CITY OF LINDSAY
WATER FEASIBILITY STUDY

DRAFT FINAL REPORT

OCTOBER 2013

Prepared for:

City of Lindsay

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Fresno, California

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ABBREVIATIONS

ADD.....average day demand
AFY .....acre-feet per year
AWWA.....American Water Works Association
CDPH.....California Department of Public Health
CIP .....capital improvement project
City.....City of Lindsay
cfs.....cubic feet per second
County.....County of Tulare
DOF.....Department of Finance
DU .....dwelling unit
GIS .....geographic information system
fps .....feet per second
gpda .....gallons per day per acre
gpcd .....gallons per capita per day
gpm .....gallons per minute
LAFCo .....Local Agency Formation Commission
MDD .....maximum day demand
MG .....million gallons
mgd .....million gallons per day
PHD.....peak hour demand
ROW .....right-of-way
SBx7-7 .....Senate Bill x7-7 (Water Conservation Act of 2009)
SOI .....Sphere of Influence
USBR .....United States Bureau of Reclamation
UPC.....Uniform Plumbing Code

EXECUTIVE SUMMARY

The City of Lindsay has a recognized water supply shortage. The City initiated this Water Feasibility Study to more fully understand the extents of the situation and explore the alternatives and scheduling of improvements to mitigate the shortage.

The evaluation of the City's water system included a review of the water supplies and demands, the surface water treatment facility, the distribution system and storage systems for existing and future (through 2030) system characteristics.

Water System Demand

The historic supply and demand numbers were taken from City records and used to determine the average water use and future demand projections for the City. The average water use was evaluated using a 10-year baseline calculation and by using the existing (2012) demands (status quo). The future demands were calculated in two manners, both using one-percent annual population growth. One used the 2012 water use (status quo) and the other used a 20 percent reduction of the 10-year calculated baseline.

Water System Supply

The City's water is supplied from both surface and groundwater sources. Evaluation of the water supply looked at the total quantity of water available during the winter months, when surface water supplies are not available, and during the summer months when surface water is usually available as well as a 'firm' groundwater supply, which assumed unavailability of the largest producing well to account for the potential of that well being temporarily offline.

Surface Water Treatment Facility

The Surface Water Treatment Facility (SWTF) provides water to the City primarily during the summer months. The SWTF's current operations were reviewed and deficiencies noted. Recommendations for potential short- and long-term solutions were described and vetted.

Distribution System

The water distribution system was evaluated using a computer model to simulate operation of the system. The water model helped to identify areas with substandard operating pressures under high-flow conditions. These deficiencies are due primarily to undersized mains or too few points of interconnection. Based on this data, recommendations for water main improvements were listed and described.

Storage System

The storage components of the water system provides redundancy, peak demand supply and fire flow for the City. Evaluation of the storage components revealed the water system has sufficient available storage volume and will not require improvement within the horizon of this study.

Recommendations

Based on the evaluations discussed above, this study recommends new supply sources in 2014, 2019 and either 2024 or 2025 (depending on the demand scenario); the new supply source could be provided through new or rehabilitated well or additional raw surface water storage to allow utilization of the SWTF for a longer period each year. Additionally, several capital improvement projects were identified based on information in the City's budget plan and as identified through the water model analysis.

1 BACKGROUND

This section presents the objectives for this Feasibility Study in addition to a list of abbreviations, reference materials and acknowledgements to assist the reader in understanding the content presented.

1.1 Objectives

The primary objectives of the water feasibility study is to provide a thorough review of current and projected water demand and supply, and the capacity of the existing water supply and distribution system to meet future needs.

The study includes recommendations to effectively manage the City of Lindsay's water supply, treatment, distribution, and demand in order to secure and maintain a sustainable system through the year 2030.

1.2 Report Organization

The feasibility study is organized into three overall sections.

Section 1 – Background This section presents the objectives and planning horizon for this Feasibility Study in addition to a list of reference materials to assist the reader in understanding the content presented.

Section 2 – City of Lindsay Characteristics This section presents a description of the study area, zoning classifications and details the historical and projected population.

Section 3 – Water System This section is divided into six primary subsections including demand, supply, treatment system, distribution system, storage system and capital improvement projects. The subsections include information on the following:

- Demand and Supply Subsections present discussions on the historic and projected demand and supply capacity and anticipated improvements needed to meet the future demands;
- Treatment System Subsection evaluates the surface water treatment plant and future improvements that will be necessary to maximize the use of surface water;
- Distribution System Subsection presents details on the assumptions utilized to build the system's water model, details of the water model and evaluation of the distribution system based on model outcomes;
- Storage System Subsection discusses the current and future storage requirements for the system to run optimally; and
- Capital Improvement Projects Subsection presents a list of necessary capital improvement projects based on the discussions presented in the previous subsections. This subsection also discusses prioritization of capital improvement projects and timing based needs of the community and water system.

1.3 Reference Material

The following documents were referenced in the preparation of this feasibility study:

- City of Lindsay General Plan, 1989, Grunwald & Associates
- Supplemental Water Supply Feasibility Study, 1991, Charles Roberts Engineers
- Water and Sewer Master Plan, 1992, Metcalf & Eddy
- Water Supply and Storage Requirements Update, 1998, Carollo Engineers
- Water Supply and Storage Capacity Requirements, 2013, Akel Engineering Group, Inc.

2 CITY OF LINDSAY CHARACTERISTICS

This section presents a description of the Study Area, City land use and zoning classifications, and details the historical and projected population.

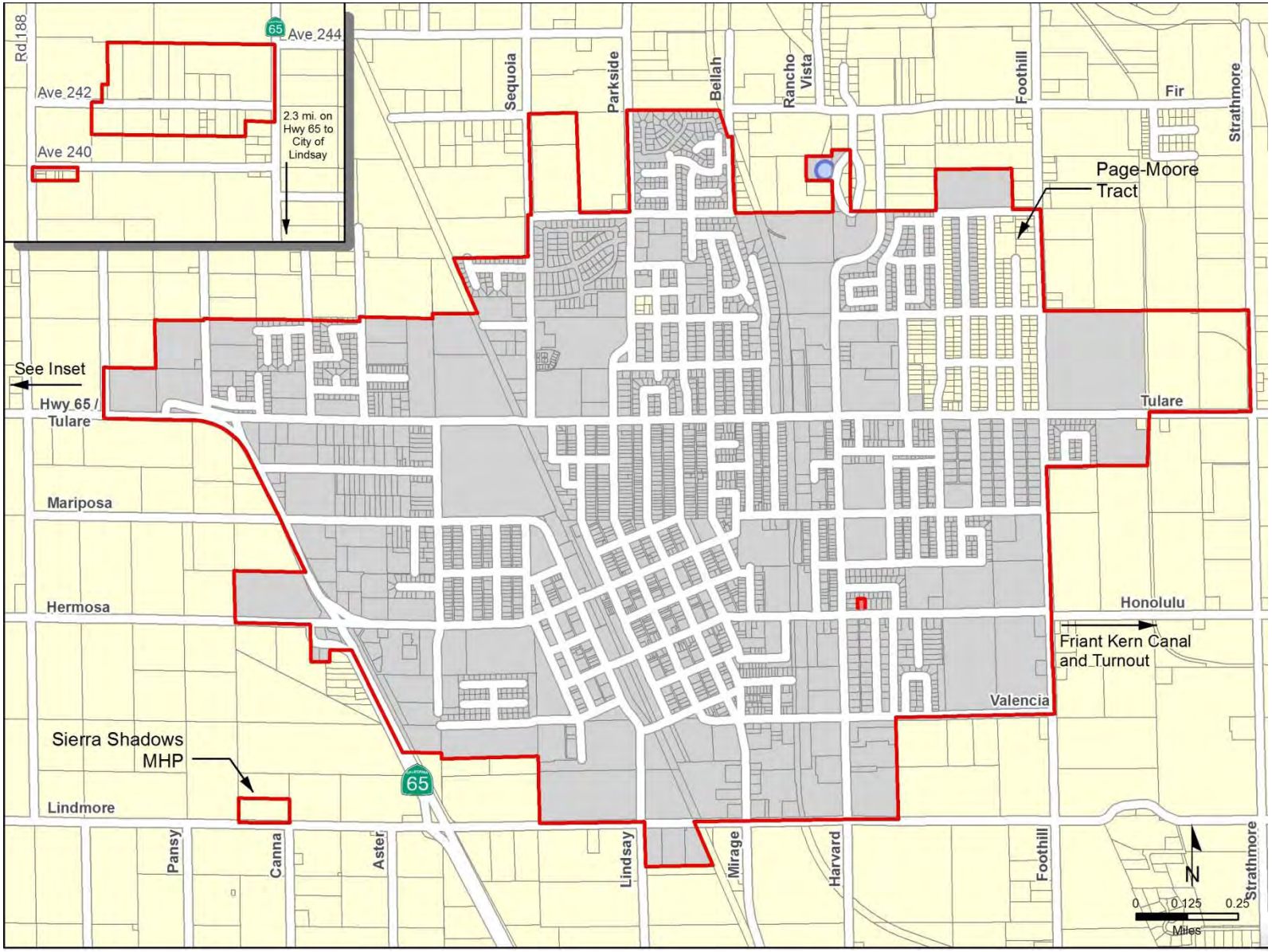
2.1 Study Area

The City of Lindsay is located in Tulare County, near the base of the Sierra Nevada Mountains in the San Joaquin Valley. The Study Area encompasses the area within the city limits, two developments outside the City limits that receive City water service, known locally as Page-Moore Tract and Sierra Shadows Mobile Home Park and an area west of the City near the intersection of Road 188 and Avenue 242 ("Western Extension"). The City encompasses approximately 1,722 acres and is home to nearly 13,000 residents, with an average 3.87[1] people per household; the service areas outside the City limits contribute over 800 additional residents. This additional population has been considered for this Study.

