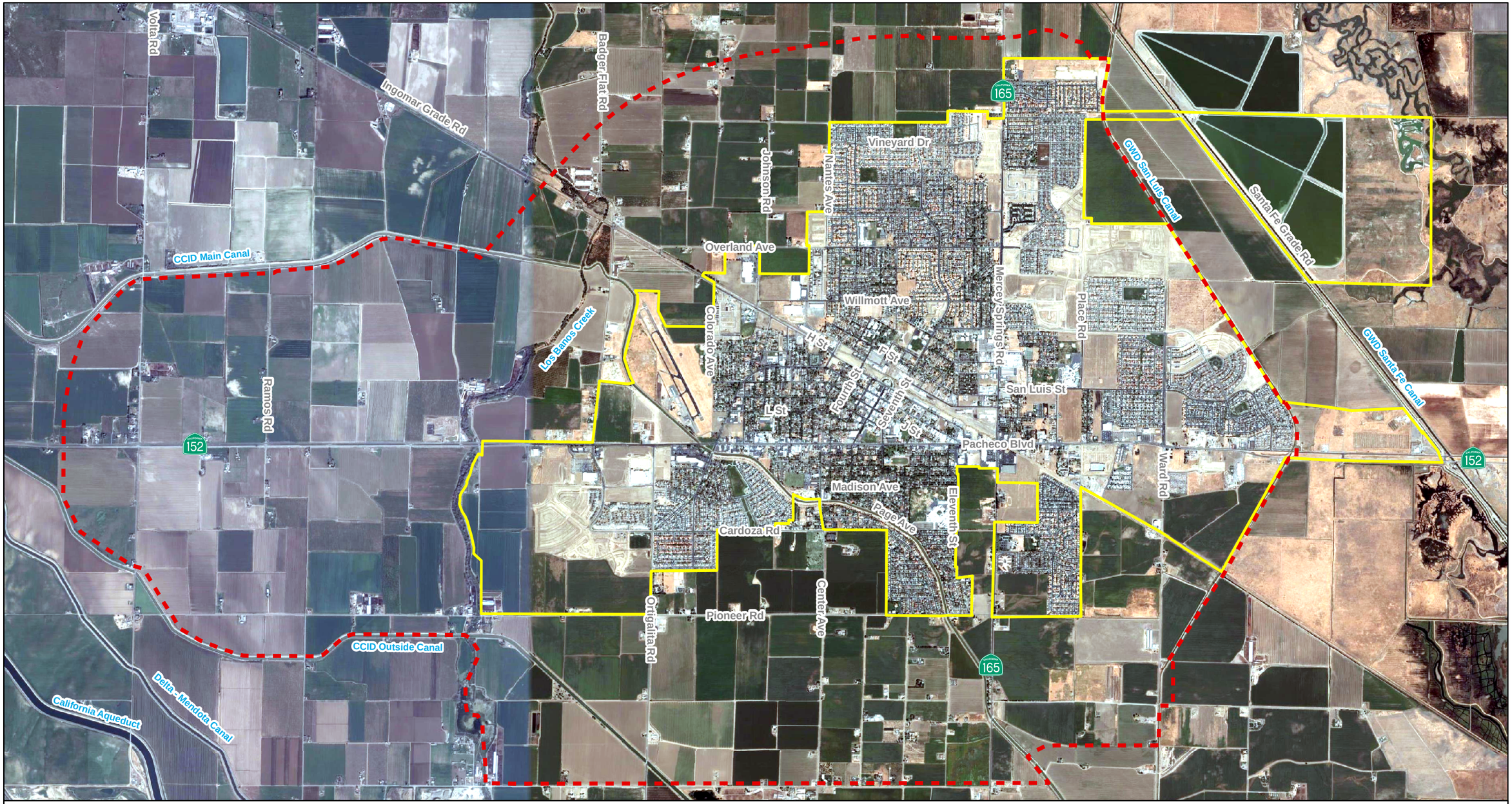
ES.2 STUDY AREA

The City's 2030 General Plan Update (2030 General Plan) sphere of influence (SOI) is the study area boundary for this water distribution system master plan (Master Plan). The Master Plan study area boundary and SOI are synonymous and will be used interchangeably throughout this report. The SOI boundary extends far beyond the current water distribution service area and is approximately 14,382 acres (22.5 square miles). The Master Plan contains a forecast of water system improvements in a large study area beyond the City limits. Figure ES.1 shows the study area boundary and the City's limits. Evaluating infrastructure needs beyond the City limits is important because: there are conceptual development plans that are beyond the City limits; and recent rapid growth in the San Joaquin Valley indicates that significant development into the study area could occur within a short planning period.

ES.3 EXISTING AND FUTURE SERVICE AREA

The land use designations (residential, commercial, etc.) used in this Master Plan are consistent with the City's 2030 General Plan. The type of land use in an area will affect the water demand, including daily variation in the demand.

[1] Delta-Mendota Subbasin Description and Information, DWR Bulletin 118 - Update 2003



Legend

Sphere of Influence[1]

City Limits

N

0 2,500 5,000 Feet

Figure ES.1
Study Area
Water Distribution System Master Plan
City of Los Banos

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1. Sphere of Influence from City of Los Banos 2030 General Plan Update, Dyett & Bhatia, July 2009

The City currently provides water service to approximately 4,582 acres (includes developed and undeveloped land) or 7.2 square miles. Note that the acreage total does not include land occupied by the WWTP because the treatment plant is located outside of the SOI. The largest land use category is residential (low, medium, and high), which accounts for approximately 2,279 acres, or approximately 50 percent of the total acreage. Commercial, office/professional, and industrial make up approximately 925 acres, or 20 percent of the total. Civic/Institutional makes up approximately 181 acres, or 4 percent. Land uses like parks, streets, and open space account for 1,197 acres, or 26 percent of the total service area.

At build-out of the SOI boundary, the City will serve approximately 14,382 acres or 22.5 square miles, which is about three times the current service area. Build-out is defined as complete development of all lands. Residential will continue to represent the largest land use category in the City and will make up approximately 38 percent of the total acreage.

ES.4 HISTORICAL AND FUTURE POPULATION

The City's population began to grow quickly after World War II owing to returning veterans and highway construction. A series of irrigation and dam projects in the 1960s brought more people to the City, however, growth slowed from 1970 to 1985. In 1990, the City's population began to grow rapidly and continued through year 2007. From 1990 through the present, the population grew from approximately 14,500 to 35,200. Over the last 20 years, the City has grown at an annual rate of about 5.1 percent.

The 2030 General Plan states that the build-out population will reach approximately 90,400 people. This build-out population reflects an annual growth rate that ranges between 4.1 to 4.6 percent. Table ES.1 summarizes the existing and projected year 2030 population.

Table ES.1 Existing and Projected Year 2030 Population
Water Distribution System Master Plan
City of Los Banos

Year	Population
2007	35,200
2030	90,400

Note:
1. Source of historical data: City of Los Banos 2030 General Plan Update, July 2009.

ES.5 HISTORICAL AND FUTURE WATER DEMANDS

The per capita consumption rate is equal to the City's average day demand (ADD) divided by its population. Between 2000 and 2007, the average per capita demand ranged between

161 gallons per capita per day (gpcd) to 240 gpcd, and averaged 210 gpcd, based on metered water deliveries.

The ADD is the total annual production or total annual metered water deliveries divided by number of days in the year. In 2006, the ADD was approximately 7.3 million gallons per day (mgd), and in 2007, the ADD increased to 8.5 mgd.

The average day maximum month demand (ADMMD) is the average demand for the month with the highest demand during the year, usually occurring in the summer. In 2006, the ADMMD was approximately 12.8 mgd and occurred in July. The highest demand month typically occurs in July, August, or September.

The MDD is the greatest water demand during a 24-hour period of the year. In general, the MDD is 2.0 to 2.5 times greater than the ADD. Daily production or metered data was not available to determine the MDD, so an industry accepted peaking factor of 2.5 was used. The PHD is the highest water demand during any one-hour period of the year. A normal day typically experiences two peak demands, in the morning and then evening. In general, the PHD ranges between 2.5 and 3.5 times greater than the ADD. Hourly demands were not available for this project, so an industry accepted peaking factor of 3.5 was used.

Developing an accurate estimate of the water demand is an important step in determining the size of water distribution system facilities, for both existing conditions and future developments. The future ADD projections were developed based on the land use projections as described in the City's 2030 General Plan. The build-out water demands projections assume 100 percent development and occupancy of all land uses within the SOI. If we assume that 5 to 10 percent of all residences, commercial buildings and offices are vacant or not developed at build-out, then the build-out demand could range between 22.4 to 24.9 mgd. For the purposes of modeling and sizing infrastructure, this Master Plan assumed 100 percent development of the SOI.

A summary of the existing and future ADD is presented in Table ES.2. If the City achieves build-out of the SOI by 2030, then the water demand will increase at an annual rate of about 5.0 percent between now and build-out of the study area. In addition to the projected average demands, Table ES.2 includes annual estimates for the MDD and PHD through build-out of the SOI. Based on these projections, it is anticipated that the City's build-out ADD and MDD will approach 24.9 mgd and 62.3 mgd, respectively.

The discussion up to this point has focused on the demand projection when the SOI is fully built out. The City's 2030 General Plan states, "Although the General Plan applies a 24-year horizon, the Plan is not intended to specify or anticipate when build-out will actually occur." If we assume that the projected population is reached by 2030, then the residential land uses will be fully built out. However, a different assumption is provided for the employment related land uses. The 2030 General Plan reports that, based on historical trends, complete build-out of employment-related land should be reached around 2055.

Based on this growth rate, it is assumed that half of the employment-related land is developed by year 2030, and the remainder is developed by 2055.

Table ES.2 Demand Summary
Water Distribution System Master Plan
City of Los Banos

Planning Year	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Peak Hour Demand (mgd)
Existing[1]	7.5	18.8	26.3
SOI Build-out[2]	24.9	62.3	87.2

Notes:
1. Based on land use and developed acreages within the City limits, and water demands for year 2006.
2. Based on land use and acreage from the City's 2030 General Plan and 100 percent build-out.

Based on the timing assumptions for build-out of residential and employment-related land uses, the following demand projections can be made (Table ES.3).

Table ES.3 Demand Projections
Water Distribution System Master Plan
City of Los Banos

Planning Year	Average Day Demand (mgd)
Existing[1]	7.5
2010	8.8
2015	10.7
2020	13.0
2025	15.7
2030	**19.0**
2035	20.1
2040	21.2
2045	22.4
2050	23.6
2055	24.9

Note:
1. Based on Average Annual Water Use Estimate Technical Memorandum, August 2007, Erler & Kalinowski, Inc. and developed land in the City.

ES.6 CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

The capacity analysis entailed identifying areas in the distribution system where pipeline capacity is insufficient to supply water at high flow rates and meet minimum pressure or maximum velocity and headloss criteria. Pipelines that lack sufficient capacity or the appropriate connectivity to distribute peak hour or fire flow demands could result in low delivery pressures. The hydraulic modeling analysis identified locations of existing and future hydraulic deficiencies resulting from these periods of high flows. This analysis also evaluated the adequacy of the City's water supply and storage capacity.

Most of the existing water distribution system has sufficient capacity to convey current peak hour or fire flow demands. However, in some locations, such as the City's downtown or in more mature neighborhoods, the distribution system could not meet minimum fire flow and pressure requirements.

The proposed improvements that will serve future users are sized for build-out conditions. As the City continues to grow beyond its current limits, it is recommended that the pipeline diameters, well and storage capacities proposed in this Master Plan be constructed so that the facilities have sufficient capacity for build-out conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended. In this Master Plan, the proposed pipe diameter represents the ultimate diameter for build-out conditions.

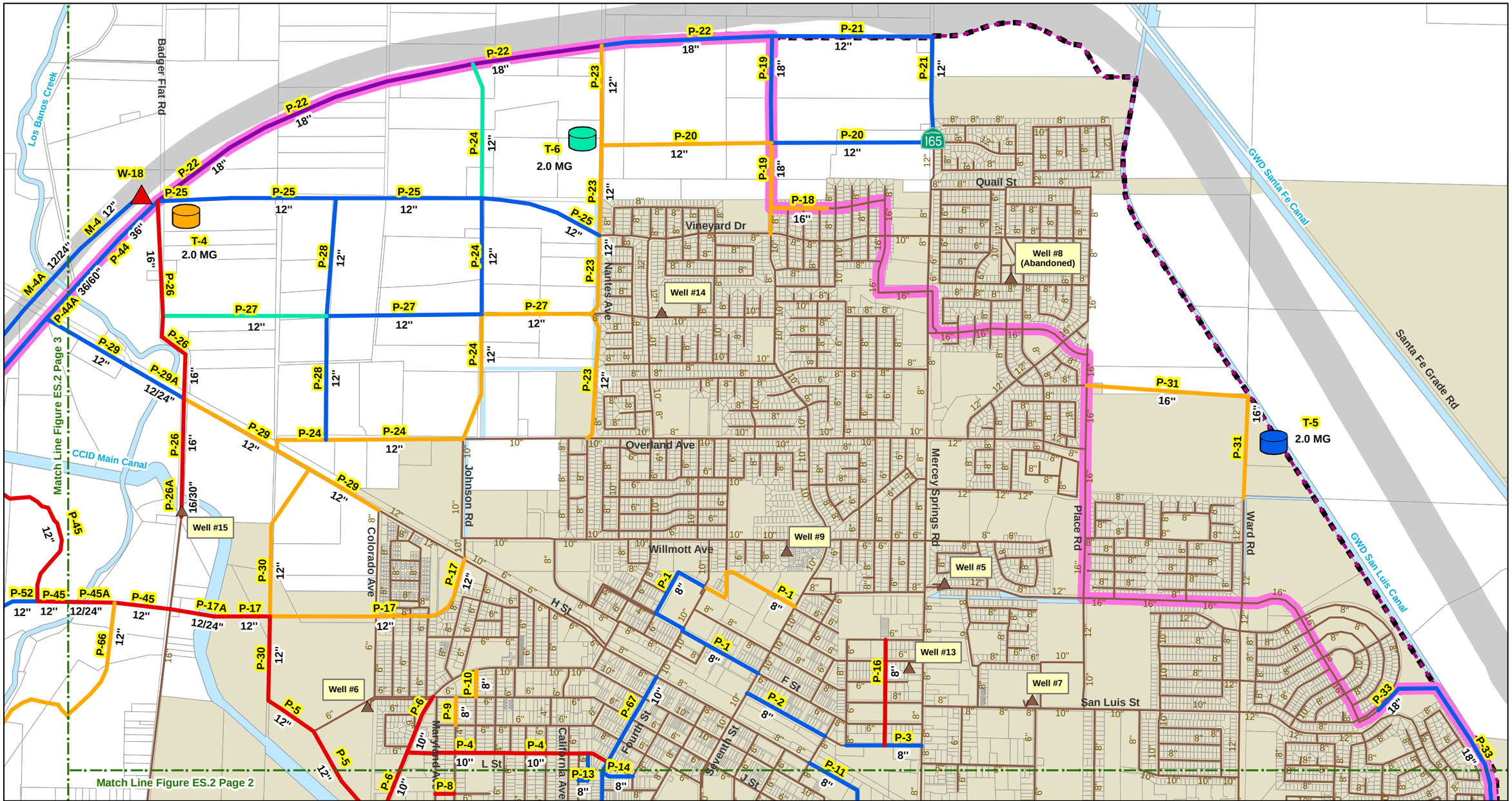
Figure ES.2 (three pages) illustrates the proposed improvements necessary to correct the existing deficiencies and to serve future users. Figure ES.2 shows the proposed improvements in different categories (colors). The different colors identify the implementation timeframe of the improvements and differentiate between near-term and long-term improvements.

Table ES.4 summarizes the improvements illustrated in Figure ES.2 with a cross-referenced number system. The figure number in the first column of Table ES.4 matches the improvement identification shown in Figure ES.2. For example "P-1" in the first row of Table ES.4 is the downtown replacement project. The table also contains a street location for the improvement, approximate size (length, diameter, volume, etc.), cost, and implementation timeframe.

ES.6.1 Existing Versus Future Improvements

An existing deficiency is one where the existing facility's capacity is insufficient to meet the planning criteria (e.g. pipeline upgrades required to meet fire flow criteria). If a project was proposed to correct an existing deficiency, then existing users were assigned 100 percent of the project's benefit, and therefore, 100 percent of the costs.

A majority of the proposed improvements are required to serve future users. Continued growth will trigger the construction of new facilities to support this growth.



Legend

Existing Water Distribution Facilities
- Groundwater Well
- Storage Tank
- Pipelines

Future Distribution Facilities

Groundwater Well
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

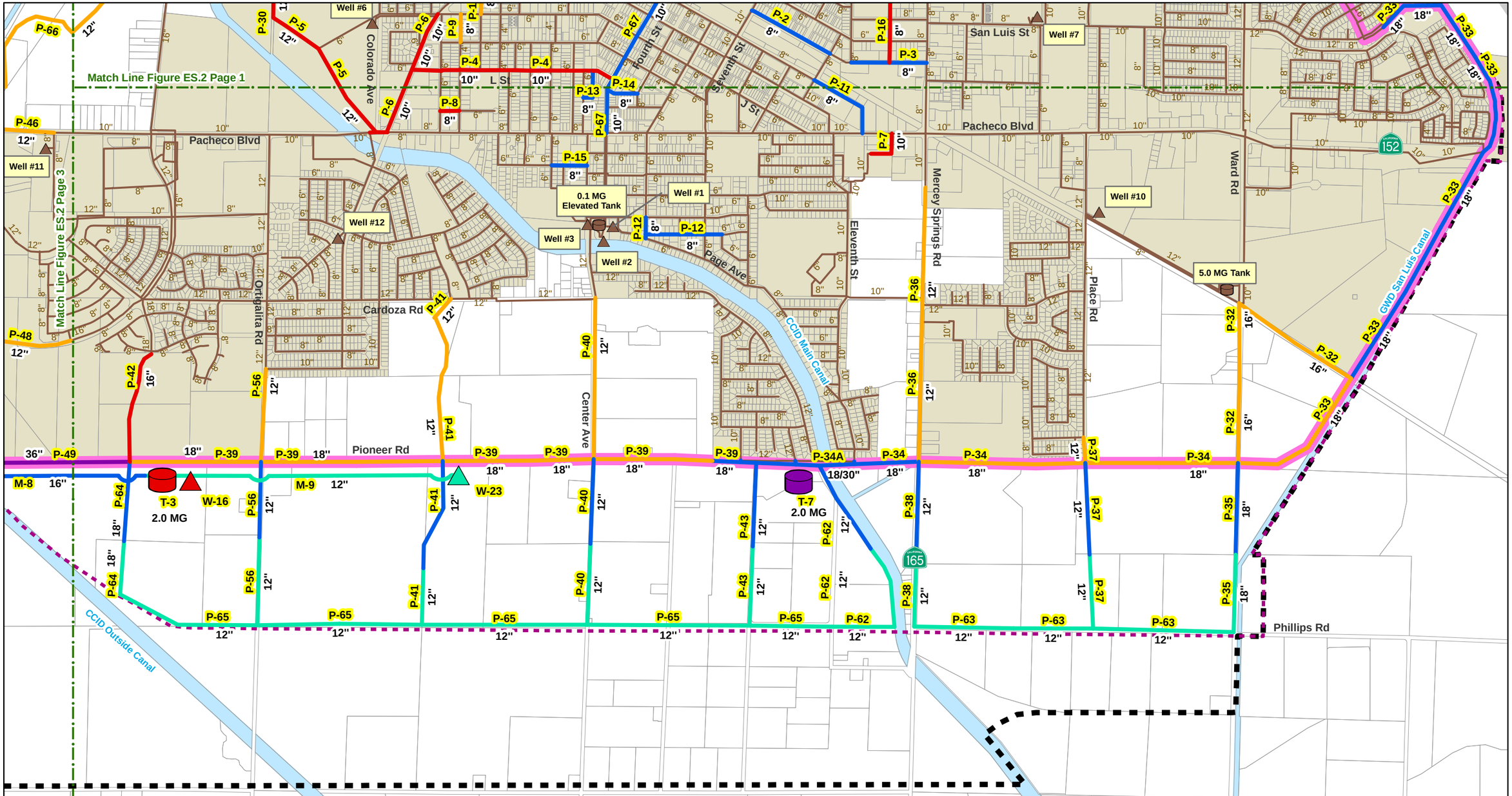
Storage Tank and Booster Pump
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

Feet
0 700 1,400

Pipelines
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- P-5 CIP ID
- 12" CIP Diameter
- 8" Existing Diameter
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)
- Transmission Main Backbone
- Urban Growth Boundary

- Parcels
- Waterways/Canals
- SR 152 Bypass Corridor
- City Limits
- Sphere of Influence

Figure ES.2
Proposed Distribution System Improvements (1 of 3)
Water Distribution
System Master Plan
City of Los Banos



Legend

Existing Water Distribution Facilities
- Groundwater Well
- Storage Tank
- Pipelines

Future Distribution Facilities

Groundwater Well
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

Storage Tank and Booster Pump
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

Feet: 0 700 1,400

Pipelines
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)
- Transmission Main Backbone
- Urban Growth Boundary

P-5 CIP ID
12" CIP Diameter
8" Existing Diameter

- Parcels
- Waterways/Canals
- SR 152 Bypass Corridor
- City Limits
- Sphere of Influence

Figure ES.2
Proposed Distribution System Improvements (2 of 3)
Water Distribution
System Master Plan
City of Los Banos

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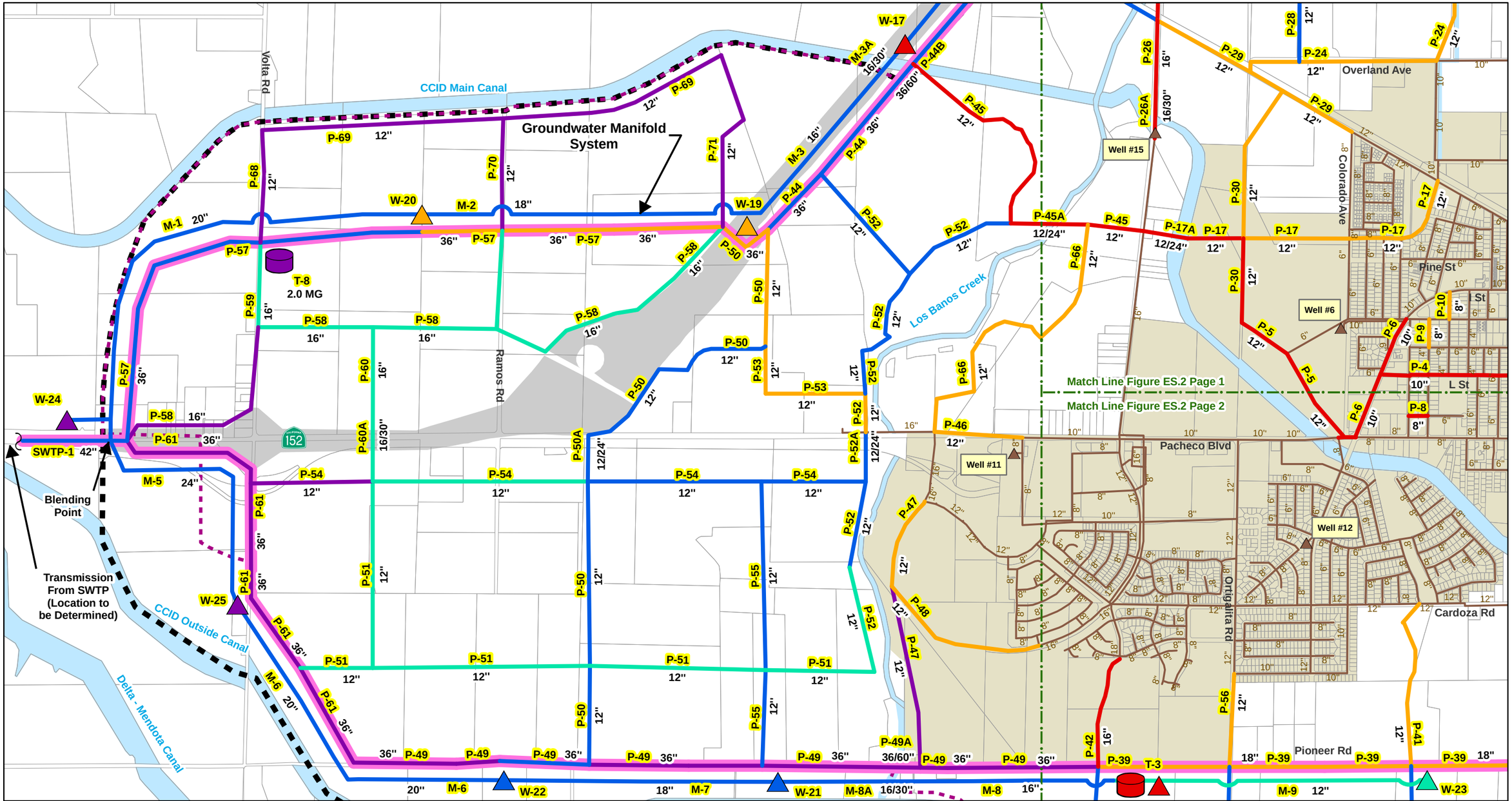


Legend

Existing Water Distribution Facilities
- Groundwater Well
- Storage Tank
- Pipelines

Future Distribution Facilities

Groundwater Well
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

Storage Tank and Booster Pump
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2025 - 2030)
- Phase 5 (2031 +)

Feet: 0 700 1,400

Pipelines
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)
- Transmission Main Backbone
- Urban Growth Boundary

P-5 CIP ID
12" CIP Diameter
8" Existing Diameter

- Parcels
- Waterways/Canals
- SR 152 Bypass Corridor
- City Limits
- Sphere of Influence

Figure ES.2
Proposed Distribution System Improvements (3 of 3)
Water Distribution
System Master Plan
City of Los Banos

Table ES.4 Capital Improvement Projects

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
Existing System Improvements																	
Pipelines																	
P-1	Pipe	C Street, D Street, 3rd Street, F Street	7th Street, North Street, C Street, E Street, F Street in downtown.	4,6	8	Replace	9,200	$ 1,275,000		$ 637,500	$ 637,500			0%	$ 1,275,000	$ -	$ -
P-2	Pipe	G Street	7th Street to 10th Street	6	8	Replace	1,450	$ 201,000			$ 201,000			0%	$ 201,000	$ -	$ -
P-3	Pipe	G Street	Mercey Springs Road to San Juan Avenue	6	8	Replace	700	$ 97,000			$ 97,000			0%	$ 97,000	$ -	$ -
P-4	Pipe	L Street	4th Street to I Street	4,6	10	New/Replace	3,300	$ 571,000	$ 571,000					0%	$ 571,000	$ -	$ -
P-5	Pipe	Within Municipal Airport	Colorado Avenue and Pacheco Blvd to end of Airport	6	12	Replace	2,300	$ 477,000	$ 477,000					0%	$ 477,000	$ -	$ -
P-6	Pipe	I Street	Colorado Avenue and Pacheco Blvd to J Street	6,8	10	Replace	2,300	$ 398,000	$ 398,000					0%	$ 398,000	$ -	$ -
P-7	Pipe	13th Street	Pacheco Blvd and 13th Street to existing 10-inch diameter pipe	-	10	New	650	$ 112,000	$ 112,000					0%	$ 112,000	$ -	$ -
P-8	Pipe	M Street	Maryland Avenue to Iowa Avenue	-	8	New	300	$ 42,000	$ 42,000					0%	$ 42,000	$ -	$ -
P-9	Pipe	Iowa Street	K Street to J Street	4	8	Replace	450	$ 62,000		$ 62,000				0%	$ 62,000	$ -	$ -
P-10	Pipe	Idaho Street	J Street to I Street	4	8	Replace	450	$ 62,000		$ 62,000				0%	$ 62,000	$ -	$ -
P-11	Pipe	H Street	10th Street to Pacheco Blvd	6	8	Replace	1,300	$ 179,000			$ 179,000			0%	$ 179,000	$ -	$ -
P-12	Pipe	Monroe Avenue, Sixth Street	Monroe Circle to 6th Street, Paige Avenue to Madison Avenue	4	8	Replace	1,600	$ 222,000			$ 222,000			0%	$ 222,000	$ -	$ -
P-13	Pipe	Center Lane	L Street to connection in alleyway near California Avenue	4	8	Replace	600	$ 83,000			$ 83,000			0%	$ 83,000	$ -	$ -
P-14	Pipe	Alleyway n/o M Street	4th Street to Fifth Street	4	8	Replace	500	$ 69,000			$ 69,000			0%	$ 69,000	$ -	$ -
P-15	Pipe	Adams Avenue	Nevada Avenue to Center Avenue	4	8	Replace	600	$ 83,000			$ 83,000			0%	$ 83,000	$ -	$ -
P-16	Pipe	Santa Rita Avenue	G Street to Romero Street	-	8	New	1,700	$ 236,000	$ 236,000					0%	$ 236,000	$ -	$ -
P-67	Pipe	4th Street	Pacheco Blvd to H Street	10	10	Replace	2,700	$ 468,000			$ 468,000			0%	$ 468,000	$ -	$ -
	Pipe	Various Locations	Water main replacement program. Average size is 10-inch diameter.	10	10	Replace	25,000	$ 4,329,000		$ 1,083,000	$ 1,082,000	$ 1,082,000	$ 1,082,000	0%	$ 4,329,000	$ -	$ -
Groundwater Wells																	
W-16	Supply Well[4]	Pioneer Road	Near Ortigalita Road	-	1,400 gpm	New		$ 1,560,000	$ 1,560,000					0%	$ 1,560,000	$ -	$ -
	Land Acquisition				0.25 acres	New		$ 60,000	$ 60,000					0%	$ 60,000	$ -	$ -
	Supply Well	Various Locations	Replace or rehabilitate existing wells. Assume one well every 15 years.	various	1,400 gpm	Replace/Rehab		$ 3,120,000		$ 1,560,000			$ 1,560,000	0%	$ 3,120,000	$ -	$ -
Water Meters																	
	Water Meters	Various Locations			3/4" and 1"	New	100	$ 250,000		$ 125,000	$ 125,000			0%	$ 250,000	$ -	$ -
						Existing Improvements Subtotal		**$ 13,956,000**	**$ 3,456,000**	**$ 3,529,500**	**$ 3,246,500**	**$ 1,082,000**	**$ 2,642,000**		**$ 13,956,000**	**$ -**	**$ -**
Future System Improvements																	
Pipelines																	
P-17	Pipe	sw/o Johnson Road	H Street to connection to 16-inch diameter pipe in Badger Flat Road	-	12	New	5,400	$ 1,122,000	$ 337,000	$ 785,000				100%	$ -	$ 1,122,000	$ -
P-17A	Casing[1]	sw/o Johnson Road	Crossing CCID Main Canal	-	12/24	New	400	$ 557,000	$ 557,000					100%	$ -	$ 557,000	$ -
P-18	Pipe	Chenin Blanc	Stonewood Drive to intersection of Chenin Blank Court	8	18	Replace	1,150	$ 326,000		$ 326,000				100%	$ -	$ -	$ 326,000
P-19	Pipe	Stonewood Drive	Vinewood Drive to future HWY 152 alignment	-	18	New	4,550	$ 1,289,000		$ 773,000	$ 516,000			100%	$ -	$ -	$ 1,289,000
P-20	Pipe	Probable Extension of St Francis Drive	Mercey Springs Rd to Nantes Avenue	-	12	New	5,400	$ 1,122,000		$ 561,000	$ 561,000			100%	$ -	$ 1,122,000	$ -
P-21	Pipe	Mercey Springs Road	St Francis Drive to future HWY 152 alignment, then west to future tank	-	12	New	4,300	$ 894,000			$ 894,000			100%	$ -	$ 894,000	$ -
P-22	Pipe	Future HWY 152 Alignment	Probable extension of Stonewood Drive to Badger Flat Road	-	18	New	10,500	$ 8,616,000			$ 2,154,000		$ 6,462,000	100%	$ -	$ -	$ 8,616,000
P-23	Pipe	Nantes Avenue	Overland Avenue to future HWY 152 Alignment	-	12	New	6,500	$ 1,351,000		$ 1,351,000				100%	$ -	$ 1,351,000	$ -
P-24	Pipe	Johnson Road	H Street to Overland Avenue, then north to future HWY 152 Alignment	-	12	New	9,350	$ 1,942,000		$ 1,068,000	$ 388,000	$ 486,000		100%	$ -	$ 1,942,000	$ -
P-25	Pipe	Capri Avenue	Nantes Avenue to future tank along future HWY 152 alignment	-	12	New	7,300	$ 1,516,000			$ 1,516,000			100%	$ -	$ 1,516,000	$ -
P-26	Pipe	Badger Flat Road	Well 15 to future HWY 152 alignment	-	16	New	5,300	$ 1,468,000	$ 1,468,000					100%	$ -	$ -	$ 1,468,000
P-26A	Casing[1]	Badger Flat Road	Crossing CCID Main Canal	-	16/30	New	400	$ 696,000	$ 696,000					100%	$ -	$ -	$ 696,000
P-27	Pipe	n/o Overland Avenue	Nantes Avenue to Badger Flat Road	-	12	New	6,950	$ 1,445,000		$ 361,250	$ 505,750	$ 578,000		100%	$ -	$ 1,445,000	$ -
P-28	Pipe	St Lucia Avenue	Overland Avenue to Capri Avenue	-	12	New	3,900	$ 810,000			$ 810,000			100%	$ -	$ 810,000	$ -
P-29	Pipe	H Street	Colorado Avenue to future HWY 152 alignment	-	12	New	6,850	$ 1,423,000		$ 853,800	$ 569,200			100%	$ -	$ 1,423,000	$ -
P-29A	Casing[1]	H Street	Crossing Los Banos Creek	-	12/24	New	200	$ 278,000			$ 278,000			100%	$ -	$ 278,000	$ -
P-30	Pipe	w/o Colorado Avenue	H Street to existing system within airport	-	12	New	4,200	$ 872,000	$ 349,000	$ 523,000				100%	$ -	$ 872,000	$ -
P-31	Pipe	Ward Road	Ward Road to Place Road	-	12	New	4,250	$ 883,000		$ 883,000				100%	$ -	$ 883,000	$ -
P-32	Pipe	Ward Road and Railroad ROW	From 5.0 MG Reservoir to Pioneer Road and San Luis Canal	-	16	New	4,800	$ 1,329,000		$ 1,329,000				100%	$ -	$ 1,329,000	$ -
P-33	Pipe	Along San Luis Canal	Existing 16-inch pipe in Creekside Circle and along San Luis Canal	-	18	New	10,550	$ 2,989,000		$ 747,000	$ 2,242,000			100%	$ -	$ -	$ 2,989,000
P-34	Pipe	Pioneer Road	Ward Avenue to Holland Avenue	-	18	New	6,800	$ 1,927,000		$ 1,445,000	$ 482,000			100%	$ -	$ -	$ 1,927,000
P-34A	Casing[1]	Pioneer Road	Crossing CCID Main Canal	-	18/30	New	400	$ 696,000			$ 696,000			100%	$ -	$ -	$ 696,000
P-35	Pipe	Ward Avenue	Pioneer Road to Phillips Road	-	18	New	2,700	$ 764,000			$ 382,000	$ 382,000		100%	$ -	$ 764,000	$ -
P-36	Pipe	Mercey Springs Avenue	Cardoza Road to Pioneer Road	-	12	New	4,450	$ 3,652,000		$ 3,652,000				100%	$ -	$ 3,652,000	$ -
P-37	Pipe	Place Road	Pioneer Road to Phillips Road	-	12	New	3,100	$ 644,000		$ 64,000	$ 290,000	$ 290,000		100%	$ -	$ 644,000	$ -
P-38	Pipe	Mercey Springs Avenue	Pioneer Road to Phillips Road	-	12	New	2,700	$ 562,000			$ 281,000	$ 281,000		100%	$ -	$ 562,000	$ -
P-39	Pipe	Pioneer Road	West of Ortigalita Road to CCID Main Canal	-	18	New	11,200	$ 3,173,000		$ 2,856,000	$ 317,000			100%	$ -	$ -	$ 3,173,000
P-40	Pipe	Center Avenue	Cardoza Road to Phillips Road	-	12	New	5,300	$ 1,101,000		$ 441,000	$ 330,000	$ 330,000		100%	$ -	$ 1,101,000	$ -
P-41	Pipe	Between Ortigalita and Center	Cardoza Road to Phillips Road	-	12	New	5,500	$ 1,142,000		$ 456,000	$ 343,000	$ 343,000		100%	$ -	$ 1,142,000	$ -