The Study Area is delineated in Figure 2-1 by the red border; the gray areas are within the City limits, while the pale yellow area is County of Tulare. The county 'island' in the northeast portion of the study area is the area referred to above as Page-Moore Tract. Sierra Shadows Mobile Home Park is in the southwest portion of the Study Area and is not contiguous to the City limits; it is located on the north side of West Lindmore Street near Canna Avenue, approximately 0.5 miles west of the City limits. The "Western Extension" area is shown as an inset in the map due to its distance from the City of approximately 2.3 miles.

[1] 2010 Census

Figure 2-1: Study Area



2.2 Land Use

The City's predominant land use is residential. There are industrial use areas along the railroad right-of-way and commercial use areas both within the downtown and near the State Route 65 alignment. Of the 1,722 acres within the Study Area, three-quarters are developed, leaving 428 acres of undeveloped area comprised of a variety of land uses including residential, mixed use and commercial.

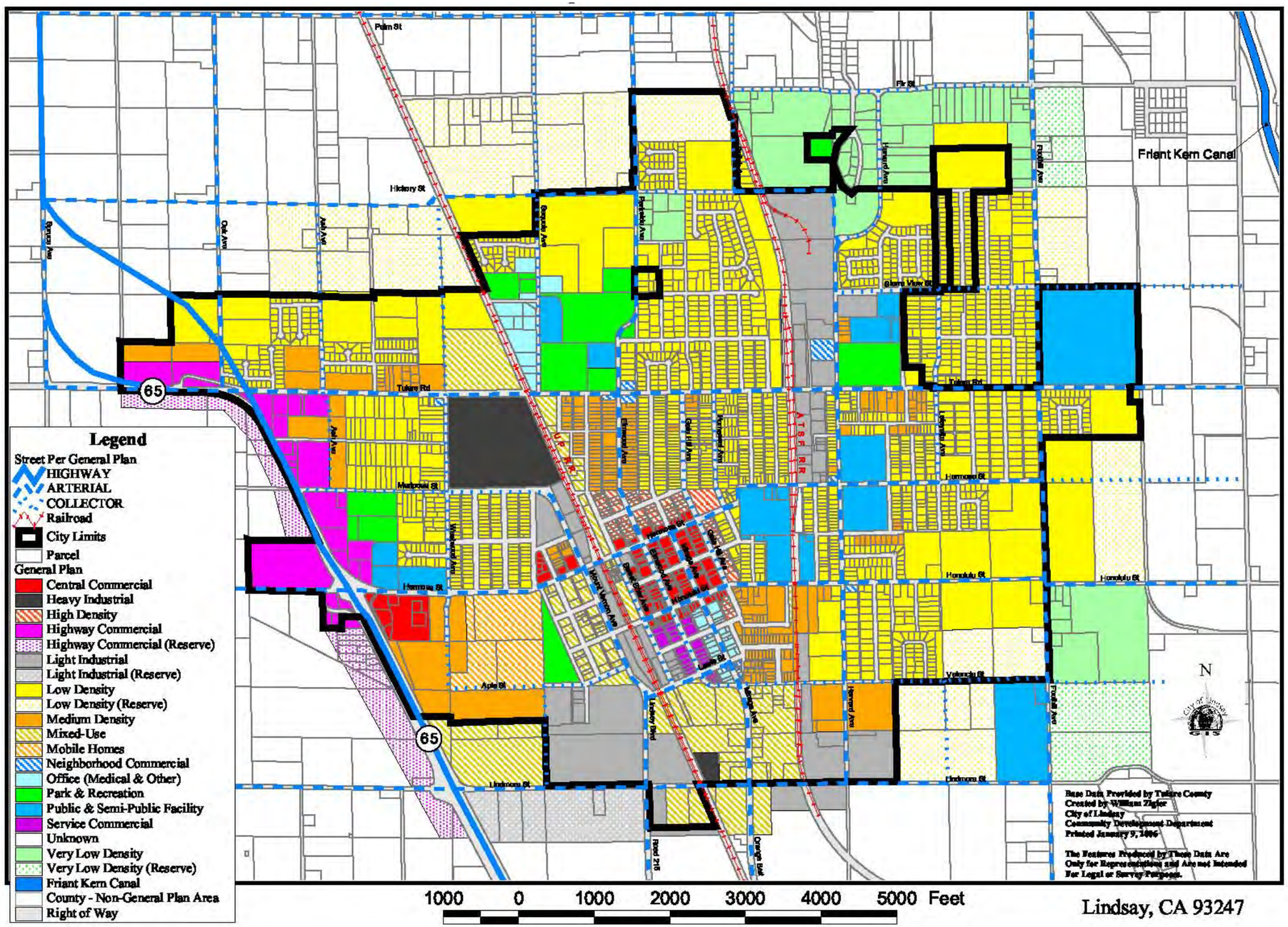
The City of Lindsay updated their General Plan and Land Use Maps in 2006. The updated Land Use Map is shown in Figure 2-2 and a summary of acreages by zoning designation is detailed in Table 2-1. This Water System Feasibility Study has a planning horizon of 2030. However, the calculations evaluating future water demands using the land use method (one of two methods, see Section 3) were extended to the estimated full build-out of the current City Limits, which could occur as late as 2070.

Table 2-1: Land Use Acreages

Land Use Category	Total Developed Acres [1]	% of Total Acreage	Total Un-Developed Acres [1]	% of Total Area	Total Acreage
Residential					
Single Family Residential (R-1-7)	490.9	77%	143	23%	633.9
Multi-Family Residential (RM-3)	120.2	77%	34.9	23%	155.1
Multi-Family Residential (RM-MH8)	12.6	100%	0	0%	12.6
Non-Residential					
Central Commercial (CC)	25.5	81%	6.1	19%	31.6
Highway Commercial (CH)	24.4	45%	29.4	55%	53.8
Neighborhood Commercial (CN)	3.4	59%	2.4	41%	5.8
Service Commercial (CS)	5.1	84%	1	16%	6.1
Professional Offices (PO)	14.1	66%	7.2	34%	21.3
Office/High Density (RM-1.5)	15	97%	0.4	3%	15.4
Mixed Use	55.4	62%	34.6	38%	90
Heavy Industry (IH)	35.5	93%	2.6	7%	38.1
Light Industry (LI)	106.3	79%	28	21%	134.3
Resource, Conservation & Open Space (RCO)	156	100%	0	0%	156
Tulare County	8.5	6%	132.1	94%	140.6
Unknown	0	0%	6.1	100%	6.1
Right-of-Way	221	100%	0	0%	221
Totals	**1293.9**	**75%**	**427.8**	**25%**	**1721.7**

[1] Data Provided By Mr. Brian Spaunhurst, City of Lindsay (2/13/2013)

Figure 2-2: City of Lindsay General Plan Map



2.3 Historical and Projected Population

The City of Lindsay has a small, but growing population. From 1975 through 1995, the population averaged a growth rate of approximately 2.5%; however the growth rate began decreasing in 1995 and was only 1.3% from 2005 to 2010. Due to this slowing of growth, the City Planning and Economic Development Department determined a future population growth projection of 1% is prudent and should be used for the this Study. Table 2-2 presents the historic and future population assumptions used to estimate water usage later in the Study.

Table 2-2: Population – Historical and Projected

Year	Service Population[6]
1975	6,919[1]
1980	7,989[1]
1985	8,759[1]
1990	9,387[2]
1995	10,367[3]
2000	11,346[2]
2005	11,989[5]
2010	12,817[2]
2015	13,417[4]
2020	14,048[4]
2025	14,711[4]
2030	15,408[4]

Notes:
[1] City of Lindsay 1989 General Plan
[2] Census Data (1990, 2000, 2010)
[3] Interpolation
[4] Projection using 1% annual growth
[5] California Department of Finance E-4 and E-5 Population Estimates
[6] Service Population includes City of Lindsay, Page-Moore Tract and Sierra Shadows Mobile Home Park

3 WATER SYSTEM

This section is divided into six primary subsections including demand, supply, treatment system, distribution system, storage system and capital improvement projects. The subsections present information concerning the historic and projected water system demands and supply characteristics, an evaluation of the water treatment system, the water system model and assumptions utilized to create the model and evaluate its results and capital improvement projects needed to sustain the City's water supply efficiently and reliably.

3.1 Water System Demand

The following sections present a progressive analysis of how the City has historically used water and, based on that history, projects demands into the future. Actual historic water usage data was collected from the City and distributed using two data sets: land use and population. The distribution of water use, using these two methods, was conducted to provide a relativity analysis and help approximately identify when and at what approximate population full build-out may occur. The objective is to provide the City with two valid trends to evaluate and track current and future water usage.

3.1.1 Historic Demand

Historic water demand was calculated for years 2001 through 2012 on a per-person basis. The Demand per person (or per capita) calculation used actual water production statistics and makes use of the population for each year, as shown in Table 3-1. Monthly water production records were obtained from the City for years 2001 through 2012; however several months of production data was missing. The missing months' data was estimated by assuming similar demands for the same month in the prior year.

The Demand Per Capita calculation was conducted according to Senate Bill x7-7 (SBx7-7) or the Urban Water Management Planning Act. This approach provides a standard method used throughout the State to determine baseline water demand and to develop future demand targets for the City.