Table ES.4 Capital Improvement Projects

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
P-42	Pipe	Future area	Pioneer Road to existing system	-	16	New	1,850	$ 513,000	$ 513,000					100%	$ -	$ -	$ 513,000
P-43	Pipe	Plow Camp Road	Pioneer Road to Phillips Road	-	12	New	2,650	$ 551,000			$ 275,500	$ 275,500		100%	$ -	$ 551,000	$ -
P-44	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	36	New	8,850	$ 5,015,000			$ 5,015,000			100%	$ -	$ -	$ 5,015,000
P-44A	Casing[1]	Future HWY 152 Alignment	Crossing CCID Main Canal	-	36/60	New	400	$ 1,392,000			$ 1,392,000			100%	$ -	$ -	$ 1,392,000
P-44B	Casing[1]	Future HWY 152 Alignment	Crossing CCID Main Canal	-	36/60	New	400	$ 1,392,000			$ 1,392,000			100%	$ -	$ -	$ 1,392,000
P-45	Pipe	Future area	CCID Main Canal to Badger Flat Road	-	12	New	6,000	$ 1,246,000	$ 1,246,000					100%	$ -	$ 1,246,000	$ -
P-45A	Casing[1]	Los Banos Creek	Crossing Los Banos Creek	-	12/24	New	200	$ 278,000	$ 278,000					100%	$ -	$ 278,000	$ -
P-46	Pipe	Pacheco Blvd	West of Badger Flat Road	-	12	New	1,450	$ 301,000		$ 301,000				100%	$ -	$ 301,000	$ -
P-47	Pipe	Future area	Pioneer Road to Stonecreek Blvd	-	12	New	4,500	$ 934,000		$ 327,000			$ 607,000	100%	$ -	$ 934,000	$ -
P-48	Pipe	Future area	Cardoza Road	-	12	New	2,800	$ 582,000		$ 582,000				100%	$ -	$ 582,000	$ -
P-49	Pipe	Pioneer Road	CCID Outside Canal to east of Los Banos Creek	-	36	New	12,050	$ 6,828,000			$ 1,024,200		$ 5,803,800	100%	$ -	$ -	$ 6,828,000
P-49A	Casing[1]	Pioneer Road	Crossing Los Banos Creek	-	36/60	New	200	$ 696,000					$ 696,000	100%	$ -	$ -	$ 696,000
P-50	Pipe	Canyon Road	Pioneer Road to future HWY 152 alignment	-	12	New	11,450	$ 2,379,000		$ 476,000	$ 1,903,000			100%	$ -	$ 2,379,000	$ -
P-50A	Casing[1]	Pacheco Blvd	HWY 152 Crossing	-	12/24	New	400	$ 557,000		$ 557,000				100%	$ -	$ 557,000	$ -
P-51	Pipe	Future area	Los Banos Creek to study area boundary	-	12	New	12,350	$ 2,566,000				$ 2,566,000		100%	$ -	$ 2,566,000	$ -
P-52	Pipe	Future area	Parallel to Los Banos Creek	-	12	New	11,000	$ 2,285,000		$ 229,000	$ 1,714,000	$ 342,000		100%	$ -	$ 2,285,000	$ -
P-52A	Casing[1]	Near Los Banos Creek	HWY 152 Crossing	-	12/24	New	300	$ 418,000		$ 418,000				100%	$ -	$ 418,000	$ -
P-53	Pipe	Future area	Near Los Banos Creek	-	12	New	4,250	$ 883,000		$ 883,000				100%	$ -	$ 883,000	$ -
P-54	Pipe	Parallel to HWY 152	Los Banos Creek to Volta Road	-	12	New	10,000	$ 2,078,000			$ 831,000	$ 623,000	$ 624,000	100%	$ -	$ 2,078,000	$ -
P-55	Pipe	Future area	Pioneer Road to s/o Pacheco Blvd	-	12	New	4,600	$ 956,000			$ 956,000			100%	$ -	$ 956,000	$ -
P-56	Pipe	Ortigalita Road	Sandra Street to Phillips Road	-	12	New	4,150	$ 863,000		$ 287,000	$ 288,000	$ 288,000		100%	$ -	$ 863,000	$ -
P-57	Pipe	Future area	HWY 152 to future HWY 152 alignment	-	36	New	12,200	$ 6,912,000		$ 3,456,000	$ 3,456,000			100%	$ -	$ -	$ 6,912,000
P-58	Pipe	Future area	North of HWY 152	-	16	New	11,900	$ 3,296,000				$ 2,307,000	$ 989,000	100%	$ -	$ 3,296,000	$ -
P-59	Pipe	Volta Road	Future area to future storage tank	-	16	New	1,350	$ 374,000				$ 374,000		100%	$ -	$ 374,000	$ -
P-60	Pipe	Between Volta and Ramos	Crosses HWY 152	-	16	New	2,500	$ 693,000				$ 693,000		100%	$ -	$ 693,000	$ -
P-60A	Casing[1]	e/o Volta Road	HWY 152 Crossing	-	16/30	New	400	$ 696,000				$ 696,000		100%	$ -	$ 696,000	$ -
P-61	Pipe	Study Area Boundary, Volta Road	Parallel to Outside Canal to HWY 152 alignment	-	36	New	7,450	$ 4,221,000					$ 4,221,000	100%	$ -	$ -	$ 4,221,000
P-62	Pipe	Along CCID Main Canal, Middle Road	Pioneer Road to Holland Avenue	-	12	New	3,950	$ 821,000			$ 328,000	$ 493,000		100%	$ -	$ 821,000	$ -
P-63	Pipe	Phillips Road	Mercey Springs Avenue to Place Road	-	12	New	4,000	$ 831,000				$ 831,000		100%	$ -	$ 831,000	$ -
P-64	Pipe	Study Area Boundary	Future area parallel to n\o Phillips Road	-	18	New	2,200	$ 624,000			$ 312,000	$ 312,000		100%	$ -	$ 624,000	$ -
P-65	Pipe	Probable extension of Middle Road	Holland Avenue to Ortigalita Road, then continues west to Madera Road	-	12	New	13,000	$ 2,700,000				$ 2,700,000		100%	$ -	$ 2,700,000	$ -
P-66	Pipe	Future area	HWY 152 to Los Banos Creek	-	12	New	5,300	$ 1,101,000		$ 1,101,000				100%	$ -	$ 1,101,000	$ -
P-68	Pipe	Volta Road	Future area to study area boundary	-	12	New	2,000	$ 415,000					$ 415,000	100%	$ -	$ 415,000	$ -
P-69	Pipe	Study Area Boundary	Volta Road to CCID Main Canal	-	12	New	7,650	$ 1,590,000					$ 1,590,000	100%	$ -	$ 1,590,000	$ -
P-70	Pipe	Ramos Road	Future area to study area boundary	-	12	New	3,650	$ 758,000				$ 341,000	$ 417,000	100%	$ -	$ 758,000	$ -
P-71	Pipe	Future area	Future HWY 152 alignment to study area boundary	-	12	New	3,200	$ 665,000					$ 665,000	100%	$ -	$ 665,000	$ -
Storage Tanks and Booster Pumps																	
T-3	Storage Tank	Pioneer Road	e/o Ortigalita Road	-	2 MG	New		$ 4,212,000	$ 4,212,000					100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000	$ 480,000					100%	$ -	$ -	$ 480,000
T-4	Storage Tank	Future HWY 152 Alignment	Near intersection with Badger Flat Road	-	2 MG	New		$ 4,212,000		$ 4,212,000				100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000		$ 480,000				100%	$ -	$ -	$ 480,000
T-5	Storage Tank	Place Road	Near intersection with Wimbledon Court	-	2 MG	New		$ 4,212,000			$ 4,212,000			100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000			$ 480,000			100%	$ -	$ -	$ 480,000
T-6	Storage Tank	Future HWY 152 Alignment	w/o Mercey Springs Avenue	-	2 MG	New		$ 4,212,000				$ 4,212,000		100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000				$ 480,000		100%	$ -	$ -	$ 480,000
T-7	Storage Tank	Pioneer Road	Near intersection with Holland Avenue	-	2 MG	New		$ 4,212,000					$ 4,212,000	100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000					$ 480,000	100%	$ -	$ -	$ 480,000
T-8	Storage Tank	Future HWY 152 Alignment	Near intersection with Volta Road	-	2 MG	New		$ 4,212,000					$ 4,212,000	100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000					$ 480,000	100%	$ -	$ -	$ 480,000
Groundwater Wells																	
W-17	Supply Well[4]	Future HWY 152 Alignment	Near CCID Main Canal	-	1,400 gpm	New		$ 1,560,000	$ 1,560,000					100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000	$ 60,000					100%	$ -	$ -	$ 60,000
W-18	Supply Well[4]	Future HWY 152 Alignment	Near intersection with Badger Flat Road	-	1,400 gpm	New		$ 1,560,000	$ 1,560,000					100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000	$ 60,000					100%	$ -	$ -	$ 60,000
W-19	Supply Well[4]	Future HWY 152 Alignment	Near CCID Canal and Ramos Road	-	1,400 gpm	New		$ 1,560,000		$ 1,560,000				100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000		$ 60,000				100%	$ -	$ -	$ 60,000
W-20	Supply Well[4]	s/o Pacheco Blvd	Near HWY 152 and Canyon Road	-	1,400 gpm	New		$ 1,560,000		$ 1,560,000				100%	$ -	$ -	$ 1,560,000

Table ES.4 Capital Improvement Projects

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Ex. Size/ Diam. (in)	Project Length/Size and Cost: New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Future Improvements: Regional ($)
	Land Acquisition				0.25 acres	New		$ 60,000		$ 60,000				100%	$ -	$ -	$ 60,000
W-21	Supply Well[4]	Pioneer Road	Near Canyon Road and Los Banos Creek	-	1,400 gpm	New		$ 1,560,000			$ 1,560,000			100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000			$ 60,000			100%	$ -	$ -	$ 60,000
W-22	Supply Well[4]	Pioneer Road	Near Canyon Road	-	1,400 gpm	New		$ 1,560,000			$ 1,560,000			100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000			$ 60,000			100%	$ -	$ -	$ 60,000
W-23	Supply Well[4]	Pioneer Road	Near intersection with Holland Avenue	-	1,400 gpm	New		$ 1,560,000				$ 1,560,000		100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000				$ 60,000		100%	$ -	$ -	$ 60,000
W-24	Supply Well[4]	n/o Future HWY 152 Alignment	Near intersection with Volta Road	-	1,400 gpm	New		$ 1,560,000					$ 1,560,000	100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ -	$ 60,000
W-25	Supply Well[4]	w/o Volta Road	Near future connection to SWTP	-	1,400 gpm	New		$ 1,560,000					$ 1,560,000	100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ -	$ 60,000
Well Manifold System																	
M-1	Pipe	Future Area	Along west side of study area boundary to future groundwater well	-	20	New	8,190	$ 2,579,000			$ 2,579,000			70%	$ 773,700	$ -	$ 1,805,300
M-2	Pipe	Future Area	Future groundwater well to future HWY 152 alignment	-	18	New	4,880	$ 1,382,000			$ 1,382,000			70%	$ 414,600	$ -	$ 967,400
M-3	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	16	New	4,520	$ 1,253,000			$ 1,253,000			70%	$ 375,900	$ -	$ 877,100
M-3A	Casing[1]	CCID Main Canal Crossing		-	16/30	New	400	$ 696,000			$ 696,000			70%	$ 208,800	$ -	$ 487,200
M-4	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	12	New	5,260	$ 1,094,000			$ 1,094,000			70%	$ 328,200	$ -	$ 765,800
M-4A	Casing[1]	Los Banos Creek Crossing		-	12/24	New	400	$ 557,000			$ 557,000			70%	$ 167,100	$ -	$ 389,900
M-5	Pipe	Study Area Boundary	Parallel to Outside Canal	-	24	New	4,460	$ 1,685,000			$ 1,685,000			70%	$ 505,500	$ -	$ 1,179,500
M-6	Pipe	Study Area Boundary	Parallel to Outside Canal and Pioneer Road	-	20	New	5,510	$ 1,735,000			$ 1,735,000			70%	$ 520,500	$ -	$ 1,214,500
M-7	Pipe	Pioneer Road		-	18	New	4,260	$ 1,207,000			$ 1,207,000			70%	$ 362,100	$ -	$ 844,900
M-8	Pipe	Pioneer Road		-	16	New	5,450	$ 1,510,000			$ 1,510,000			70%	$ 453,000	$ -	$ 1,057,000
M-8A	Casing[1]	Los Banos Creek Crossing			16/30	New	400	$ 696,000			$ 696,000			70%	$ 208,800	$ -	$ 487,200
M-9	Pipe	Pioneer Road	West of Ortigalita Road	-	12	New	5,080	$ 1,056,000				$ 1,056,000		70%	$ 316,800	$ -	$ 739,200
Surface Water Treatment Plant																	
SWTP	SWTP	Pacheco Blvd	West of the City limits	-	20 MGD	New		$ 140,400,000		$ 7,020,000	$ 133,380,000			70%	$ 42,120,000	$ -	$ 98,280,000
	Land Acquisition				10 acres	New		$ 2,400,000			$ 2,400,000			70%	$ 720,000	$ -	$ 1,680,000
SWTP	SWTP Expansion	Pacheco Blvd	West of the City limits	-	2 MGD	New		$ 14,040,000					$ 14,040,000	70%	$ 4,212,000	$ -	$ 9,828,000
SWTP	SWTP Expansion	Pacheco Blvd	West of the City limits	-	4 MGD	New		$ 28,080,000					$ 28,080,000	70%	$ 8,424,000	$ -	$ 19,656,000
SWTP-1	Transmission Line	Pacheco Blvd	CA Aqueduct to future transmission main	-	42	New	11,000	$ 7,271,000		$ 364,000	$ 6,907,000			70%	$ 2,181,000	$ -	$ 5,090,000
SWTP-2	Casing[1]	Pacheco Blvd	Crossing CCID Outside Canal	-	42/72	New	350	$ 1,462,000		$ 73,000	$ 1,389,000			70%	$ 439,000	$ -	$ 1,023,000
SWTP-3	Casing[1]	Pacheco Blvd	Crossing Delta Mendota Canal	-	42/72	New	400	$ 1,671,000		$ 84,000	$ 1,587,000			70%	$ 501,000	$ -	$ 1,170,000
SWTP-4	Casing[1]	Pacheco Blvd	Crossing California Aqueduct	-	42/72	New	500	$ 2,087,000		$ 104,000	$ 1,983,000			70%	$ 626,000	$ -	$ 1,461,000
SWTP-5	Casing[1]	Pacheco Blvd	Crossing HWY 152	-	42/72	New	400	$ 1,671,000		$ 84,000	$ 1,587,000			70%	$ 501,000	$ -	$ 1,170,000
							Future Improvements Subtotal	**$ 360,263,000**	**$ 13,376,000**	**$ 42,753,050**	**$ 204,000,650**	**$ 22,899,500**	**$ 77,233,800**		**$ 64,359,000**	**$ 54,850,000**	**$ 241,054,000**
							CIP Total (Existing and Future)	**$ 374,219,000**	**$ 16,832,000**	**$ 46,282,550**	**$ 207,247,150**	**$ 23,981,500**	**$ 79,875,800**		**$ 78,315,000**	**$ 54,850,000**	**$ 241,054,000**

Notes:

1. Proposed casings size and carrier pipe size.
2. Baseline Construction Cost plus 20% to account for unforeseen events and unknown conditions.
3. Estimated Construction Cost plus 30% to cover other costs including Engineering, Construction Management, and Program Implementation.
4. Final location of future groundwater wells and storage tanks to be determined.
5. Land acquisition costs were included for the storage tank/booster pumps, wells, and surface water treatment plant, but were not included for the pipelines, since these will be located in public right of way.
6. Costs are based on the Engingeering News Record Construction Cost Index 20-city average of 8592.

Future users were assigned 100 percent of the future project's benefit and 100 percent of the costs.

Most projects were assigned 100 percent to either existing or future users. The two exceptions were the 20 mgd surface water treatment plant (SWTP) scheduled to go on-line in year 2025 and the groundwater manifold piping system. The split was based on the existing ADD (7.56 mgd) divided by projected build-out ADD (24.9 mgd). Existing users will account for 30 percent of the SWTP benefits, and future users represent 70 percent of the benefits. More information on the breakdown in cost split between existing and future users and whether a proposed improvement is intended to correct an existing deficiency, to serve a future user, or both is provided in Chapters 6 and 7.

The future improvements were broken down further based on their funding source. Future improvements will be funded by developers or through development impact fees. All projects fall into one of the three following categories:

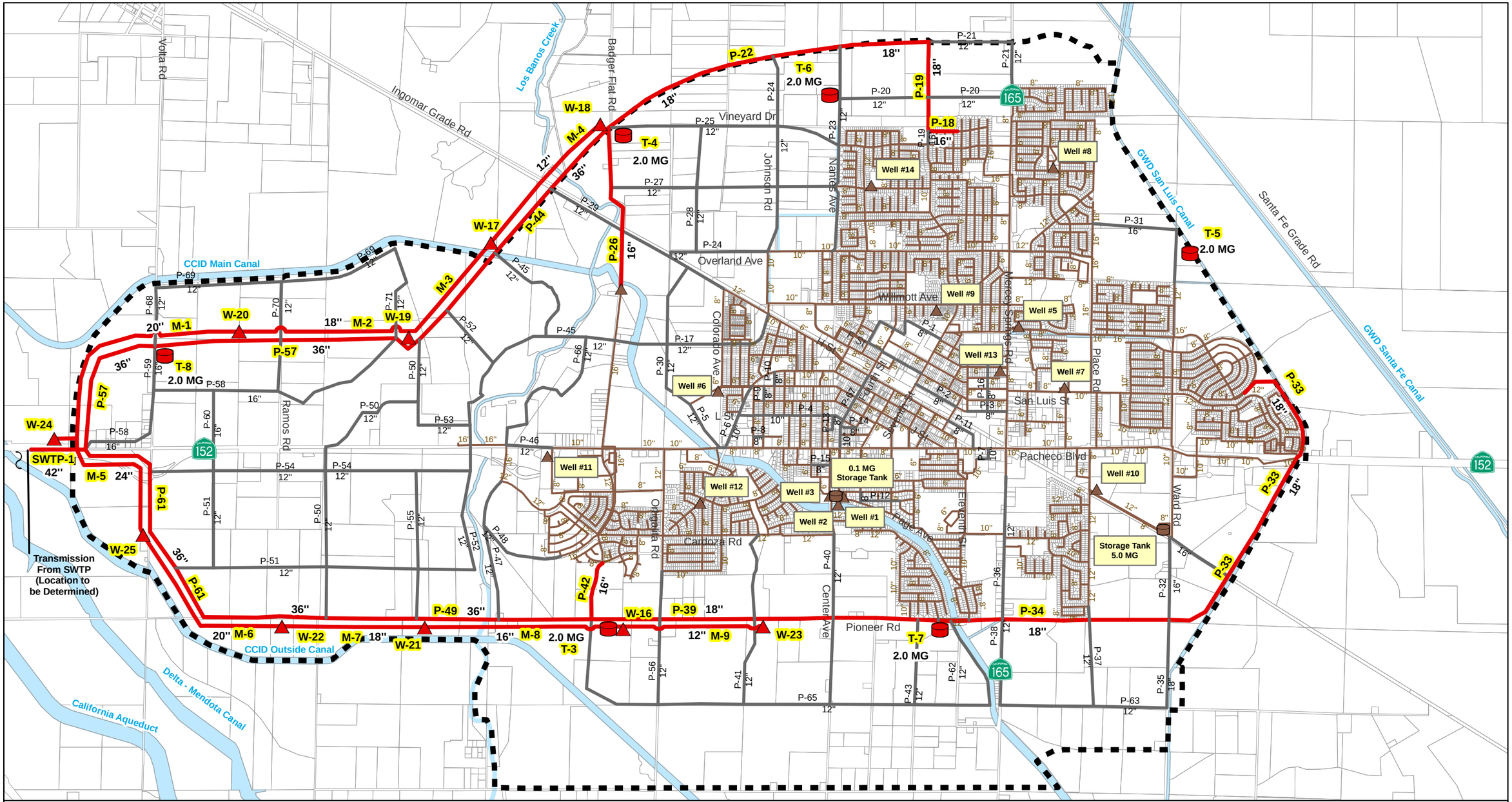
- Existing Improvements: Existing improvements correct existing deficiencies or rehabilitate/replace existing facilities that have reached their useful life. These projects are funded through user rates.
- Developer Improvements: Future improvements that serve new users. These improvements will be developer funded and/or may be part of a reimbursement agreement between developers.
- Regional Improvements: Future improvements that serve new users. These improvements will be funded through water development impact fees collected by the City.

The majority of future improvements are Developer Improvements, but water transmission mains, groundwater manifold pipe system, storage tanks, wells, and the treatment plant were designated Regional Improvements. The Regional Improvements are shown in Figure ES.3

ES.6.2 Water Supply Capacity Improvements

A significant drop in development between 2007 and 2010 allowed for deferment of the water supply improvements. Even though the maximum day demand projections appear to exceed the firm capacity, in reality the near term drop in development kept water demand levels relatively constant through 2009. If demands start to increase rapidly, then the City should review the supply projections.

This Master Plan contains recommendations for new groundwater wells to meet future demands. Three new 2.0 mgd capacity wells are required by 2015. Seven new wells are required through the year 2025, at which time the 20 mgd SWTP will be on-line. Following the installation of the SWTP, which will be sized to meet ADD, a new well will not be necessary until year 2030. The SWTP will likely have sufficient capacity to meet all the



Legend

Existing Water Distribution Facilities
- Groundwater Well
- Storage Tank
- Pipelines

Future Distribution Facilities

Regional Improvements
- Groundwater Well
- Storage Tank
- Pipeline

Developer Improvements
- Pipeline
- NC-2 Regional CIP ID
- S2-7 CIP ID
- Parcels
- Waterways/Canals
- Sphere of Influence
- 12" CIP Diameter
- 8" Existing Diameter

N

0 2,500 5,000 Feet

Figure ES.3
Regional Improvements
Water Distribution
System Master Plan
City of Los Banos

City's demands for six months of the year. The other six months, the City will need to supplement the treatment plant supply with well water.

Possible well locations are shown in Figure ES.2. The locations shown are conceptual, but the goal was to space the new wells approximately one mile apart, to locate them along the transmission main backbone that will circle the entire City, and to locate them within the higher quality groundwater on the west side of the study area. The different color illustrations for the wells in the figure signify the timeframe that the wells should be installed.

The City will also conduct intermittent rehabilitation or replacement of existing wells to modernize aging infrastructure or to abandon wells with poor water quality. This Master Plan assumed that two wells would be rehabilitated or replaced over the next 20 years.

ES.6.3 Storage Tank and Booster Pump Capacity Improvements

A significant drop in development between 2007 and 2010 allowed for deferment of water storage improvements. Even though the storage projections appear to exceed the required storage capacity, in reality the near term drop in new development kept water demand levels relatively constant through 2009. If demands start to increase rapidly, then the City should revise the storage projections.

The required storage from 2008 through build-out of the SOI is calculated and presented in Section 6 of this Master Plan. The required storage for 2010 is projected to equal approximately 6.1 MG, which is 1,000,000 gallons greater than the current available storage. In order to meet this deficiency, the City should begin planning and designing a new storage tank.

This Master Plan assumed that future storage tanks would be 2 MG in capacity. The first 2.0 MG storage tank should be on-line in 2012. Subsequent 2.0 MG storage tanks are installed every five to eight years through year 2035. The last tank is installed in year 2049. In total, six storage tanks (2.0 MG each) will be installed to meet future storage requirements.

The proposed tank locations are distributed throughout the system and are shown in Figure ES.2. The locations shown are conceptual, but the goal was to locate them along the transmission main backbone that will circle the City. In some locations, tanks are placed adjacent to proposed wells. Each storage tank will require the installation of a pump station. Hence, six new booster pump stations are recommended in this Master Plan. Although the booster pumps are not shown on Figure ES.2, the reader should assume their presence.

ES.6.4 Pipeline Improvements

This Master Plan is proposing about 73 miles of new pipelines to serve future users and approximately 16 miles of existing pipeline replacement to correct existing deficiencies or to restore aging water mains.

ES.6.4.1 Existing System Improvements

It is recommended that the City replace some of the small diameter pipelines in the downtown area and in some of the more mature neighborhoods. These small diameter pipes are unable to deliver water at high rates and meet the fire flow pressure requirements. There are also new pipelines that are recommended for the existing system to improve connectivity and to replace the last remaining cast iron pipe in the distribution system. Figure ES.2 illustrates the existing system improvements necessary to meet the fire flow criteria and to improve connectivity. The pipeline replacement projects intended to improve fire flow pressure requirements are identified as high priority projects. These projects are illustrated as red pipelines in Figure ES.2 and are labeled as Phase 1 projects, which suggest that they would be the first projects implemented for the water system.

In addition to the pipeline improvements recommended to mitigate capacity deficiencies, the City should implement a water main replacement program. The water main replacement program will remove older pipes that may be corroded or encrusted with mineral deposits, and replace them with new pipes. This program will improve distribution of water and could improve water quality by removing corroded pipes. The City should consider an asset management program to assess the condition of pipes and establish a schedule for replacing the deteriorated pipes in the system.

ES.6.4.2 Future System Improvements

All future system pipeline improvements will serve undeveloped areas. Most of the proposed pipelines fall in the 12- to 18-inch diameter range. However, building the backbone transmission main around the City is a primary goal of this Master Plan. As the City builds more production wells on the west side of the City, the transmission main backbone will provide the facilities necessary to pump water from higher quality groundwater aquifers on the west, to the customers on the eastside of town. When the City's SWTP goes on-line in 2025, the transmission main loop should be developed enough to deliver water to all points of the City. This backbone was generally sized to be 16-inch diameter and larger to provide flexibility for the potential future SWTP and/or extraction wells on the west side of the City.

ES.6.4.3 Well Manifold System

When the future SWTP is on-line, the City's preference would be to blend the groundwater with the treated surface water prior to distribution. Blending would be achieved by installing a manifold piping system connected to new wells on the west side of the study area. The

manifold system would pipe water west and connect to the treated SWTP pipeline bringing water from the California Aqueduct. The manifold system would consist of a northern reach connecting wells on the northern perimeter of the study area, and a southern reach for the wells along the southern perimeter.

Blending treated surface water with groundwater would achieve uniform water quality throughout the distribution system. When the SWTP comes on-line, it will have sufficient capacity to serve the City's demands for most of the year. During the summer when water use increases, the wells will be needed to meet maximum day and peak hour demands. Some of the City's wells have hardness concentrations that exceed 400 mg/L as $CaCO_3$ and total dissolved solids (TDS) concentrations that exceed 700 mg/L on average. Blending the two water sources will avoid residents living close to wells from receiving mostly groundwater with higher hardness and TDS concentrations during the summer. Blending treated surface water with groundwater will decrease the hardness and TDS concentrations of the mixed supply and ensure that residents receive a more uniform water quality throughout the year.

ES.6.5 Meter Installation

There are approximately 100 un-metered water users in the City. The City plans to install meters on each of these customers. According to City staff, the meters are likely 3/4-inch or 1-inch service connections. The locations of these un-metered services are not shown on the figures.

ES.7 CAPITAL PROJECT PRIORITIZATION

The capital improvements for the City's water distribution system were prioritized based on the following factors:

- Addressing the most capacity deficient pipelines under fire flow demand conditions.
- Increasing supply (groundwater and surface water) capacity to serve existing and future users
- Increasing storage capacity to serve future users
- Building the distribution and transmission pipelines necessary to serve future users

Higher priority projects were listed within the Phase 1 (2010-15) and Phase 2 (2016-20) implementation timeframes in Table ES.4. Lower priority projects were listed in Phase 3 (2021-25) through Phase 5 (2030+).

The existing system improvements were proposed primarily to provide sufficient water pressure in the downtown area during a fire. The fire flow demand criteria recommended by the City's Fire Department resulted in more improvements necessary to meet the flow and pressure requirements.

Future development will require the construction of new pipelines, wells, and storage tanks to serve new users. Proposed improvements within areas identified for early development were assigned a higher priority. Areas within an approved tentative map tract received the highest priority. The actual implementation of the improvements serving future users depends on the pace of development. The priorities presented below are estimates based on available information provided by the City. Changes in the City's planning assumptions or growth projections could increase or decrease the priority of each improvement.

ES.7.1 Existing System Improvement Prioritization

The existing system improvements required to meet fire flow and water supply criteria were assigned a high priority. Due to economic conditions and the slow down in development between 2007 and 2010, the probability and practicality of building all these improvements in the next five years is low. For this reason, the improvements were distributed amongst the first three phases according to priority and the level of benefit provided to the existing system. Water supply improvements and pipelines that provided the greatest benefit (e.g. greater fire flow pressure, improved connectivity, enhanced distribution) to existing users were ranked with the highest priority and are grouped into Phase 1 (P-4 through P-8, P-16, and W-16). The remaining improvements were distributed between Phases 2 and 3 (P-1, P-2, P-3, P-9 through P-15, and P-67). P-67 will replace the last cast iron pipeline in the distribution system. Figure ES.2 illustrates the location of these improvements and the phasing by color code.

The water main replacement program would be an on-going project that would be implemented in Phases 2 through 5. The water well replacement or rehabilitation project assumes a project once every 15 years. It was assumed that the water meter installation program would begin in year 2010 and continue until completed.

ES.7.2 Future System Improvement Prioritization

The implementation of distribution system improvements that serve future growth will depend on the City's pace of development and selection of areas to be served with urban infrastructure. The City provided guidance on future development and phasing of infrastructure to serve future users. Based on this input, the projects were grouped into the following timeframes:

- Years 2010 through 2015
- Years 2016 through 2020
- Years 2021 through 2025
- Years 2026 through 2030
- Beyond 2031

ES.7.2.1 Phase 1 and 2 Projects (2010-2020)

The high priority future system improvements are those required to serve anticipated growth from 2010 through 2020. The majority of these improvements are distribution pipelines, but they also include wells and storage tanks. Wells 17 through 20 (four new wells total) are necessary to meet projected MDD through year 2020. Two new 2.0 MG storage tanks with booster pumps will be needed by 2015 to meet operational and fire storage requirements.

As shown in Table ES.4 and illustrated in Figure ES.2, there are several pipeline improvements that fall into the Phase 1 and 2 categories and are considered high priority distribution pipeline improvements. The highest priority pipeline projects that serve new users include P-17, P-30, P-32, P-42, and P-45. Improvements P-17 and P-30 link the existing 16-inch diameter pipeline in Badger Flat Road to the existing 6-inch diameter pipeline within the airport property (note that the 6-inch diameter pipeline is scheduled for replacement and upsize to a 12-inch diameter). Improvement P-42 extends a new 16-inch diameter pipeline from the Stonecreek and Cardoza Road area down to Pioneer Road where new Well No. 16 is shown.

There are a number of Phase 2 pipeline improvements that extend out to proposed tank and well sites, or serve areas that could be developed by year 2020. Some general areas with a near term development potential include the proposed industrial park around Ward Road, land between Cardoza and Pioneer Road, commercial areas around Highway 152 on the west side of the City, and vacant land around Nantes and Overland Avenues. As shown in Figure ES.2, pipelines illustrated as Phase 2 improvements serve these areas.

ES.7.2.2 Phase 3 through 5 Projects (2021 and beyond)

The lower priority future system improvements are those required to serve anticipated growth from 2021 and beyond. Wells 21 and 22 are necessary between years 2021 and 2023 to meet projected MDD. As discussed previously, when the SWTP comes on-line in year 2025, the last two wells are not required until after year 2050. Four new 2.0 MG storage tanks with booster pumps will be needed from year 2022 through build-out of the study area.

The pipeline improvements in Phase 3 extend farther out towards the boundary of the study area. This is also the phase that a significant amount of the northern loop of the transmission main backbone around the City would be completed. The northern loop placement follows the proposed Highway 152 bypass alignment. This segment of the transmission main is critical because if the SWTP comes on-line by year 2025, this pipeline would serve as the primary transmission of potable water from the west to the east. Pipeline improvements P-57, P-44, P-25, P-29, and P-52 should be completed by the end of Phase 3 to serve the future SWTP.

ES.7.2.3 Surface Water Treatment Plant Prioritization

The SWTP is the single largest project that the City will construct through build-out of the study area. This Master Plan assumed that the treatment plant would be on-line by year 2025. Projects of this size and importance typically require years to plan, design, permit, and construct. The SWTP includes an additional level of complexity in that water supply contracts need to be secured from the State Water Project. Although work on securing the water supply contracts could start in the next few years, this Master Plan assumed that the majority of work to plan, permit, design, and construct would occur between 2021 and 2025, but some work would be conducted prior to year 2021.

ES.8 CAPITAL PROJECT COSTS

A summary of the capital project costs and the implementation timeframe is presented in Table ES.4. The future improvements are broken down further into Regional or Developer Improvements. The difference between these two is the funding source. The Regional Improvements were illustrated in Figure ES.3 and include the surface water treatment plant, the transmission main around the City, the groundwater manifold piping system, wells, and tanks. The breakdown in existing and future user share by phase for existing and future users is presented in Table ES.5.

Table ES.5 Existing Versus Future User Cost Share
Water Distribution System Master Plan
City of Los Banos

Reimbursement Category	Implementation Phase					Total ($, mill.)
	2010-15 ($, mill.)	2016-20 ($, mill.)	2021-25 ($, mill.)	2026-30 ($, mill.)	2031 + ($, mill.)	
Existing Improvements(2)	3.46	5.85	52.33	1.40	15.28	**78.32**
Future Developer Improvements(3)	2.77	17.49	13.76	15.53	5.31	**54.85**
Future Regional Improvements(4)	10.61	22.95	141.16	7.05	59.29	**241.05**
Total	**16.83**	**46.28**	**207.25**	**23.98**	**79.88**	**374.22**

Notes:
1. All costs are in November 2009 dollars. ENR CCI 20 City average = 8592
2. Projects are funded through user rates.
3. Projects are developer funded and/or may be part of a development reimbursement agreement.
4. Projects funded through water development impact fees collected by the City.

BACKGROUND

1.1 INTRODUCTION

This chapter presents a brief summary of the water distribution service area, the need for this water distribution system master plan (Master Plan) and the objectives of the study. A list of abbreviations is also provided to assist the reader in understanding the information.

1.2 BACKGROUND

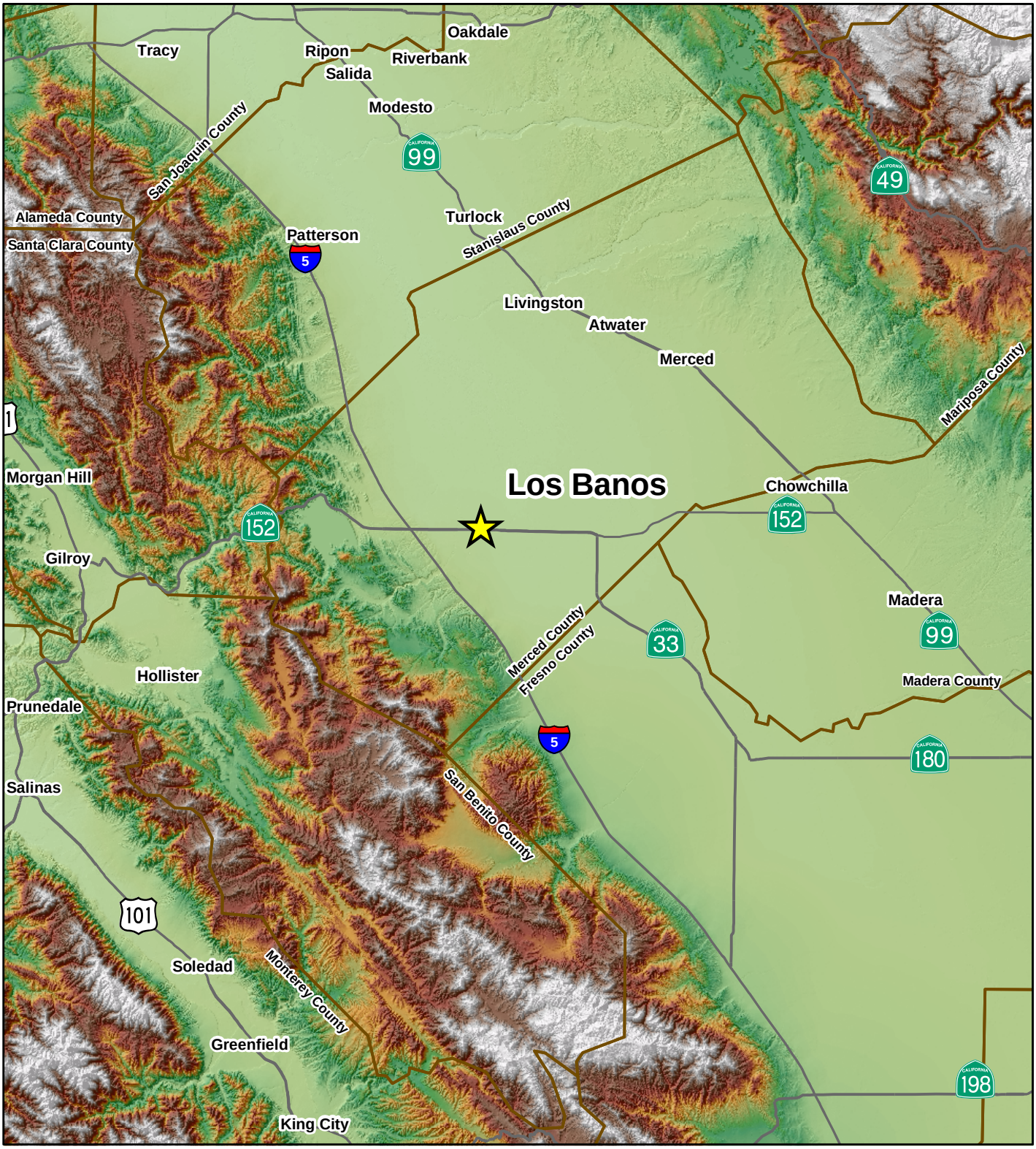
The City of Los Banos (City) is located in western Merced County (County), in the northern portion of the San Joaquin Valley. Figure 1.1 presents a location map of the City. The City is located near the junction of California State Route (SR)-152 and Interstate 5. Los Banos is the second largest city in the County[1]. The City owns, maintains and operates water supply wells and water lines throughout the City. The City pumps and delivers water to its residential, commercial, institutional, and industrial customers within the service area.

1.3 WATER SERVICE AREA

Figure 1.2 illustrates the City's current water distribution service area. The City manages and maintains over 142 miles of water lines spanning 4- to 30-inches in diameter, 13 wells, one water tower, and one above ground water storage tank. In addition to these major facilities, the City also maintains thousands of water valves and hydrants throughout the City.

The City's previous water distribution system master plan, completed in September 2000 (2000 Master Plan), included a capacity evaluation, recommended improvements to mitigate hydraulic deficiencies, recommended improvements to accommodate growth, and summarized capital costs associated with the improvements. From the time when the 2000 Master Plan was completed, the City's General Plan, land uses, study boundary, infrastructure, and operational conditions changed, creating the need for a new master plan. The land use assumptions in this Master Plan were based on the City's 2030 General Plan Update (2030 General Plan) and projected future developments within the sphere of influence (SOI). Should future planning conditions change from the assumptions stated in this Master Plan (i.e., accelerated growth, more intense developments, etc.), revisions and adjustments to the Master Plan recommendations would be necessary.

[1] City of Los Banos 2030 General Plan Update, Approved July 15, 2009



Legend

Elevation

High : 4,500 Feet

Low : Sea Level

County Boundary

Major Roads

Miles

0 7.5 15

Figure 1.1
Regional Location Map
Water Distribution
System Master Plan
City of Los Banos

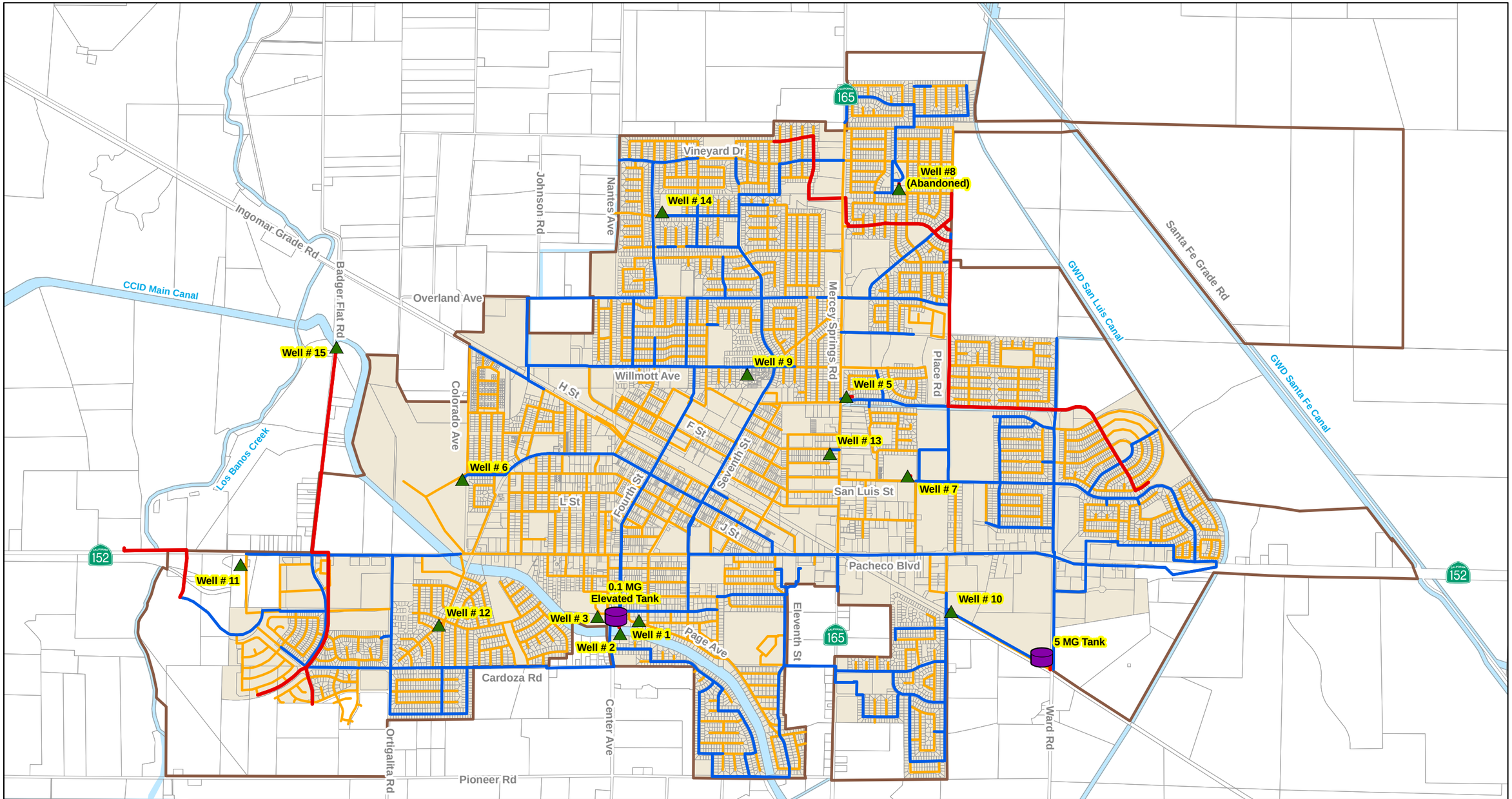


Figure 1.2
Current Water Distribution Service Area
Water Distribution System Master Plan
City of Los Banos

1.4 SCOPE AND AUTHORIZATION

The purpose of this Master Plan is to identify capacity deficiencies in the distribution system, develop feasible alternatives to correct these deficiencies, and plan the infrastructure that will serve future development. On October 9, 2007, the City approved a professional service agreement with Carollo Engineers, P.C. (Carollo) to prepare this Master Plan for the water distribution system, which included the following main tasks:

- Model development
- Distribution system analysis and capital project development
- Master Plan preparation

1.5 REPORT ORGANIZATION

The Master Plan report contains seven chapters, followed by appendices that provide supporting documentation for the information presented in the report. The chapters are briefly described below:

Chapter 1 - Background. This chapter presents the need for this Master Plan and the objectives of the study. A list of abbreviations and reference material is also provided to assist the reader in understanding the information presented.

Chapter 2 - Study Area Description. This chapter presents a description of the study area, defines the land use classifications, and summarizes the historical population trends.

Chapter 3 - Planning Criteria. This chapter presents the planning criteria for evaluating the water distribution system. The planning criteria address the distribution system capacity, minimum pressure, maximum velocity and headloss, supply and storage requirements, average water demand coefficients, and demand peaking factors.

Chapter 4 - Water Demand Projections. This chapter presents the calculation of the water demands used to model the existing and future distribution system.

Chapter 5 - Water Distribution System Facilities and Hydraulic Model. This chapter describes the development and calibration of the City's water distribution system hydraulic model.

Chapter 6 - Capacity Evaluation and Proposed Improvements. This chapter discusses the hydraulic evaluation of the distribution system and the proposed projects that correct capacity deficiencies and serve future users.

Chapter 7 - Capital Improvement Projects. This chapter presents the capital improvement projects and a summary of the capital costs. This chapter is organized to assist the City in making finance decisions.

1.6 ACKNOWLEDGMENTS

Carollo Engineers wishes to acknowledge and thank Mr. Mark Fachin, Public Works Director/City Engineer; Mr. Gary Hutsell, Assistant Public Works Director; Mr. Royal Lloyd, Wastewater Treatment Plant Supervisor; Mr. Tim Marrison, Assistant Fire Chief; Mr. Stanley Silva; and Ms. Melinda Wall. Their cooperation and courtesy in obtaining a variety of necessary information were valuable components in completing and producing this report.

1.7 ABBREVIATIONS AND DEFINITIONS

To conserve space and to improve readability, the following abbreviations are used in this report.

ADD	average day demand
AFY	acre-feet per year
ASCE	American Society of Civil Engineers
CDPH	California Department of Public Health
CIP	capital improvement project
City	City of Los Banos
cfs	cubic feet per second
County	County of Merced
DOF	California Department of Finance
DU	dwelling unit
ENR CCI	Engineering News Record Construction Cost Index
EPA	U.S. Environmental Protection Agency
GIS	geographic information system
fps	feet per second
gpda	gallons per day per acre
gpcd	gallons per capita per day
gpm	gallons per minute
LF	linear feet

LAFCo	Local Agency Formation Commission
MDD	maximum day demand
MG	million gallons
mgd	million gallons per day
mgm	million gallons per month
mgy	million gallons per year
PHD	peak hour demand
ROW	right-of-way
SOI	Sphere of Influence
SWTP	Surface Water Treatment Plant

1.8 REFERENCE MATERIAL

The following documents were referenced in the preparation of this master plan:

- City of Los Banos 2030 General Plan Update, Approved July 15, 2009
- City of Los Banos Improvement Standards and Specifications, October 2004
- City of Los Banos Year 2000 Water Master Plan, Stoddard & Associates, September 2000
- City of Los Banos 2005 Urban Water Management Plan, Stoddard Engineering/Boyle, April 2006
- City of Los Banos, Average Annual Water Use Estimate, Erler & Kalinowski, Inc., August 14, 2007

Chapter 2

STUDY AREA DESCRIPTION

This chapter presents a description of the study area, defines the land use classifications, and summarizes the historical population trends.

2.1 STUDY AREA

The 2030 General Plan Update (2030 General Plan) sphere of influence (SOI) is the study area boundary for this water distribution system master plan (Master Plan). The Master Plan study boundary and SOI are synonymous and will be used interchangeably throughout this report. The SOI boundary extends far beyond the current water distribution service area and is approximately 14,382 acres (22.5 square miles). The Master Plan contains a forecast of water system improvements in a large study area beyond the City of Los Banos (City) limits. Figure 2.1 shows the study area boundary and the City's limits.

Evaluating infrastructure needs beyond the City limits is important because:

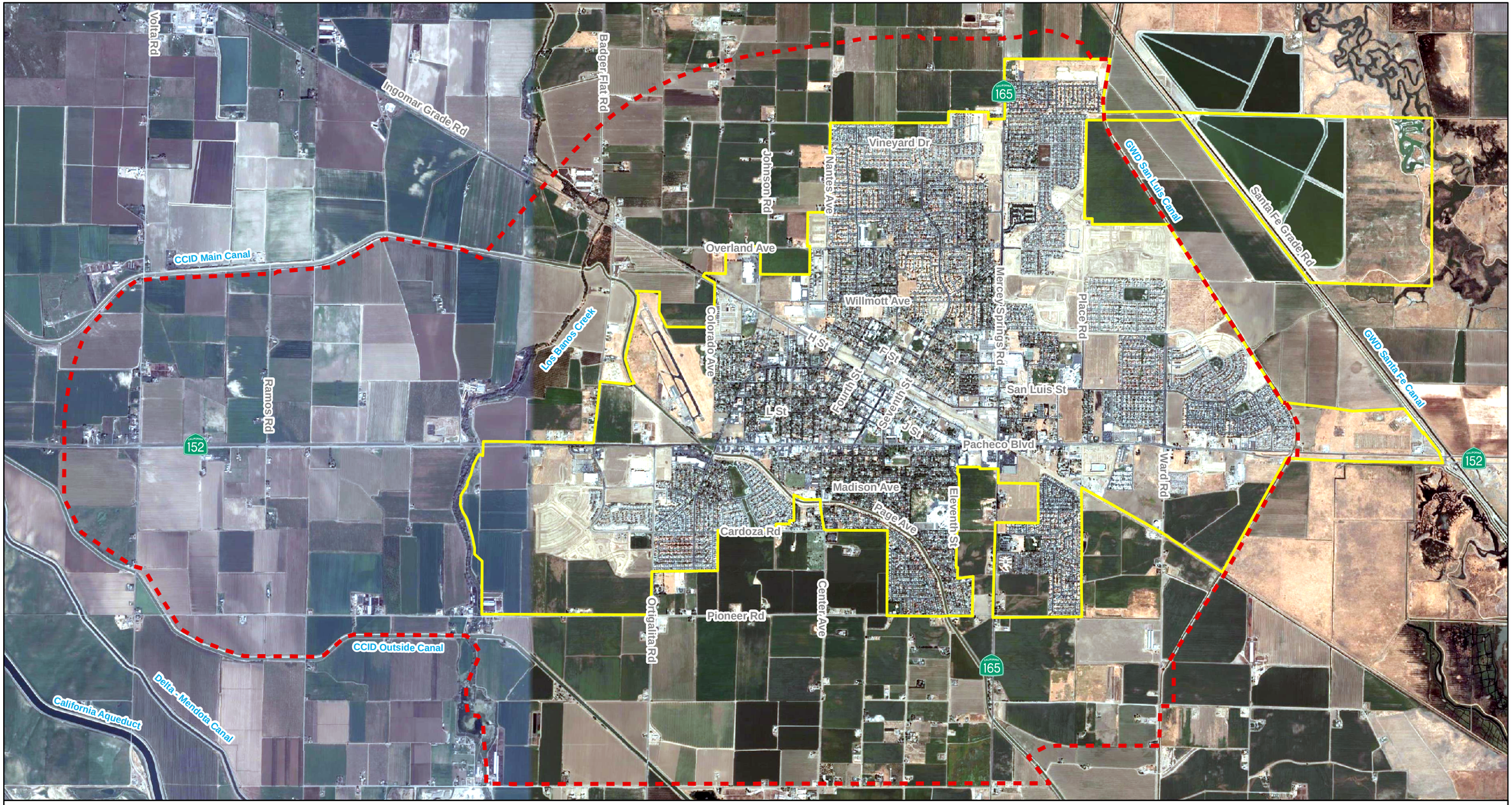
- there are conceptual development plans that are beyond the City limits; and
- recent rapid growth in the San Joaquin Valley indicates that significant development into the study area could occur within a short planning period.

2.2 PLANNING PERIOD

The Master Plan study area is intended to include the existing City limits and development within the SOI that could occur through the year 2030. Existing and projected populations and land uses within the study area are discussed in this chapter.

2.3 CLIMATE

The City is characterized by hot, dry summers and relatively mild winters. Annual rainfall generally totals slightly less than nine inches, with approximately 90 percent of the rainfall occurring between November to April. In the winter months, fog conditions often persist for several days, but the season is generally short.



Legend

Sphere of Influence[1]

City Limits

N

0 2,500 5,000 Feet

Figure 2.1
Study Area
Water Distribution System Master Plan
City of Los Banos

1. Sphere of Influence from City of Los Banos 2030 General Plan Update, Dyett & Bhatia, June 2009

2.4 LAND USE

The 2030 General Plan guides development within the SOI and establishes the long-range development policies. The general plan also provides land use and population projections. Land use and population information are integral components in determining the amount of water demand within the City. The type of land use in an area will affect the volume and character of the water demand. Adequately estimating the demand of water from various land use types is important in sizing and maintaining water system facilities.

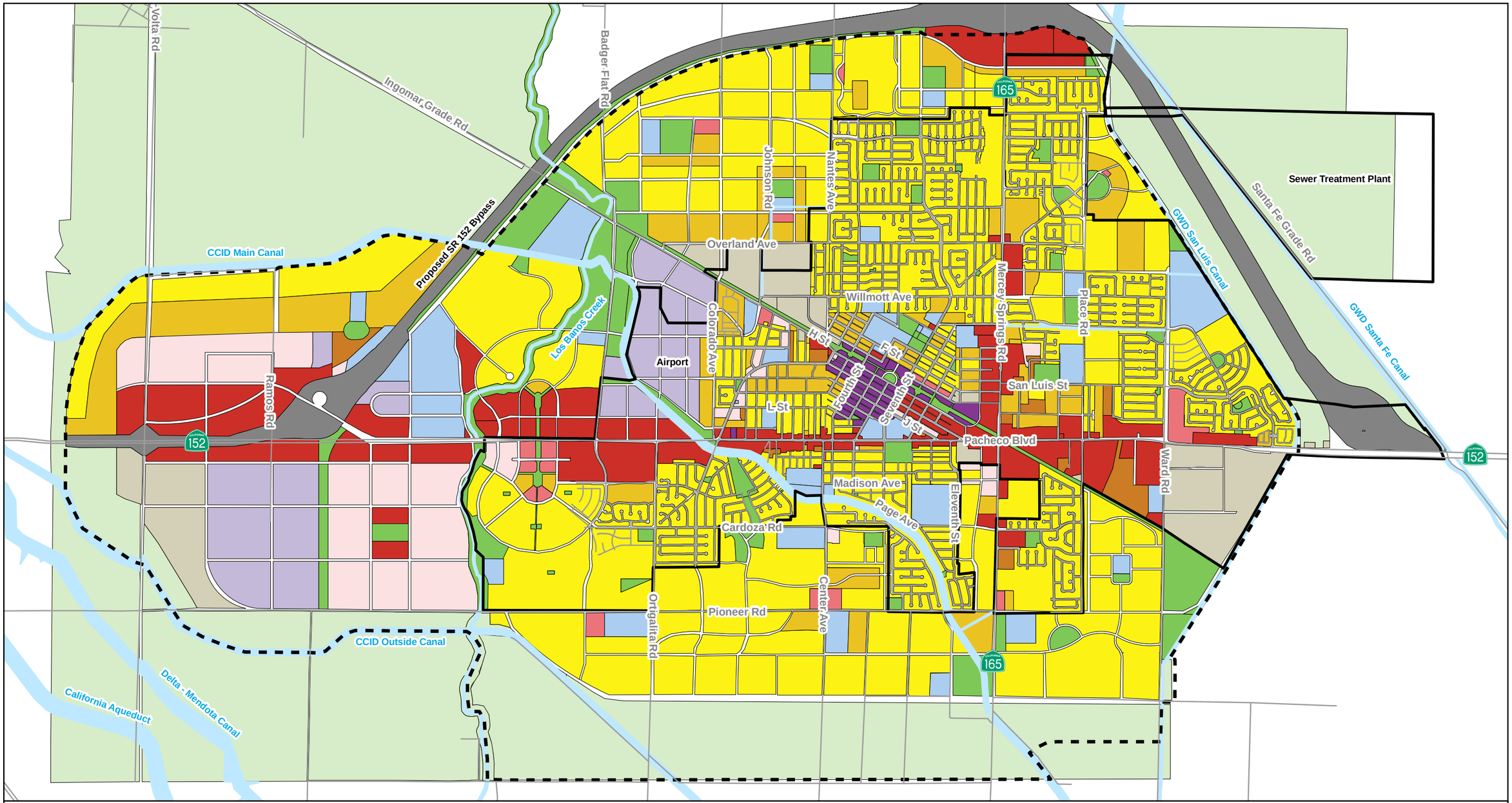
Land use assumptions used in this study are consistent with the 2030 General Plan. Since the land use assumptions forecast the type of growth within the SOI, this association to the Master Plan should ensure that the water demand projections and facilities required to serve future growth are consistent with the City's guiding document on development. Figure 2.2 illustrates the different land uses found in the 2030 General Plan. The study area's land use designation and respective acreage totals are summarized in Table 2.1. Appendix A provides a description of the different land uses. The descriptions are excerpts from the 2030 General Plan.

2.4.1 Water Distribution Service Area by Land Use

2.4.1.1 Existing Service Area Land Use

The City provides water distribution service to residents, businesses, and other institutions within its City limits. Table 2.1 provides the acreage totals by land use classification within the SOI. Also included in Table 2.1 are the land use totals for the 2007 water service area, and the breakdown between developed land, which generates water demand, and undeveloped land that will be developed in the future. The City currently provides water service to approximately 4,582 acres (includes developed and undeveloped land) or 7.2 square miles. Note that the acreage total does not include land occupied by the City's wastewater treatment plant (WWTP) because the treatment plant is located outside of the SOI.

The largest land use category is residential (low, medium, and high), which accounts for approximately 2,279 acres, or approximately 50 percent of the total acreage. Commercial, office/professional and industrial make up approximately 925 acres, or 20 percent of the total. Civic/Institutional makes up approximately 181 acres, or 4 percent. Other land uses such as parks, streets, and open space account for 1,197 acres, or 26 percent of the total service area.



Legend

- Streets
- Waterways/Canals
- Sphere of Influence
- City Limits

General Plan Land Use[1]

Residential

- Low Density Residential
- Medium Density Residential
- High Density Residential

Commercial

- Commercial
- Employment Park
- Neighborhood Commercial
- Professional Office

Industrial

- Industrial

Public/Quasi-Public

- Civic/Institutional
- Park

Other

- Mixed Use
- Agriculture/Rural
- SR 152 Bypass Corridor

N

0 2,500 5,000 Feet

Figure 2.2
General Plan Land Use
Water Distribution
System Master Plan
City of Los Banos

carollo Engineers. Working Wonders With Water

1. Land use source: City of Los Banos, 2030 General Plan Update, Final, July 15, 2009, Dyett & Bhatia

Table 2.1 Study Area Land Use Designations
Water Distribution System Master Plan
City of Los Banos

Land Use Designation	SOI[1] (acres)	2007 City Service Area[2] (acres)	(acres)	(acres)
Residential				
Low Density Residential	4,452	1,851	1,605	246
Medium Density Residential	875	372	179	193
High Density Residential	98	56	52	4
Mixed Use				
Mixed Use	73	44	38	6
Neighborhood Commercial	89	68	21	46
Commercial/Office Professional				
Commercial	991	445	255	190
Office/Professional	574	96	55	41
Employment Park	555	149	136	14
Industrial	498	124	88	36
Others				
Agriculture/Rural	1,560	0	0	0
Parks, Trails & Open Space	852	355	323	31
Civic/Institutional	573	181	167	14
SR 152 Bypass Corridor	205	0	0	0
Streets/Roads	2,989	843	805	38
Total	**14,382**	**4,582**	**3,723**	**858**

Notes:
1. Los Banos 2030 General Plan Sphere of Influence is the study area boundary.
2. Total excludes the wastewater treatment plant.

2.4.1.2 Future Service Area Land Use

At build-out of the SOI boundary, the City will serve approximately 14,382 acres. Build-out is defined as complete development of all lands. The breakdown of the different land use categories is provided in Table 2.1.

2.5 HISTORICAL AND FUTURE POPULATION

The City has historically been an agricultural based community and supports food processing facilities and related agricultural services. The City's population began to grow quickly after World War II owing to returning veterans and highway construction[1]. A series of irrigation and dam projects in the 1960s brought more people to the City, however, growth slowed from 1970 to 1985. In 1990, the City's population began to grow rapidly and continued through year 2007. From 1990 through the present, the population grew from approximately 14,500 to 35,200. Over the last 20 years, the City has grown at an annual rate of about 5.1 percent.

The 2030 General Plan states that the build-out population will reach 90,400 people. This build-out population reflects an annual growth rate that ranges between 4.1 to 4.6 percent. Table 2.2 and Figure 2.3 summarize the City's historical and projected population to year 2030.

[1] City of Los Banos 2030 General Plan Update, July 2009

Table 2.2	**Historical and Projected Population Water Distribution System Master Plan City of Los Banos**
Year	**Population**
1910	745
1920	1,276
1930	1,745
1940	2,214
1950	3,868
1960	5,272
1970	9,188
1980	10,341
1990	14,519
2000	25,869
2007	35,200
2010	40,300
2020	60,700
2030	90,400

Note:
1. Source of historical data and population projection: City of Los Banos 2030 General Plan Update, Approved July 15, 2009

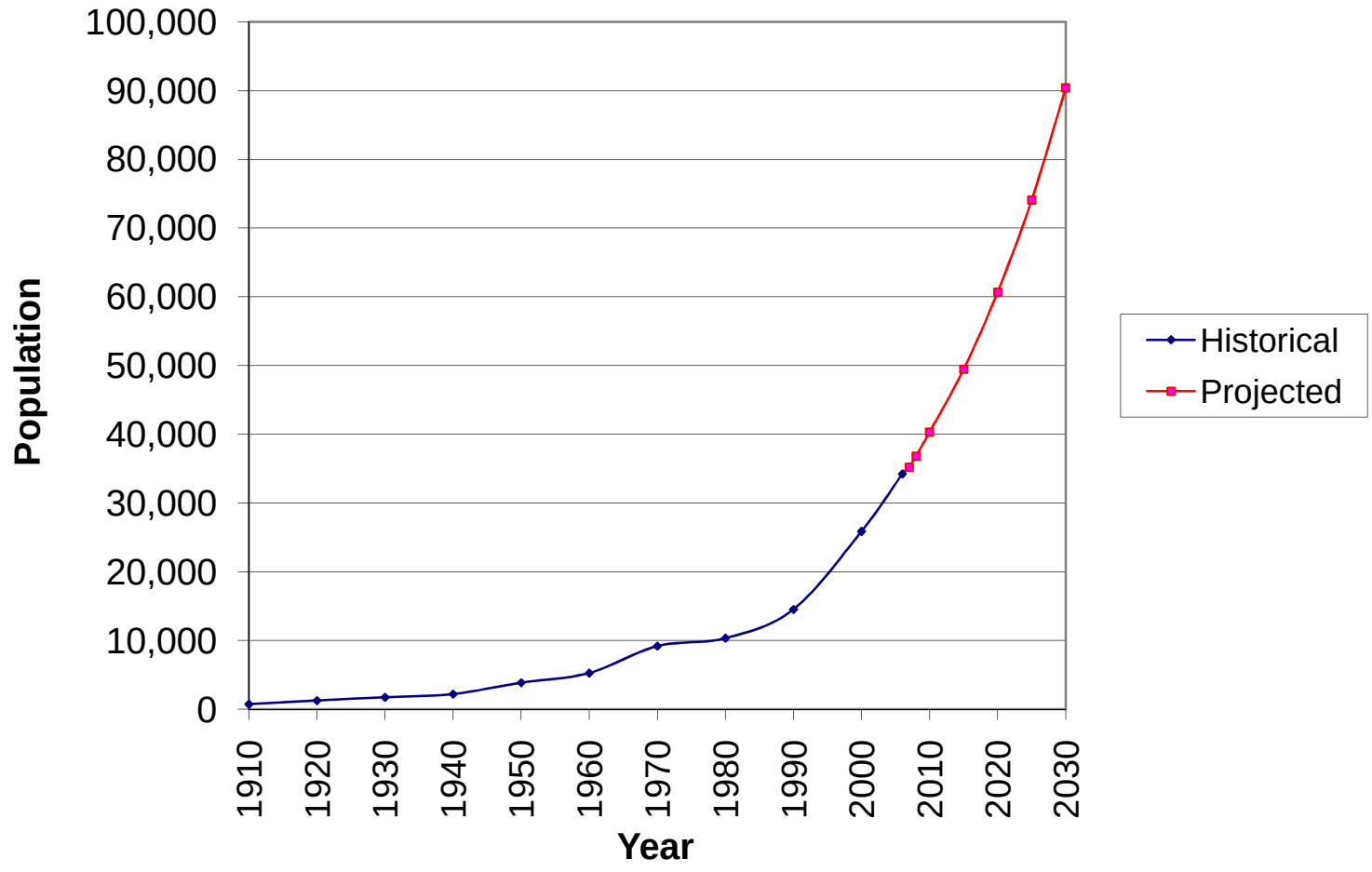


Figure 2.3
Historical and Projected Population
Water Distribution System Master Plan
City of Los Banos

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pw:\Los Banos\7833A00\Disciplines\Population.xls\Sheet1

PLANNING CRITERIA

The City of Los Banos' (City) water supply, storage, and distribution facilities were evaluated based on the planning criteria defined in this chapter. The criteria include standards from the City's Improvement Standards and Specifications (Improvement Standards). The developed criteria address the water supply capacity, storage capacity, acceptable service pressures, distribution main performance, average annual water demand coefficients, and daily and hourly peaking factors.

3.1 WATER SUPPLY CAPACITY

In determining the adequacy of the water supply facilities, the source must be large enough to meet the varying water demand conditions, as well as provide sufficient water during potential emergencies such as power outages and natural or created disasters.

This study does not include an analysis of the groundwater aquifer yield, however the 2005 UWMP study assumes that future water supply capacity will continue to be extracted from groundwater wells. The City is also planning for a future surface water treatment plant (SWTP) to meet average day demands (ADD).

3.2 FIRM SUPPLY CAPACITY

In accordance with industry standard practices and the California Department of Public Health (CDPH) criteria for "New and Existing Source Capacity" on water supply (proposed Water Works Standards 2007), at all times, a public water system's water source shall have the capacity to meet the system's maximum day demand (MDD). For reliability purposes, it is desirable to maintain a firm water supply capacity equal to the MDD. Firm capacity is equal to total capacity, minus the capacity of the largest well. Water required for peak hour demand (PHD) or for fire flows would come from storage.

3.2.1 Standby Supply Capacity

Standby production capacity is required for system reliability. Under normal operating conditions, it is possible that one or two of the City's wells could be placed out of service during MDD conditions due to equipment malfunction, for servicing, or for water quality concerns. Industry standard practice suggests counting the capacity of the largest well as the standby capacity. This surplus is required to mitigate the potential impact of lost production capabilities.

3.2.2 Recommended Supply Capacity

The adequate source of supply for the City will consist of groundwater wells with a firm capacity that can meet the MDD. The City's largest well is excluded from the firm capacity total. At build-out, the calculation of firm capacity would exclude the City's two largest wells.

3.2.3 Future Surface Water Treatment Plant

The City plans to construct a SWTP on the west side of town. It was assumed that the future SWTP would have sufficient capacity to meet ADD. The addition of the SWTP does not modify the supply capacity criteria.

3.3 STORAGE REQUIREMENTS

The principal function of storage is to provide reserve supply of water for: 1) operational equalization, 2) fire reserve, and 3) emergency needs. Operational storage is directly related to the amount of water necessary to meet peak demands. The intent of operational storage is to provide the difference in quantity between the customer's peak demands and the system's reliable available supply. The volume of water allocated for emergency uses is decided based on the historical record of emergencies experienced, and on the amount of time which is expected to lapse before a hypothetical emergency can be corrected.

3.3.1 Operational Storage

This storage is the amount of desirable stored water in a system to regulate fluctuations in demand so that extreme variations will not be imposed on the source of supply. Operational storage typically serves the peak demands exerted during the MDD. With operational storage, system pressures are improved and stabilized to better serve customers throughout the service area. Operational storage is commonly estimated between 25 percent and 50 percent of the MDD. This study recommends an operational storage equal to 25 percent of the City's MDD.

AWWA M-32 states that operational storage is typically between 10 to 15 percent of the MDD for large systems, but could exceed 30 percent for small systems or arid climates.

The CDPH proposed Water Works Standards (2007) stipulate that a water system shall be able to meet four hours of PHD with source capacity, storage capacity, and/or emergency source connections. Four hours of PHD is approximately equal to 25 percent of the City's MDD.

3.3.2 Fire Storage

This storage is the amount required to meet the necessary MDD plus fire flow demands. The City's fire department established a fire flow rate of 3,500 gallons per minute (gpm) for a duration of three hours for industrial fire flows. This provision equated to a storage

requirement of 0.63 million gallons (MG) and will allow the water system to respond to fires in residential, commercial, or industrial areas.

3.3.3 Emergency Storage

This storage is the volume recommended to meet demands during emergency situations such as pipeline failures, major transmission main failures, pump failures, electrical power outages, or natural disasters. The amount of emergency storage included within a particular water distribution system is an owner option, based on an assessment of risk, the desired degree of system dependability, economic considerations, and water quality concerns. In California, emergency storage is usually estimated at 50 to 100 percent of the MDD.

Until recently, historical data indicated a rarity of prolonged power outages in California cities, and thus groundwater aquifers were considered appropriate emergency storage, if pumping methods were reliable. Recent power shortages suggest a need to incorporate this capacity in aboveground storage tanks. The City currently relies entirely on groundwater for supply; however, there are plans to build a SWTP in the future. While the City operates on a groundwater well-based supply system, the recommendation is to have zero emergency storage. However, as the City migrates from a well supply to a surface water supply system, the emergency storage should equal 50 percent of the MDD. This storage can be supplied by either above ground tanks or groundwater supply wells.

3.3.4 Total Storage

The planned construction of the SWTP requires two sets of total storage criteria; one prior to and the other following the construction of the SWTP. The recommended minimum operational storage capacity for the City is equal to 25 percent of the MDD. Additionally, the recommended fire storage capacity is equivalent to 0.63 MG. The recommended emergency storage is equal to zero prior to the construction of the SWTP and 50 percent of the MDD following the construction. This criteria is further summarized with the following equation.