Pursuant to SBx7-7, the baseline consumption rate is calculated using a 10- or 15-year approach. Selecting between a 10- or 15-year approach is determined by the amount of recycled water the City uses; use of recycled water greater than 10% would dictate a 15-year approach. Since the City does not have a recycled water system, the 10 year approach was used. Based on the SBx7-7 guidelines for calculating the 10-year baseline, the period must end between December 31, 2004 and December 31, 2010, therefore the data from 2001-2010 can be utilized for this purpose. The historical water demand and average demand per capita for 2001-2012 are detailed in Table 3-1.

Table 3-1: Historical Water Use and Daily Demand

Year	System Population[1,2]	Water Demand (MGY)[3]	Demand per Capita (gpcd)
2001	11,364	757	183
2002	11,413	777	187
2003	11,598	880	208
2004	11,778	811	189
2005	11,989	895	205
2006	12,086	841	191
2007	12,068	854	194
2008	12,491	982	215
2009	12,675	1009	218
2010	12,817	962	206
2011	13,026	855	180
2012	13,311	901	185
10-Year Base Daily Per Capita Water Use (2001-2010)			**199**

Notes:
[1] California Department of Finance E-4 and E-5 Population Estimates
[2] Service Population includes City of Lindsay, Page-Moore Tract and Sierra Shadows Mobile Home Park, as the City provides water to these areas outside the city limits
[3]Million Gallons per Year

As shown in Table 3-1, the 10-year baseline water use is 199 gpcd; which is utilized in the following section to determine the target water usage rates for years 2015-2030.

The second method used to document historic water demand was Land Use, which calculated water unit factors based on existing developed land using net acreages. For the year 2011 the total water demand was distributed across the developed residential and non-residential acreages within the City's water service area. As shown in Table 3-2, the recommended existing unit factors for residential areas are 2,425[2] gallons per day per net acre (gpd/na) and 2,530[2] gpd/na for non-residential.

The recommended residential and non-residential water unit factors shown in Table 3-2 are used in the Project Demand section to approximate water demands in the year when full build-out of the City occurs.

[2] Values rounded in Table 3-2.

Table 3-2: Existing Demands and Unit Demand Factors

Land Use Classification	Existing Net Acreage	Existing Production (gpd)[1]	Unadjusted Unit Factor (gpd/na)	Balance to Production (gpd)	Vacancy Rate (%)[2]	Adjusted Unit Factor (gpd/na)	Recommended Unit Factor	Balance Using Recommended Unit Factors (gpd)
Residential	624	1,480,814	2,375	1,480,814	2%	2,422	2,425	1,512,303
Non-Residential	449	987,209	2,198	987,209	15%	2,528	2,530	1,136,210
Non-Demand Generating	221							
Totals	**1,294**	**2,468,023**		**2,468,023**				**2,648513**

Notes:
[1] 2011 Data provided by City staff
[2] American Community Survey estimates; 2007-2011 5-Year Estimates

3.1.2 Projected Demand

Two scenarios have been evaluated to identify the most reasonable and prudent range of Projected Demands for the City. The first scenario was derived by calculating the water usage target using the approach required by SBx7-7. A second "Status Quo" scenario was developed using more traditional water use targets such as the 10-year baseline of 199 gpcd and the 2012 water usage rate of 185 gpcd.

3.1.2.1 Water Use Targets

It is unrealistic to predict with a single scenario how the City will grow and use water resources. By extending the two scenarios described above into the future, the demand for water resources and infrastructure will have a higher probability of falling within the bounds established by these two scenarios. As time passes, this range will provide the City with the flexibility to make adjustments to their operations and infrastructure. The development of the demand projections for these two scenarios is discussed below and is shown jointly with water supply in Figure 3-1.

Scenario No. 1 – Per Capita Demand with Conservation (159 gpcd)

To be compliant with SBx7-7 the Department of Water Resources has determined that cities must reduce water consumption by 20% from their 10 year baseline by the year 2020. For the City of Lindsay, that requirement yields a water use target of 159 gpcd. This target is considered an optimistic scenario but must be included in a comparative analysis for determining the City's Projected Demands. This scenario is extended into the future and shown in Table 3-3. It results in a 2030 Average Daily Demand (ADD) of 2.42 MGD.

Scenario No. 2 – "Status Quo" Per Capita Demand Without Conservation (185 gpcd)

The City already fully meters water services and employs many conservation methods, leading to a comparatively low 10-year baseline[3] of 199 gpcd. A fully-metered system has an innate conservation component by illustrating to the customers, through their monthly bills, the individual water usage and how water and money can be saved by employing conservation techniques. For these reasons, the Scenario 1 water use target of 159 gpcd is considered aggressive. A "status quo" water use scenario of 185 gpcd (based on 2012 demands) has been selected as a second water use target and alternative.

The status quo scenario simply extends the water demands experienced by the City for the year 2012. The City's 2012 water usage was 185 gpcd and is a sustainable water usage target for a metered City in the South San Joaquin Valley. The 185 gpcd target is 7% lower than the 199 gpcd 10-year baseline and will require the City to continue with its conservation efforts. This water usage scenario is shown in Table 3-3. By sustaining this usage rate the City's 2030 ADD would be 2.82 MGD.

[3] According to the California Water Plan Update 2005, the average per capita use for the Tulare Lake region was 268, 311 and 315 gpcd for the years 1999, 2000 and 2001, respectively; yielding an average of 298 gpcd for that time period.

The 185 gpcd water use demand factor from Scenario No. 2 was selected as the target for infrastructure planning purposes. This scenario is considered realistic and not overly optimistic or conservative, based on existing usage characteristics. The water supply infrastructure and capital plan described in Sections 3.2 and 3.6 are based on the status quo demand of 185 gpcd.

While the planning horizon for this Study is 2030, Table 3-3 water demand projections continue to the year 2070. The projection to the year 2070 was done to estimate at what point in time full build-out may occur, and is discussed in greater detail in Section 3.1.2.2

3.1.2.2 Land Use Water Unit Factors

The second method used to document historic water demand was Land Use, which calculated water unit factors based on existing developed land using net acreages. The water unit factors were calculated based on the existing developed acreages and production, then applied to future developed acreages to determine the total water demand at build-out.

The calculations for the existing land use water unit factors are shown in Table 3-2. The existing and recommended lands use factors are shown in Table 3-4, which also shows the build-out water demand for the City will be approximately 3.7 MGD, which correlates to the demand calculated for each scenario. As shown in Table 3-3, full build-out may happen as late as the year 2070 under Scenario No.1 and the year 2059 for Scenario No. 2.

Table 3-3: Projected Water Demand - Water Use Target Methods

Year	Projected Population	Scenario No. 1: Conservation Water Use Target (159gpcd)		Scenario No. 2: Status Quo Water Use Target (185gpcd)	
		Per Capita Demand (gpcd)	Average Day Demand (MGD)	Per Capita Demand (gpcd)	Average Day Demands (MGD)
2013	13,346	185	2.46	185	2.46
2014	13,381	183	2.44	185	2.47
2015	13,417	181	2.42	185	2.48
2016	13,537	179	2.40	185	2.48
2017	13,658	175	2.37	185	2.50
2018	13,781	171	2.34	185	2.53
2019	13,904	167	2.30	185	2.55
2020	14,048	163	2.27	185	2.57
2021	14,174	159	2.23	185	2.60
2022	14,302	159	2.25	185	2.62
2023	14,430	159	2.27	185	2.65
2024	14,560	159	2.29	185	2.67
2025	14,711	159	2.32	185	2.69
2026	14,844	159	2.34	185	2.72
2027	14,978	159	2.36	185	2.75
2028	15,113	159	2.38	185	2.77
2029	15,249	159	2.40	185	2.80
2030	15,408	159	2.42	185	2.82
2031	15,547	159	2.45	185	2.85
2032	15,688	159	2.47	185	2.88
2033	15,830	159	2.49	185	2.90
2034	15,974	159	2.52	185	2.93
2035	16,119	159	2.54	185	2.96
2036	16,265	159	2.56	185	2.98
2037	16,413	159	2.59	185	3.01
2038	16,562	159	2.61	185	3.04
2039	16,712	159	2.63	185	3.06
2040	16,865	159	2.66	185	3.09
2041	17,018	159	2.68	185	3.12
2042	17,173	159	2.71	185	3.15
2043	17,330	159	2.73	185	3.18
2044	17,488	159	2.76	185	3.21
2045	17,647	159	2.78	185	3.24
2046	17,808	159	2.81	185	3.26
2047	17,971	159	2.83	185	3.29
2048	18,135	159	2.86	185	3.32
2049	18,301	159	2.88	185	3.35
2050	18,469	159	2.91	185	3.39
2051	18,638	159	2.94	185	3.42
2052	18,809	159	2.96	185	3.45
2053	18,981	159	2.99	185	3.48
2054	19,155	159	3.02	185	3.51
2055	19,331	159	3.05	185	3.54
2056	19,508	159	3.07	185	3.58

Year	Projected Population	Scenario No. 1: Conservation Water Use Target (159gpcd)		Scenario No. 2: Status Quo Water Use Target (185gpcd)	
		Per Capita Demand (gpcd)	Average Day Demand (MGD)	Per Capita Demand (gpcd)	Average Day Demands (MGD)
2057	19,688	159	3.10	185	3.64
2058	19,869	159	3.13	185	3.68
2059	20,051	159	3.16	185	3.71
2060	20,236	159	3.19		
2061	20,422	159	3.22		
2062	20,610	159	3.25		
2063	20,800	159	3.28		
2064	20,992	159	3.31		
2065	21,185	159	3.34		
2066	21,381	159	3.37		
2067	21,578	159	3.40		
2068	21,777	159	3.43		
2069	21,979	159	3.46		
2070	22,182	159	3.49		