Vs = 25% MDD + Fire Flow + 0% MDD *(Prior to SWTP Construction)*

Vs = 25% MDD + Fire Flow + 50% MDD *(Post SWTP Construction)*

where, Vs is the Total Required Storage volume, in gallons

MDD is the maximum day demand, in gallons

Fire Flow is equivalent to 0.63 MG

The City currently operates one ground level storage tank with a capacity of 5.0 MG and one elevated tank with a capacity of 0.1 MG.

3.4 SERVICE PRESSURES

Pressures maintained within distribution systems vary depending on distribution system operations and pressure zone topography. It is essential that the water pressure in a consumer's residence or place of business be neither too high nor too low. Low pressures, below 30 pounds per square inch (psi), cause annoying flow reductions when more than one water-using appliance is used. High pressures may cause faucets to leak and valve seats to wear out quickly. Additionally, high service pressures usually result in wasted water and high water utility bills. The Uniform Plumbing Code (UPC) requires water pressures not exceed 80 psi at service connections, unless the service is provided with a pressure-reducing device.

The American Water Works Association (AWWA) Manual on Distribution Network Analysis of Water Utilities (AWWA M-32), indicates that pressures between 30 psi and 90 psi are generally expected during the range of system water demands including: ADD, MDD, maximum storage replenishment rate, and PHD. Based on Carollo's experience with water system planning, it is recommended that a minimum pressure of 35 psi be maintained during the PHD, while a pressure of 40 psi be maintained during the MDD.

Another service pressure criteria is related to fire flows and was devised to ensure adequate positive pressure head for the booster pumps in the fire trucks. The fire pressure criteria requires a minimum acceptable residual pressure of 20 psi at the connecting hydrant used for fighting the fire.

3.5 DISTRIBUTION MAINS

Transmission grid mains are generally sized to carry the greater of 1) the PHD, or 2) the MDD plus fire flow. Other criteria related to the distribution piping include the maximum and minimum velocities and the maximum allowable friction losses.

High velocities may cause damage to the pipes and to their appurtenances. Normally, velocities of 10 feet per second (fps) (AWWA M-32), or higher, do not cause ill effects if they occur for a limited duration. It is normally good practice to become concerned when pipe velocities exceed 8 fps on a continuous basis.

As long as the maximum velocity criteria and the pressure criteria are not violated, high head loss by itself is not an important factor. However, it may be a warning that the pipe is nearing the limit of its carrying capacity, and may not have sufficient capacity to perform under stringent conditions. It is normally good practice to monitor pipes that have a head loss in excess of 10 feet per 1,000 feet (AWWA M-32).

The roughness coefficients for calculating head loss in pipes will be based on industry standards for similar pipe materials and service age (Table 3.1). The hydraulic model

completed for the 2000 Master Plan developed the roughness coefficients for the existing system.

Table 3.1 Pipe Roughness
Water Distribution System Master Plan
City of Los Banos

	Age (Years)					
Pipe Material	**0**	**10**	**20**	**30**	**40**	**50**
Asbestos Cement	120	125	125	125	125	125
Cast Iron	120	110	100	90	80	70
Ductile Iron	130	125	120	115	110	105
Plastic (PVC)	140	140	140	140	140	140
Steel	130	120	110	100	90	80

Note: At age = 0, the roughness coefficients are commonly used values for new pipes. Roughness coefficients decrease with age at a rate that depends on pipe material. For planning purposes, roughness of Asbestos Cement and PVC pipes are assumed constant, while the remaining pipe materials decrease by age.

3.6 FIRE FLOWS

Fire flows stress a water system in a specific area of the fire and often show existing deficiencies, if any, within the general area of the simulated fire. The deficiencies are generally associated with pipe sizes (diameter) or age (roughness) that result in high headloss and lower pressures. The fire flow criteria measures a system's ability to deliver a high rate of water while maintaining a minimum pressure.

To evaluate the effect of fire flows throughout the distribution system, large point demands are applied at selected areas. The fire flow demands are run concurrent with the maximum day demand. Simulating maximum day demand plus fire flows also demonstrates the performance of supply sources, booster pumps, and storage tanks operating under very high demand conditions.

Below are the recommended fire flow criteria for the different land uses:

- Residential fire flows: 2,000 gpm for a duration of two hours
- Commercial fire flows: 3,500 gpm for a duration of two hours
- Industrial fire flows: 3,500 gpm for a duration of three hours

These criteria were established by the City's fire department[1]. The fire flow criteria above are slightly greater in flow and duration than the criteria from the water distribution system master plan (2000 Master Plan). Therefore, some of the improvements discussed in Chapter 5 are necessary to meet the more stringent fire flow requirements.

[1] Personal communication with Mr. Tim Marrison, Assistant Fire Chief, October 18, 2007.

WATER DEMAND

This chapter summarizes the City of Los Banos' (City) historical water consumption and production records used to determine the daily, monthly, and seasonal fluctuations experienced by the water system. Also summarized are the average annual water demand coefficients, daily and hourly peaking factors, and the projected demands through build-out of the sphere of influence (SOI).

4.1 HISTORICAL WATER USE

4.1.1 Per Capita Consumption

The per capita consumption rate is used for estimating the City's future water requirements, evaluating the adequacy of the supply source, and determining storage needs. The consumption rate, expressed in gallons per capita per day (gpcd), is applied to the projected population to yield future water requirements.

Historical City residential per capita water use is calculated by dividing the City's total consumption by the total population. The City's Department of Water Resources, Public Water System Statistics was reviewed to collect annual water well production and metered water deliveries. There were slight differences between the production and metered readings; therefore, calculations were completed for each of the two categories. Table 4.1 shows the historical water production, metered water deliveries, and per capita consumption from 2000 to 2007.

The average per capita demand ranged between 161 gpcd (2000) to 240 gpcd (2007). Between 2001 and 2007, the average per capita demand was 210 gpcd, based on metered water deliveries, and is the value used in this report to calculate future water demand. For comparison, the 2000 Water Master Plan reported that the 1998 per capita water use was 250 gpcd.

4.1.2 Seasonal Demands and Peaking Factors

Peaking factors represent the water use seasonal and daily variations, above or below the average annual water demand. The various peaking conditions are either statistical concepts or numerical values established through a review of historical data and are, at times, adjusted to reflect a level of conservatism.

Peaking conditions that are of particular significance to hydraulic analysis of the water system include the average day demand (ADD), average day maximum month demand (ADMMD), maximum day demand (MDD), and the peak hour demand (PHD). Peaking

Table 4.1 Historical Water Production and Metered Water Deliveries
Water Distribution System Master Plan
City of Los Banos

		Water Well Production						Metered Water Deliveries					
Year	**Population**	**Total Annual (AFY)**	**Per Capita Demand (gpcd)**	**Average Day (mgd)**	**Avg. Day Max. Month (mgd)**	**Maximum Month**	**Max. Month: Avg. Day Ratio**	**Total Annual (AFY)**	**Per Capita Demand (gpcd)**	**Average Day (mgd)**	**Avg. Day Max. Month (mgd)**	**Maximum Month**	**Max Month: Avg. Day Ratio**
2000	25,869	4,691	161	4.2	7.6	August	1.8	N/A	N/A	N/A	N/A	N/A	N/A
2001	27,506	5,463	177	4.9	7.3	August	1.5	6,455	211	5.8	Note 2	Note 2	N/A
2002	28,397	7,172	225	6.4	9.1	July	1.4	6,964	219	6.2	8.9	September	1.4
2003	29,139	6,803	208	6.1	11.0	July	1.8	6,484	198	5.8	8.8	August	1.5
2004	30,626	7,331	213	6.5	10.9	September	1.7	6,767	196	6.0	9.9	August	1.6
2005	32,380	7,598	209	6.8	12.3	August	1.8	6,969	192	6.2	11.2	August	1.8
2006	34,223	8,064	210	7.2	12.6	August	1.7	8,178	213	7.3	12.8	July	1.8
2007	35,200	9,078	230	8.1	13.4	August	1.7	9,250	240	8.5	15.2	July	1.8
			204				**1.7**		**210**				**1.7**

Notes:
1. Source Data from the City's Department of Water Resources, Public Water System Statistics.
2. Metered data for 2001 showed inconsistencies in the monthly totals.

factors for expressing these demands as a function of the ADD were developed based on the City's demand patterns. Table 4.1 summarizes the ADD and the ADMMD from 2000 through 2007.

4.1.2.1 Average Day Demand (ADD)

The average day demand is the total annual production or total annual metered water deliveries divided by number of days in the year. In 2006, the ADD was approximately 7.3 mgd, and in 2007, the ADD increased to 8.5 mgd.

4.1.2.2 Average Day Maximum Month Demand (ADMMD)

The ADMMD is the average demand for the month with the highest demand during the year, usually occurring in the summer. In 2006, the ADMMD was approximately 12.8 mgd and occurred in July. The highest demand month typically occurs in July, August or September. The ADMMD peaking factor is expressed as a multiplier applied to the ADD, and is used primarily in the evaluation of supply capabilities. As shown in Table 4.1, the average ratio of ADMMD to ADD was 1.7.

Average Day Maximum Month Demand = 1.7 x Average Day Demand

4.1.2.3 Maximum Day Demand (MDD)

The MDD is the greatest water demand during a 24-hour period of the year. The MDD peaking factor is expressed as a multiplier applied to the ADD. Water system supply sources are typically sized to meet the anticipated MDD of a water system. In general, the MDD is 2.0 to 2.5 times greater than the ADD. Daily production or metered data was not available to determine the MDD, so an industry accepted peaking factor of 2.5 was used.

Maximum Day Demand = 2.5 x Average Day Demand

4.1.2.4 Peak Hour Demand (PHD)

The PHD is the highest water demand during any one-hour period of the year. A normal day typically experiences two peak demands, in the morning and then evening. The PHD is expressed as a multiplier applied to the ADD. PHD simulations model high water use throughout the system and assist in identifying areas of the distribution system that experience low pressures.

In general, the PHD ranges between 2.5 and 3.5 times greater than the ADD. Hourly demands were not available for this project, so an industry accepted peaking factor of 3.5 was used.

Peak Hour Demand = 3.5 x Average Day Demand

4.1.2.5 Daily Diurnal Pattern

In the absence of hourly production records, an hourly diurnal pattern was developed for this study using the recommended peaking factors. These peaking factors are shown in Table 4.2 and on Figure 4.1. Table 4.2 includes values for hourly demands during existing and projected MDD conditions. These diurnal patterns were used in the hydraulic computer model to perform 24-hour simulations for evaluating the capacity of the City's existing distribution system and for sizing improvements.

4.2 WATER DEMAND PROJECTIONS

For water distribution system master plans, developing relationships between land use and demand is a method typically employed to develop average day demands. The water demand planning criteria are typically based on standard practice values, but then refined based on actual data. The land use demand coefficients were established to estimate ADD within the study area.

4.2.1 Existing Water Demand Coefficients

The average annual water demand coefficients are factors that provide a means to transform a land use category from acreage into a water demand. The demand coefficient is usually expressed in gallons per day per acre (gpda), and when multiplied by the land use acreage, the product is equal to the average water demand for that land use. The resulting demand is then input into the water distribution system model. Since water demand varies by land use, an assessment of water consumption by land use category provides an accurate representation of demands throughout the City.

This Master Plan relied on work completed by others for the derivation of water demand coefficients. The "Average Annual Water Use Estimate Technical Memorandum, August 2007[1]" summarized the analysis for developing water demand coefficients and for projecting future water demands. The water demand coefficients from the technical memorandum analysis are summarized in Table 4.3.

To confirm the validity of these coefficients, the developed acreage within the City limits were multiplied by the demand coefficients. The resulting average demand was approximately 7.5 mgd. In comparison, the 2006 ADD (based on DWR Public Water System Statistics maintained by the City) was approximately 7.3 mgd. There is less than a three percent difference between the metered water deliveries and the calculated average demand based on the coefficients. Therefore, the coefficients derived in the technical memorandum are appropriate for this Master Plan.

[1] Average Annual Water Use Estimate Technical Memorandum, August 2007, Erler & Kalinowski

Table 4.2 Daily Diurnal Water Demand Pattern
Water Distribution System Master Plan
City of Los Banos

Demand Condition	Time (Hours) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-Hour Average
Diurnal Pattern (Peaking Factors)																									
Average Day Demand (ADD)	0.65	0.70	0.75	0.80	1.10	1.30	**1.40**	1.30	1.20	1.10	0.95	1.10	0.90	0.80	0.95	1.00	1.20	1.30	1.20	1.00	0.90	0.85	0.80	0.75	1.00
Maximum Day (MDD)	1.63	1.75	1.88	2.00	2.75	3.25	**3.50**	3.25	3.00	2.75	2.38	2.75	2.25	2.00	2.38	2.50	3.00	3.25	3.00	2.50	2.25	2.13	2.00	1.88	2.50
Maximum Month (MMD)	1.11	1.19	1.28	1.36	1.87	2.21	**2.38**	2.21	2.04	1.87	1.62	1.87	1.53	1.36	1.62	1.70	2.04	2.21	2.04	1.70	1.53	1.45	1.36	1.28	1.70
Existing Water Demands (mgd)																									**(mgd)**
Average Day Demand (ADD)	4.9	5.3	5.6	6.0	8.3	9.8	**10.5**	9.8	9.0	8.3	7.1	8.3	6.8	6.0	7.1	7.5	9.0	9.8	9.0	7.5	6.8	6.4	6.0	5.6	7.5
Maximum Day (MDD)	12.2	13.1	14.1	15.0	20.6	24.4	**26.3**	24.4	22.5	20.6	17.8	20.6	16.9	15.0	17.8	18.8	22.5	24.4	22.5	18.8	16.9	15.9	15.0	14.1	18.8
Projected Demands: Sphere of Influence Boundary (mgd)																									**(mgd)**
Average Day Demand (ADD)	16.2	17.4	18.7	19.9	27.4	32.4	**34.9**	32.4	29.9	27.4	23.7	27.4	22.4	19.9	23.7	24.9	29.9	32.4	29.9	24.9	22.4	21.2	19.9	18.7	24.9
Maximum Day (MDD)	40.5	43.6	46.7	49.8	68.5	80.9	**87.2**	80.9	74.7	68.5	59.1	68.5	56.0	49.8	59.1	62.3	74.7	80.9	74.7	62.3	56.0	52.9	49.8	46.7	62.3

Note: 1) Peaking Factors are multipliers applied to the average day demand

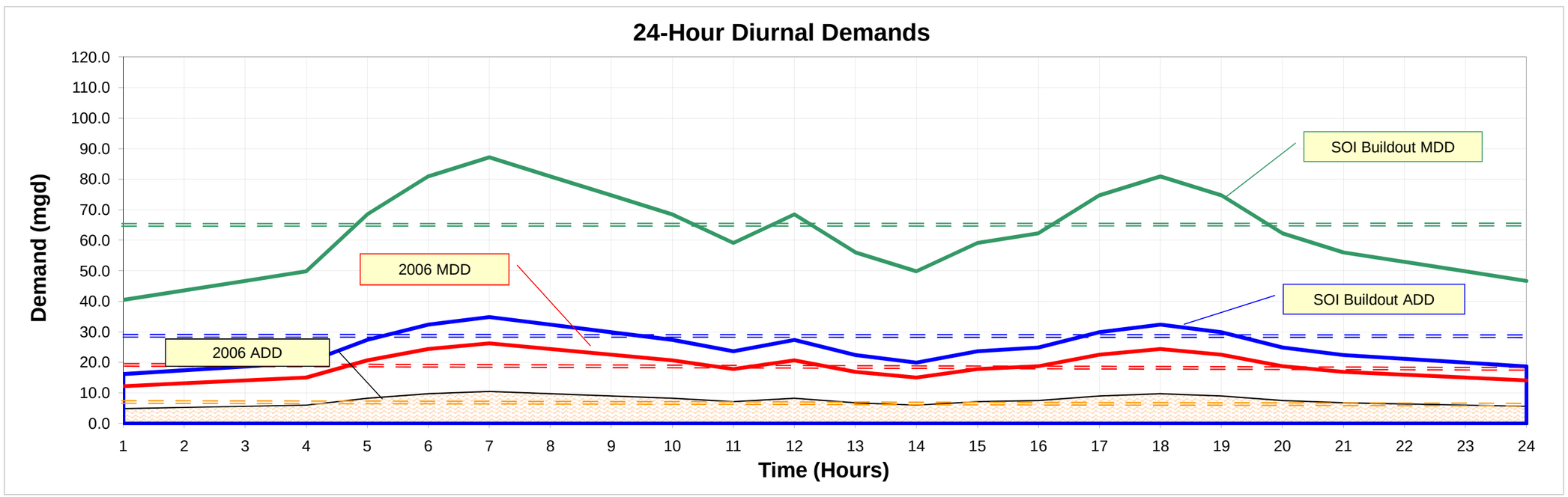

Figure 4.1
Daily Diurnal Water Demand Pattern
Water Distribution System Master Plan
City of Los Banos

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Table 4.3 Existing Water Demand Coefficients
Water Distribution System Master Plan
City of Los Banos

Land Use Designation	Developed[(1),(2)] (acres)	2007 Water Distribution Service Area: Demand Coefficient[(3)] (gpd/acre)	Average Day Demand (gpd)	Annual Demand (AFY)	Percent of Total Demand
Residential					
Low Density Residential	1,605	2,180	3,499,000	3,920	46%
Medium Density Residential	179	3,370	602,000	674	8%
High Density Residential	52	4,550	236,000	264	3%
Mixed Use					
Mixed Use	38	3,080	117,000	131	2%
Neighborhood Commercial	21	2,500	53,000	59	1%
Commercial/Office Professional					
Commercial	255	2,500	637,000	714	8%
Office/Professional	55	2,500	138,000	155	2%
Employment Park	136	2,500	340,000	381	4%
Industrial	88	2,500	219,000	245	3%
Others					
Agriculture/Rural	0	0	0	0	0%
Parks, Trails & Opens Space	323	4,020	1,300,000	1,456	17%
Civic/Institutional	167	2,500	417,000	467	6%
SR 152 Bypass Corridor	0	0	0	0	0%
Streets/Roads	805	0	0	0	0%
Total	**3,723**		**7,558,000**	**8,467**	**100%**

Notes:
1. City limit total excludes the wastewater treatment plant.
2. Area totals exclude streets and roads. Streets and roads account for approximately 21 percent of the developed City limits.
3. Demand coefficients from the “Average Annual water Use Estimate” Technical Memorandum, August 2007, Erler & Kalinowski, Inc.

Table 4.3 also breaks down the percentage of demand attributed to each land use. Residential customers make up about 57 percent of the existing demand and 49 percent of the developed land. Commercial, Industrial, Civic, and Office make up approximately 25 percent of the demand and 20 percent of the developed land. Parks, open space, and streets make up the rest.

4.2.2 Future Water Demands

Developing an accurate estimate of the water demand is an important step in determining the size of water distribution system facilities, for both existing conditions and future developments. The future ADD was generated in a similar manner as the existing ADD. Future demand projections were developed based on the land use projections as described in the City's 2030 General Plan Update (2030 General Plan).

As previously reported, build-out of the SOI boundary will nearly triple the current City service area. The build-out water demands were calculated by multiplying each land use area by its corresponding demand coefficient. The resulting demand projections are summarized in Table 4.4. The demands summarized in Table 4.4 assume 100 percent development and occupancy of all land uses within the SOI. If we assume that 5 to 10 percent of all residences, commercial buildings and offices are vacant or not developed at build-out, then the build-out demand could range between 23.4 to 24.9 mgd. For the purposes of modeling and sizing infrastructure, this Master Plan assumed 100 percent development of the SOI.

A summary of the existing and future ADD is presented in Table 4.5. If the City achieves build-out of the SOI by 2030, then the water demand will increase at an annual rate of about 5.0 percent between now and build-out of the study area. In addition to the projected average demands, Table 4.5 includes annual estimates for the MDD and PHD through build-out of the SOI. Based on these projections, it is anticipated that the City's build-out ADD and MDD will approach 24.9 mgd and 62.3 mgd, respectively.

For comparison, the water demands were projected using the population method. Based on a projected 2030 population of 90,400 and an average per capita demand of 210 gpcd, the projected ADD could approach 19.0 mgd. The population method for calculating water demand results in a much lower projection when compared to the land use method. One reason for the lower estimate using the population approach is that employment related lands (e.g. commercial, office, and industrial) will make up a larger percentage of the land use and water demand in the future. The water demands imparted by these employment related lands will increase the future per capita consumption rate, which averaged 210 gpcd over the last seven years. Currently, many local residents commute to areas outside of the City for work.

Table 4.4 SOI Build-out Water Demand Projections
Water Distribution System Master Plan
City of Los Banos

Land Use Designation	Developed[1] (acres)	Projected Build-out of Sphere of Influence: Demand Coefficient[2] (gpd/acre)	Average Day Demand (gpd)	Annual Demand (AFY)	Percent of Total Flow
Residential					
Low Density Residential	4,452	2,180	9,706,000	10,873	39%
Medium Density Residential	875	3,370	2,947,000	3,301	12%
High Density Residential	98	4,550	448,000	502	2%
Mixed Use					
Mixed Use	73	3,080	225,000	252	1%
Neighborhood Commercial	89	2,500	223,000	250	1%
Commercial/Office Professional					
Commercial	991	2,500	2,477,000	2,775	10%
Office/Professional	574	2,500	1,434,000	1,606	6%
Employment Park	555	2,500	1,387,000	1,554	6%
Industrial	498	2,500	1,244,000	1,394	5%
Others					
Agriculture/Rural	1,560	0	0	0	0%
Parks, Trails & Opens Space	852	4,020	3,423,000	3,835	14%
Civic/Institutional	573	2,500	1,433,000	1,605	6%
SR 152 Bypass Corridor	205	0	0	0	0%
Streets/Roads[3]	2,989	0	0	0	0%
Total	**14,382**		**24,947,000**	**27,946**	**100%**

Notes:
1. Total excludes the wastewater treatment plant and about 150 acres outside the SOI, but within the City limits along SR152.
2. Demand coefficients from the "Average Annual water Use Estimate" Technical Memorandum, August 2007, Erler & Kalinowski, Inc.
3. Adjustments to the acreage totals for the other land uses were made in order to maintain a Streets/Roads total that is approximately 21 percent of the total.

Table 4.5 Demand Summary Water Distribution System Master Plan City of Los Banos			
Planning Year	**Average Day Demand (mgd)**	**Maximum Day Demand (mgd)**	**Peak Hour Demand (mgd)**
Existing[1]	7.5	18.8	26.3
SOI Build-out[2]	24.9	62.3	87.2

Notes:
1. Based on land use and developed acreages within the City limits, and water demands for year 2006.
2. Based on land use and acreage from the City's 2030 General Plan and 100 percent build-out.

The 2030 General Plan states that complete build-out of employment related land should be reached around 2055, which is 25 years beyond the planning horizon of this Master Plan. The timing for achieving build-out of the employment related land will effect the phasing of capital projects, but not the build-out demand. Phasing of capital projects is discussed in later chapters of this master plan.

4.2.3 Growth Horizon

The discussion up to this point has focused on the demand projection when the SOI is fully built out. The City's 2030 General Plan states, "Although the General Plan applies a 24-year horizon, the Plan is not intended to specify or anticipate when build-out will actually occur." If we assume that the projected population is reached by 2030, then the residential land uses will be fully built out. However, a different assumption is provided for the employment related land uses. The 2030 General Plan reports that, based on historical trends, complete build-out of employment-related land should be reached around 2055. Based on this growth rate, it is assumed that half of the employment-related land is developed by year 2030, and the remainder is developed by 2055.

Based on the timing assumptions for build-out of residential and employment-related land uses, the following demand projections can be made (Table 4.6).

4.2.4 Future Water Resources

The City may require that new developments secure future water resources to serve their developments. To assist the City in approximating the amount of water resources required to serve future development, Table 4.7 forecasts the annual increase in water demand. As shown in the table, by year 2025 the City's average annual demand could increase to 17,600 acre-feet per year (afy). From 2007 through 2025, future developments would need to secure approximately 8,800 afy of water resources for the City to serve future customers.

Table 4.6 Demand Projections Water Distribution System Master Plan City of Los Banos	
Planning Year	**Average Day Demand (mgd)**
Existing[1]	7.5
2010	8.8
2015	10.7
2020	13.0
2025	15.7
2030	**19.0**
2035	20.1
2040	21.2
2045	22.4
2050	23.6
2055	24.9

Note:
1. Based on Average Annual Water Use Estimate Technical Memorandum, August 2007, Erler & Kalinowski, Inc. and developed land in the City.

4.3 PLANNING CRITERIA SUMMARY

Table 4.8 provides a summary of the planning criteria.

Table 4.7 Future Water Resource Demand
Water Distribution System Master Plan
City of Los Banos

Year	Average Annual Demand (acre-feet per year)	Annual Demand Increase (acre-feet per year)	Cumulative Demand Increase
2007	8,800	-	-
2008	9,100	300	300
2009	9,500	400	700
2010	9,900	400	1,100
2011	10,300	400	1,500
2012	10,700	400	1,900
2013	11,100	400	2,300
2014	11,500	400	2,700
2015	12,000	500	3,200
2016	12,400	400	3,600
2017	12,900	500	4,100
2018	13,400	500	4,600
2019	14,000	600	5,200
2020	14,500	500	5,700
2021	15,100	600	6,300
2022	15,700	600	6,900
2023	16,300	600	7,300
2024	16,900	600	8,100
2025	17,600	700	8,800
2026	18,300	700	9,500
2027	19,000	700	10,200
2028	19,700	700	10,900
2029	20,500	800	11,700
2030	21,300	800	12,500
2031	21,500	200	12,700
2032	21,800	300	13,000
2033	22,000	200	13,200
2034	22,300	300	13,500
2035	22,500	200	13,700
2036	22,700	200	13,900
2037	23,000	300	14,200
2038	23,200	200	14,400
2039	23,500	300	14,700
2040	23,800	300	15,000
2041	24,000	200	15,200
2042	24,300	300	15,500
2043	24,500	200	15,700
2044	24,800	300	16,000
2045	25,100	300	16,300
2046	25,300	200	16,500
2047	25,600	300	16,800
2048	25,900	300	17,100
2049	26,200	300	17,400
2050	26,500	300	17,700
2051	26,800	300	18,000
2052	27,100	300	18,300
2053	27,300	200	18,500
2054	27,600	300	18,800
2055	27,900	300	19,100

Table 4.8 Planning Criteria Summary
Water Distribution System Master Plan
City of Los Banos

Source of Supply

The adequate source of supply is required to meet:	**Near Term**	Maximum Day Demand + 1 well (largest) standby
	Build-out	Maximum Day Demand + 2 wells (largest) standby

Storage

The adequate Pressure Zone storage shall meet:	**Prior to Surface Water Treatment Plant Construction**	
	Operational Storage =	25% of Maximum Day Demand
	Fire Storage =	0.63 MG (3,500 gpm for 3 hours)
	Emergency Storage =	0% Maximum Day Demand
	Post Surface Water Treatment Plant Construction	
	Operational Storage =	25% of Maximum Day Demand
	Fire Storage =	0.63 MG (3,500 gpm for 3 hours)
	Emergency Storage =	50% of Maximum Day Demand
		Groundwater wells to meet emergency storage

Distribution Mains

The distribution system should be sized to meet the:	Peak Hour Demand
Criteria for judging the adequacy of existing pipelines:	Maximum desirable pipeline velocity: 8 feet per second Maximum desirable headloss: 10 feet/1,000 feet

Headloss in Pipes (Roughness Coefficients)

Headloss in pipes shall be calculated based on the following roughness coefficient table:

	Age (Years)					
Pipe Material	**0**	**10**	**20**	**30**	**40**	**50**
Asbestos Cement	125	125	125	125	125	125
Cast Iron	120	110	100	90	80	70
Ductile Iron	130	125	120	115	110	105
Plastic (PVC)	140	140	140	140	140	140
Steel	130	120	110	100	90	90

Service Pressures

The recommended low pressures are as follows:	Minimum Pressure (during Maximum Day) =	40 psi
	Minimum Pressure (during Peak Hour) =	35 psi
	Minimum Residual Pressure (during Fires) =	20 psi

Water Use Peaking Factors

Fluctuations in water demands shall be based on:	Average Day Maximum Month Demand =	1.7 x Average Day Demand
	Maximum Day Demand =	2.5 x Average Day Demand
	Peak Hour Demand =	3.5 x Average Day Demand

Average Day Demand Coefficients

These demand coefficients are applied to the net land use acreages to yield average day water demands:

	Coefficients	
Land Use Category	**(gpd/acre)**	**(gpm/acre)**
Low Density Residential	2,180	1.51
Medium Density Residential	3,370	2.34
High Density Residential	4,550	3.16
Mixed Use	3,080	2.14
Neighborhood Commercial	2,500	1.74
Commercial	2,500	1.74
Office/ Professional	2,500	1.74
Employment Park	2,500	1.74
Industrial	2,500	1.74
Agriculture/Rural	0	0.00
Parks, Trails & Open Space	4,020	2.79
Civic/Institutional	2,500	1.74
SR 152 Bypass Corridor	0	0.00

Fire Flows

In the study, water system response is adequate when it provides the following flows:	Residential fire flow =	2,000 gpm for a duration of 2 hours
	Commercial fire flow =	3,500 gpm for a duration of 2 hours
	Industrial fire flow =	3,500 gpm for a duration of 3 hours

DISTRIBUTION SYSTEM FACILITIES AND HYDRAULIC MODEL

This chapter presents an overview of the City of Los Banos' (City) water supply, water distribution system, and storage facilities. The chapter also describes the development and calibration of the City's water distribution system hydraulic model. This hydraulic model was used to identify existing and future system deficiencies and to recommend the improvements described in Chapter 6.

5.1 WATER SERVICE AREA OVERVIEW

The City provides potable water service to its residential, commercial, industrial, and institutional customers within the City limits and sphere of influence (SOI). Groundwater is currently the only source of water supply for the City. The City is located within the San Joaquin River Hydrologic Region (groundwater basin) and extracts its groundwater supply from the Delta-Mendota Subbasin[1] via a series of groundwater wells distributed throughout the City.

The City's municipal water supply system consists of 13 active groundwater wells scattered throughout the City (Figure 5.1). Well No. 8 is out of service due to elevated concentrations of uranium. Well No. 15 did not operate in year 2007, or for the last three months of 2006.

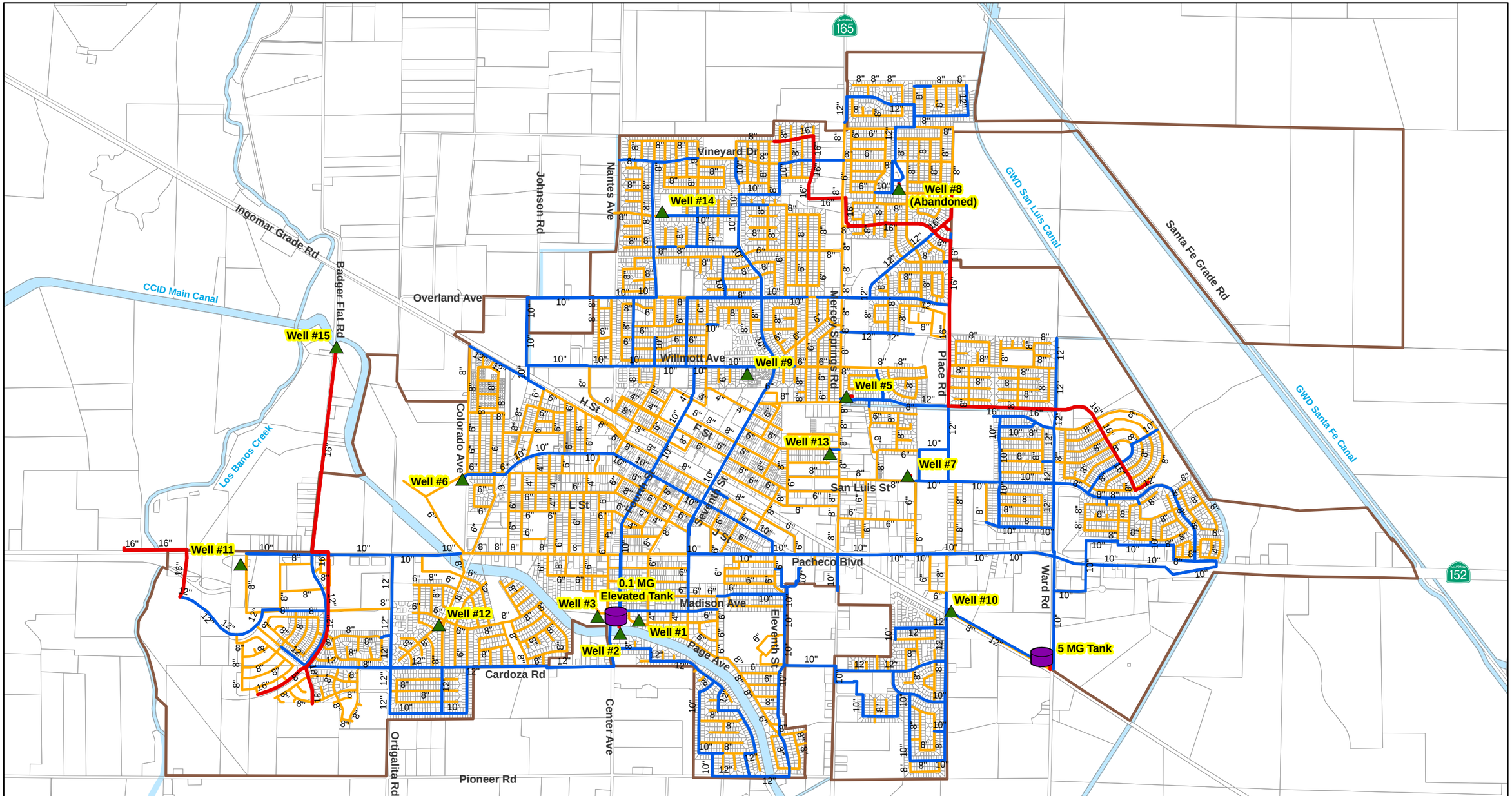
Water is transmitted from the wells to the consumers via a distribution system with pipe sizes ranging between 4- and 30-inches in diameter. The City's water system facilities also include a 100,000 gallon elevated storage tank, and a five million gallon (MG) above ground storage tank equipped with four booster pumps.

5.1.1 Distribution System

The City's current water distribution system consists of over 142 miles of pipelines ranging in diameter from 4- to 30-inches. Figure 5.1 shows a map of the existing distribution system, pipe diameters, and alignments. The figure also shows the well and tank locations. Table 5.1 provides a breakdown by diameter of the modeled distribution system. Nearly half of the City's pipelines that were modeled are 8-inch diameter.

As shown in Figure 5.1 and summarized in Table 5.1, there is approximately 26,000 feet of 16-inch diameter pipeline that is the beginning of a transmission loop around the entire City. The 2000 Water Master Plan recommended the construction of a backbone transmission main around the City. The transmission main backbone was sized in anticipation of moving water from new wells or a surface water treatment plant (SWTP) (higher quality sources) on the west end of the City to demand areas on the east side. This backbone was generally

[1] City of Los Banos 2005 Urban Water Management Plan, Stoddard Engineering/Boyle, April 2006



Legend

Existing Water Distribution System

- Groundwater Well
- Storage Tank

Water Pipeline Diameter

- 8" and Smaller
- 10" - 14"
- 16" and Larger

- City Limits
- Waterways/Canals
- Parcels

N

Feet

0 2,000 4,000

Figure 5.1
Existing Water Distribution System
Water Distribution System Master Plan
City of Los Banos

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sized to be 16-inch diameter and larger to provide flexibility for the potential future SWTP and/or extraction wells on the west side of the City.

The loop around the City is not complete, but the future pipelines recommended in this water distribution system master plan (Master Plan) build on the recommendations of the 2000 Water Master Plan. The study area for this Master Plan is larger, therefore there were some modifications required in the pipe sizes and alignments to meet the growth boundaries of the 2030 General Plan Administrative Draft (2030 General Plan). The future improvements are discussed in Chapter 6.

Table 5.1 Modeled Water System Pipeline Summary
Water Distribution System Master Plan
City of Los Banos

Diameter (inch)	Length (feet)	Diameter (inch)	Length (feet)
4	14,180	16	25,827
6	158,422	18	423
8	315,947	20	24
10	130,321	24	337
12	71,505	30	46
14	24		
		Total	**717,056**

Source: City provided AutoCAD data.

5.1.2 Pressure Zones

The topography of the City is generally flat. The ground elevations within the SOI range from approximately 98 feet to 145 feet above mean sea level, with the higher elevations in the southwest part of the SOI. The existing City ground elevations reach a maximum of approximately 130 feet above mean sea level. Due to the minor variations in ground elevation throughout the SOI, the City's water distribution system consists of only one pressure zone.

5.1.3 Supply Sources

5.1.3.1 Groundwater

The City currently relies on groundwater from the Delta-Mendota groundwater subbasin to provide water to its residential, industrial, and commercial users. Surface water and recycled water sources are not currently utilized by the City. The Delta-Mendota Subbasin is bounded on the west by the Coast Ranges, and on the north by the Stanislaus/San Joaquin County line[2]. The eastern boundary follows the San Joaquin River. For more

[2] Delta-Mendota Subbasin Description and Information, DWR Bulletin 118 - Update 2003

information on the groundwater basins and geology of the area, please refer to the City's 2005 Urban Water Management Plan and the 2000 Water Master Plan.

Within the City and the study area, depth to the shallowest groundwater ranges from approximately 10 to 15 feet, but there are reports of groundwater depths reaching 20 to 40 feet in some parts of the City. The 2005 Urban Water Management Plan reported that water levels in the Delta-Mendota Subbasin have fluctuated over the years, but remained relatively stable.

5.1.3.2 Surface Water

The City currently has no surface water contracts. The 2000 Water Master Plan reported that if development and treatment of groundwater becomes infeasible in the future, acquisition and treatment of surface water supply would be the next choice. Some existing wells have been placed on stand-by due to water quality issues. If this trend continues or if the City is required to place costly treatment systems at each well, then a new SWTP would provide a high quality source of water and would mitigate future groundwater quality risks. City staff confirmed that it would likely pursue surface water contracts. The California Aqueduct/San Luis Canal (California Aqueduct) is the potential surface water supply for the City, which would have to purchase a contract supply of State Water Project water.

The preliminary locations of a future SWTP are not established, but the likely location is west of the study area. This Master Plan assumes that a new SWTP will be on-line by year 2020. The phasing of new groundwater supply wells and storage facilities is based on this assumption. More discussion on the improvements necessary to distribute treated surface water is provided in Chapter 6.

5.1.4 Recycled Water

The City does not operate a recycled water system. At the time of writing this report, there were no plans to develop a recycled water system.

5.1.5 Groundwater Wells

The City owns and operates 13 groundwater wells that are used to serve the entire water demands within the City. These existing wells and their nominal production rates are summarized in Table 5.2 and their locations are shown on Figure 5.1. As shown in Table 5.2, the combined supply capacity of these 13 wells is 14,875 gallons per minute (gpm) or 21.4 million gallons per day (mgd). Pump tests run by the City in 2007 confirmed the capacities reported in Table 5.2.

5.1.6 Storage Reservoirs

There are two storage reservoirs in the City; a 100,000 gallon elevated storage tank at the Public Works Department on Madison Avenue, and a 5 MG above ground storage tank on

South Ward Road near the railroad right of way. The 5 MG storage tank was completed in 2005. The locations of these tanks are shown on Figure 5.1.

Table 5.2 Water Supply Wells
Water Distribution System Master Plan
City of Los Banos

Well No.[1]	Capacity[2] (gpm)	Capacity (mgd)	Auxiliary Power	Motor Type	Water Quality
1	900	1.3	Yes	Fixed Speed	
2	850	1.2	Yes	Fixed Speed	Coliform, gravel
3	575	0.8	Yes	Fixed Speed	
5	1,400	2.0	Yes	Two Speed	
6	800	1.2	Yes	Fixed Speed	Milky water (air bubbles)
7	1,400	2.0	Yes	Two Speed	At MCL for Gross Alpha
9	900	1.3	Yes	VFD	
10	1,500	2.2	Yes	VFD	
11	900	1.3	Yes	VFD	
12	900	1.3	Yes	VFD	
13	1,850	2.7	Yes	VFD	
14	1,800	2.6	Yes	VFD	
15[3]	1,100	1.6	Yes	VFD	
Total[4]	**14,875**	**21.4**			
Firm[4]	**13,025**	**18.8**			

Notes:
1. Well No. 8 is out of service due to elevated concentrations of uranium.
2. Source: 2000 Water Master Plan (Stoddard Engineering) and City staff.
3. Well No. 15 did not operate in year 2007, or for the last three months of 2006.
4. Well No. 13 not included in firm capacity.

5.1.7 Booster Pump Stations

Due to relatively flat terrain of the City, there is only one pressure zone in the water distribution system. Booster pump stations are therefore not needed to convey flow from lower pressure zones to higher pressure zones. The only pumps in the water system are the well pumps and four booster pumps at the 5 MG storage tank to pump water from the tank into the distribution system. The well pump capacities are summarized in Table 5.2 and the four booster pumps have a total pumping capacity of 10,500 gpm (15.1 mgd).

5.2 DISTRIBUTION SYSTEM HYDRAULIC MODEL

Hydraulic network analysis is a powerful tool used in all aspects of water distribution planning, facility sizing, operation, management, emergency response, system reliability analysis, fire flow capacity evaluation, as well as water quality simulations. The City's hydraulic model was developed to evaluate the adequacy of the existing distribution system and for planning future facilities and pipelines.

5.2.1 Data Collection and Validation

Data necessary for the development of the hydraulic model was collected from the City's Public Works, engineering and operational staff. The data included an earlier hydraulic model developed for the 2000 Water Master Plan, existing AutoCAD drawings, as well as available record drawings, and well information.

The data validation process included a review by City staff of the facilities included in the hydraulic model. City staff comments were compared to existing AutoCAD and development drawings, and used to update the developed computer hydraulic model. System operational data were collected from City staff familiar with the day-to-day operation of the water system.

5.2.2 Elements of the Hydraulic Model

The City's hydraulic model combines information on the physical and operational characteristics of the water system, and performs calculations to solve a series of mathematical equations to simulate flows in pipes and pressures at nodes. Elements comprising the computer modeling process include defining pipes and nodes, and allocating water demands. Skeletonizing is the process by which water networks are stripped of pipelines not considered essential for the intended analysis purpose.

In the City's case, the hydraulic model developed for the 2000 Water Master Plan included all distribution system pipelines 4-inch diameter and larger. The model excluded the smaller water laterals that serve individual residents and businesses, as these are not necessary for master planning work. This Master Plan added the pipelines that were built since the completion of the previous master plan. Figure 5.1 is a graphical representation of the City's water distribution hydraulic model.

5.2.2.1 <u>Pipes and Nodes</u>

Computer modeling requires gathering detailed numerical information on the physical characteristic of the modeled water system, such as pipe sizes (diameters), lengths, and general system geometry.

Pipe and node components represent the physical elements describing the water network. A node represents a location in the network where a demand can be applied or water can be supplied to the system, while a pipe segment represents the actual transmission or

distribution pipe. Pump performance curve data, defining the operation of the existing pumps and booster stations, were also incorporated in the computer model.

5.2.2.2 Tanks and Reservoirs

Tank and reservoir components are used to represent above ground storage tanks, reservoirs, water treatment plant supplies, or the groundwater aquifer. The specified dimensions and storage type determine the functionality of this component.

5.2.2.3 Pumps

Pump components are used to represent booster station pumps or well pumps. All system pumps were modeled with their system controls as provided by the City's operation staff. All pumps were modeled with multi-point pump curves (if available) that are based on a combination of the manufacturer's pump curve and the most recent pump test. Information input on each model pump include diameter (inches), pump curve, and controls.

5.2.2.4 Valves

Valve components are used to represent pressure-reducing valves (PRVs), flow control valves (FCVs) or pressure sustaining valves (PSVs). These types of valves are not in the distribution system and therefore not in the model. Gate valves and other types of valves that do not impact system pressures or flows were not included in the model.

5.2.2.5 Demand Allocation

Allocation of water demands to appropriate nodes in the hydraulic model was accomplished in several steps that included an analysis of Citywide land use distribution and use of the City's billing records. Water demands based on billing records were assigned to appropriate nodes by using the billing addresses and software feature that links the customer's address to the nearest node. Adjustments were made to the demands to balance the Citywide demand to the 2006 average day demand (ADD). For future demands, water service areas tributary to junction nodes were delineated and the resulting demand calculated by applying water demand factors. Variations to the ADD, such as maximum day demand (MDD) were also developed by creating separate demand sets to simulate high demand conditions. The diurnal curves presented previously were also input in the hydraulic model to conduct 24-hour extended period simulations (EPS).

5.3 HYDRAULIC MODEL CALIBRATION

The model calibration consisted of two parts, a macro calibration and a fire flow (hydrant) test calibration. This section describes both of the calibration steps.

5.3.1 Macro Calibration

The initial calibration process consisted of a macro calibration. Carollo Engineers, P.C. (Carollo) ran the model under existing demand conditions and made the necessary

adjustments in order for the model to forecast pressures measured in the distribution system and to ensure that the reservoirs were replenishing following peak hour demands. Adjustments to the model included modifications of pipeline connectivity, operational controls, ground elevations, and pump curves.

The macro calibration process included executing the following steps to ensure that the model produces reasonable results.

5.3.1.1 Transmission Main Connectivity

Carollo used the connectivity features of the hydraulic modeling software to verify the connectivity of the transmission and distribution mains within the distribution system. Proper connectivity ensures that there are no interruptions in the pipe connections. Possible issues found using the connectivity locators were reviewed on a case-by-case basis to determine whether adjustments needed to be made to the connectivity of the model. The model output reports on headloss (ft/kft) and velocity (ft/s) were also be used to locate possible connectivity issues that required adjustment.

5.3.1.2 System Pressures

The City provided Carollo with estimates of typical pressures throughout the distribution system. The macro calibration compared the model output to these typical pressures. This process allowed Carollo to locate errors in facility size (pipe diameters and pump capacity), ground elevations, connectivity, and operational controls.

5.3.1.3 Pump Performance Data

Hydraulic model results for each well pump were compared to pump design data and pump tests provided by the City. This comparison was used to verify that the facility attributes entered into the model, such as pump power, groundwater depth, and the pump curves, matched the model results and City operations staff field observations.

5.3.2 Fire Flow Field Testing

The primary purpose of fire flow field-testing is to calibrate the model, estimate roughness coefficients, and verify the model's ability to accurately represent the distribution system. Fire flow tests, conducted by the City Fire Department, were used to develop a calibrated hydraulic model by closely matching water model pressures to field pressures under similar demand and system boundary conditions. Model calibration is typically achieved by modifying a pipeline's roughness coefficient, although other parameters may be adjusted as calibration results are generated.

Hazen-Williams roughness coefficients, or C-factors, have industry accepted values based on pipeline material, diameter, and age. Characteristics specific to the City's distribution system such as water quality, temperature, construction methodologies, and material suppliers may result in roughness coefficients that differ from the typical range. Fire flow

calibration is used to refine the initial roughness coefficient estimate and reflects the conditions of the City's distribution system. Older pipes tend to experience tuberculation, which increases headloss and reduces pressure.

During average demand conditions, flows are low and the roughness of a pipe causes a relatively small impact on the pressures of a distribution system. However, as the flows increase during high demand days, velocities within pipelines increase and the roughness of a pipe contributes to more head loss and lower pressures. Fire flow tests are useful for assessing a pipelines roughness coefficient because they generate a high velocity in the pipe. The high velocity causes a significant drop in pressure, which can be used to estimate a pipeline's roughness coefficient.

Typically, static pressure measurements are collected under normal demand conditions. Next, a hydrant is opened to release a large amount of flow and to cause a significant headloss or pressure drop. The City's Fire Department conducted several hydrant tests that stressed the City's distribution system by creating a difference in pressure between the point of hydrant flow and neighboring hydrants. Adjustments to a pipeline's roughness coefficient were made until the model's predicted pressures reasonably matched field measured pressures within an acceptable tolerance. The roughness coefficients were adjusted only within an acceptable range for a given pipe material and age. If a modeled pipe was unable to match the calibration results without deviation from the acceptable range of roughness coefficients, then there may be cause for further investigation of a previously unknown field condition. Examples of such conditions that typically arise during hydraulic model calibration include closed, partially closed or malfunctioning valves, extreme corrosion within pipelines, pipeline connectivity and size. These conditions were not found in the City's hydraulic model and the model predicted results match the field measured pressures.

CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

This chapter presents the results of the capacity evaluation of the water supply, distribution, and storage facilities. The chapter also presents improvements to mitigate existing system deficiencies and for servicing future growth. These improvements are recommended based on the system's technical requirements, cost effectiveness, and operational reliability.

6.1 SUPPLY CAPACITY

The additional water supply requirements for the City of Los Banos (City) under existing and future demand conditions were determined by comparing the available water supplies with the projected water demands. The supply requirements under the following conditions are described below:

- Largest Well Out of Service
- Fire Flow Conditions
- Power Outage
- Emergency Condition

The recommended supply capacity improvements are then provided to mitigate supply deficiencies.

6.1.1 Largest Well Out of Service

A significant drop in development between 2007 and 2010 allowed for deferment of the water supply improvements. Even though the maximum day demand (MDD) projections appear to exceed the firm capacity, in reality the near term drop in new development kept water demand levels relatively constant through 2009. If demands start to increase rapidly, then the City should revise the supply projections.

The water supply requirements to meet MDD with the largest well out of service are presented in Table 6.1. The anticipated surface water treatment plant (SWTP) is assumed to be in place by the year 2025 in this analysis. Hence, the largest single supply source in years 2008 through 2025 will be Well 13, which has a capacity of 2.7 mgd. In year 2025 and beyond, the SWTP will be the largest supply source. As shown in Table 6.1, in 2009 the MDD is projected to equal 21.2 million gallons per day (mgd), and the current firm capacity (capacity with Well 13 out of service) is 18.8 mgd. The City should begin planning for the installation of Well 16 to meet this deficiency. In total, seven new wells are needed prior to year 2025 to meet the projected MDD. After year 2025, the SWTP will be on-line and the wells will be used to supplement the SWTP supply and to provide emergency supply. The SWTP supply was taken into account

Table 6.1 Well Supply Requirements - Largest Well Out of Service
Water Distribution System Master Plan
City of Los Banos

Year	Maximum Day Demand[1] (mgd)	Firm Capacity[2] (mgd)	Well Capacity Increase[3] (mgd)	New Well Number	Firm Capacity Upgrade (mgd)	Total Well Supply Capacity (mgd)
2008	20.4	18.8			18.8	21.5
2009	21.2	18.8			18.8	21.5
2010	22.0	18.8			18.8	21.5
2011	22.9	18.8	2	16	20.8	23.5
2012	23.8	20.8			20.8	23.5
2013	24.7	20.8	2	17	22.8	25.5
2014	25.7	22.8			22.8	25.5
2015	26.7	22.8	2	18	24.8	27.5
2016	27.8	24.8			24.8	27.5
2017	28.8	24.8	2	19	26.8	29.5
2018	30.0	26.8			26.8	29.5
2019	31.2	26.8	2	20	28.8	31.5
2020	32.4	28.8			28.8	31.5
2021	33.6	28.8	2	21	30.8	33.5
2022	35.0	30.8			30.8	33.5
2023	36.3	30.8	2	22	32.8	35.5
2024	37.8	32.8			32.8	35.5
2025[4]	39.2	32.8	SWTP On-Line in Year 2025		32.8	35.5
2026	40.8	32.8			32.8	35.5
2027	42.4	32.8			32.8	35.5
2028	44.0	32.8			32.8	35.5
2029	45.8	32.8			32.8	35.5
2030[5]	47.6	32.8	2	23	32.8	37.5
2031	48.1	32.8			32.8	37.5
2032	48.6	32.8			32.8	37.5
2033	49.1	32.8			32.8	37.5
2034	49.7	32.8			32.8	37.5
2035	50.2	32.8			32.8	37.5
2036	50.8	32.8			32.8	37.5
2037	51.3	32.8			32.8	37.5
2038	51.9	32.8			32.8	37.5
2039	52.4	32.8			32.8	37.5
2040	53.0	32.8			32.8	37.5
2041	53.6	32.8			32.8	37.5
2042	54.2	32.8			32.8	37.5
2043	54.8	32.8			32.8	37.5
2044	55.4	32.8			32.8	37.5
2045	56.0	32.8			32.8	37.5
2046	56.6	32.8			32.8	37.5
2047	57.2	32.8			32.8	37.5
2048	57.8	32.8			32.8	37.5
2049	58.4	32.8			32.8	37.5
2050	59.1	32.8	2	24	34.8	39.5
2051	59.7	34.8			34.8	39.5
2052	60.4	34.8			34.8	39.5
2053	61.0	34.8	2	25	36.8	41.5
2054	61.7	36.8			36.8	41.5
2055	62.4	36.8			36.8	41.5

Notes:
1. Maximum day demand projections based on year 2007 demand data as the base year and growth projections that achieve build-out of the planning area by year 2055.
2. Capacity with Well No. 13 out of service. Well No. 13 capacity 2.7 mgd.
3. A significant drop in development between 2007 and 2010 allowed for deferment of the water supply improvements. Even though the maximum day demand projections appear to exceed the firm capacity in reality the near term drop in new development kept water demand levels relatively constant through 2009. If demands start to increase rapidly, then the City should revise the supply projections.
4. Master Plan assumes that in year 2025, a 20 mgd SWTP will be on-line.
5. At build-out of study area, stand-by well capacity increases to two wells. The system's firm capacity does not increase.

when calculating groundwater supply requirements. Due to the difficulty in accurately predicting growth on an annual basis, the implementation schedule shown should be confirmed by future demand data. Adjustments to the implementation schedule should be made to match increases or decreases in the pace of development.

Following the installation of the SWTP, three additional wells will be necessary to supplement the treatment plant's supply to meet MDD, to provide emergency supply and provide stand-by (redundant) capacity. However, these additional wells will not be necessary until year 2050. This analysis assumed that the SWTP will have sufficient capacity to meet the City's average day demand (ADD), and the treatment plant will have an initial capacity of 20 mgd in year 2020. Figure 6.1 illustrates the information from Table 6.1 in graph form. Although Table 6.1 estimates the year that new wells will come on-line, Figure 6.1 illustrates the possible range of years that wells will be installed. A range is provided since it is difficult to predict the actual year that a new well is required. Note the large increase in supply capacity following the installation of the SWTP.

6.1.2 Fire Flow

The City's two existing and future water storage tanks will meet fire flow requirements. There is no need to install additional wells to meet fire flow requirements.

6.1.3 Power Outage

According to the City's 2005 Urban Water Management Plan, in preparation of possible electrical service interruptions, the City has installed dual drive equipment on all 13 of its wells. These wells are equipped with backup diesel (7 wells) and natural gas (6 wells) engines to be used in the event of a power failure. The backup equipment is routinely maintained and tested to ensure the facilities can operate in the event of a power outage. No additional wells are needed in case of power outage.

6.1.4 Emergency Condition

The City's 2005 Urban Water Management Plan (2005 UWMP) reported that since the City relies solely on groundwater for its source of water supply, it is not subject to reduction in its water supply like communities that rely on surface water to meet all or a portion of their water demands. According to the 2005 UWMP, The City has engaged in extensive emergency planning in preparation of potential service interruptions caused by power outages or a major event such as an earthquake or flooding.

The 2005 UWMP reported that following an earthquake, depending on the magnitude of the event, the system failures could range from a water main break, loss of a well, or loss of the SWTP. The impacts of such failures could lead to reduced water quality or lower pressures, but service could continue at reduced levels and pressures. The 2005 UWMP reports that in these cases the City would request that customers reduce their

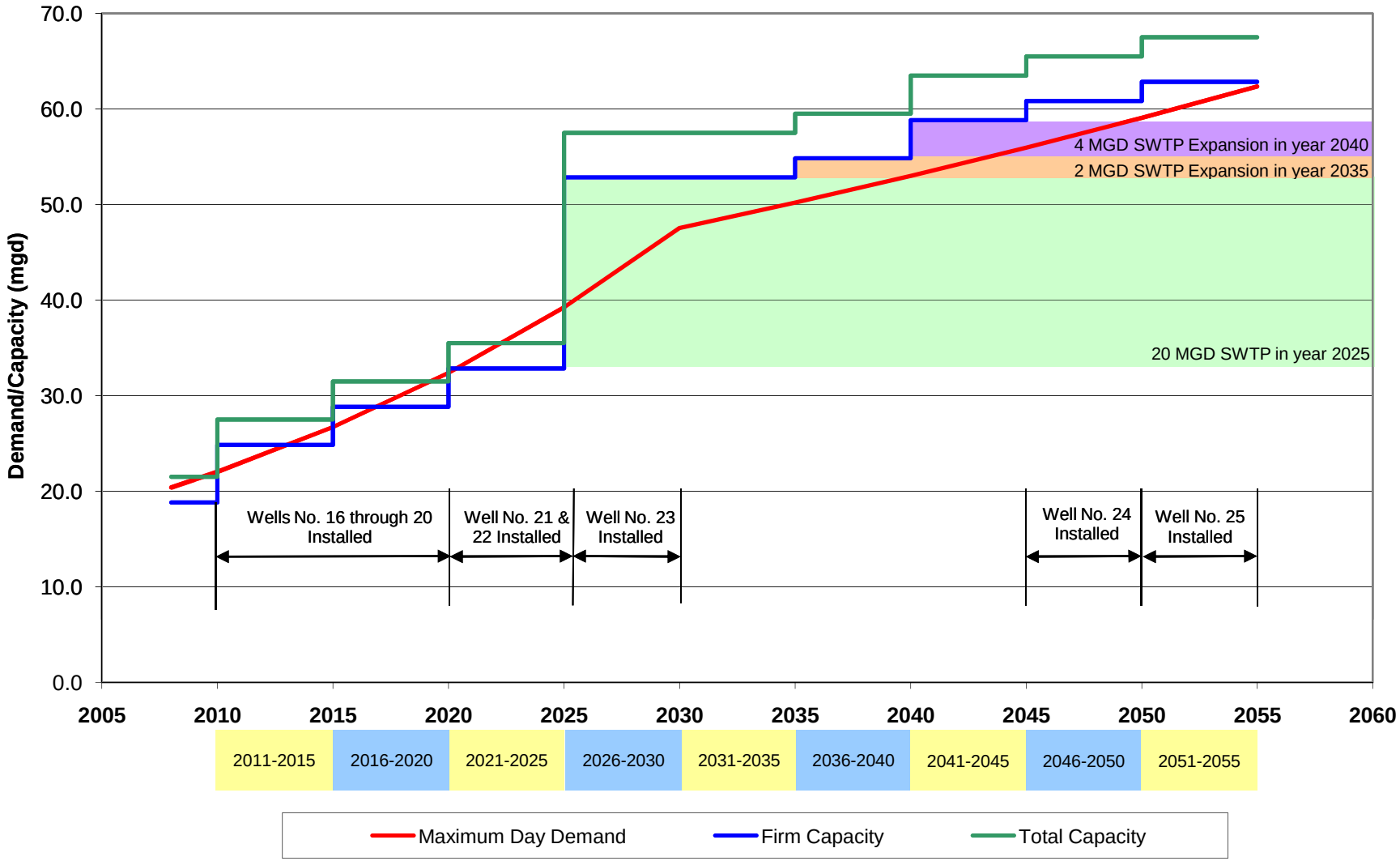

Figure 6.1
Increase in Demand and Supply
Water Distribution System Master Plan
City of Los Banos

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pw:/CA/Los Banos/7833A00/Disciplines/Water/TablesWater.xls/Fig 6.1 Demand

water use and operate the system to best meet demands. Depending on the severity of the distribution system interruption, the City may also rely on interagency cooperation not only to provide communications but also to provide physical and material assistance. Please refer to the 2005 UWMP for more detailed information on the City's Water Shortage Contingency Plan.

The City currently has sufficient well capacity to meet reduced levels of service. If the City mandated a decrease in water use following an emergency, it would have sufficient capacity to meet ADD with seven of its lowest producing wells (or four of its largest wells). Since the City maintains backup power supply at each well, there should be sufficient supply to meet reduced demands following an emergency. No additional wells are needed to meet emergency conditions.

6.1.5 Surface Water Treatment Plant

By year 2025, the City plans to have a SWTP on-line to meet the majority of the City's water demands. This water distribution system master plan (Master Plan) assumes that a new 20 mgd SWTP will be on-line by year 2025. The California Aqueduct/San Luis Canal (California Aqueduct) is the potential surface water supply for the City, which would have to purchase a contract supply of State Water Project water. The preliminary locations of a future SWTP are not established, but the likely location is west of the study area. The California Aqueduct is approximately two miles from the study area.

To deliver water from the SWTP to the connection point at the distribution system, a 42-inch diameter transmission main will be needed. The 42-inch diameter transmission main will have sufficient capacity to deliver water from the treatment plant through build-out of the study area. There are major crossings for this pipeline including the Delta-Mendota Canal, the Outside Canal, irrigation ditches, roads and possibly Highway 152.

A 20 mgd treatment plant will provide the City with sufficient capacity to serve ADD through 2035, at which time a 2.0 mgd expansion should be implemented. A subsequent 4.0 mgd expansion should be planned in 2040 to provide sufficient capacity to meet ADD through build-out of the study area. The timing and capacity of the expansions are based entirely on the ADD projections, and are intended for forecasting capital improvements and costs. The City could decide to expand up to 26.0 mgd in year 2035, instead of up to 22.0 mgd. These options should be explored during the planning of the SWTP. According to the City's DWR Public Water System Statistics, a treatment plant that meets ADD should have sufficient capacity to meet a majority of the City's demands about six months of the year during low demand periods (typically November through April). Groundwater well production will be necessary to supplement surface water supplies during warm months and during peak hour demand (PHD) periods. However, the primary source of supply will be the SWTP for the entire system. For this analysis, no assumptions were made regarding storage or the SWTP's ability to provide PHDs.

During the planning of the SWTP, if it is determined that the plant will provide storage and peak hour pumping capacity, then the recommendations in this Master Plan should be adjusted accordingly.

6.1.6 Supply Recommendations

Based on the analysis of the demands and supply conditions previously discussed, the following water supply improvements are recommended:

- Install new groundwater wells to meet future demands. A new 2.0 mgd capacity well is required in 2011. Seven new wells are required through the year 2025, at which time the 20 mgd SWTP will be on-line. Following the installation of the SWTP, which will be sized to meet ADD, a new well will not be necessary until year 2030. The SWTP will likely have sufficient capacity to meet all the City's demands for six months of the year. The other six months, the City will need to supplement the treatment plant supply with well water.

  Possible well locations are shown in Figure 6.2. The locations shown are conceptual, but the goal was to space the new wells approximately one mile apart, to locate them along the transmission main backbone that will circle the entire City, and to locate them within the higher quality groundwater on the west side of the study area. The different color illustrations for the wells in the figure signify the timeframe that the wells should be installed. The phase in the figure is consistent with the implementation schedule in Table 6.1.

  Table 6.2 combines the implementation schedule for the wells and the SWTP, and summarizes when the new wells and the SWTP would be added to the system. The total system (wells plus the SWTP) capacity from year 2008 through build-out of the system is also presented in Table 6.2. The information in Table 6.2 was presented graphically in Figure 6.1.

  The City will also conduct intermittent rehabilitation or replacement of existing wells to modernize aging infrastructure or to abandon wells with poor water quality. This Master Plan assumed that two wells would be rehabilitated or replaced over the next 20 years.

- If the City does not construct a new SWTP, then groundwater wells will continue to be installed to meet the City's MDD. From 2008 through build-out of the study area, 25 new wells would be installed, seven of which would be constructed prior to year 2020. Between years 2020 and 2030, the City would average one well installation per year. After year 2030 through build-out of the study area, the City would average one well installation every three years.

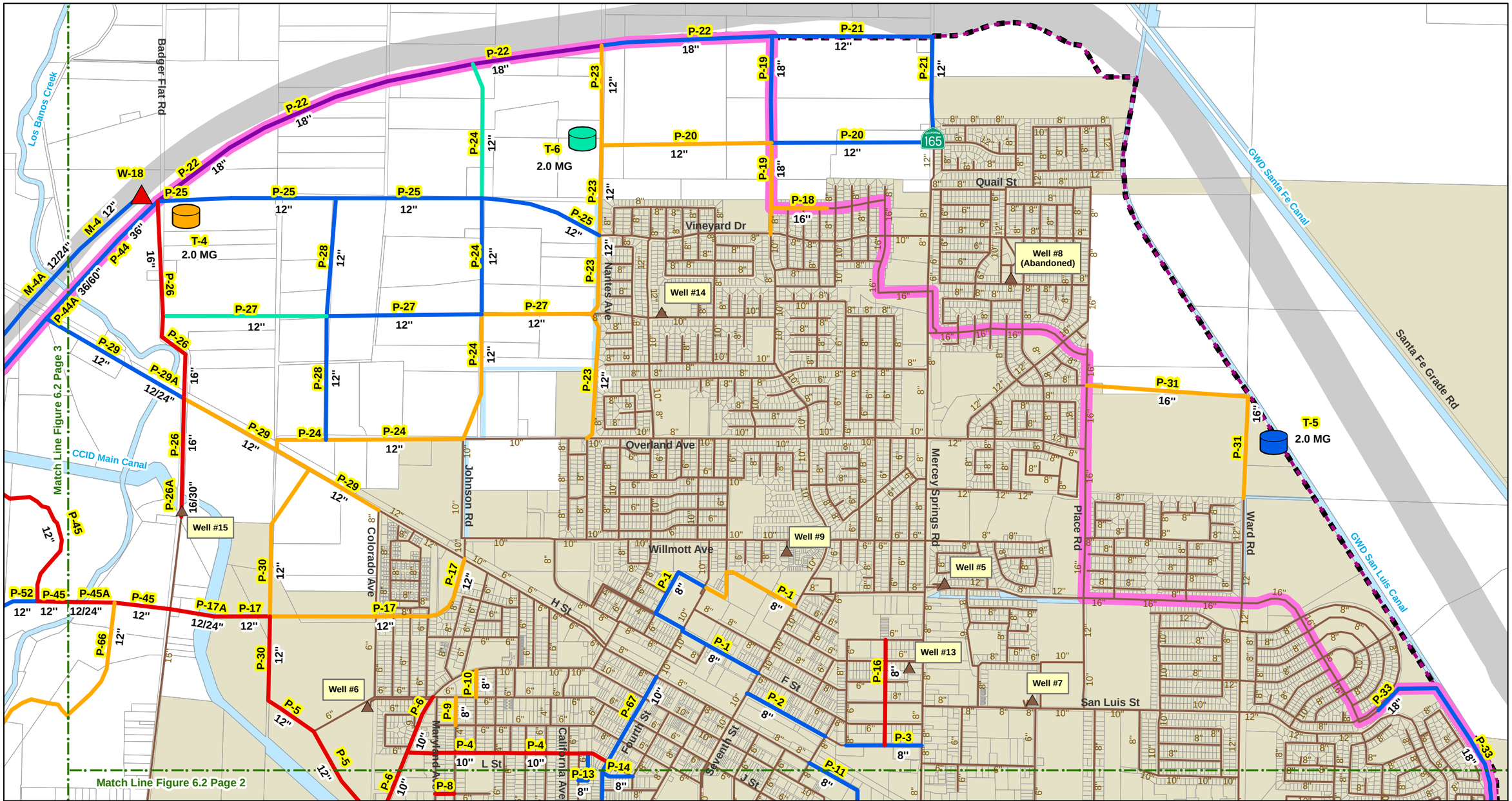
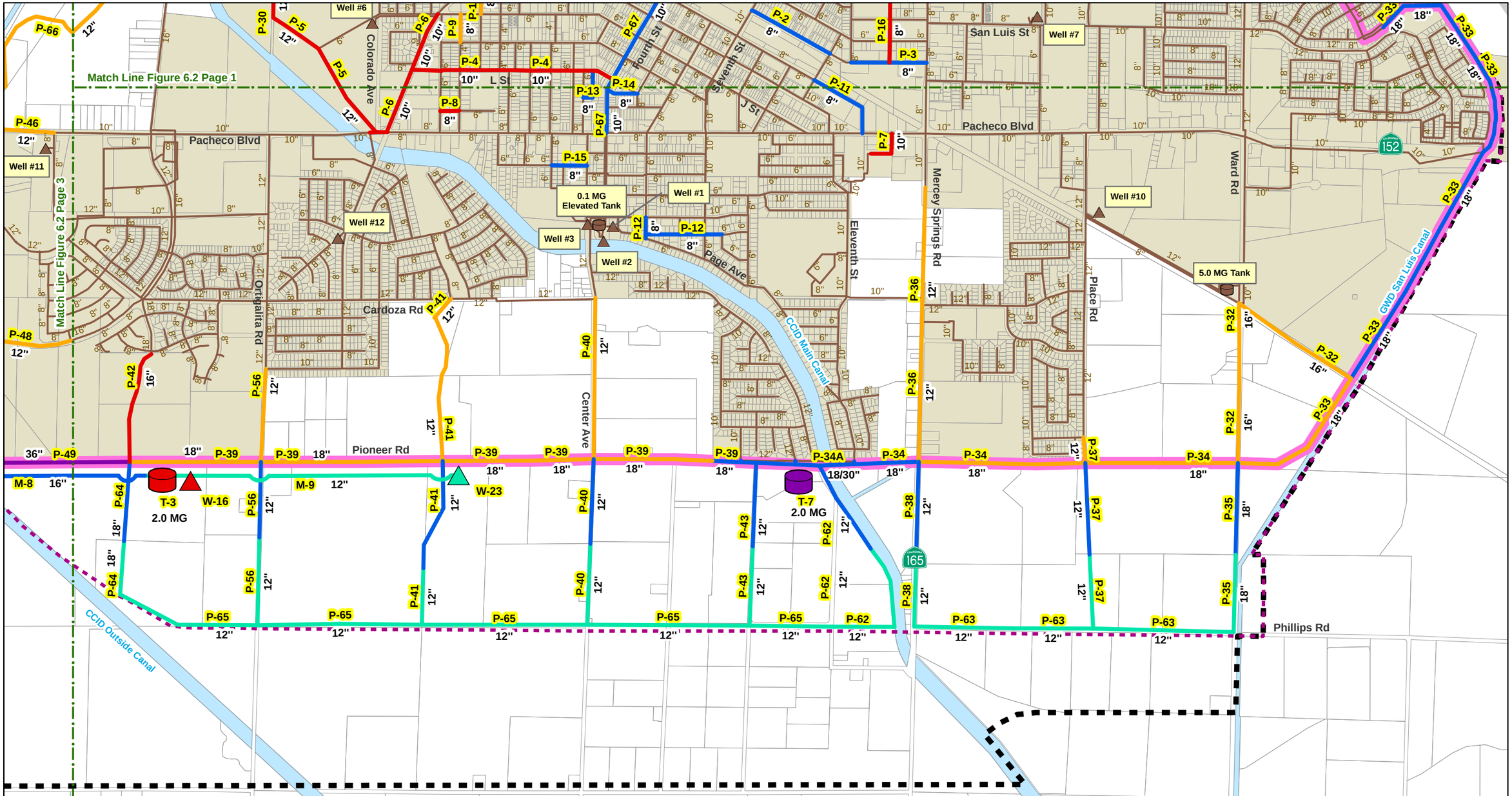