Table 3-4: Water Demand Projections – Land Use Method

Land Use Classification	Existing Net Acreage	Water Unit Factor (gpd/na)	Balance Using Recommended Unit Factors (gpd)	Total Future Land Use (net acres)	Lands Remaining to Develop (net acres)	Future Water Demand (gpd/na)	Future Water Demand at 100% Build-out (gpd)
Residential	624	2,425	1,512,303	802	178	431,335	1,943,638
Non-Residential	449	2,530	1,136,210	693	244	616,634	1,752,845
Non-Demand Generating	221			227	6		
Totals	**1,294**	**2,468,023**		**1,721**	**428**		**3,696,482**

3.2 Water System Supply

3.2.1 Current Supply Capacity

This Study analyzed the adequacy of current water supplies to meet present and future demands. The City employs two types of water supplies, groundwater and surface water. The reliability of each is affected by a variety of outside factors

The City relies heavily on surface water, which is affected by climate factors, canal maintenance periods and high demand periods during the summer. Also, the relatively fixed flow rate of surface water limits its usefulness in dealing with the variability between winter and summer demands, straining the system's supply capacity and its ability to meet the demands, especially during times when the surface water supply is completely unavailable. The demand discussion above focused on Average Day Demand; however, the City must be able to meet consecutive Maximum Day Demands during the summer months. Also, a critical time for the City is created by the maintenance cycle of the Friant Kern Canal, which is taken out of operation for two to four months in the fall of every third year, making surface water completely unavailable for that time. Because of these supply irregularities, summer and winter months are evaluated separately.

While the demand in the summer months is substantially higher than the winter months, the available water supply consists of surface and groundwater during the summer, while the winter supply is limited to the capacity of the groundwater wells for the time when the Friant Kern Canal is offline for maintenance. The City's water supply capacity is detailed in Table 3-5.

The City's supply capacity is calculated both as Total Capacity and Firm Capacity. The Total Capacity is the simple addition of all water supply sources available during the winter or summer months. The Firm Capacity is equal to the total capacity, minus the capacity of the largest source available during the summer or winter months. The Firm Capacity is considered the readily-available supply used to meet Maximum Daily demands. Due to maintenance activities, emergency situations, and/or water quality problems the Firm Capacity is used to evaluate supply adequacy.

The current Firm Capacity for the summer months is 3.67 MGD, while it is only 1.08 MGD for the winter months.

Table 3-5: Water Supply Capacity

Supply Source	Rated Capacity[1] (gpm)	Status[2]	Updated Water Supply Capacity		
			Groundwater Active Wells (MGD)	Surface Water Treatment Capacity (MGD)	Emergency Supply[3] (MGD)
Well 2	600	Abandoned	-	-	-
Well 4	800	Abandoned	-	-	-
Well 6	800	Abandoned	-	-	-
Well 11	1,000	Active	-	-	-
Well 13	1,100	Abandoned	-	-	-
Well 14	750	Active	1.08	-	1.08
Well 15	1,200	Active	1.73	-	1.73
Water Treatment Plant	1,800[4]	Active	-	2.59	-
		Totals	**2.81**	**2.59**	**2.81**

Available Supply					
Summer Months Supply			Winter Months Supply[5]		
	(MGD)	(gpm)		(MGD)	(gpm)
Firm Capacity[6]	3.67	2,550	Firm Capacity[6]	1.08	750
Total Capacity	5.40	3,750	Total Capacity	2.81	1,950

Notes:

[1] Water Supply and Storage Requirements Update, June 1998, Carollo Engineers.

[2] Wells 2, 4, and 6 have been abandoned due to water quality issues; Well 13 is utilized for emergency purposes only.

[3] Total emergency supply excludes the SWTP.

[4] The SWTP production ranges from 1,600 to 1,800 but for purposes of identifying total capacity, 1,800 has been utilized.

[5] Winter Months Supply excludes the SWTP.

[6] Firm Capacity excludes the largest production well.

3.2.2 Projected Supply Capacity

For comparison, the projected supply capacity was evaluated based both on the demand assumptions described as Scenario No. 1 status quo (185 gpcd) and Scenario No. 2 conservation (159 gpcd) water demands. These demands are currently considered Average Daily demands. The California Water Works Standards requires that public water systems have the capacity at all times to meet the system's Maximum Day Demand. Therefore, the Scenario No.1 and 2 demands are converted to Maximum Daily (MDD) demands in Table 3-6. However, the entire system was modeled using MDD plus fire flow, as discussed further in Section 3.4.

The Average Daily demands are adjusted based on peaking factors, which vary between summer and winter. The 1992 Water System Master Plan identifies these peaking factors as 1.68 and 1.39, respectively. For the purposes of this Study, these factors have been conservatively adjusted to 1.8 for summer Maximum Day and 1.4 for winter Maximum Day.

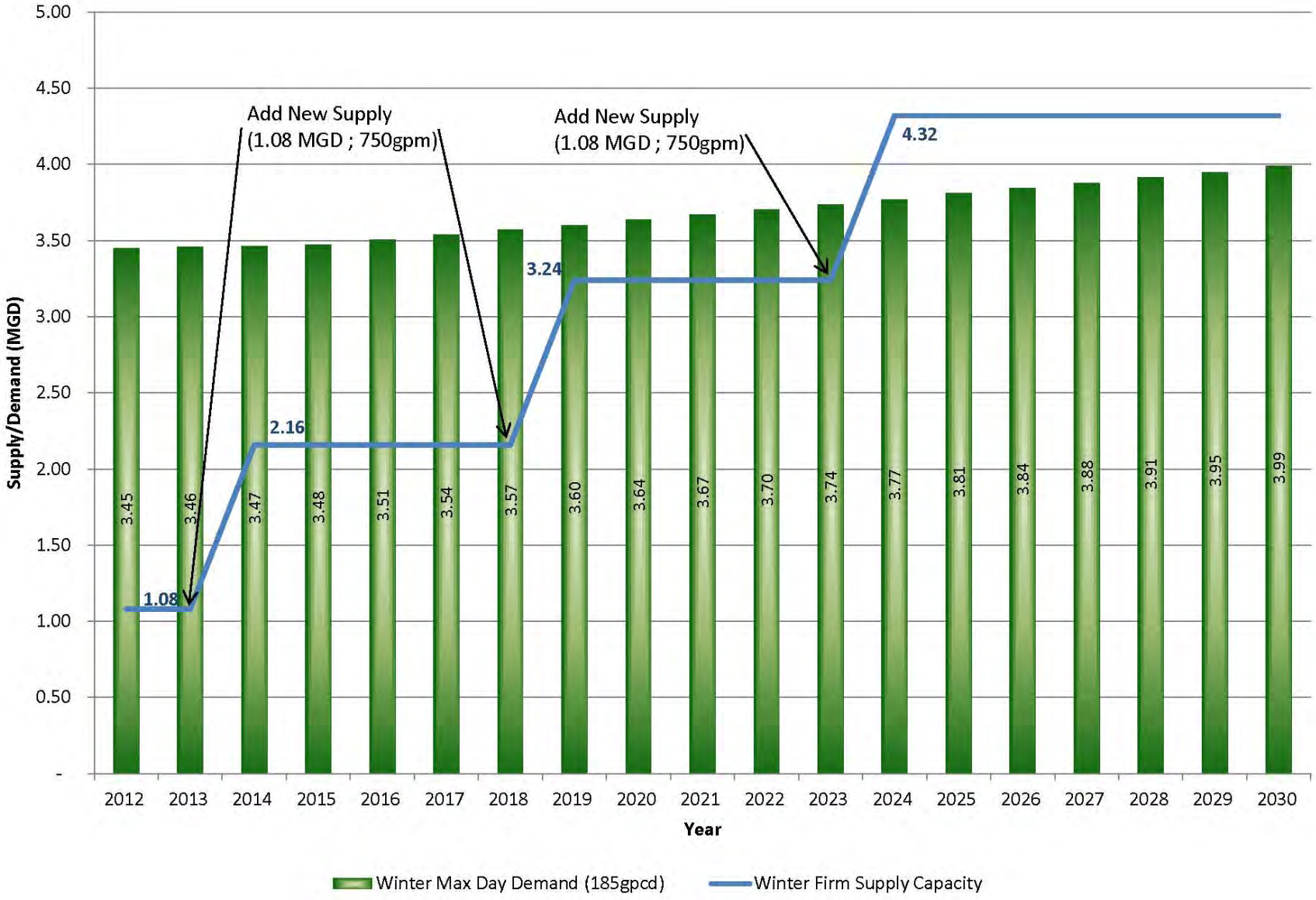
These calculations reveal immediate supply deficit which must be addressed and also track the supply deficit to determine at what point, for each water demand scenario, an additional water supply is needed. As shown in Table 3-6, both water demand scenarios highlight an immediate need for a new 750-gpm well; however, the addition of an additional water supply is not necessary until 2019 under Scenario No. 2 (185 gpcd). Under Scenario No. 1, there is no need for an additional water supply within the planning horizon of this Study. Figure 3-1 illustrates the winter supply needs based on Scenario No. 2. The possible inclusion of additional surface water storage in 2019 is discussed in more detail in Section 3.3.

Additional calculations were performed to model a reduced allocation in the surface water supply during the summer months, which has been experienced each of the last several years. Since 2006 the City has not received 100% allocation any year, with the range varying between 39% (2006) and 76% (2009). Calculating the available supply using a reduced allocation of 40% allowed analysis of whether additional wells would be required. It was determined that the winter months, where no surface water is accounted for, are still the critical time for water supply and will control the need for an additional water supply.