Figure 6.2
Proposed Distribution System Improvements (1 of 3)
Water Distribution
System Master Plan
City of Los Banos



Legend

Existing Water Distribution Facilities
- Groundwater Well
- Storage Tank
- Pipelines

Future Distribution Facilities

Groundwater Well
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

Storage Tank and Booster Pump
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

Feet: 0 700 1,400

Pipelines
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)
- Transmission Main Backbone
- Urban Growth Boundary

P-5 CIP ID
12" CIP Diameter
8" Existing Diameter

- Parcels
- Waterways/Canals
- SR 152 Bypass Corridor
- City Limits
- Sphere of Influence

Figure 6.2
Proposed Distribution System Improvements (2 of 3)
Water Distribution
System Master Plan
City of Los Banos

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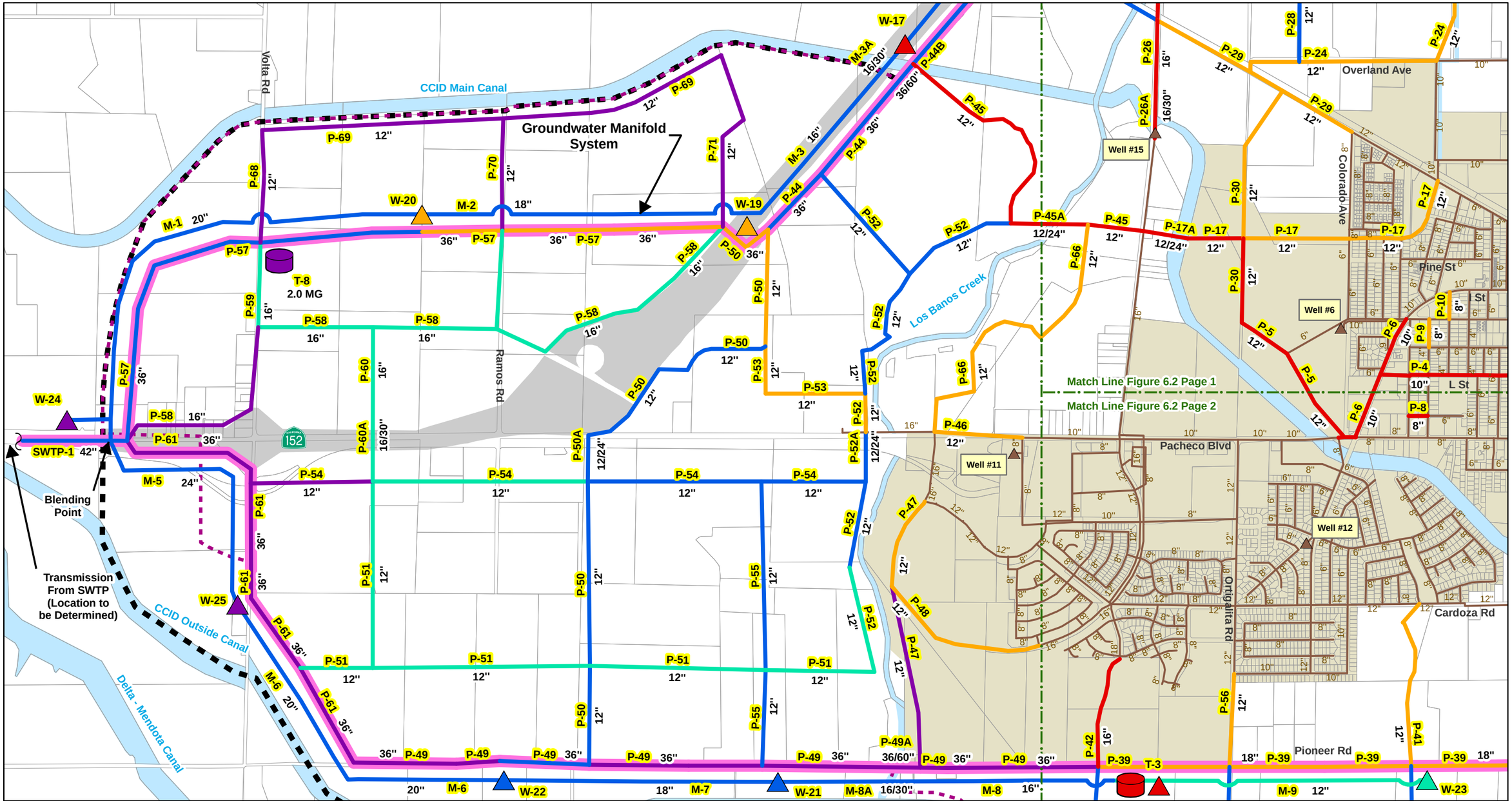

Legend

Existing Water Distribution Facilities
- Groundwater Well
- Storage Tank
- Pipelines

Future Distribution Facilities

Groundwater Well
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)

Storage Tank and Booster Pump
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2025 - 2030)
- Phase 5 (2031 +)

Feet
0 700 1,400

Pipelines
- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031 +)
- Transmission Main Backbone
- Urban Growth Boundary

P-5 CIP ID
12" CIP Diameter
8" Existing Diameter

- Parcels
- Waterways/Canals
- SR 152 Bypass Corridor
- City Limits
- Sphere of Influence

Figure 6.2
Proposed Distribution System Improvements (3 of 3)
Water Distribution
System Master Plan
City of Los Banos

Table 6.2 Total Supply Capacity
Water Distribution System Master Plan
City of Los Banos

Year	Well Capacity Increase				Surface water Treatment Plant Capacity (mgd)	SWTP + Wells	
	New Well Number	Capacity Increase[3] (mgd)	Firm Capacity[1] (mgd)	Total Well Capacity (mgd)		System Firm Capacity (mgd)	System Total Capacity (mgd)
2008			18.8	21.5		18.8	21.5
2009			18.8	21.5		18.8	21.5
2010			18.8	21.5		18.8	21.5
2011	16	2	20.8	23.5		20.8	23.5
2012			20.8	23.5		20.8	23.5
2013	17	2	22.8	25.5		22.8	25.5
2014			22.8	25.5		22.8	25.5
2015	18	2	24.8	27.5		24.8	27.5
2016			24.8	27.5		24.8	27.5
2017	19	2	26.8	29.5		26.8	29.5
2018			26.8	29.5		26.8	29.5
2019	20	2	28.8	31.5		28.8	31.5
2020			28.8	31.5		28.8	31.5
2021	21	2	30.8	33.5		30.8	33.5
2022			30.8	33.5		30.8	33.5
2023	22	2	32.8	35.5		32.8	35.5
2024			32.8	35.5		32.8	35.5
2025[2]	SWTP On-Line in Year 2025		32.8	35.5	20	52.8	55.5
2026			32.8	35.5	20	52.8	55.5
2027			32.8	35.5	20	52.8	55.5
2028			32.8	35.5	20	52.8	55.5
2029			32.8	35.5	20	52.8	55.5
2030	23	2	32.8	37.5	20	52.8	57.5
2031			32.8	37.5	20	52.8	57.5
2032			32.8	37.5	20	52.8	57.5
2033			32.8	37.5	20	52.8	57.5
2034			32.8	37.5	20	52.8	57.5
2035			32.8	37.5	22	54.8	59.5
2036			32.8	37.5	22	54.8	59.5
2037			32.8	37.5	22	54.8	59.5
2038			32.8	37.5	22	54.8	59.5
2039			32.8	37.5	22	54.8	59.5
2040			32.8	37.5	26	58.8	63.5
2041			32.8	37.5	26	58.8	63.5
2042			32.8	37.5	26	58.8	63.5
2043			32.8	37.5	26	58.8	63.5
2044			32.8	37.5	26	58.8	63.5
2045			32.8	37.5	26	58.8	63.5
2046			32.8	37.5	26	58.8	63.5
2047			32.8	37.5	26	58.8	63.5
2048			32.8	37.5	26	58.8	63.5
2049			32.8	37.5	26	58.8	63.5
2050	24	2	34.8	39.5	26	60.8	65.5
2051			34.8	39.5	26	60.8	65.5
2052			34.8	39.5	26	60.8	65.5
2053	25	2	36.8	41.5	26	62.8	67.5
2054			36.8	41.5	26	62.8	67.5
2055			36.8	41.5	26	62.8	67.5

Notes:
1. Capacity with Well No. 13 out of service. Well No. 13 capacity 2.7 mgd.
2. Master Plan assumes that in year 2025, a 20 mgd SWTP will be on-line.
3. A significant drop in development between 2007 and 2010 allowed for deferment of the water supply improvements. Even though the maximum day demand projections appear to exceed the firm capacity, in reality the near term drop in new development kept water demand levels relatively constant through 2009. If demands start to increase rapidly, then the City should revise the supply projections.

6.2 STORAGE TANKS

The City completed the construction of a five million gallon (MG) storage tank in 2005. This tank and the 100,000 gallon elevated storage tank provide the City with operational storage to meet PHDs and fire flow storage (3,500 gpm fire flow for three hours). Operational storage was defined as 25 percent of the MDD. The storage capacity criteria are defined in Chapter 3.

A significant drop in development between 2007 and 2010 allowed for deferment of water storage improvements. Even though the required storage projections appear to exceed the storage capacity, in reality the near term drop in new development kept water demand levels relatively constant through 2009. If demands start to increase rapidly, then the City should revise the storage projections.

Unfortunately, the existing storage is at capacity. The required storage from 2008 through build-out of the SOI is calculated in Table 6.3. The required storage for 2009 is projected to equal approximately 5.9 MG, which is 800,000 gallons greater than the current available storage. In order to meet this deficiency, the City should begin planning and designing a new storage tank. This Master Plan assumed that future storage tanks would be 2 MG in capacity. The City may decide to design and build larger storage tanks in the future based on need and land availability. Building larger storage tanks would decrease the number of tanks needed, but the overall volume of storage in the distribution system at build-out would be the same. Instead of the City building six, 2.0 MG storage tanks, the City could build three, 4.0 MG tanks.

As shown in Table 6.3, the first 2.0 MG storage tank should be on-line in 2012. Subsequent 2.0 MG storage tanks are installed every five to seven years through year 2035. The last tank is installed in year 2049. In total, six storage tanks (2.0 MG each) will be installed to meet future storage requirements. Similar to Figure 6.1, Figure 6.3 illustrates the required increase in storage capacity through build-out of the study area. The figure shows the step increase in storage capacity with each new tank that is installed.

Note that there is no emergency storage in the storage capacity calculation. In the event of an emergency, the groundwater supply wells will have sufficient capacity to supply 50 percent of the MDD. This is a reasonable assumption considering that every well has backup power supply; and, as reported in the 2005 UWMP, the Delta-Mendota Subbasin water levels are very stable, and there are large volumes of groundwater available for supply.

Possible tank locations are distributed throughout the system and are shown in Figure 6.2. The locations shown are conceptual, but the goal was to locate them along the transmission main backbone that will circle the entire City. In some locations, tanks

Table 6.3 Storage Capacity Requirements
Water Distribution System Master Plan
City of Los Banos

		Storage Criteria			Storage Capacity Increase		
Year	**Maximum Day Demand (mgd)**	**Operational Storage, 25% of MDD (MG)**	**Fire flow Storage, 3,500 gpm for 3 hrs. (MG)**	**Required storage (MG)**	**Initial Storage Capacity (MG)**	**Storage Capacity Increase (MG)**	**Total Storage Capacity (MG)**
2008[1]	20.4	5.1	0.63	5.7	5.1		5.1
2009	21.2	5.3	0.63	5.9	5.1		5.1
2010	22.0	5.5	0.63	6.1	5.1		5.1
2011	22.9	5.7	0.63	6.4	5.1		5.1
2012	23.8	5.9	0.63	6.6	5.1	2.0	7.1
2013	24.7	6.2	0.63	6.8	7.1		7.1
2014	25.7	6.4	0.63	7.1	7.1		7.1
2015	26.7	6.7	0.63	7.3	7.1		7.1
2016	27.8	6.9	0.63	7.6	7.1	2.0	9.1
2017	28.8	7.2	0.63	7.8	9.1		9.1
2018	30.0	7.5	0.63	8.1	9.1		9.1
2019	31.2	7.8	0.63	8.4	9.1		9.1
2020[2]	32.4	8.1	0.63	8.7	9.1		9.1
2021	33.6	8.4	0.63	9.0	9.1		9.1
2022	35.0	8.7	0.63	9.5	9.1	2.0	11.1
2023	36.3	9.1	0.63	9.7	11.1		11.1
2024	37.8	9.4	0.63	10.1	11.1		11.1
2025	39.2	9.8	0.63	10.4	11.1		11.1
2026	40.8	10.2	0.63	10.8	11.1		11.1
2027	42.4	10.6	0.63	11.2	11.1	2.0	13.1
2028	44.0	11.0	0.63	11.6	13.1		13.1
2029	45.8	11.4	0.63	12.1	13.1		13.1
2030	47.6	11.9	0.63	12.5	13.1		13.1
2031	48.1	12.0	0.63	12.6	13.1		13.1
2032	48.6	12.2	0.63	12.8	13.1		13.1
2033	49.1	12.3	0.63	12.9	13.1		13.1
2034	49.7	12.4	0.63	13.0	13.1		13.1
2035	50.2	12.6	0.63	13.2	13.1	2.0	15.1
2036	50.8	12.7	0.63	13.3	15.1		15.1
2037	51.3	12.8	0.63	13.5	15.1		15.1
2038	51.9	13.0	0.63	13.6	15.1		15.1
2039	52.4	13.1	0.63	13.7	15.1		15.1
2040	53.0	13.3	0.63	13.9	15.1		15.1
2041	53.6	13.4	0.63	14.0	15.1		15.1
2042	54.2	13.5	0.63	14.2	15.1		15.1
2043	54.8	13.7	0.63	14.3	15.1		15.1
2044	55.4	13.8	0.63	14.5	15.1		15.1
2045	56.0	14.0	0.63	14.6	15.1		15.1
2046	56.6	14.1	0.63	14.8	15.1		15.1
2047	57.2	14.3	0.63	14.9	15.1		15.1
2048	57.8	14.5	0.63	15.1	15.1		15.1
2049	58.4	14.6	0.63	15.2	15.1	2.0	17.1
2050	59.1	14.8	0.63	15.4	17.1		17.1
2051	59.7	14.9	0.63	15.6	17.1		17.1
2052	60.4	15.1	0.63	15.7	17.1		17.1
2053	61.0	15.3	0.63	15.9	17.1		17.1
2054	61.7	15.4	0.63	16.1	17.1		17.1
2055	62.4	15.6	0.63	16.2	17.1		17.1

Note:
1. Existing storage capacity is 5.1 MG made up of 5.0 MG storage tank and 100,000 gallon elevated storage tank.
2. Following completion of the SWTP, the available well capacity is sufficient to supply 50 percent of the MDD for emergency storage. Therefore, the storage tanks will not require an allocation for emergency storage.
3. A significant drop in development between 2007 and 2010 allowed for deferment of water storage improvements. Even though the required storage projections appear to exceed the storage capacity, in reality the near term drop in new development kept water demand levels relatively constant through 2009. If demands start to increase rapidly, then the City should revise the storage projections.

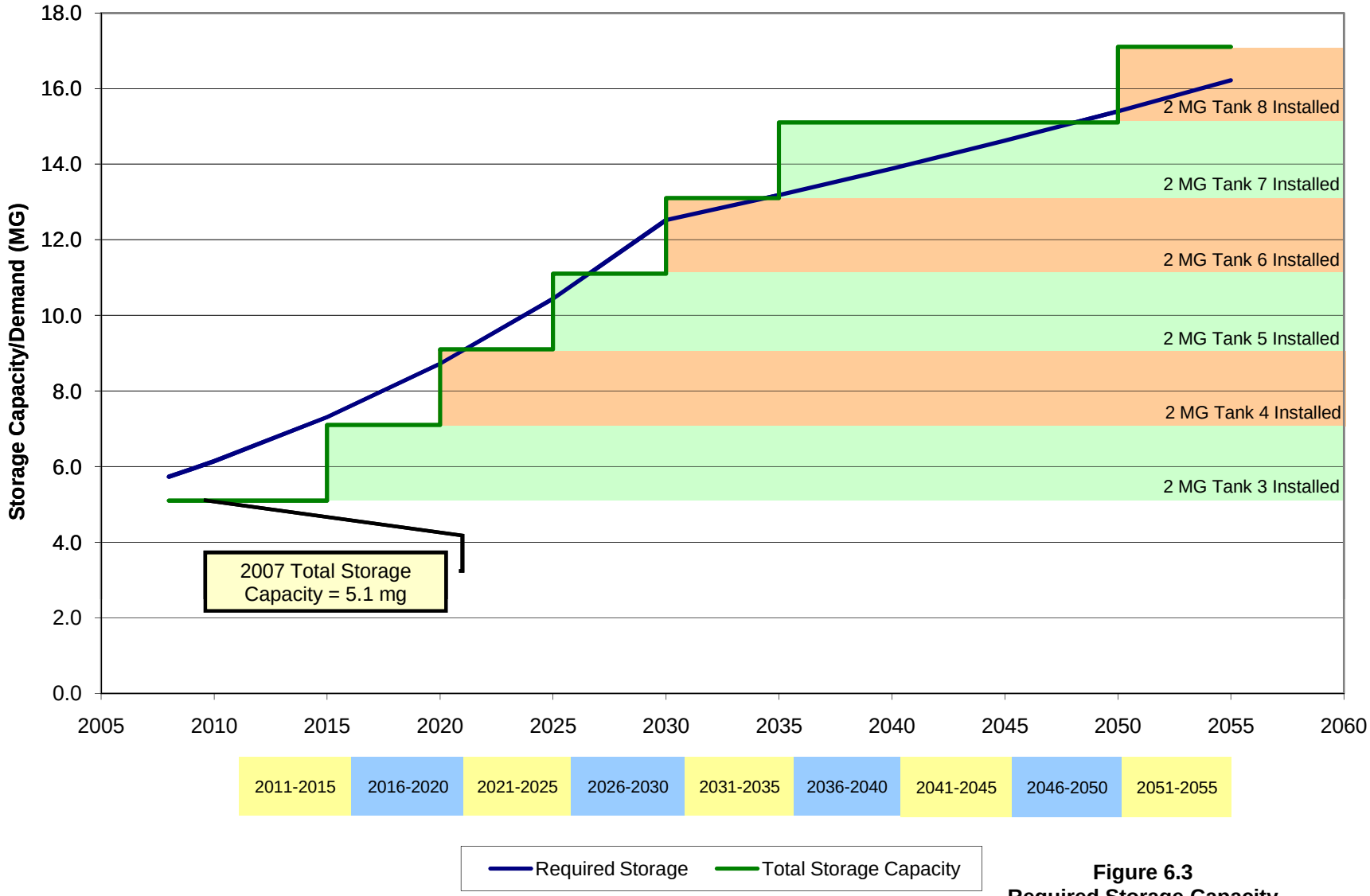

Figure 6.3
Required Storage Capacity
Water Distribution System Master Plan
City of Los Banos

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pw:/CA/Los Banos/7833A00/Disciplines/Water/TablesWater.xls/Figure 6.3 Storage

are placed adjacent to proposed wells. The reservoirs with no well will be filled from the transmission system during low demand times, then emptied during peak demand periods. Proper operation of the reservoirs will be necessary to reduce water age and water quality issues such as disinfection by-products. The phasing illustrated in the figure is consistent with the implementation schedule shown in Table 6.3.

6.3 BOOSTER PUMP STATIONS

Each storage tank will require the installation of a pump station. Hence, six new booster pump stations are recommended in this Master Plan. Although the booster pumps are not shown on Figure 6.2, the reader should assume their presence. It is assumed that the booster pumps would have sufficient capacity to drain the tank in six hours, to provide the operational storage in the distribution system. A possible configuration for the future booster pump stations would consist of four, 2,000 gallon per minute (gpm) pumps. The firm and total capacity for each pump station would be 6,000 and 8,000 gpm, respectively.

If the City builds different size reservoirs in the future, then the pump capacity would need to be revised. The final pump station design capacity will be determined during the planning and design phase.

6.4 PIPELINES

This Master Plan is proposing about 73 miles of new pipelines to serve future users and approximately 16 miles of existing pipeline replacement to correct existing deficiencies or to restore aging water mains.

6.4.1 Existing System Improvements

It is recommended that the City replace some of the small diameter pipelines in the downtown area and in some of the more mature neighborhoods. These small diameter pipes are unable to deliver water at high rates and meet the fire flow pressure requirements. Fire flows were simulated in conjunction with the MDD to identify the capability of the distribution system to respond to hypothetical fires. Only one hypothetical fire was applied during a single model simulation, and the magnitude of the fire flow varied depending on the predominant land use density or intensity. For example, 3,500 gpm for three hours was simulated in industrial areas. The fire flow was reduced to 1,500 gpm for two hours for residential areas. There are also new pipelines that are recommended for the existing system to improve connectivity.

Figure 6.2 illustrates the existing system improvements necessary to meet the fire flow criteria. The pipeline replacement projects intended to improve fire flow pressure requirements are identified as high priority projects. These projects are illustrated as red

pipelines in Figure 6.2 and are labeled as Phase 1 projects, which suggest that they would be the first projects implemented for the water system.

6.4.2 Future System Improvements

All future system pipeline improvements will serve undeveloped areas. Most of the proposed pipelines fall in the 12- to 18-inch diameter range. However, building the backbone transmission main around the City is a primary goal of this Master Plan. This transmission main was first recommended in the 2000 Water Master Plan, and part of it has been constructed. There is 26,000 feet of 16-inch diameter pipeline in the northeast part of the City that is the beginning of a transmission loop. As the City builds more production wells on the west side of the City, the transmission main backbone will provide the facilities necessary to pump water from higher quality groundwater aquifers on the west, to the customers on the east side of town. When the City's SWTP goes on-line in 2025, the transmission main loop should be developed enough to deliver water to all points in the City. This backbone was generally sized to be 16-inch diameter and larger to provide flexibility for the potential future SWTP and/or extraction wells on the west side of the City.

It should be noted that there are undeveloped areas zoned agriculture/rural in the southwest portion of the study area that sit at higher elevations. If the land use designation is changed and these areas are connected to the water system, they will likely experience lower water pressure compared to other lower elevation areas of the City. One mitigating condition is that this area is located near the southern perimeter of the proposed transmission main loop, which helps maintain pressures above the minimum 40 pounds per square inch (psi) criteria. Depending on final grading of the undeveloped land, some residences and businesses could experience pressures below 40 psi during peak demand periods.

As build-out of this area continues, the City should consider increasing the operating pressure range of the water system to boost the pressure in these areas. If the City decides to increase its water system operating pressure, then the existing 0.1 MG elevated storage tank would be impacted and likely require some modifications such as an altitude valve and pump. Instead of increasing the operating pressure system wide, the City could install booster pumps and create a small southwest pressure zone that is separate from the rest of the system.

As the City continues to develop to the southwest and grow beyond the study area into higher elevations, a new pressure zone would likely be required. The higher elevations in the southwest provide an opportunity to install an at grade reservoir that can drain to lower elevations and provide adequate pressure.

6.4.3 Water Main Replacement

In addition to the pipeline improvements recommended to mitigate capacity deficiencies, the City will implement a water main replacement program. The water main replacement program will remove older pipes that may be corroded or encrusted with mineral deposits, and replace them with new pipes. This program will improve distribution of water and could improve water quality by removing corroded pipes. These older water mains are located throughout the City and are not shown in Figure 6.2. Project P-67 is not part of the water main replacement program, but this project will replace the last remaining cast iron pipeline in the distribution system. The City should also consider an asset management program to identify which pipes need to be replaced and establish a schedule for replacement, as well as assess the pipe condition.

6.4.4 Well Manifold System

When the future SWTP is on-line, the City's preference would be to blend the groundwater with the treated surface water prior to distribution. Blending would be achieved by installing a manifold piping system connected to new wells on the west side of the study area. The manifold system would pipe water west and connect to the treated SWTP pipeline bringing water from the California Aqueduct. The manifold system would consist of a northern reach connecting wells on the northern perimeter of the study area, and a southern reach for the wells along the southern perimeter.

Blending treated surface water with groundwater would achieve uniform water quality throughout the distribution system. When the SWTP comes on-line, it will have sufficient capacity to serve the City's demands for most of the year. During the summer when water use increases, the wells will be needed to meet maximum day and peak hour demands. Some of the City's wells have hardness concentrations that exceed 400 mg/L as $CaCO_3$ and total dissolved solids (TDS) concentrations that exceed 700 mg/L on average. Blending the two water sources will avoid residents living close to wells from receiving mostly groundwater with higher hardness and TDS concentrations during the summer. Blending treated surface water with groundwater will decrease the hardness and TDS concentrations of the mixed supply and ensure that residents receive a more uniform water quality throughout the year.

6.5 METER INSTALLATION

There are approximately 100 un-metered water users in the City. The City plans to install meters on each of these customers. According to City staff, the meters are likely 3/4-inch or 1-inch service connections. The locations of these un-metered services are not shown on the figures.

6.6 RECOMMENDED IMPROVEMENTS

Based on the evaluation criteria discussed in Chapter 3, the hydraulic model was used to further evaluate the capacity of the existing distribution system. The hydraulic model evaluation consisted of 24-hour simulations during normal operations of MDD conditions, which also includes PHD conditions.

Figure 6.2 provides a graphical illustration of the improvements recommended to mitigate capacity deficiencies in the existing water system and planned improvements to meet future demand as identified by the hydraulic analysis. Each development project will need further site-specific or project level engineering analysis and proposed solutions to be consistent with the overall infrastructure approach in this Master Plan. The improvements are summarized in Table 6.4 with a cross-referenced number system. The columns used in Table 6.4 refer to the following:

- Figure Number: Assigned number that corresponds to the Proposed Improvements Table. This is an alphanumeric number that starts with one letter indicating the type of improvement P= Pipe, T = Tank, W = Well and continues with a number.
- Type of improvement: Storage tanks, wells, pipelines, jacked steel casings, and water treatment.
- Street Description: Street along in which the improvement is proposed.
- Limits: Description of the beginning and end of a proposed pipeline project.
- Ex. Size/Diameter: This is the size of the existing pipeline/facility. It represents the diameter of the existing pipelines (in inches), the size of the storage reservoirs (in MG), and the size of the wells (in gpm).
- New Size/Diameter: This is the size of the proposed improvement. It represents the diameter of the proposed pipelines (in inches), the size of the storage tanks (in MG), and the size of the wells (in gpm).
- Additionally, for jacked steel casings, the size of the casing as well as the carrier pipe are indicated (in inches).
- Length: Estimated length of the proposed improvement (in feet). It should be noted that the length estimates do not account for re-routing the alignment to avoid unknown conditions.

6.6.1 Existing Versus Future Improvements

An existing deficiency is one where the existing facility's capacity is insufficient to meet the planning criteria (e.g. pipeline upgrades required to meet fire flow criteria). If a project was proposed to correct an existing deficiency, then existing users were assigned 100 percent of the project's benefit, and therefore, 100 percent of the costs.

Table 6.4 Proposed Water Distribution System Improvements

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020	Phase 3 2021-2025	Phase 4 2026-2030	Phase 5 2031+
Existing System Improvements												
Pipelines												
P-1	Pipe	C Street, D Street, 3rd Street, F Street	7th Street, North Street, C Street, E Street, F Street in downtown.	4,6	8	Replace	9,200		Phase 2	Phase 3		
P-2	Pipe	G Street	7th Street to 10th Street	6	8	Replace	1,450			Phase 3		
P-3	Pipe	G Street	Mercey Springs Road to San Juan Avenue	6	8	Replace	700			Phase 3		
P-4	Pipe	L Street	4th Street to I Street	4,6	10	New/Replace	3,300	Phase 1				
P-5	Pipe	Within Municipal Airport	Colorado Avenue and Pacheco Blvd to end of Airport	6	12	Replace	2,300	Phase 1				
P-6	Pipe	I Street	Colorado Avenue and Pacheco Blvd to J Street	6,8	10	Replace	2,300	Phase 1				
P-7	Pipe	13th Street	Pacheco Blvd and 13th Street to existing 10-inch diameter pipe	-	10	New	650	Phase 1				
P-8	Pipe	M Street	Maryland Avenue to Iowa Avenue	-	8	New	300	Phase 1				
P-9	Pipe	Iowa Street	K Street to J Street	4	8	Replace	450		Phase 2			
P-10	Pipe	Idaho Street	J Street to I Street	4	8	Replace	450		Phase 2			
P-11	Pipe	H Street	10th Street to Pacheco Blvd	6	8	Replace	1,300			Phase 3		
P-12	Pipe	Monroe Avenue, Sixth Street	Monroe Circle to 6th Street, Paige Avenue to Madison Avenue	4	8	Replace	1,600			Phase 3		
P-13	Pipe	Center Lane	L Street to connection in alleyway near California Avenue	4	8	Replace	600			Phase 3		
P-14	Pipe	Alleyway n/o M Street	4th Street to Fifth Street	4	8	Replace	500			Phase 3		
P-15	Pipe	Adams Avenue	Nevada Avenue to Center Avenue	4	8	Replace	600			Phase 3		
P-16	Pipe	Santa Rita Avenue	G Street to Romero Street	-	8	New	1,700	Phase 1				
P-67	Pipe	4th Street	Pacheco Blvd to H Street	10	10	Replace	2,700			Phase 3		
	Pipe	Various Locations	Water main replacement program. Average size is 10-inch diameter.	10	10	Replace	25,000		Phase 2	Phase 3	Phase 4	Phase 5
Groundwater Wells												
W-16	Supply Well[4]	Pioneer Road	Near Ortigalita Road	-	1,400 gpm	New		Phase 1				
	Supply Well	Various Locations	Replace or rehabilitate existing wells. Assume one well every 15 years.	various	1,400 gpm	Replace/Rehab			Phase 2			Phase 5
Water Meters												
	Water Meters	Various Locations			3/4" and 1"	New	100		Phase 2	Phase 3		
Future System Improvements												
Pipelines												
P-17	Pipe	sw/o Johnson Road	H Street to connection to 16-inch diameter pipe in Badger Flat Road	-	12	New	5,400	Phase 1	Phase 2			
P-17A	Casing[1]	sw/o Johnson Road	Crossing CCID Main Canal	-	12/24	New	400	Phase 1				
P-18	Pipe	Chenin Blanc	Stonewood Drive to intersection of Chenin Blank Court	8	18	Replace	1,150		Phase 2			
P-19	Pipe	Stonewood Drive	Vinewood Drive to future HWY 152 alignment	-	18	New	4,550		Phase 2	Phase 3		
P-20	Pipe	Probable Extension of St Francis Drive	Mercey Springs Rd to Nantes Avenue	-	12	New	5,400		Phase 2	Phase 3		
P-21	Pipe	Mercey Springs Road	St Francis Drive to future HWY 152 alignment, then west to future tank	-	12	New	4,300		Phase 2	Phase 3		
P-22	Pipe	Future HWY 152 Alignment	Probable extension of Stonewood Drive to Badger Flat Road	-	18	New	10,500			Phase 3		Phase 5
P-23	Pipe	Nantes Avenue	Overland Avenue to future HWY 152 Alignment	-	12	New	6,500		Phase 2			
P-24	Pipe	Johnson Road	H Street to Overland Avenue, then north to future HWY 152 Alignment	-	12	New	9,350		Phase 2	Phase 3	Phase 4	
P-25	Pipe	Capri Avenue	Nantes Avenue to future tank along future HWY 152 alignment	-	12	New	7,300			Phase 3		
P-26	Pipe	Badger Flat Road	Well 15 to future HWY 152 alignment	-	16	New	5,300	Phase 1				
P-26A	Casing[1]	Badger Flat Road	Crossing CCID Main Canal	-	16/30	New	400	Phase 1				
P-27	Pipe	n/o Overland Avenue	Nantes Avenue to Badger Flat Road	-	12	New	6,950		Phase 2	Phase 3	Phase 4	
P-28	Pipe	St Lucia Avenue	Overland Avenue to Capri Avenue	-	12	New	3,900			Phase 3		
P-29	Pipe	H Street	Colorado Avenue to future HWY 152 alignment	-	12	New	6,850		Phase 2	Phase 3		
P-29A	Casing[1]	H Street	Crossing Los Banos Creek	-	12/24	New	200			Phase 3		
P-30	Pipe	w/o Colorado Avenue	H Street to existing system within airport	-	12	New	4,200	Phase 1	Phase 2			
P-31	Pipe	Ward Road	Ward Road to Place Road	-	12	New	4,250		Phase 2			
P-32	Pipe	Ward Road and Railroad ROW	From 5.0 MG Reservoir to Pioneer Road and San Luis Canal	-	16	New	4,800		Phase 2			
P-33	Pipe	Along San Luis Canal	Existing 16-inch pipe in Creekside Circle and along San Luis Canal	-	18	New	10,550		Phase 2	Phase 3		
P-34	Pipe	Pioneer Road	Ward Avenue to Holland Avenue	-	18	New	6,800		Phase 2	Phase 3		
P-34A	Casing[1]	Pioneer Road	Crossing CCID Main Canal	-	18/30	New	400			Phase 3		
P-35	Pipe	Ward Avenue	Pioneer Road to Phillips Road	-	18	New	2,700			Phase 3	Phase 4	
P-36	Pipe	Mercey Springs Avenue	Cardoza Road to Pioneer Road	-	12	New	4,450		Phase 2			
P-37	Pipe	Place Road	Pioneer Road to Phillips Road	-	12	New	3,100		Phase 2	Phase 3	Phase 4	
P-38	Pipe	Mercey Springs Avenue	Pioneer Road to Phillips Road	-	12	New	2,700		Phase 2	Phase 3	Phase 4	

Table 6.4 Proposed Water Distribution System Improvements

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020	Phase 3 2021-2025	Phase 4 2026-2030	Phase 5 2031+
P-39	Pipe	Pioneer Road	West of Ortigalita Road to CCID Main Canal	-	18	New	11,200		Phase 2	Phase 3		
P-40	Pipe	Center Avenue	Cardoza Road to Phillips Road	-	12	New	5,300		Phase 2	Phase 3	Phase 4	
P-41	Pipe	Between Ortigalita and Center	Cardoza Road to Phillips Road	-	12	New	5,500		Phase 2	Phase 3	Phase 4	
P-42	Pipe	Future area	Pioneer Road to existing system	-	16	New	1,850	Phase 1				
P-43	Pipe	Plow Camp Road	Pioneer Road to Phillips Road	-	12	New	2,650			Phase 3	Phase 4	
P-44	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	36	New	8,850			Phase 3		
P-44A	Casing(1)	Future HWY 152 Alignment	Crossing CCID Main Canal	-	36/60	New	400			Phase 3		
P-44B	Casing(1)	Future HWY 152 Alignment	Crossing CCID Main Canal	-	36/60	New	400			Phase 3		
P-45	Pipe	Future area	CCID Main Canal to Badger Flat Road	-	12	New	6,000	Phase 1				
P-45A	Casing(1)	Los Banos Creek	Crossing Los Banos Creek	-	12/24	New	200	Phase 1				
P-46	Pipe	Pacheco Blvd	West of Badger Flat Road	-	12	New	1,450		Phase 2			
P-47	Pipe	Future area	Pioneer Road to Stonecreek Blvd	-	12	New	4,500		Phase 2			Phase 5
P-48	Pipe	Future area	Cardoza Road	-	12	New	2,800		Phase 2			
P-49	Pipe	Pioneer Road	CCID Outside Canal to east of Los Banos Creek	-	36	New	12,050			Phase 3		Phase 5
P-49A	Casing(1)	Pioneer Road	Crossing Los Banos Creek	-	36/60	New	200					Phase 5
P-50	Pipe	Canyon Road	Pioneer Road to future HWY 152 alignment	-	12	New	11,450		Phase 2	Phase 3		
P-50A	Casing(1)	Pacheco Blvd	HWY 152 Crossing	-	12/24	New	400		Phase 2	Phase 3		
P-51	Pipe	Future area	Los Banos Creek to study area boundary	-	12	New	12,350				Phase 4	
P-52	Pipe	Future area	Parallel to Los Banos Creek	-	12	New	11,000		Phase 2	Phase 3	Phase 4	
P-52A	Casing(1)	Near Los Banos Creek	HWY 152 Crossing	-	12/24	New	300		Phase 2			
P-53	Pipe	Future area	Near Los Banos Creek	-	12	New	4,250		Phase 2			
P-54	Pipe	Parallel to HWY 152	Los Banos Creek to Volta Road	-	12	New	10,000			Phase 3	Phase 4	Phase 5
P-55	Pipe	Future area	Pioneer Road to s/o Pacheco Blvd	-	12	New	4,600			Phase 3		
P-56	Pipe	Ortigalita Road	Sandra Street to Phillips Road	-	12	New	4,150		Phase 2	Phase 3	Phase 4	
P-57	Pipe	Future area	HWY 152 to future HWY 152 alignment	-	36	New	12,200		Phase 2	Phase 3		
P-58	Pipe	Future area	North of HWY 152	-	16	New	11,900				Phase 4	Phase 5
P-59	Pipe	Volta Road	Future area to future storage tank	-	16	New	1,350				Phase 4	
P-60	Pipe	Between Volta and Ramos	Crosses HWY 152	-	16	New	2,500				Phase 4	
P-60A	Casing(1)	e/o Volta Road	HWY 152 Crossing	-	16/30	New	400				Phase 4	
P-61	Pipe	Study Area Boundary, Volta Road	Parallel to Outside Canal to HWY 152 alignment	-	36	New	7,450					Phase 5
P-62	Pipe	Along CCID Main Canal, Middle Road	Pioneer Road to Holland Avenue	-	12	New	3,950			Phase 3	Phase 4	
P-63	Pipe	Phillips Road	Mercey Springs Avenue to Place Road	-	12	New	4,000				Phase 4	
P-64	Pipe	Study Area Boundary	Future area parallel to n\o Phillips Road	-	18	New	2,200			Phase 3	Phase 4	
P-65	Pipe	Probable extension of Middle Road	Holland Avenue to Ortigalita Road, then continues west to Madera Road	-	12	New	13,000				Phase 4	
P-66	Pipe	Future area	HWY 152 to Los Banos Creek	-	12	New	5,300		Phase 2			
P-68	Pipe	Volta Road	Future area to study area boundary	-	12	New	2,000					Phase 5
P-69	Pipe	Study Area Boundary	Volta Road to CCID Main Canal	-	12	New	7,650					Phase 5
P-70	Pipe	Ramos Road	Future area to study area boundary	-	12	New	3,650				Phase 4	Phase 5
P-71	Pipe	Future area	Future HWY 152 alignment to study area boundary	-	12	New	3,200					Phase 5
Storage Tanks and Booster Pumps												
T-3	Storage Tank	Pioneer Road	e/o Ortigalita Road	-	2 MG	New		Phase 1				
	Land Acquisition			-	2 acres	New		Phase 1				
T-4	Storage Tank	Future HWY 152 Alignment	Near intersection with Badger Flat Road	-	2 MG	New			Phase 2			
	Land Acquisition			-	2 acres	New			Phase 2			
T-5	Storage Tank	Place Road	Near intersection with Wimbledon Court	-	2 MG	New				Phase 3		
	Land Acquisition			-	2 acres	New				Phase 3		
T-6	Storage Tank	Future HWY 152 Alignment	w/o Mercey Springs Avenue	-	2 MG	New					Phase 4	
	Land Acquisition			-	2 acres	New					Phase 4	
T-7	Storage Tank	Pioneer Road	Near intersection with Holland Avenue	-	2 MG	New						Phase 5
	Land Acquisition			-	2 acres	New						Phase 5
T-8	Storage Tank	Future HWY 152 Alignment	Near intersection with Volta Road	-	2 MG	New						Phase 5
	Land Acquisition			-	2 acres	New						Phase 5

Table 6.4 Proposed Water Distribution System Improvements

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020	Phase 3 2021-2025	Phase 4 2026-2030	Phase 5 2031+
Groundwater Wells												
W-17	Supply Well[4]	Future HWY 152 Alignment	Near CCID Main Canal	-	1,400 gpm	New		Phase 1				
	Land Acquisition				0.25 acres	New		Phase 1				
W-18	Supply Well[4]	Future HWY 152 Alignment	Near intersection with Badger Flat Road	-	1,400 gpm	New		Phase 1				
	Land Acquisition				0.25 acres	New		Phase 1				
W-19	Supply Well[4]	Future HWY 152 Alignment	Near CCID Canal and Ramos Road	-	1,400 gpm	New			Phase 2			
	Land Acquisition				0.25 acres	New			Phase 2			
W-20	Supply Well[4]	s/o Pacheco Blvd	Near HWY 152 and Canyon Road	-	1,400 gpm	New			Phase 2			
	Land Acquisition				0.25 acres	New			Phase 2			
W-21	Supply Well[4]	Pioneer Road	Near Canyon Road and Los Banos Creek	-	1,400 gpm	New				Phase 3		
	Land Acquisition				0.25 acres	New				Phase 3		
W-22	Supply Well[4]	Pioneer Road	Near Canyon Road	-	1,400 gpm	New				Phase 3		
	Land Acquisition				0.25 acres	New				Phase 3		
W-23	Supply Well[4]	Pioneer Road	Near intersection with Holland Avenue	-	1,400 gpm	New					Phase 4	
	Land Acquisition				0.25 acres	New					Phase 4	
W-24	Supply Well[4]	n/o Future HWY 152 Alignment	Near intersection with Volta Road	-	1,400 gpm	New						Phase 5
	Land Acquisition				0.25 acres	New						Phase 5
W-25	Supply Well[4]	w/o Volta Road	Near future connection to SWTP	-	1,400 gpm	New						Phase 5
	Land Acquisition				0.25 acres	New						Phase 5
Well Manifold System												
M-1	Pipe	Future Area	Along west side of study area boundary to future groundwater well	-	20	New	8,190			Phase 3		
M-2	Pipe	Future Area	Future groundwater well to future HWY 152 alignment	-	18	New	4,880			Phase 3		
M-3	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	16	New	4,520			Phase 3		
M-3A	Casing[1]	CCID Main Canal Crossing		-	16/30	New	400			Phase 3		
M-4	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	12	New	5,260			Phase 3		
M-4A	Casing[1]	Los Banos Creek Crossing		-	12/24	New	400			Phase 3		
M-5	Pipe	Study Area Boundary	Parallel to Outside Canal	-	24	New	4,460			Phase 3		
M-6	Pipe	Study Area Boundary	Parallel to Outside Canal and Pioneer Road	-	20	New	5,510			Phase 3		
M-7	Pipe	Pioneer Road		-	18	New	4,260			Phase 3		
M-8	Pipe	Pioneer Road		-	16	New	5,450			Phase 3		
M-8A	Casing[1]	Los Banos Creek Crossing			16/30	New	400			Phase 3		
M-9	Pipe	Pioneer Road	West of Ortigalita Road	-	12	New	5,080				Phase 4	
Surface Water Treatment Plant												
SWTP	SWTP	Pacheco Blvd	West of the City limits	-	20 MGD	New			Phase 2	Phase 3		
	Land Acquisition				10 acres	New				Phase 3		
SWTP	SWTP Expansion	Pacheco Blvd	West of the City limits	-	2 MGD	New						Phase 5
SWTP	SWTP Expansion	Pacheco Blvd	West of the City limits	-	4 MGD	New						Phase 5
SWTP-1	Transmission Line	Pacheco Blvd	CA Aqueduct to future transmission main	-	42	New	11,000		Phase 2	Phase 3		
SWTP-2	Casing[1]	Pacheco Blvd	Crossing CCID Outside Canal	-	42/72	New	350		Phase 2	Phase 3		
SWTP-3	Casing[1]	Pacheco Blvd	Crossing Delta Mendota Canal	-	42/72	New	400		Phase 2	Phase 3		
SWTP-4	Casing[1]	Pacheco Blvd	Crossing California Aqueduct	-	42/72	New	500		Phase 3	Phase 3		
SWTP-5	Casing[1]	Pacheco Blvd	Crossing HWY 152	-	42/72	New	400		Phase 2	Phase 3		

A majority of the proposed improvements are required to serve future users. Continued growth will trigger the construction of new facilities to support this growth. Future users were assigned 100 percent of the future project's benefit and 100 percent of the costs.

Most projects were assigned 100 percent to existing or future users. Two exceptions were the 20 MG SWTP scheduled to go on-line in year 2025 and the groundwater manifold piping system. The split was based on the existing ADD (7.56 mgd) divided by projected build-out ADD (24.9 mgd). Existing users will receive 30 percent of the SWTP benefits, and future users will receive 70 percent of the benefits. More information on the breakdown in cost split between existing and future users and whether a proposed improvement is intended to correct an existing deficiency, to serve a future user, or both is provided in Table 7.3.

The future improvements were broken down further based on their funding source. Future improvements will be funded by developers or through development impact fees. All projects fall into one of the three following categories:

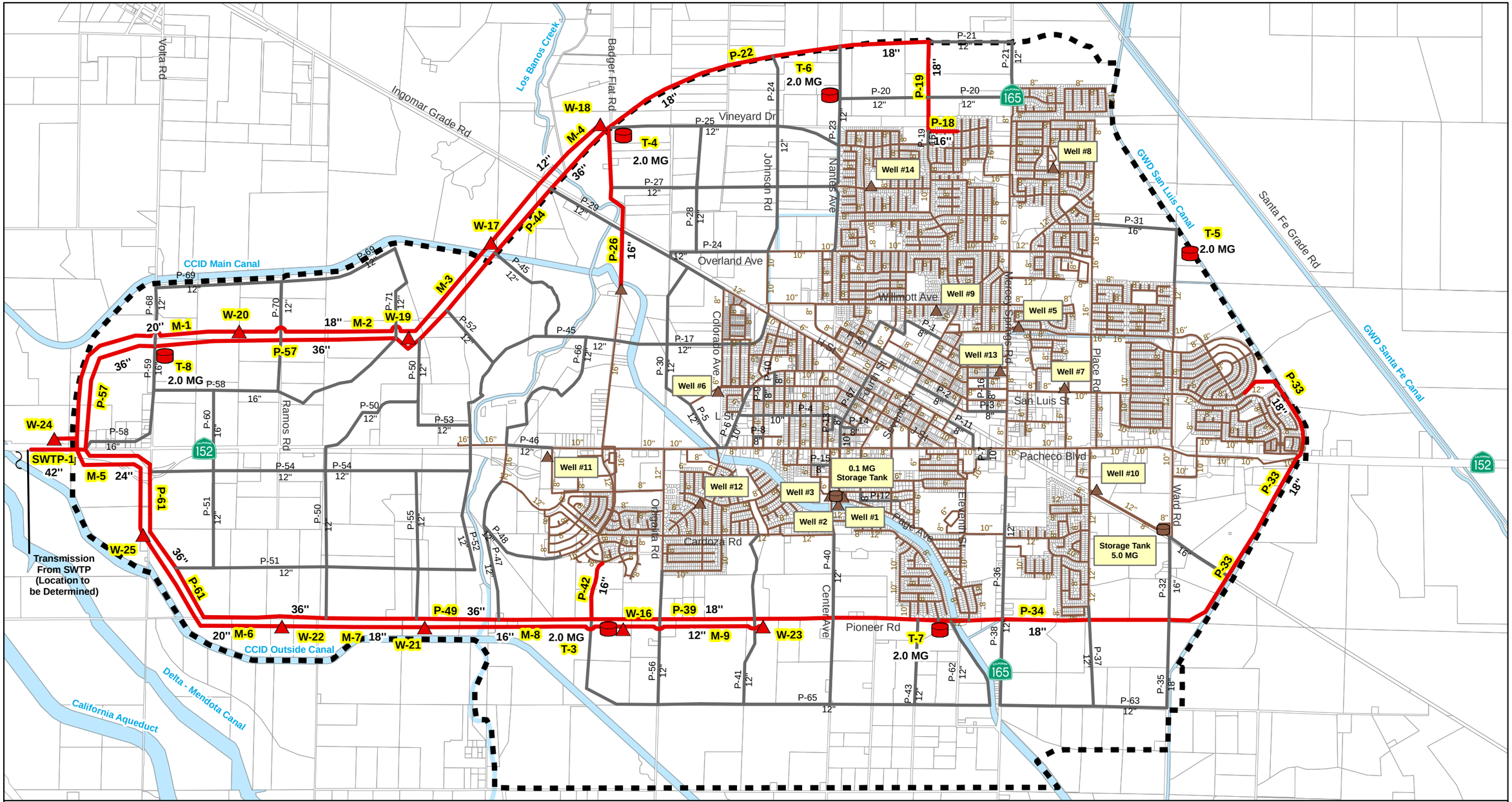
- Existing Improvements: Existing improvements correct existing deficiencies or rehabilitate/replace existing facilities that have reached their useful life. These projects are funded through user rates.
- Developer Improvements: Future improvements that serve new users. These improvements will be developer funded and/or may be part of a reimbursement agreement between developers.
- Regional Improvements: Future improvements that serve new users. These improvements will be funded through water development impact fees collected by the City.

The majority of future improvements are Developer Improvements. The water transmission mains, manifold piping system, storage tanks, wells, and the treatment plant were designated Regional Improvements. The Regional Improvements are shown in Figure 6.4.

6.7 PROJECT PRIORITIZATION

The proposed projects provide the City with a list of improvements that will correct capacity deficiencies in the distribution system that could occur during a fire flow event and from deficiencies caused by increased demand from future growth. When fully implemented, the capital projects will enhance the distribution of water during maximum demand conditions to existing and future users, and meet the planning criteria.

Prioritizing the required capital improvements for the City's water distribution system is an important aspect of this Master Plan. The improvement projects were prioritized based on the following factors:



Legend

Existing Water Distribution Facilities
- Groundwater Well
- Storage Tank
- Pipelines

Future Distribution Facilities

Regional Improvements
- Groundwater Well
- Storage Tank
- Pipeline

Developer Improvements
- Pipeline
- NC-2 Regional CIP ID
- S2-7 CIP ID

- Parcels
- Waterways/Canals
- Sphere of Influence
- 12" CIP Diameter
- 8" Existing Diameter

N

0 2,500 5,000 Feet

Figure 6.4
Regional Improvements
Water Distribution
System Master Plan
City of Los Banos

- Addressing the most capacity deficient pipelines that are undersized for fire flow demand conditions received the highest priority.
- Increasing supply (groundwater and surface water) capacity to serve future users
- Increasing storage capacity to serve future users
- Building the distribution and transmission pipelines necessary to serve future users

The existing system improvements were proposed primarily to provide sufficient water pressure in the downtown area during a fire. The fire flow demand criteria recommended by the City's Fire Department resulted in additional improvements to meet the flow and pressure requirements.

Future development will require the construction of new pipelines, wells, and storage tanks to serve new users. Proposed improvements within areas identified for early development were assigned a higher priority. Areas within an approved tract received the highest priority. The actual implementation of the improvements serving future users depends on the pace of development. The priorities presented below are estimates based on available information provided by the City. Changes in the City's planning assumptions or growth projections could increase or decrease the priority of each improvement.

The projects shown in Figure 6.2 are color coded according to phase, which reflects their priority. Table 6.4 indicates the phasing timeframe for each capital project. As shown in the table, the new future pipeline serving the west-central part of the City (P-17) is required in the near term (as indicated by the Phase 1 and 2 entries in the 2010-2015 and 2016-2020 columns). This is a high priority project.

6.7.1 Existing System Improvement Prioritization

The existing system improvements required to meet fire flow and water supply criteria were assigned a high priority. Due to economic conditions and the slow down in development, the probability and practicality of construction all these improvements in the next five years is low. For this reason, the improvements were distributed amongst the first three phases according to priority and the level of benefit provided to the existing system. Water supply improvements and pipelines that provided the greatest benefit (e.g. greater fire flow pressure, improved connectivity, enhanced distribution) to existing users were ranked with the highest priority and are grouped into Phase 1 (P-4 through P-8, P-16, and W-16). The remaining improvements were distributed between Phases 2 and 3 (P-1, P-2, P-3, P-9 through P-15, and P-67). P-67 will replace the last cast iron pipeline in the distribution system. Figure ES.2 illustrates the location of these improvements and the phasing by color code.

The water main replacement program would be an on-going project that would be implemented in Phases 2 through 5. The water well replacement or rehabilitation project assumes a project once every 15 years. It was assumed that the water meter installation program would begin in year 2010 and continue until completed.

6.7.2 Future System Improvement Prioritization

The implementation of distribution system improvements that serve future growth will depend on the City's pace of development and selection of areas to be served with urban infrastructure. The City provided guidance on future development and phasing of infrastructure to serve future users. Based on this input, the projects were grouped into the following timeframes:

- Years 2010 through 2015
- Years 2016 through 2020
- Years 2021 through 2025
- Years 2026 through 2030
- Beyond 2031

6.7.2.1 Phase 1 and 2 Projects (2010-2020)

The high priority future system improvements are those required to serve anticipated growth from 2010 through 2020. The majority of these improvements are distribution pipelines, but they also include wells and storage tanks. Wells 17 through 20 (four new wells total) are necessary to meet projected MDD through year 2020. Two new 2.0 MG storage tanks with booster pumps will be needed by 2015 to meet operational and fire storage requirements.

As shown in Table 6.4 and illustrated in Figure 6.2, there are several pipeline improvements that fall into the Phase 1 and 2 categories and are considered high priority distribution pipeline improvements. The highest priority pipeline projects that serve new users include P-17, P-30, P-32, P-42, and P-45. Improvements P-17 and P-30 link the existing 16-inch diameter pipeline in Badger Flat Road to the existing 6-inch diameter pipeline within the airport property (note that the 6-inch diameter pipeline is scheduled for replacement and upsize to a 12-inch diameter). Improvement P-42 extends a new 16-inch diameter pipeline from the Stonecreek and Cardoza Road area down to Pioneer Road where new Well 16 is shown.

There are a number of Phase 2 pipeline improvements that extend out to proposed tank and well sites, or serve areas that could be developed by year 2020. Some general areas with a near term development potential include the proposed industrial park around Ward Road, land between Cardoza and Pioneer Road, commercial areas around Highway 152 on the west side of the City, and vacant land around Nantes and Overland

Avenues. As shown in Figure 6.2, pipelines illustrated as Phase 2 improvements serve these areas.

Pipeline improvements P-32, P-33, and P-34 around Ward Road and the proposed industrial park are important because they provide water service to an important development site in the City. These pipeline improvements also help the City fully utilize the 5 MG reservoir and booster pump station because the existing 10-inch and 12-inch diameter pipes have limited capacity and cannot convey full capacity of the pump station. Water age and turnover might be an issue in this reservoir also, the City will not realize the full benefits of this reservoir until larger mains leaving the reservoir connect to other points of the distribution system.

6.7.2.2 Phase 3 through 5 Projects (2021 and beyond)

The lower priority future system improvements are those required to serve anticipated growth from 2021 and beyond. Wells 21 and 22 are necessary between years 2021 and 2023 to meet projected MDD. As discussed previously, when the SWTP comes on-line in year 2025, the last two wells are not required until after year 2050. Four new 2.0 MG storage tanks with booster pumps will be needed from year 2022 through build-out of the study area.

The pipeline improvements in Phase 3 extend farther out towards the boundary of the study area. This is also the phase that a significant amount of the northern loop of the transmission main backbone around the City would be completed. The northern loop placement follows the proposed Highway 152 bypass alignment. This segment of the transmission main is critical because if the SWTP comes on-line by year 2025, this pipeline would serve as the primary transmission of potable water from the west to the east. Pipeline improvements P-57, P-44, P-25, P-29, and P-52 should be completed by the end of Phase 3 to serve the future SWTP.

6.7.2.3 Surface Water Treatment Plant Prioritization

The SWTP is the single largest project that the City will construct through build-out of the study area. This Master Plan assumed that the treatment plant would be on-line by year 2025. Projects of this size and importance typically require years to plan, design, permit, and construct. The SWTP includes an additional level of complexity in that water supply contracts need to be secured from the State Water Project. Although work on securing the water supply contracts could start in the next few years, this Master Plan assumed that the majority of work to plan, permit, design, and construct would occur between 2021 and 2025, but some work would be conducted prior to year 2021.

CAPITAL IMPROVEMENT PROJECTS

This chapter presents the recommended capital improvement projects (CIP) for the City of Los Banos (City) water distribution system and a summary of the capital costs. This chapter is organized to assist the City in making finance decisions, and to plan the water system improvements through build-out of the 2030 General Plan Update (2030 General Plan). The CIP is based on the evaluation of the City's water distribution system, and on the recommended projects described in the previous chapters.

7.1 CAPITAL IMPROVEMENT PROJECT COSTS

The capacity upgrades and new service projects set the foundation for the City's water distribution system CIP. The cost estimates presented in this study are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo Engineers, P.C. (Carollo) experience on other projects. The costs are based on an Engineering News Record Construction Cost Index 20-city average of 8592 (November 2009).

7.2 COST ESTIMATING ACCURACY

The cost estimates presented in the CIP have been prepared for general master planning purposes and for guidance in project evaluation and implementation. Final costs of a project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors such as: preliminary alignment generation, investigation of alternative routings, and detailed utility and topography surveys.

The Association for the Advancement of Cost Engineering (AACE) defines an Order of Magnitude Estimate for master plan studies as an approximate estimate made without detailed engineering data. It is normally expected that an estimate of this type would be accurate within +50 percent to -30 percent. This section presents the assumptions used in developing order of magnitude cost estimates for recommended facilities.

7.3 CONSTRUCTION UNIT COSTS

The construction costs are representative of water distribution system facilities under normal construction conditions and schedules.

7.3.1 Pipeline Unit Costs

Water distribution system pipeline improvements range in size from 8-inches to 42-inches in diameter. Pipe casings up to 72-inches in diameter are included for major crossings (e.g. canals, highways, railroad) of the transmission main from the California Aqueduct/surface water treatment plant (SWTP) to the City's distribution system. Pipeline unit costs are

shown in Table 7.1. The construction cost estimates are based upon these unit costs. The unit costs are for “typical” field conditions with construction in stable soil.

Table 7.1 Pipeline Construction Unit Costs
Water Distribution System Master Plan
City of Los Banos

Pipe Size (inches)	$/Linear Foot
8	89
10	111
12	133
16	178
18	182
24	242
30	303
36	363
42	424
Pipeline Casing for Major Crossings	
24	892
30	1,115
72	2,676

Note:
1. ENR CCI 20 City Average (November 2009) = 8592

7.3.2 Tank and Booster Pump, Well, and Treatment Plant Costs

Construction unit costs were also developed for the storage tanks and booster pumps, groundwater supply wells, and the SWTP. The unit costs for these facilities are summarized in Table 7.2.

Table 7.2 Facility Construction Unit Costs
Water Distribution System Master Plan
City of Los Banos

Facility	Unit Cost
Storage Tanks and Booster Pump Stations =	$1.35 per gallon of storage
Groundwater Supply Wells =	$500,000 per 1 mgd of capacity
Surface Water Treatment Plant =	$4.50 per gallon of treatment capacity

Note:
1. ENR CCI 20 City Average (November 2009) = 8592

Acquisition of property, easements, and right-of-way (ROW) may be required for some of the recommended projects, but not all. Pipeline corridor or easements are assumed to be in public ROW. Variables affecting properties can result in widely varying land prices. For these reasons, land acquisition costs are not included in the water distribution system master plan (Master Plan).

7.3.3 Land Acquisition Costs

The land acquisition costs for water pipelines was assumed to be zero because these will be located within public right of way. However, land acquisition may be required for well and storage tank sites. The land acquisition cost the City assumes for public land purchases is $240,000 per acre based on a land appraisal that the City conducts each year.

7.4 PROJECT COSTS AND CONTINGENCIES

7.4.1 Baseline Construction Cost

This is the total estimated construction cost, in dollars, of the proposed improvement. Pipeline, storage tank and booster pump station, wells, and SWTP Baseline Construction Costs were developed using the following criteria:

- Pipeline: Calculated by multiplying the estimated length by the unit cost.
- Storage Tank/Booster Pump Station: Calculated by multiplying the tank volume by the unit cost.
- Groundwater Supply Well: Calculated by multiplying the well capacity in mgd by the unit cost.
- Surface Water Treatment Plant: Calculated by multiplying the SWTP capacity in gallons by the unit cost.

7.4.2 Estimated Construction Cost

Contingency costs must be reviewed on a case-by-case basis because they will vary considerably with each project. Consequently, it is appropriate to allow for uncertainties associated with the preliminary layout of a project. Such factors as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are a few of the items that can increase project costs for which it is wise to make allowances in preliminary estimates. To assist the City in making finance decisions for these future construction projects, contingency costs will be added to the planning budget as percentages of the total construction cost, divided into two categories: Estimated Construction Cost and Capital Improvement Cost.

Since knowledge about site-specific conditions of each proposed project is limited at the master planning stage, a 20 percent contingency was applied to the Baseline Construction Cost to account for unforeseen events and unknown conditions. The Estimated

Construction Cost for the proposed distribution system improvement consists of the Baseline Construction Cost plus the 20 percent construction contingency.

7.4.3 Capital Improvement Cost

Other project construction contingency costs are divided into three subcategories, totaling 30 percent: 10 percent engineering, 10 percent construction management, and 10 percent program implementation. Engineering services associated with new facilities include preliminary investigations and reports, ROW acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. For this study, engineering costs are assumed to equal 10 percent of the Estimated Construction Cost.

Construction management covers such items as contract management and inspection during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that construction management charges will equal approximately 10 percent of the Estimated Construction Cost.

Finally, there are program implementation costs, which cover such items as legal fees, environmental/CEQA compliance requirements, financing expenses, administrative costs, and interest during construction. The cost of these items can also vary, but for the purpose of this Master Plan, it is assumed that program implementation costs will equal 10 percent of the Estimated Construction Cost.

The Capital Improvement Cost is the total of the Estimated Construction Cost (including contingency) plus the other costs discussed in the previous paragraphs.

As shown below, the total cost of all project construction contingencies (construction, engineering services, construction management, and program implementation) is approximately 56 percent of the Baseline Construction Cost. Note that contingencies were not applied to land acquisition costs.

Example:

Baseline Construction Cost	$1,000,000
Construction Contingency (20%)	200,000
Estimated Construction Cost	1,200,000
Engineering Cost (10%)	120,000
Construction Management (10%)	120,000
Program Implementation (10%)	120,000
Capital Improvement Cost	$1,560,000

A summary of the capital project costs is presented in Table 7.3. This table identifies the projects, provides a brief description of the project, identifies facility size (e.g. pipe diameter and length), and the capital improvement cost. The table also shows the probable phase in which the project would be implemented. The implementation timeframe was based on the priority of each project to correct existing deficiencies or to serve future users.

7.5 CAPITAL IMPROVEMENT IMPLEMENTATION

As discussed in Chapter 6, the CIPs are prioritized based on their urgency to mitigate existing deficiencies and for servicing anticipated growth. It is recommended that improvements to mitigate existing deficiencies be constructed as soon as possible. The deficiencies in the future system have a significant total capital cost that is best distributed based on the order in which the City will develop.

The implementation phases are separated into 5-year increments. Each project is itemized by phase in Table 7.3 and a summary by phase is provided in Table 7.4. The tanks, wells, and SWTP upgrades were phased by comparing the forecast demand with the available supply and storage capacity. The need for new pipelines was based on the City's projection for extending urban services to new developments, and on the timing for connecting the future SWTP to the transmission main loop.

7.6 EXISTING VERSUS FUTURE USER COST SHARE

The improvements proposed in this Master Plan either benefit existing users, or are required to service new development and future users. Some of the projects, like the SWTP, provide benefit to both existing and future users. An opinion of benefit to future users, based on preliminary project information, was included in Table 7.3. It was assumed that projects intended to correct existing deficiencies provide no benefit to future users, and would be required regardless of future development. It was also assumed that future users would benefit entirely from the construction of facilities necessary to serve future development. The benefit from the SWTP was split according to the ratio of existing average day flow versus build-out average day flow, as discussed in Chapter 6. The future improvements are broken down further into Regional or Developer Improvements. The difference between these two is the funding source, which was described in Chapter 6. The Regional Improvements were illustrated in Figure 6.4 and include the surface water treatment plant, transmission main around the City, the groundwater manifold piping system, wells, and tanks.

A breakdown in existing and future user cost share of the proposed projects by phase is summarized in Table 7.4. The costs increase significantly in Phase 3 (2021 through 2025) for both existing and future users because of the SWTP.

Table 7.3 Capital Improvement Projects

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
Existing System Improvements																	
Pipelines																	
P-1	Pipe	C Street, D Street, 3rd Street, F Street	7th Street, North Street, C Street, E Street, F Street in downtown.	4,6	8	Replace	9,200	$ 1,275,000		$ 637,500	$ 637,500			0%	$ 1,275,000	$ -	$ -
P-2	Pipe	G Street	7th Street to 10th Street	6	8	Replace	1,450	$ 201,000			$ 201,000			0%	$ 201,000	$ -	$ -
P-3	Pipe	G Street	Mercey Springs Road to San Juan Avenue	6	8	Replace	700	$ 97,000			$ 97,000			0%	$ 97,000	$ -	$ -
P-4	Pipe	L Street	4th Street to I Street	4,6	10	New/Replace	3,300	$ 571,000	$ 571,000					0%	$ 571,000	$ -	$ -
P-5	Pipe	Within Municipal Airport	Colorado Avenue and Pacheco Blvd to end of Airport	6	12	Replace	2,300	$ 477,000	$ 477,000					0%	$ 477,000	$ -	$ -
P-6	Pipe	I Street	Colorado Avenue and Pacheco Blvd to J Street	6,8	10	Replace	2,300	$ 398,000	$ 398,000					0%	$ 398,000	$ -	$ -
P-7	Pipe	13th Street	Pacheco Blvd and 13th Street to existing 10-inch diameter pipe	-	10	New	650	$ 112,000	$ 112,000					0%	$ 112,000	$ -	$ -
P-8	Pipe	M Street	Maryland Avenue to Iowa Avenue	-	8	New	300	$ 42,000	$ 42,000					0%	$ 42,000	$ -	$ -
P-9	Pipe	Iowa Street	K Street to J Street	4	8	Replace	450	$ 62,000		$ 62,000				0%	$ 62,000	$ -	$ -
P-10	Pipe	Idaho Street	J Street to I Street	4	8	Replace	450	$ 62,000		$ 62,000				0%	$ 62,000	$ -	$ -
P-11	Pipe	H Street	10th Street to Pacheco Blvd	6	8	Replace	1,300	$ 179,000			$ 179,000			0%	$ 179,000	$ -	$ -
P-12	Pipe	Monroe Avenue, Sixth Street	Monroe Circle to 6th Street, Paige Avenue to Madison Avenue	4	8	Replace	1,600	$ 222,000			$ 222,000			0%	$ 222,000	$ -	$ -
P-13	Pipe	Center Lane	L Street to connection in alleyway near California Avenue	4	8	Replace	600	$ 83,000			$ 83,000			0%	$ 83,000	$ -	$ -
P-14	Pipe	Alleyway n/o M Street	4th Street to Fifth Street	4	8	Replace	500	$ 69,000			$ 69,000			0%	$ 69,000	$ -	$ -
P-15	Pipe	Adams Avenue	Nevada Avenue to Center Avenue	4	8	Replace	600	$ 83,000			$ 83,000			0%	$ 83,000	$ -	$ -
P-16	Pipe	Santa Rita Avenue	G Street to Romero Street	-	8	New	1,700	$ 236,000	$ 236,000					0%	$ 236,000	$ -	$ -
P-67	Pipe	4th Street	Pacheco Blvd to H Street	10	10	Replace	2,700	$ 468,000			$ 468,000			0%	$ 468,000	$ -	$ -
	Pipe	Various Locations	Water main replacement program. Average size is 10-inch diameter.	10	10	Replace	25,000	$ 4,329,000		$ 1,083,000	$ 1,082,000	$ 1,082,000	$ 1,082,000	0%	$ 4,329,000	$ -	$ -
Groundwater Wells																	
W-16	Supply Well[4]	Pioneer Road	Near Ortigalita Road	-	1,400 gpm	New		$ 1,560,000	$ 1,560,000					0%	$ 1,560,000	$ -	$ -
	Land Acquisition				0.25 acres	New		$ 60,000	$ 60,000					0%	$ 60,000	$ -	$ -
	Supply Well	Various Locations	Replace or rehabilitate existing wells. Assume one well every 15 years.	various	1,400 gpm	Replace/Rehab		$ 3,120,000		$ 1,560,000			$ 1,560,000	0%	$ 3,120,000	$ -	$ -
Water Meters																	
	Water Meters	Various Locations			3/4" and 1"	New	100	$ 250,000		$ 125,000	$ 125,000			0%	$ 250,000	$ -	$ -
						Existing Improvements Subtotal		**$ 13,956,000**	**$ 3,456,000**	**$ 3,529,500**	**$ 3,246,500**	**$ 1,082,000**	**$ 2,642,000**		**$ 13,956,000**	**$ -**	**$ -**
Future System Improvements																	
Pipelines																	
P-17	Pipe	sw/o Johnson Road	H Street to connection to 16-inch diameter pipe in Badger Flat Road	-	12	New	5,400	$ 1,122,000	$ 337,000	$ 785,000				100%	$ -	$ 1,122,000	$ -
P-17A	Casing[1]	sw/o Johnson Road	Crossing CCID Main Canal	-	12/24	New	400	$ 557,000	$ 557,000					100%	$ -	$ 557,000	$ -
P-18	Pipe	Chenin Blanc	Stonewood Drive to intersection of Chenin Blank Court	8	18	Replace	1,150	$ 326,000		$ 326,000				100%	$ -	$ -	$ 326,000
P-19	Pipe	Stonewood Drive	Vinewood Drive to future HWY 152 alignment	-	18	New	4,550	$ 1,289,000		$ 773,000	$ 516,000			100%	$ -	$ -	$ 1,289,000
P-20	Pipe	Probable Extension of St Francis Drive	Mercey Springs Rd to Nantes Avenue	-	12	New	5,400	$ 1,122,000		$ 561,000	$ 561,000			100%	$ -	$ 1,122,000	$ -
P-21	Pipe	Mercey Springs Road	St Francis Drive to future HWY 152 alignment, then west to future tank	-	12	New	4,300	$ 894,000			$ 894,000			100%	$ -	$ 894,000	$ -
P-22	Pipe	Future HWY 152 Alignment	Probable extension of Stonewood Drive to Badger Flat Road	-	18	New	10,500	$ 8,616,000			$ 2,154,000		$ 6,462,000	100%	$ -	$ -	$ 8,616,000
P-23	Pipe	Nantes Avenue	Overland Avenue to future HWY 152 Alignment	-	12	New	6,500	$ 1,351,000		$ 1,351,000				100%	$ -	$ 1,351,000	$ -
P-24	Pipe	Johnson Road	H Street to Overland Avenue, then north to future HWY 152 Alignment	-	12	New	9,350	$ 1,942,000		$ 1,068,000	$ 388,000	$ 486,000		100%	$ -	$ 1,942,000	$ -
P-25	Pipe	Capri Avenue	Nantes Avenue to future tank along future HWY 152 alignment	-	12	New	7,300	$ 1,516,000			$ 1,516,000			100%	$ -	$ 1,516,000	$ -
P-26	Pipe	Badger Flat Road	Well 15 to future HWY 152 alignment	-	16	New	5,300	$ 1,468,000	$ 1,468,000					100%	$ -	$ -	$ 1,468,000
P-26A	Casing[1]	Badger Flat Road	Crossing CCID Main Canal	-	16/30	New	400	$ 696,000	$ 696,000					100%	$ -	$ -	$ 696,000
P-27	Pipe	n/o Overland Avenue	Nantes Avenue to Badger Flat Road	-	12	New	6,950	$ 1,445,000		$ 361,250	$ 505,750	$ 578,000		100%	$ -	$ 1,445,000	$ -
P-28	Pipe	St Lucia Avenue	Overland Avenue to Capri Avenue	-	12	New	3,900	$ 810,000			$ 810,000			100%	$ -	$ 810,000	$ -
P-29	Pipe	H Street	Colorado Avenue to future HWY 152 alignment	-	12	New	6,850	$ 1,423,000		$ 853,800	$ 569,200			100%	$ -	$ 1,423,000	$ -
P-29A	Casing[1]	H Street	Crossing Los Banos Creek	-	12/24	New	200	$ 278,000			$ 278,000			100%	$ -	$ 278,000	$ -
P-30	Pipe	w/o Colorado Avenue	H Street to existing system within airport	-	12	New	4,200	$ 872,000	$ 349,000	$ 523,000				100%	$ -	$ 872,000	$ -
P-31	Pipe	Ward Road	Ward Road to Place Road	-	12	New	4,250	$ 883,000		$ 883,000				100%	$ -	$ 883,000	$ -
P-32	Pipe	Ward Road and Railroad ROW	From 5.0 MG Reservoir to Pioneer Road and San Luis Canal	-	16	New	4,800	$ 1,329,000		$ 1,329,000				100%	$ -	$ 1,329,000	$ -
P-33	Pipe	Along San Luis Canal	Existing 16-inch pipe in Creekside Circle and along San Luis Canal	-	18	New	10,550	$ 2,989,000		$ 747,000	$ 2,242,000			100%	$ -	$ -	$ 2,989,000
P-34	Pipe	Pioneer Road	Ward Avenue to Holland Avenue	-	18	New	6,800	$ 1,927,000		$ 1,445,000	$ 482,000			100%	$ -	$ -	$ 1,927,000
P-34A	Casing[1]	Pioneer Road	Crossing CCID Main Canal	-	18/30	New	400	$ 696,000			$ 696,000			100%	$ -	$ -	$ 696,000
P-35	Pipe	Ward Avenue	Pioneer Road to Phillips Road	-	18	New	2,700	$ 764,000			$ 382,000	$ 382,000		100%	$ -	$ 764,000	$ -
P-36	Pipe	Mercey Springs Avenue	Cardoza Road to Pioneer Road	-	12	New	4,450	$ 3,652,000		$ 3,652,000				100%	$ -	$ 3,652,000	$ -
P-37	Pipe	Place Road	Pioneer Road to Phillips Road	-	12	New	3,100	$ 644,000		$ 64,000	$ 290,000	$ 290,000		100%	$ -	$ 644,000	$ -
P-38	Pipe	Mercey Springs Avenue	Pioneer Road to Phillips Road	-	12	New	2,700	$ 562,000			$ 281,000	$ 281,000		100%	$ -	$ 562,000	$ -
P-39	Pipe	Pioneer Road	West of Ortigalita Road to CCID Main Canal	-	18	New	11,200	$ 3,173,000		$ 2,856,000	$ 317,000			100%	$ -	$ -	$ 3,173,000
P-40	Pipe	Center Avenue	Cardoza Road to Phillips Road	-	12	New	5,300	$ 1,101,000		$ 441,000	$ 330,000	$ 330,000		100%	$ -	$ 1,101,000	$ -
P-41	Pipe	Between Ortigalita and Center	Cardoza Road to Phillips Road	-	12	New	5,500	$ 1,142,000		$ 456,000	$ 343,000	$ 343,000		100%	$ -	$ 1,142,000	$ -