Table 3-6: Projected Demand and Supply Capacity

Year	Population	Scenario No. 1: Conservation Water Use Target (159 gpcd)							Scenario No. 2: Status Quo Water Use Target (185 gpcd)						
		Average Daily Per Capita Water Use	Average Daily Demand	Maximum Day Demand		Maximum Day Supply Deficiency		New Supply (1.08MGD; 750gpm)	Average Daily Per Capita Water Use	Average Daily Demand	Maximum Day Demand		Maximum Day Supply Deficiency		New Supply (1.08MGD; 750gpm)
		(gpcd)	(MGD)	Summer (MGD)	Winter (MGD)	Summer (MGD)	Winter (MGD)		(gpcd)	(MGD)	Summer (MGD)	Winter (MGD)	Summer (MGD)	Winter (MGD)	
			Existing Supply (MGD)			1.08	3.67			Existing Supply (MGD)			1.08	3.67	
2012	13,311	185	2.46	4.43	3.45	-0.76	-2.37		185	2.46	4.43	3.45	-0.76	-2.37	
2013	13,346	183	2.44	4.40	3.42	-0.77	-2.38		185	2.47	4.44	3.46	-0.73	-2.34	
2014	13,381	181	2.42	4.36	3.39	-	-1.31	1	185	2.48	4.46	3.47	-	-1.23	1
2015	13,417	179	2.40	4.32	3.36	-	-1.32		185	2.48	4.47	3.48	-	-1.20	
2016	13,537	175	2.37	4.26	3.32	-	-1.35		185	2.50	4.51	3.51	-	-1.16	
2017	13,658	171	2.34	4.20	3.27	-	-1.38		185	2.53	4.55	3.54	-	-1.11	
2018	13,781	167	2.30	4.14	3.22	-	-1.41		185	2.55	4.59	3.57	-	-1.06	
2019	13,904	163	2.27	4.08	3.17	-	-0.36	1	185	2.57	4.63	3.60	-	-	1
2020	14,048	159	2.23	4.02	3.13	-	-0.40		185	2.60	4.68	3.64	-	-	
2021	14,174	159	2.25	4.06	3.16	-	-0.43		185	2.62	4.72	3.67	-	-	
2022	14,302	159	2.27	4.09	3.18	-	-0.46		185	2.65	4.76	3.70	-	-	
2023	14,430	159	2.29	4.13	3.21	-	-0.50		185	2.67	4.81	3.74	-	-	
2024	14,560	159	2.32	4.17	3.24	-	-	1	185	2.69	4.85	3.77	-	-	
2025	14,711	159	2.34	4.21	3.27	-	-		185	2.72	4.90	3.81	-	-	1
2026	14,844	159	2.36	4.25	3.30	-	-		185	2.75	4.94	3.84	-	-	
2027	14,978	159	2.38	4.29	3.33	-	-		185	2.77	4.99	3.88	-	-	
2028	15,113	159	2.40	4.33	3.36	-	-		185	2.80	5.03	3.91	-	-	
2029	15,249	159	2.42	4.36	3.39	-	-		185	2.82	5.08	3.95	-	-	
2030	15,408	159	2.45	4.41	3.43	-	-		185	2.85	5.13	3.99	-	-	

Figure 3-1: Winter Demand

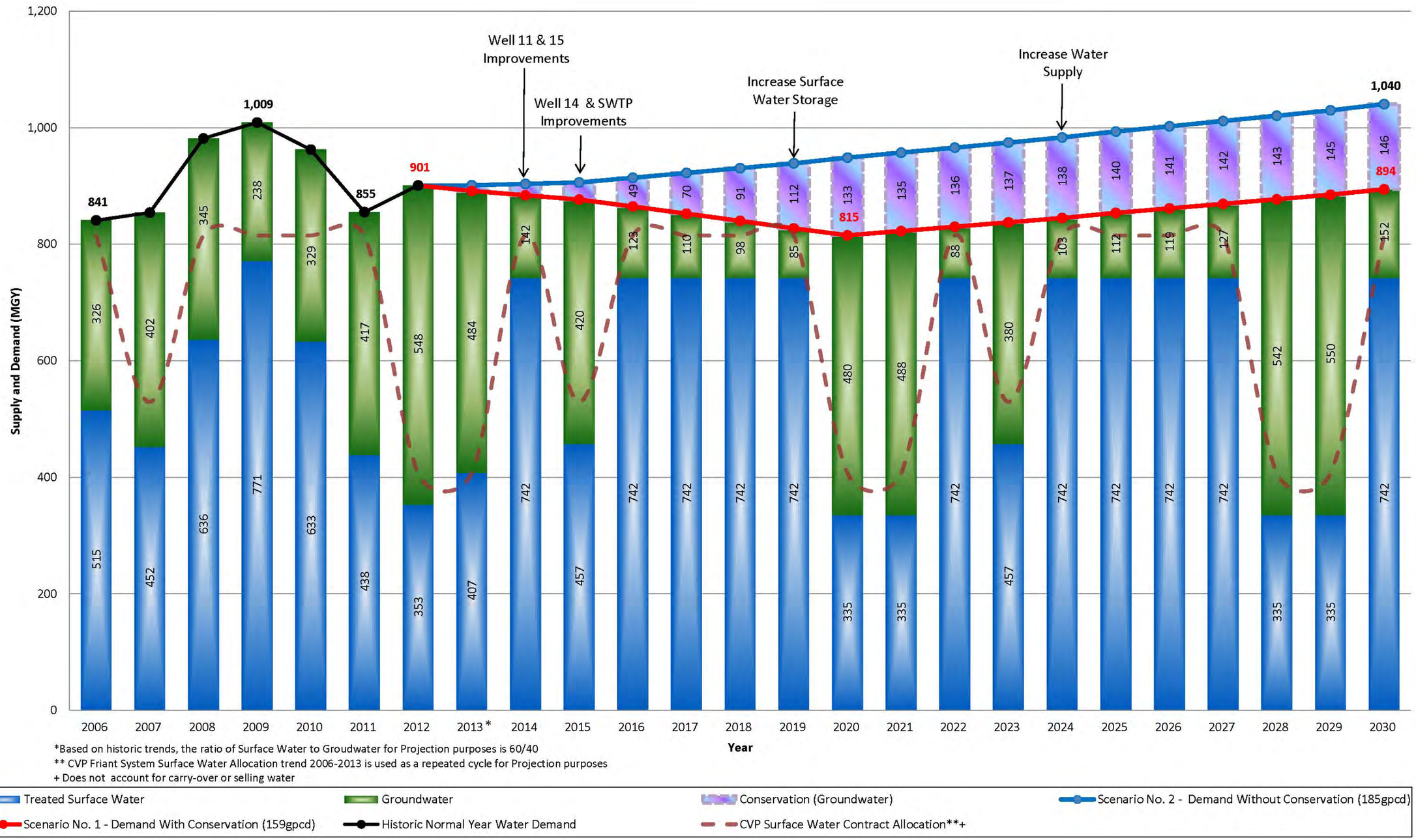


Projected demands and associated additional supply needs are both shown in Figure 3-2. The black, red and blue lines shown the historical demand, Scenario No. 1 projected demand and Scenario No. 2 projected demand, respectively. Between 2013 and 2030 an increasingly large envelope opens between the two scenarios. This envelope represents the area where the City's actual demand will likely fall. It is possible the City will maintain the status quo demand of 185 gpcd with no reduction, as illustrated by Scenario 2, however, the envelope allows the reader to see the range by which the City and the customers could employ additional conservation measures.

The blue bar represents the treated surface water and reflects a cycling of full and reduced allocations in wet and dry water years based on the historical data (see Section 3.7.2). The volume of treated surface water that can be delivered to the system has been reduced to account for the backwash water, as discussed in Section 3.3.1.1. It must be noted that the red curve is a reconstruction of historical events, i.e., the rainfall and subsequent CVP Class 1 water allocations over an actual period of years from 2006 to 2013. In the future, the City can expect similar variation in magnitude of the CVP allocations from year to year; however the order and duration of full and partial allocation will be dependent on actual hydrological occurrences and will not be exactly what is illustrated here.

The green bars represent pumped groundwater required under both scenarios, while the purple bars represent the extra increment of pumped groundwater necessary if demand is not brought below the status quo by additional conservation measures. Because there is no additional supply of surface water identified, it is assumed the differential between the two demand scenarios would be supplied using groundwater. The last piece of information presented on the figure is the impact of the supply improvement projects that are already planned by the City or are being proposed as a result of this Study (see Section 3.6)

Figure 3-2: Historic and Projected Supply and Demand



3.3 Water Treatment System

The City retains surface water supply and conveyance contracts with the United States Bureau of Reclamation (USBR), Friant Water Users Authority and has access to 2,500 acre-feet per year, depending on annual water supply allocations established by USBR. Upon delivery of the surface water, the City treats and distributes potable water throughout the community, in addition to the groundwater supply. During the peak demand periods in the summer, when the surface water supply is available, the City's supply is primarily surface water, with groundwater augmenting the supply as necessary depending on the annual water supply allocations in effect each year. Surface water deliveries are halted while the Friant Kern Canal is taken off-line for general maintenance and dewatering, typically during every third year from November through as late as February; the supply scenario switches during this period and the City is totally dependent on groundwater.

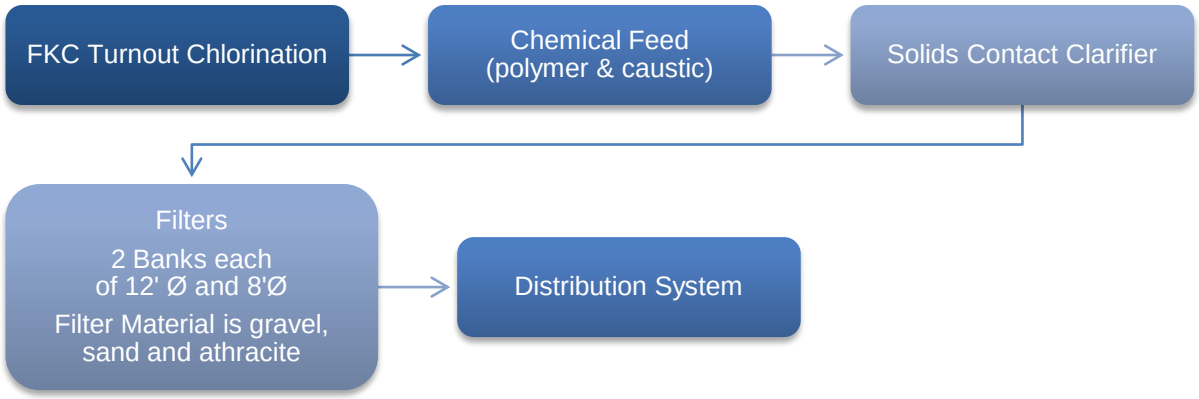
3.3.1 Surface Water Treatment System Evaluation

3.3.1.1 Current Operations

The surface water enters the City's infrastructure through a turnout at the Friant-Kern Canal, on the east side of town, and travels through dual 12-inch pipes to the Surface Water Treatment Plant (SWTP). At the turnout, chlorine is added in sufficient quantity to maintain a residual through the treatment process and into the distribution system. The treatment process is shown in Figure 3-3.

The SWTP is capable of handling flows between 1,600 and 1,800 gpm. The SWTP is illustrated in Figure 3-3 below. The filters are backwashed approximately every four days, based on source water turbidity levels that vary throughout the delivery year. The backwash is accomplished by backwashing one bank of filters at a time for 42 or 35 minutes per bank at 1,700 gpm or 750 gpm, for the 12'Ø and 8'Ø filters, respectively. Approximately 60 to 85 acre-feet of water is annually for backwash purposes. Backwash water is discharged via piped storm drain line to the City's stormwater basins.

Figure 3-3: SWTP Process



3.3.1.2 Current Deficiencies

The SWTP is operating with several deficiencies currently including decreased output during peak flows due to backwashing, ineffective floc formation, loss of backwash water, and elevated DBP levels at the storage tank.

- During peak flows, filter run times are reduced to a point that the filters are constantly backwashing, which is decreasing the output of the plant. It appears that, during peak flows, coagulation polymer is short-circuiting through the clarifier and carrying over to the filters, contributing to clogging and therefore shortening time between backwashes.
- An inline static mixer is used to inject the polymer. This injection happens approximately 15 feet before the clarifier. This setup may not allow for optimal or even effective mixing of the polymer and may not allow for effective floc formation.
- The backwash wastewater is lost to the storm water basin and is not available for reuse. Surface water treatment plants can be designed and permitted to recycle backwash water in quantities up to 10% of the incoming plant flow.
- Levels of disinfection byproducts (DBPs) are elevated in an area near the four million gallon storage tank. The City is currently in compliance with the State of California DHS's required Maximum Contaminant Level (MCL) for DBPs, in part because compliance is determined based upon the DBP average across the entire distribution system. In 2014, new Stage 2 DBP regulations will begin to affect Lindsay. These new rules will require that compliance with the DBPs be achieved at each location, not averaged over the system. Without improvements, portions of the City's system will then be out of compliance.

3.3.2 <u>Short and Long Term Improvements</u>

The four issues listed above can be solved temporarily through several short term options while permanent solutions may require longer-term planning and fund sourcing. The following noted observations were key in determining possible solutions.

- An analysis of the filter loading rates indicates that at 1600 gpm, the filters are being loaded at 1.63 gpm/SF of filter area. This is well below the typical design rate of 3.0 gpm/SF. The carryover of solids from the solids contact clarifier appears to be leading to the lower loading rates.
- When feeding polymer into a solids contact clarifier, rapid mix and flocculation are normally used. Flocculation is typically done in a separate chamber or baffled zone with the clarifier unit and provide for at least 30 minutes of flocculation.
- The backwashing rates, times and volume of water appear to be normal for the diameter of the pressure filters.

Short Term Solutions

- Modify the solids contact clarifier by installing a rapid mix device and installing a flocculation zone.
- Modify the solids contact clarifier by installing some sections of plate or tube settlers to allow for longer contact time in the clarifier.
- The recommended modifications to the clarifier should aid in organics removal, decreasing DBPs. Another potential option would be to replace two inches of anthracite in the pressure filters with two inches of granular activated carbon.

Long Term Solutions

- Add Additional Pressure Filters

  In order to meet peak demand, more pressure filters could be added. However, there is very limited space available at the current water treatment plant site. Any additional filters would need to be placed at a different location.
- Provide Filtration At The Canal Turn Out

  Sand filters could be installed at the canal turn out to provide some pre-filtration before the water travels to the water treatment plant. This should reduce the amount of solids that would need to be removed by the filters at the water treatment plant.
- Reuse The Backwash Wastewater

  A new pond would need to be constructed to collect the backwash waste water. The settled waste water could then be returned to the head of the water treatment plant and mixed the incoming raw water. A conceptual design and Preliminary Opinion of Probable Construction Costs has been prepared and is included in Appendix B.

3.4 Water Distribution System

The City's existing water distribution system is comprised of steel, asbestos-cement (AC) and polyvinyl-chloride (PVC) water mains, ranging in size from 4-inch through 12-inch. The water mains are typically located within the street rights-of-way; however, in some portions of town, mains are located within easements along the rear property line in residential back yards.

3.4.1 Water Model Basis and Assumptions

A model of the distribution system was prepared and subjected to simulated fire flow demands to gauge the robustness of the system and discover any areas with pressure issues.

The water model, developed using EPANET2 and WaterCAD v.8i, was based on current system demands and does not account for future growth characteristics or scenarios. The model was constructed using GIS Shapefiles, aerial photographs, and City land use maps.

The first step in preparation of a water model entails determining appropriate system demands to be utilized and any assumptions necessary for the model to correctly analyze the system. The water system model is based on actual demands and normalized for purposes of modeling the system; these demands are shown in Table 3-7.

Table 3-7: Water Model System Demands

Description	Demand (gpm)	Notes
Average Day Demand (ADD)[1]	1,840	Based on a Total Daily Demand of 2,648,513 gallons
Maximum Day Demand (MDD)	3,312	Based on peaking factor of 1.8 applied to the ADD
Peak Hour Demand (PHD)	4,968	Based on peaking factor of 1.5 applied to the MDD
Fire Flow (FF)[2]	2,000	Fire flow requirement for a period of two hours
MDD + FF	5,312	Total combined flow required to meet MDD and FF

Notes:
1 The ADD is based on 2011 existing demand received from the City
2 The FF requirement determined from data received from Mr. Mike Camarena, March 3, 2013 via email

The subsequent step entails developing substantiated assumptions and known system characteristics. These include system component capacities and constants. For purposes of the model, the Hazen-Williams equations were employed, assuming C-Factors of 100 for the City Hall and Page-Moore areas of town and 130 for the remainder. The difference in C-Factors was based on the difference in pipe material in the two areas of town. The system component capacities are detailed in Table 3-8.

Table 3-8: System Components

Component	Capacity / Notes
Well 14	750 gpm at 75 psi
Well 15	1200 gpm at 75 psi
SWTP	1800 gpm at 90 psi
Storage Tank	4 MG / Fills from system during low demand; supplies water in addition to wells and SWTP when required to maintain constant pressure

3.4.2 Distribution System Evaluation

The water model should be considered a high-level evaluation. This model was not calibrated with actual fire hydrant flow tests or pump performance data. Such calibration can be conducted in the future when a more accurate performance evaluation is needed.