Table 7.3 Capital Improvement Projects

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
P-42	Pipe	Future area	Pioneer Road to existing system	-	16	New	1,850	$ 513,000	$ 513,000					100%	$ -	$ -	$ 513,000
P-43	Pipe	Plow Camp Road	Pioneer Road to Phillips Road	-	12	New	2,650	$ 551,000			$ 275,500	$ 275,500		100%	$ -	$ 551,000	$ -
P-44	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	36	New	8,850	$ 5,015,000			$ 5,015,000			100%	$ -	$ -	$ 5,015,000
P-44A	Casing[1]	Future HWY 152 Alignment	Crossing CCID Main Canal	-	36/60	New	400	$ 1,392,000			$ 1,392,000			100%	$ -	$ -	$ 1,392,000
P-44B	Casing[1]	Future HWY 152 Alignment	Crossing CCID Main Canal	-	36/60	New	400	$ 1,392,000			$ 1,392,000			100%	$ -	$ -	$ 1,392,000
P-45	Pipe	Future area	CCID Main Canal to Badger Flat Road	-	12	New	6,000	$ 1,246,000	$ 1,246,000					100%	$ -	$ 1,246,000	$ -
P-45A	Casing[1]	Los Banos Creek	Crossing Los Banos Creek	-	12/24	New	200	$ 278,000	$ 278,000					100%	$ -	$ 278,000	$ -
P-46	Pipe	Pacheco Blvd	West of Badger Flat Road	-	12	New	1,450	$ 301,000		$ 301,000				100%	$ -	$ 301,000	$ -
P-47	Pipe	Future area	Pioneer Road to Stonecreek Blvd	-	12	New	4,500	$ 934,000		$ 327,000			$ 607,000	100%	$ -	$ 934,000	$ -
P-48	Pipe	Future area	Cardoza Road	-	12	New	2,800	$ 582,000		$ 582,000				100%	$ -	$ 582,000	$ -
P-49	Pipe	Pioneer Road	CCID Outside Canal to east of Los Banos Creek	-	36	New	12,050	$ 6,828,000			$ 1,024,200		$ 5,803,800	100%	$ -	$ -	$ 6,828,000
P-49A	Casing[1]	Pioneer Road	Crossing Los Banos Creek	-	36/60	New	200	$ 696,000					$ 696,000	100%	$ -	$ -	$ 696,000
P-50	Pipe	Canyon Road	Pioneer Road to future HWY 152 alignment	-	12	New	11,450	$ 2,379,000		$ 476,000	$ 1,903,000			100%	$ -	$ 2,379,000	$ -
P-50A	Casing[1]	Pacheco Blvd	HWY 152 Crossing	-	12/24	New	400	$ 557,000		$ 557,000				100%	$ -	$ 557,000	$ -
P-51	Pipe	Future area	Los Banos Creek to study area boundary	-	12	New	12,350	$ 2,566,000				$ 2,566,000		100%	$ -	$ 2,566,000	$ -
P-52	Pipe	Future area	Parallel to Los Banos Creek	-	12	New	11,000	$ 2,285,000		$ 229,000	$ 1,714,000	$ 342,000		100%	$ -	$ 2,285,000	$ -
P-52A	Casing[1]	Near Los Banos Creek	HWY 152 Crossing	-	12/24	New	300	$ 418,000		$ 418,000				100%	$ -	$ 418,000	$ -
P-53	Pipe	Future area	Near Los Banos Creek	-	12	New	4,250	$ 883,000		$ 883,000				100%	$ -	$ 883,000	$ -
P-54	Pipe	Parallel to HWY 152	Los Banos Creek to Volta Road	-	12	New	10,000	$ 2,078,000			$ 831,000	$ 623,000	$ 624,000	100%	$ -	$ 2,078,000	$ -
P-55	Pipe	Future area	Pioneer Road to s/o Pacheco Blvd	-	12	New	4,600	$ 956,000			$ 956,000			100%	$ -	$ 956,000	$ -
P-56	Pipe	Ortigalita Road	Sandra Street to Phillips Road	-	12	New	4,150	$ 863,000		$ 287,000	$ 288,000	$ 288,000		100%	$ -	$ 863,000	$ -
P-57	Pipe	Future area	HWY 152 to future HWY 152 alignment	-	36	New	12,200	$ 6,912,000		$ 3,456,000	$ 3,456,000			100%	$ -	$ -	$ 6,912,000
P-58	Pipe	Future area	North of HWY 152	-	16	New	11,900	$ 3,296,000				$ 2,307,000	$ 989,000	100%	$ -	$ 3,296,000	$ -
P-59	Pipe	Volta Road	Future area to future storage tank	-	16	New	1,350	$ 374,000				$ 374,000		100%	$ -	$ 374,000	$ -
P-60	Pipe	Between Volta and Ramos	Crosses HWY 152	-	16	New	2,500	$ 693,000				$ 693,000		100%	$ -	$ 693,000	$ -
P-60A	Casing[1]	e/o Volta Road	HWY 152 Crossing	-	16/30	New	400	$ 696,000				$ 696,000		100%	$ -	$ 696,000	$ -
P-61	Pipe	Study Area Boundary, Volta Road	Parallel to Outside Canal to HWY 152 alignment	-	36	New	7,450	$ 4,221,000					$ 4,221,000	100%	$ -	$ -	$ 4,221,000
P-62	Pipe	Along CCID Main Canal, Middle Road	Pioneer Road to Holland Avenue	-	12	New	3,950	$ 821,000			$ 328,000	$ 493,000		100%	$ -	$ 821,000	$ -
P-63	Pipe	Phillips Road	Mercey Springs Avenue to Place Road	-	12	New	4,000	$ 831,000				$ 831,000		100%	$ -	$ 831,000	$ -
P-64	Pipe	Study Area Boundary	Future area parallel to n\o Phillips Road	-	18	New	2,200	$ 624,000			$ 312,000	$ 312,000		100%	$ -	$ 624,000	$ -
P-65	Pipe	Probable extension of Middle Road	Holland Avenue to Ortigalita Road, then continues west to Madera Road	-	12	New	13,000	$ 2,700,000				$ 2,700,000		100%	$ -	$ 2,700,000	$ -
P-66	Pipe	Future area	HWY 152 to Los Banos Creek	-	12	New	5,300	$ 1,101,000		$ 1,101,000				100%	$ -	$ 1,101,000	$ -
P-68	Pipe	Volta Road	Future area to study area boundary	-	12	New	2,000	$ 415,000					$ 415,000	100%	$ -	$ 415,000	$ -
P-69	Pipe	Study Area Boundary	Volta Road to CCID Main Canal	-	12	New	7,650	$ 1,590,000					$ 1,590,000	100%	$ -	$ 1,590,000	$ -
P-70	Pipe	Ramos Road	Future area to study area boundary	-	12	New	3,650	$ 758,000				$ 341,000	$ 417,000	100%	$ -	$ 758,000	$ -
P-71	Pipe	Future area	Future HWY 152 alignment to study area boundary	-	12	New	3,200	$ 665,000					$ 665,000	100%	$ -	$ 665,000	$ -
Storage Tanks and Booster Pumps																	
T-3	Storage Tank	Pioneer Road	e/o Ortigalita Road	-	2 MG	New		$ 4,212,000	$ 4,212,000					100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000	$ 480,000					100%	$ -	$ -	$ 480,000
T-4	Storage Tank	Future HWY 152 Alignment	Near intersection with Badger Flat Road	-	2 MG	New		$ 4,212,000		$ 4,212,000				100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000		$ 480,000				100%	$ -	$ -	$ 480,000
T-5	Storage Tank	Place Road	Near intersection with Wimbledon Court	-	2 MG	New		$ 4,212,000			$ 4,212,000			100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000			$ 480,000			100%	$ -	$ -	$ 480,000
T-6	Storage Tank	Future HWY 152 Alignment	w/o Mercey Springs Avenue	-	2 MG	New		$ 4,212,000				$ 4,212,000		100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000				$ 480,000		100%	$ -	$ -	$ 480,000
T-7	Storage Tank	Pioneer Road	Near intersection with Holland Avenue	-	2 MG	New		$ 4,212,000					$ 4,212,000	100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000					$ 480,000	100%	$ -	$ -	$ 480,000
T-8	Storage Tank	Future HWY 152 Alignment	Near intersection with Volta Road	-	2 MG	New		$ 4,212,000					$ 4,212,000	100%	$ -	$ -	$ 4,212,000
	Land Acquisition			-	2 acres	New		$ 480,000					$ 480,000	100%	$ -	$ -	$ 480,000
Groundwater Wells																	
W-17	Supply Well[4]	Future HWY 152 Alignment	Near CCID Main Canal	-	1,400 gpm	New		$ 1,560,000	$ 1,560,000					100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000	$ 60,000					100%	$ -	$ -	$ 60,000
W-18	Supply Well[4]	Future HWY 152 Alignment	Near intersection with Badger Flat Road	-	1,400 gpm	New		$ 1,560,000	$ 1,560,000					100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000	$ 60,000					100%	$ -	$ -	$ 60,000
W-19	Supply Well[4]	Future HWY 152 Alignment	Near CCID Canal and Ramos Road	-	1,400 gpm	New		$ 1,560,000		$ 1,560,000				100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000		$ 60,000				100%	$ -	$ -	$ 60,000
W-20	Supply Well[4]	s/o Pacheco Blvd	Near HWY 152 and Canyon Road	-	1,400 gpm	New		$ 1,560,000		$ 1,560,000				100%	$ -	$ -	$ 1,560,000

Table 7.3 Capital Improvement Projects

Water Distribution System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-2015 ($)	Phase 2 2016-2020 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
	Land Acquisition				0.25 acres	New		$ 60,000		$ 60,000				100%	$ -	$ -	$ 60,000
W-21	Supply Well[4]	Pioneer Road	Near Canyon Road and Los Banos Creek	-	1,400 gpm	New		$ 1,560,000			$ 1,560,000			100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000			$ 60,000			100%	$ -	$ -	$ 60,000
W-22	Supply Well[4]	Pioneer Road	Near Canyon Road	-	1,400 gpm	New		$ 1,560,000			$ 1,560,000			100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000			$ 60,000			100%	$ -	$ -	$ 60,000
W-23	Supply Well[4]	Pioneer Road	Near intersection with Holland Avenue	-	1,400 gpm	New		$ 1,560,000				$ 1,560,000		100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000				$ 60,000		100%	$ -	$ -	$ 60,000
W-24	Supply Well[4]	n/o Future HWY 152 Alignment	Near intersection with Volta Road	-	1,400 gpm	New		$ 1,560,000					$ 1,560,000	100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ -	$ 60,000
W-25	Supply Well[4]	w/o Volta Road	Near future connection to SWTP	-	1,400 gpm	New		$ 1,560,000					$ 1,560,000	100%	$ -	$ -	$ 1,560,000
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ -	$ 60,000
Well Manifold System																	
M-1	Pipe	Future Area	Along west side of study area boundary to future groundwater well	-	20	New	8,190	$ 2,579,000			$ 2,579,000			70%	$ 773,700	$ -	$ 1,805,300
M-2	Pipe	Future Area	Future groundwater well to future HWY 152 alignment	-	18	New	4,880	$ 1,382,000			$ 1,382,000			70%	$ 414,600	$ -	$ 967,400
M-3	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	16	New	4,520	$ 1,253,000			$ 1,253,000			70%	$ 375,900	$ -	$ 877,100
M-3A	Casing[1]	CCID Main Canal Crossing		-	16/30	New	400	$ 696,000			$ 696,000			70%	$ 208,800	$ -	$ 487,200
M-4	Pipe	Future HWY 152 Alignment	Badger Flat Road to future area	-	12	New	5,260	$ 1,094,000			$ 1,094,000			70%	$ 328,200	$ -	$ 765,800
M-4A	Casing[1]	Los Banos Creek Crossing		-	12/24	New	400	$ 557,000			$ 557,000			70%	$ 167,100	$ -	$ 389,900
M-5	Pipe	Study Area Boundary	Parallel to Outside Canal	-	24	New	4,460	$ 1,685,000			$ 1,685,000			70%	$ 505,500	$ -	$ 1,179,500
M-6	Pipe	Study Area Boundary	Parallel to Outside Canal and Pioneer Road	-	20	New	5,510	$ 1,735,000			$ 1,735,000			70%	$ 520,500	$ -	$ 1,214,500
M-7	Pipe	Pioneer Road		-	18	New	4,260	$ 1,207,000			$ 1,207,000			70%	$ 362,100	$ -	$ 844,900
M-8	Pipe	Pioneer Road		-	16	New	5,450	$ 1,510,000			$ 1,510,000			70%	$ 453,000	$ -	$ 1,057,000
M-8A	Casing[1]	Los Banos Creek Crossing			16/30	New	400	$ 696,000			$ 696,000			70%	$ 208,800	$ -	$ 487,200
M-9	Pipe	Pioneer Road	West of Ortigalita Road	-	12	New	5,080	$ 1,056,000				$ 1,056,000		70%	$ 316,800	$ -	$ 739,200
Surface Water Treatment Plant																	
SWTP	SWTP	Pacheco Blvd	West of the City limits	-	20 MGD	New		$ 140,400,000		$ 7,020,000	$ 133,380,000			70%	$ 42,120,000	$ -	$ 98,280,000
	Land Acquisition				10 acres	New		$ 2,400,000			$ 2,400,000			70%	$ 720,000	$ -	$ 1,680,000
SWTP	SWTP Expansion	Pacheco Blvd	West of the City limits	-	2 MGD	New		$ 14,040,000					$ 14,040,000	70%	$ 4,212,000	$ -	$ 9,828,000
SWTP	SWTP Expansion	Pacheco Blvd	West of the City limits	-	4 MGD	New		$ 28,080,000					$ 28,080,000	70%	$ 8,424,000	$ -	$ 19,656,000
SWTP-1	Transmission Line	Pacheco Blvd	CA Aqueduct to future transmission main	-	42	New	11,000	$ 7,271,000		$ 364,000	$ 6,907,000			70%	$ 2,181,000	$ -	$ 5,090,000
SWTP-2	Casing[1]	Pacheco Blvd	Crossing CCID Outside Canal	-	42/72	New	350	$ 1,462,000		$ 73,000	$ 1,389,000			70%	$ 439,000	$ -	$ 1,023,000
SWTP-3	Casing[1]	Pacheco Blvd	Crossing Delta Mendota Canal	-	42/72	New	400	$ 1,671,000		$ 84,000	$ 1,587,000			70%	$ 501,000	$ -	$ 1,170,000
SWTP-4	Casing[1]	Pacheco Blvd	Crossing California Aqueduct	-	42/72	New	500	$ 2,087,000		$ 104,000	$ 1,983,000			70%	$ 626,000	$ -	$ 1,461,000
SWTP-5	Casing[1]	Pacheco Blvd	Crossing HWY 152	-	42/72	New	400	$ 1,671,000		$ 84,000	$ 1,587,000			70%	$ 501,000	$ -	$ 1,170,000
							Future Improvements Subtotal	**$ 360,263,000**	**$ 13,376,000**	**$ 42,753,050**	**$ 204,000,650**	**$ 22,899,500**	**$ 77,233,800**		**$ 64,359,000**	**$ 54,850,000**	**$ 241,054,000**
							CIP Total (Existing and Future)	**$ 374,219,000**	**$ 16,832,000**	**$ 46,282,550**	**$ 207,247,150**	**$ 23,981,500**	**$ 79,875,800**		**$ 78,315,000**	**$ 54,850,000**	**$ 241,054,000**

Notes:

1. Proposed casings size and carrier pipe size.
2. Baseline Construction Cost plus 20% to account for unforeseen events and unknown conditions.
3. Estimated Construction Cost plus 30% to cover other costs including Engineering, Construction Management, and Program Implementation.
4. Final location of future groundwater wells and storage tanks to be determined.
5. Land acquisition costs were included for the storage tank/booster pumps, wells, and surface water treatment plant, but were not included for the pipelines, since these will be located in public right of way.
6. Costs are based on the Engingeering News Record Construction Cost Index 20-city average of 8592.

Table 7.4 Existing Versus Future User Cost Share
Water Distribution System Master Plan
City of Los Banos

Reimbursement Category	Implementation Phase					Total ($, mill.)
	2010-2015 ($, mill.)	2016-2020 ($, mill.)	2021-2025 ($, mill.)	2026-2030 ($, mill.)	2031 + ($, mill.)	
Existing Improvement[2]	3.46	5.85	52.33	1.40	15.28	**78.32**
Future Developer Improvement[3]	2.77	17.49	13.76	15.53	5.31	**54.85**
Future Regional Improvement[4]	10.61	22.95	141.16	7.05	59.29	**241.05**
Total	**16.83**	**46.28**	**207.25**	**23.98**	**79.88**	**374.22**

Notes:
1. All costs are in November 2009 dollars. ENR CCI 20 City average = 8592
2. Projects are funded through user rates.
3. Projects are developer funded and/or may be part of a development reimbursement agreement.
4. Projects funded through water development impact fees collected by the City.

APPENDIX A - LAND USE DESCRIPTIONS

City of Los Banos

2030 General Plan Update

Approved July 15, 2009

The Downtown District is located between the Union Pacific rail corridor and Pacheco Boulevard; it is surrounded by older residential neighborhoods, commercial uses, schools, and parks. The major commercial land uses are located along two State routes. Some industrial land is located in close proximity to the Union Pacific Railroad and Los Banos Municipal Airport. Parks of various sizes are distributed throughout the city, often in close proximity to schools.

3.2 GENERAL PLAN DIAGRAM

The land use framework of the General Plan is illustrated in the General Plan Diagram (Figure 3-2). It designates the proposed general location, distribution, and extent of land uses through buildout. As required by State law, land use classifications—shown as color/graphic patterns, letter designations, or labels on the diagram—specify a range for housing density and building intensity for each type of designated land use. These density/intensity standards allow future street improvements and public facility needs to be determined.

The Diagram is to be used and interpreted only in conjunction with the text and other figures contained in the General Plan. The legend of the General Plan Diagram includes the land use classifications described below. The Diagram is not parcel-specific, and uses on sites less than one acre in size are generally not depicted.

LAND USE FRAMEWORK

The General Plan Diagram illustrates the following ideas:

- Clearly Defined Urban Edges. As depicted on the General Plan Diagram, all development is planned to occur within the Urban Growth Boundary.
- Economic Development and Jobs. A significant amount of land is set aside for job-related land uses. Areas designated "Office and Professional", "Employment Park", and "Industrial" accommodate uses that will provide employment opportunities for existing and future residents.
- Integrated Neighborhoods and Neighborhood Centers. The General Plan Diagram depicts a *network* of neighborhoods; they are all walkable and include community facilities such as parks and schools, and have a central focal point. The diagrams show how these neighborhoods are related to each other and to neighborhood centers and shopping areas.
- A Mix of Housing Types. Three types of residential density ranges are depicted on the Diagram. These will accommodate a full range of housing types and prices to provide housing choice.
- Enhanced Community Character and Aesthetics. The physical character of Los Banos will be enhanced through compact design, pedestrian-oriented circulation, neighborhood-centered activities, and environmental sensitivity. The arrangements of land uses on the General Plan Diagram create a framework within which quality community design is possible.
- Parks. A system of neighborhood and County parks and trails are depicted on the General Plan Diagram. Medium and High Density residential uses are often situated adjacent to these parks, which will provide amenities to nearby residents.

- A Network of Open Space. All of the Parks and Open Space uses are linked by a system of parkways, bikeways, and roadways.
- A Range of Commercial and Retail Opportunities. The General Plan provides for the full range of commercial and retail uses needed for the future population and business community. Regionally-oriented establishments are placed on major roadway corridors; community- and neighborhood-oriented uses are placed within planned communities and neighborhoods.
- Adequate, Flexible School Sites. New school sites are proposed to accommodate future students. The sites depicted on the General Plan Diagram are intended to relate well to adjacent uses, such as neighborhood focal areas and park sites. It should be noted that school site locations can be adjusted if the School District chooses not to locate in those areas and the land will be designated as its surrounding uses.

DENSITY/INTENSITY STANDARDS

The General Plan establishes density/intensity standards for each use classification. Residential density is expressed as housing units per gross acre (including public streets and other rights-of-way). Maximum permitted ratio of gross floor area to site area, called Floor Area Ratio (FAR), is specified for non-residential uses. FAR is a broad measure of building bulk that controls both visual prominence and traffic generation. It can be clearly translated to a limit on building bulk in the Zoning Ordinance and is independent of the type of use occupying the building.

Density (housing units per acre) and intensity (FAR) standards are for gross developable land (that is, including proposed streets and other rights-of-way), but excluding areas subject to physical or environmental constraints, which include ridgelines and steep hillside slopes, creek corridors and floodways, and areas to be dedicated for greenways or habitat protection. The density/intensity standards do not imply that development projects will be approved at the maximum density or intensity specified for each use. Zoning regulations consistent with General Plan policies and/or site conditions may reduce development potential within the stated ranges.

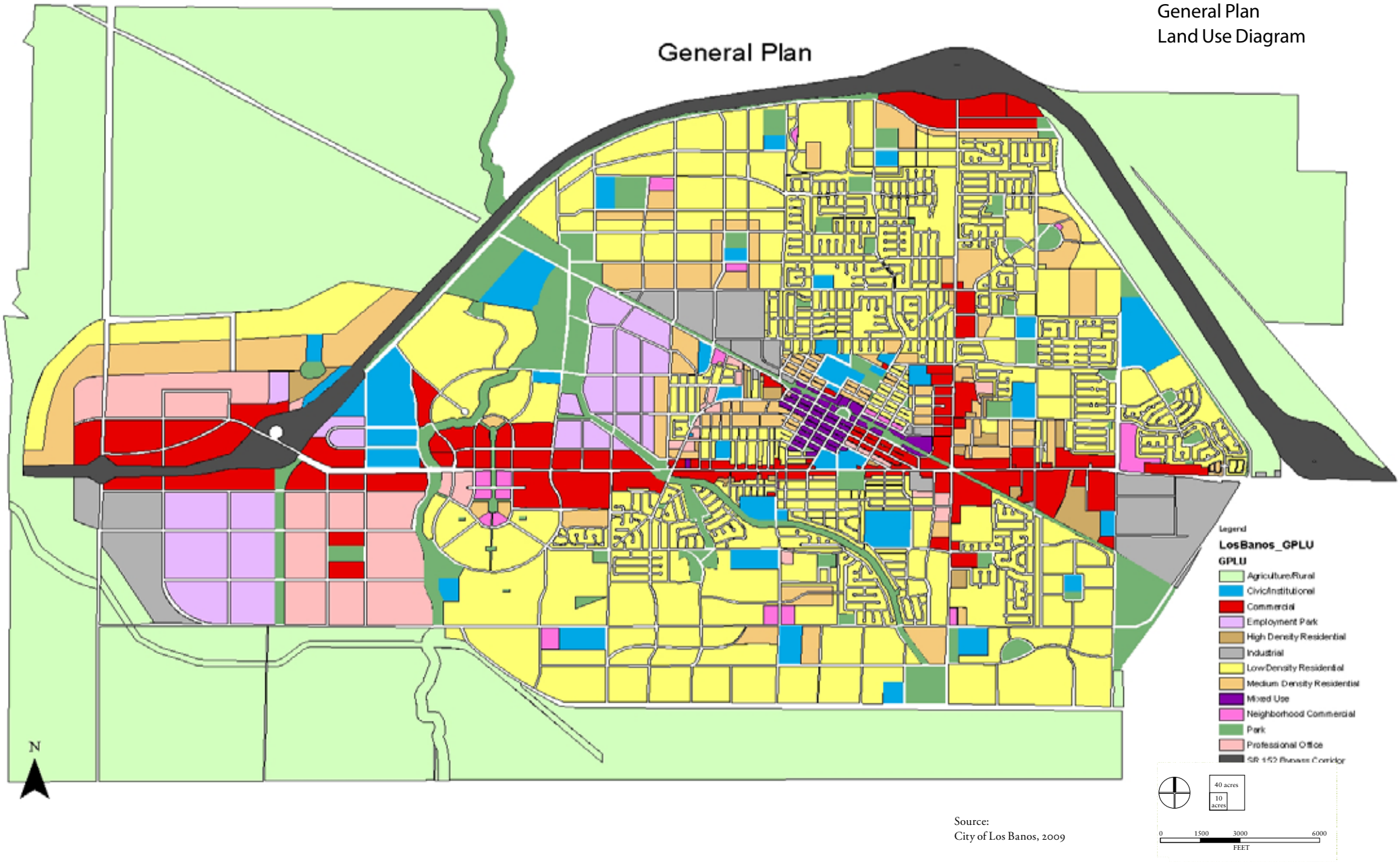
The Zoning Ordinance will provide specific exceptions to the FAR limitations for uses with low employment densities, such as research facilities, or uses with low peak-hour traffic generation, such as a hotel or hospital. Intensity standards for non-residential and mixed-use development are for each entire development site; that is, intensities on individual parcels may exceed the maximum, provided each overall development project does not exceed the stipulated intensity.

LAND USE CLASSIFICATIONS

The following descriptions apply to land uses indicated on the General Plan Land Use Diagram. Land use classifications are organized into the following categories: Residential, Mixed Use, Commercial, Office/Industrial and Public/Open Space. These land use classifications are meant to be broad enough to give the City flexibility in implementing policy, but clear enough to provide sufficient direction to carry out the General Plan. The City's Zoning Ordinance will contain more detailed provisions and standards. More than one zoning district may be consistent with a single General Plan land use classification.

Figure 3-2

General Plan
Land Use Diagram



Source:
City of Los Banos, 2009

Residential

Low Density Residential. This designation is intended for single-family development on lot sizes found in more urban settings. Development intensities range from 2 to 6 units per net acre, and an average density of 4 units per net acre is used for buildout projections.

Medium Density Residential. This designation is intended for small-lot single family low density apartment complexes and multiple-unit homes with typical lot sizes ranging from 2,000 to 5,000 square feet. Allowable residential density is between 7 and 18 units per net acre. The high range of this density is achievable with supportive development regulations and does not necessarily require multi-family development. An average density of 12 units per acre is used for buildout projections.

High Density Residential. This designation is intended for multi-family apartments and condominium development. Residential densities ranging from 12 to 30 units per net acre, with an average density of 20 units per acre used for buildout projections.

Mixed Use

Downtown Mixed Use. This designation is intended for mixed-use development, located downtown, allowing for a mixture of commercial, office, institutional, public/semi public, and residential uses. Maximum FAR for non-residential uses are 0.25 for retail, and 2.0 for office use, with a maximum of 18 dwelling units per acre. For buildout projections, an average density of 12 residential units per net acre and a non-residential FAR of 1.0 are used.

Rail Trail Corridor. This designation is intended for pedistrian oriented mixed use development located on the rail trail corridor allowing for a mixture of commercial, office, instirutional, public/semi-public and residential uses.

Neighborhood Commercial. This designation is intended for a mix of neighborhood-scale commercial use that includes small-scale office space and small retail stores, including grocery stores that serve local neighborhoods. The FAR range for this use is between 0.25 and 0.6, with a typical buildout value of 0.3.

Commercial/Office/Industrial

Commercial. This designation is intended for large-scale commercial developments that serve both residents, visitors, and the surrounding region. Examples of this land use include: shopping centers, large-format retail, auto sales and travel-related services such as hotels, gas stations, and restaurants. These uses typically require excellent access to freeway interchanges. The FAR ranges from 0.25 to 0.60 with a typical value of 0.25 used for buildout estimates.

Office/Professional. This designation is intended for small-scale offices and campus-like office complex development, including professional and medical offices, and research and development (R&D) activities. This designation may also allow small restaurants, support services, and convenience retail activities. The FAR range for Office/Professional use is 0.25 to 0.60, with a typical FAR for build-out estimates of 0.30.

Employment Park. This designation is intended for a mix of light industrial, research and development (R&D)/high technology, office, commercial, and service uses. Typical uses might include office space and R&D/light industrial with limited customer access and support commercial services. Uses in this category are expected to have elements of architectural and landscape design. The FAR ranges from 0.25 to 0.50, with a typical value of 0.35 for buildout estimates.

Industrial. This designation allows primary manufacturing, R&D, wholesale and warehouse distribution, agricultural sales and services, and similar activities including those with outdoor facilities. It also accommodates warehousing and distribution, with support commercial services and ancillary office space. No large-scale retail uses are allowed to minimize land-use conflicts and provide support for commercial areas. The FAR range for Industrial use is 0.25 to 0.35, and the typical FAR for build-out estimates is 0.30.

The density and intensity (FAR) standards used in the General Plan are shown in Table 3-2.

3–2: General Plan Land Use Density Assumptions

	Density (units/net acre)			Floor Area Ratio (FAR)		
Land Use Classification	Min	Typical	Max	Min	Typical	Max
Agricultural/Rural		0.05	0.1[1]	0.01	0.01	0.05
Environmental Conservation						0.01
Special Use Park						0.05
Civic/Institutional						
Low Density Residential	2.0	4.0	6.0			
Medium Density Residential	7.0	12.0	18.0			
High Density Residential	12.0	20.0	30.0			
Downtown Mixed Use	-	12.0	18.0	0.50[2]	1.00	2.00
Neighborhood Commercial				0.25	0.30	0.60
Commercial				0.25	0.25	0.60
Office/Professional				0.25	0.30	0.60
Employment Park				0.25	0.35	0.50
Industrial				0.25	0.30	0.35

[1] 0.4 for cluster rural residential within proposed SOI.

[2] 0.25 for retail

Other

Grasslands Ecological Area. Land within this designation is considered an important resource that needs protection from urban development; it includes the Los Banos Wildlife Area.

Agriculture/Rural. This designation is generally intended for rural and agricultural land uses without municipal services. The typical development allows for large parcels with housing and agricultural related service buildings and uses an average density of 0.1 units per acre for buildout projections. Where applied to land within the SOI adjacent to residential development, clustered, very low density "executive" housing in a rural setting is allowed at an average density of 0.4 units per acre.

Parks. Public and private recreation sites and facilities at intensities of up to 0.05 FAR.

Civic/Institutional. This designation is intended for lands owned by public entities, including schools, administrative offices, corporation yards, and public facilities, including recycling centers, sewage treatment ponds, police and fire stations.

GENERAL PLAN BUILDOUT

Full development under the General Plan is referred to as "buildout". When buildout will actually occur is not specified in or anticipated by the Plan, and designation of a site for a certain use does not necessarily mean that the site will be built/redeveloped with the time horizon of the Plan. Furthermore the airport zoning may prevent full buildout if the airport remains in its current location.

Table 3-3 shows the buildout acreage of the General Plan Diagram. Most areas that are planned for new development are residential in use, totaling about 4,270 acres.

3–3: Development Under the General Plan (Acres)

Land Use	Total Buildout	Percent of Total
Residential	4,270	25
Low Density Residential	3,670	21
Medium Density Residential	590	3
High Density Residential	10	<1
Mixed Use	180	1
Mixed Use	10	<1
Neighborhood Commercial	170	1
Commercial/Office Professional	2,610	15
Commercial	760	4
Office Professional	520	3
Employment Park	820	5
Industrial	510	3
Others	10,370	60
Agriculture/Rural	7,820	45
Parks, Trails & Open Space	1,320	8
Civic/Institutional	490	3
SR-152 Bypass	750	4
Total	17,420	100.0

3.3 PATTERN OF DEVELOPMENT, GROWTH AND EXPANSION

The General Plan Diagram reflects the community's desire to preserve and protect agricultural lands and retain the City's small-town character. The policies presented in this section are intended to help Los Banos achieve growth in a sustainable manner. Specifically, a focused development pattern can be achieved through measures that control growth, manage infrastructure and services, and establish performance standards for different land uses.

GUIDING POLICIES

LU-G-1 Promote a sustainable, balanced land use pattern that satisfies existing needs and safeguards future needs of the City.

LU-G-2 Maintain a well-defined compact urban form, with a defined urban growth boundary and development intensities on land designated for urban uses.

LU-G-3 Ensure that new development provides for infrastructure, schools, parks, neighborhoods shops, and community facilities in close proximity to residents.

IMPLEMENTING ACTIONS

Growth Management

LU-I-1 Delineate an Urban Growth Boundary in the General Plan Land Use Diagram that is an area within which urban development will occur.