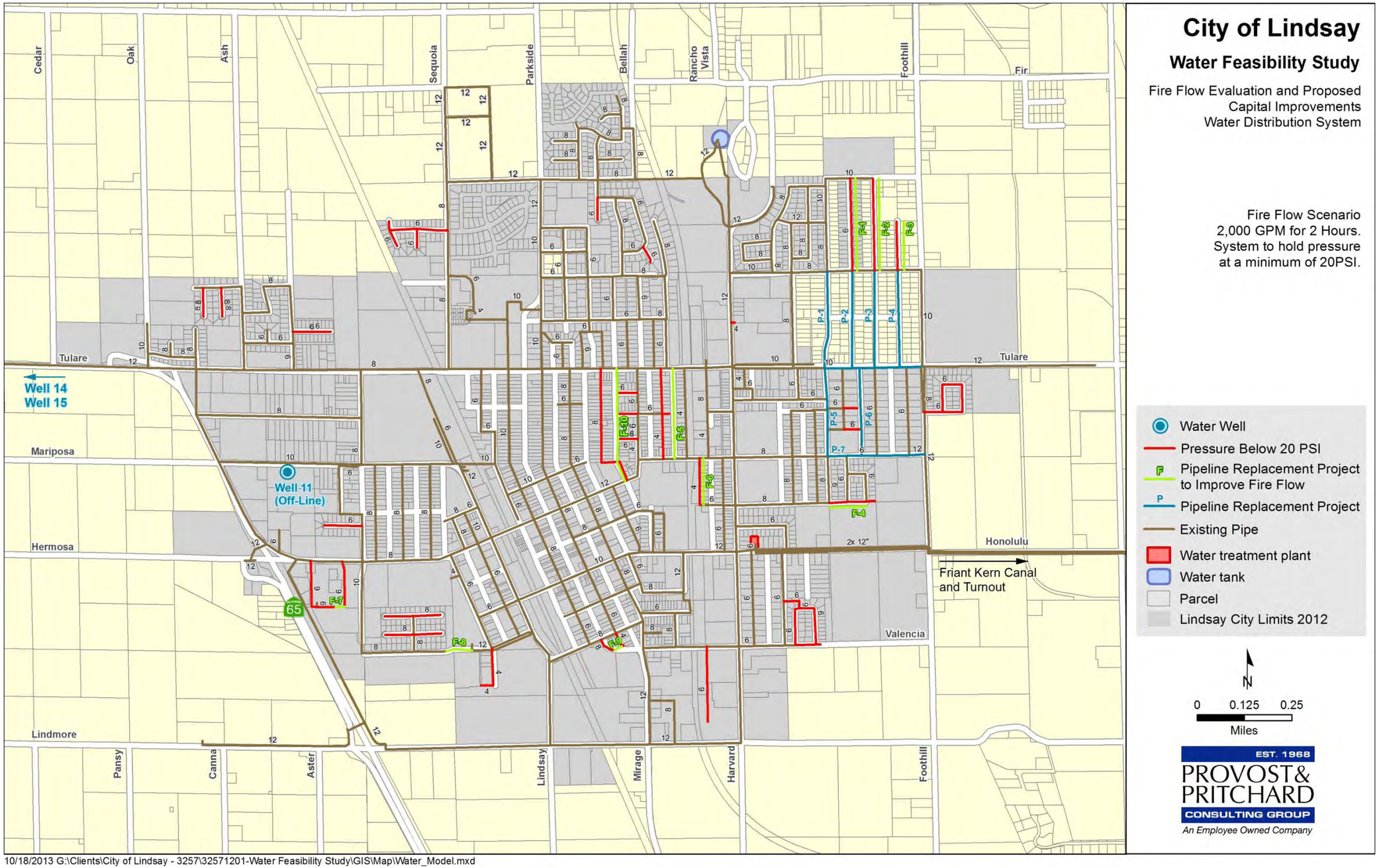
Through evaluation of the water model, several areas of concern within the distribution system were highlighted as having pressure deficits during a fire event. A fire event pressure deficit is defined as lower than 20 psi during a 2-hour, 2,000 gpm fire event. Several of these deficits can be mitigated by installing additional water mains to complete system loops or replacing existing undersized water mains. The Fire Flow Evaluation (Figure 3-4) illustrates the areas of concern by showing the existing deficient water mains in red. Some of the water mains shown as red may have a green line in parallel. This green line indicates the need for a water main improvement project to resolve the fire event deficiency.

The figure also shows possible water main improvement projects in blue. The water main projects identified as blue would replace or augment non-standard and undersized mains to improve overall system functionality.

Areas identified in red but without an accompanying green or blue project are those where a pressure problem exists but a solution was not readily apparent. These include isolated dead-ends or areas with only one point of connection, where a ‘loop’ option is not readily available.

The possible water main improvement solutions are further detailed in the Capital Improvement Plan Matrix, discussed in Section 3.6.

Figure 3-4: Fire Flow Evaluation



10/18/2013 G:\Clients\City of Lindsay - 3257\32571201-Water Feasibility Study\GIS\Map\Water_Model.mxd

3.5 Water Storage System

The City's water storage requirements include operational, emergency and fire storage. The available storage consists of a single 4-million gallon storage tank, at the north end of town. Operational and Emergency storage requirements are each calculated at fifty-percent of the Average Day Demand (Table 3-9). The Fire Storage requirement is based on fighting the largest possible fire, considered to be an industrial fire, requiring 3,000 gpm for three hours (0.54 MG). The current and future storage requirements are detailed in Table 3-9 and illustrate that the existing storage capacity of 4.0 MG is sufficient to 2030 and possibly beyond.

Table 3-9: Water System Storage

Year	Population	Conservation Water Use Target (159 gpcd)								Status Quo Water Use Target (185 gpcd)							
		Average Daily Per Capita Water Use	Average Daily Demand	Storage Requirements				Available Storage	Storage Deficiency	Average Daily Per Capita Water Use	Average Daily Demand	Storage Requirements				Available Storage	Storage Deficiency[1]
				Operational	Fire	Emergency	Total					Operational	Fire	Emergency	Total		
		(gpcd)	(MGD)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(gpcd)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)
2012	13,311	185	2.46	1.23	0.54	1.23	3.00	4.0	1.00	185	2.46	1.23	0.54	1.23	3.00	4.0	1.00
2013	13,346	183	2.44	1.22	0.54	1.22	2.98	4.0	1.02	185	2.47	1.23	0.54	1.23	3.01	4.0	0.99
2014	13,381	181	2.42	1.21	0.54	1.21	2.96	4.0	1.04	185	2.48	1.24	0.54	1.24	3.02	4.0	0.98
2015	13,417	179	2.40	1.20	0.54	1.20	2.94	4.0	1.06	185	2.48	1.24	0.54	1.24	3.02	4.0	0.98
2016	13,537	175	2.37	1.18	0.54	1.18	2.91	4.0	1.09	185	2.50	1.25	0.54	1.25	3.04	4.0	0.96
2017	13,658	171	2.34	1.17	0.54	1.17	2.88	4.0	1.12	185	2.53	1.26	0.54	1.26	3.07	4.0	0.93
2018	13,781	167	2.30	1.15	0.54	1.15	2.84	4.0	1.16	185	2.55	1.27	0.54	1.27	3.09	4.0	0.91
2019	13,904	163	2.27	1.13	0.54	1.13	2.81	4.0	1.19	185	2.57	1.29	0.54	1.29	3.11	4.0	0.89
2020	14,048	159	2.23	1.12	0.54	1.12	2.77	4.0	1.23	185	2.60	1.30	0.54	1.30	3.14	4.0	0.86
2021	14,174	159	2.25	1.13	0.54	1.13	2.79	4.0	1.21	185	2.62	1.31	0.54	1.31	3.16	4.0	0.84
2022	14,302	159	2.27	1.14	0.54	1.14	2.81	4.0	1.19	185	2.65	1.32	0.54	1.32	3.19	4.0	0.81
2023	14,430	159	2.29	1.15	0.54	1.15	2.83	4.0	1.17	185	2.67	1.33	0.54	1.33	3.21	4.0	0.79
2024	14,560	159	2.32	1.16	0.54	1.16	2.86	4.0	1.14	185	2.69	1.35	0.54	1.35	3.23	4.0	0.77
2025	14,711	159	2.34	1.17	0.54	1.17	2.88	4.0	1.12	185	2.72	1.36	0.54	1.36	3.26	4.0	0.74
2026	14,844	159	2.36	1.18	0.54	1.18	2.90	4.0	1.10	185	2.75	1.37	0.54	1.37	3.29	4.0	0.71
2027	14,978	159	2.38	1.19	0.54	1.19	2.92	4.0	1.08	185	2.77	1.39	0.54	1.39	3.31	4.0	0.69
2028	15,113	159	2.40	1.20	0.54	1.20	2.94	4.0	1.06	185	2.80	1.40	0.54	1.40	3.34	4.0	0.66
2029	15,249	159	2.42	1.21	0.54	1.21	2.96	4.0	1.04	185	2.82	1.41	0.54	1.41	3.36	4.0	0.64
2030	15,408	159	2.45	1.22	0.54	1.22	2.99	4.0	1.01	185	2.85	1.43	0.54	1.43	3.39	4.0	0.61

[1]Storage Deficiency shown as a positive number indicates a surplus of storage capacity; the system does not have any storage deficiencies.

3.6 Capital Improvement Projects

Through the process of analyzing supply, demand, storage capacity, treatment and modeling the system, several possible capital improvement projects presented themselves. These projects are described in the following sections and are separated into five categories: pipelines, groundwater wells, groundwater treatment, surface water treatment and tank improvements.

The existing Capital Improvement Plan (CIP) includes several projects. These are shown in Table 3-10, along with the proposed projects developed through this Study.

Table 3-10: CIP Matrix

Project No.	Project Type	Project Description	Notes	Project Limits	Project Specifics					Project Timing								Possible Funding Source
					Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Estimate	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2020-2025	2025-2030	
Pipelines																		
M-1	P	Well 15 - Pipeline	1		12	12	**	1300	$300,000	$300,000								SRF/IRWM
M-2	C	Well 15 - Pipeline	1		12	12	**	1300	$385,000		$385,000							SRF/IRWM
Varies (See Table 3-11)	C	Main Line Replacement/ Dead End Elimination	1, 2	TBD	8	8	Replace	1300	Varies		$300,000	$315,000	$300,000	$300,000	$300,000	$300,000	$300,000	Enterprise
Groundwater Wells																		
W-1	C	New Well (Winter Demand)	2, 3	TBD		750 gpm	New		$900,000	$900,000								Enterprise
W-2	C	Replacement Well	2, 4	TBD		750 gpm	Replace		$1,000,000						$1,000,000			Enterprise
W-3	C	New Well (Winter Demand)	2, 3	TBD		750 gpm	New		$1,000,000							$1,000,000		Enterprise
Ground Water Well Treatment																		
WT-1	P	Well 11 - Blending	1	Well 11			New		$1,500,000	$1,500,000								SRF
WT-2	P	Well 14 - Filtration	1	Well 14			New		$90,000	$90,000								SRF
WT-3	C	Well 14 - Filtration	1	Well 14			New		$800,000		$800,000							SRF
WT-4	C	Well 11 - Water Treatment	1	Well 11			New		$12,750,000	$12,750,000								IRWM
Surface Water Treatment																		
SW-1	C	Disinfection Renovation	1	Canal Turnout			Replace		$250,000	$250,000								Enterprise
SW-2	C	Pump Replacement	1	SWTP			Replace		$50,000	$50,000								Enterprise
SW-3	C	Filter Bank Renovations	1	SWTP			Replace		$800,000		$800,000							Enterprise
SW-4	C	Chemical Treatment Upgrade	1	Canal Turnout			Replace		$500,000		$500,000							Enterprise
SW-5	C	Turnout Upgrades	1	Canal Turnout			Replace		$750,000			$750,000						Enterprise
SW-6	P	Surface Water Storage	2, 3	TBD		10 Acres	New		$850,000			$850,000						IRWM
SW-7	C	Surface Water Storage	2, 3	TBD		100 AF	New		$2,150,000					$2,150,000				IRWM
Tank Improvements																		
T-1	C	Surge Tank Additions	1	TBD			New		$175,000			$175,000						Enterprise
T-2	C	Storage Tank Renovation	1	TBD			Replace		$250,000			$250,000						Enterprise
Totals										$15,840,000	$2,785,000	$2,340,000	$300,000	$2,450,000	$1,300,000	$1,300,000	$300,000	

Notes:
P = Planning Project
C = Construction Project
*** Project is to replace existing pipe to increase contact time, not due to pipeline failure.*
1 Project Listed in Existing Capital Improvement Plan.
2 Project Proposed for Inclusion in CIP; additional details in Water Feasibility Study.
3 Supply Projects are potentially interchangeable based on timing and demand needs.
4 Planned well replacement by the year 2030, as a result of reaching useful life expectancy. .

3.6.1 Pipeline Projects

The Draft CIP lists two pipeline projects, which are the planning and construction phases of a pipeline replacement project in Laurel Avenue in fiscal years (FY) 2013-14 and 2014-15, respectively.

The projects proposed as a result of this Study are listed in Table 3-11 and stem directly from the water model analysis conducted see (Figure 3-4). The projects are divided into two categories, Fire Flow and Pipeline Replacement Projects. The Fire Flow Projects are being proposed to assist in correcting pressure problems that limit the ability to meet minimum fire standards in certain areas. The Pipeline Replacement Projects are being proposed to replace old or undersized water mains or to complete loops in areas that limit system functionality.

Table 3-11: Pipeline Projects (From Water Model)

Project No.	Project Description	Project Limits	Project Specifics			
			Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)
Fire Flow Projects						
F-1	Replace existing undersized, old main	Sycamore Ave from Hickory St to Sierra View St	6	8	Replace	1,275
F-2	Replace existing undersized, old main	Laurel Ave from Hickory St to Sierra View St	4	6	Replace	1,275
F-3	Replace existing undersized, old main	Page Ave from Sierra View St north to end of cul-de-sac	4	6	Replace	630
F-4	Replace existing undersized, old main	Samoa St from Lafayette Ave to Sycamore Ave	6	8	Replace	525
F-5	Replace existing undersized, old main	Orange Ave from Tulare Rd to Hermosa St	4	8	Replace	675
F-6	Replace existing undersized, old main	Oxford Ave from Hermosa St to Samoa St	4	8	Replace	1,300
F-7	Install new main to complete loop	Behind shopping center near Hermosa St and Westwood Ave	---	8	New	180
F-8	Install new main to complete loop	Apia St along edge of Olive Grove Ball Park	---	8	New	380
F-9	Install new main to complete loop	Easement from Elmwood Ave to alley off Lewis St between Elmwood Ave and Mirage Ave	---	8	New	200
F-10	Relocate existing rear yard main to street ROW; complete loop	Homassel Ave from Tulare Rd to Hermosa St	8	8	Replace	1,625
Pipeline Replacement Projects						
P-1	Replace existing undersized, old main	Lafayette Ave from Sierra View St to Tulare Rd	4	6	Replace	1,300
P-2	Replace existing undersized, old main	Sycamore Ave from Sierra View St to Tulare Rd	4	6	Replace	1,300
P-3	Replace existing undersized, old main	Laurel Ave from Sierra View St to Tulare Rd	4	6	Replace	1,300
P-4	Replace existing undersized, old main	Page Ave from Sierra View St to Tulare Rd	4	6	Replace	1,300
P-5	Relocate existing rear yard main to street ROW and upsize	Lafayette Ave from Hermosa St to Tulare Rd	6	8	Replace	1,275
P-6	Relocate existing rear yard main to street ROW and upsize	Sycamore Ave from Hermosa St to Tulare Rd	6	8	Replace	1,250
P-7	Replace undersized main	Hermosa St from Lafayette Ave to Foothill Ave	6	8	Replace	1,350

3.6.1.1 Project Cost Estimates

Due to the conceptual nature of the proposed projects, an overall estimate for construction cost, contingency, design, and construction management has been prepared; detailed estimates should be prepared during the planning and design phases of each project. Based on past similar projects, a cost of $170 per lineal foot of water main has been used to determine the preliminary construction cost; this unit price is estimated to include all required items to fully install the pipe including material purchase, trench, compaction, roadway resurfacing and worker protections. These preliminary estimates are to provide the City with budgetary expectation. More detailed estimates will be required as the projects approach the design phase.

Table 3-12: Pipeline Projects Construction Cost

Project Name	Construction Cost	Construction Contingency (20%)	Engineering & Construction Management (15%)	Total Preliminary Cost Estimate
F-1	$216,800	$43,400	$32,500	$292,700
F-2	$216,800	$43,400	$32,500	$292,700
F-3	$107,100	$21,400	$16,100	$144,600
F-4	$89,300	$17,900	$13,400	$120,600
F-5	$114,800	$23,000	$17,200	$155,000
F-6	$221,000	$44,200	$33,200	$298,400
F-7	$30,600	$6,100	$4,600	$41,300
F-8	$64,600	$12,900	$9,700	$87,200
F-9	$34,000	$6,800	$5,100	$45,900
F-10	$276,300	$55,300	$41,400	$373,000
P-1	$221,000	$44,200	$33,200	$298,400
P-2	$221,000	$44,200	$33,200	$298,400
P-3	$221,000	$44,200	$33,200	$298,400
P-4	$221,000	$44,200	$33,200	$298,400
P-5	$229,500	$45,900	$34,400	$309,800
P-6	$216,800	$43,400	$32,500	$292,700
P-7	$212,500	$42,500	$31,900	$286,900
P-8	$229,500	$45,900	$34,400	$309,800

3.6.2 Groundwater Well Projects

Two types of groundwater well projects are proposed. The first is a new supply well to meet the City's demands. As shown in Table 3-6 and Figure 3-1, the City will need an additional well in 2014, or as soon as feasible, to meet current winter demands. Additional supply sources will be required in 2019 and 2024, likely; depending on per capita demand trends (see Section 3.2.2). These added supply sources can be

provided via additional groundwater wells or through additional surface water storage so surface water deliveries received spring through fall can be utilized during the winter months also; further discussion on the potential surface water storage project can be found in Section 3.6.4. The second type of groundwater well project is a replacement project. It is anticipated that within 5 years an existing well will reach the end of its serviceable life and require major rehabilitation or full replacement. These projects are all proposed as a result of this Study and are shown in Table 3-10.

3.6.2.1 Preliminary Engineer's Opinion of Probably Construction Cost

Preliminary construction costs have been prepared for each of these projects; however, during the planning and design process detailed cost estimates will be required and could possibly vary from the costs provided in Table 3-13.

Table 3-13: Groundwater Well Projects Construction Cost

Project Name	Project Description	Construction Cost	Construction Contingency (20%)	Engineering & Construction Management (15%)	Total Preliminary Cost Opinion
W-1	New Supply Well	$650,000	$130,000	$120,000	$900,000
W-2	Well Replacement	$725,000	$145,000	$130,000	$1,000,000
W-3	New Supply Well	$725,000	$145,000	$130,000	$1,000,000

3.6.3 Groundwater Well Treatment Projects

The Draft CIP lists four groundwater well treatment projects, two for planning and two for construction, as shown in Table 3-10. The Planning and Construction phases for Well 11 Blending and Treatment are anticipated in occur in FY 2013-2014 and rely on SRF and/or IRWM funding sources to be initiated. The Planning and Construction phases for Well 14 Filtration are anticipated in FY 2013-14 and 2014-15, respectively; they also are dependent on SRF funding sources.

No additional groundwater well treatment projects are being proposed as a result of this Study.

3.6.4 Surface Water Treatment Projects

The Draft CIP lists five surface water treatment projects, all are construction projects, as shown in Table 3-10. These projects are anticipated to occur in FY 2013-14 through 2015-16.

As a result of this Study, one additional project is being recommended and consists of planning and construction phases. The project is Surface Water Storage and would provide the additional supply that is recommended by 2019. This additional supply need could be met via an additional groundwater well. However, the well option would not provide the additional efficiency improvements such as backwash water recovery that the surface water treatment plant operations could receive together with the addition to the surface water storage.

Additional surface water storage and backwash water recovery could be provided by constructing a levee and excavating a basin. There are several properties between the canal turnout structure on the Friant Kern Canal and the SWTP that could be purchased for this purpose. An exhibit showing a possible configuration of the storage basin is shown in Appendix B.

3.6.4.1 Project Cost Estimates

Preliminary construction costs have been prepared for this project; however, during the planning and design process, detailed cost estimates will be required and could possibly vary from the costs provided in Table 3-14.

Table 3-14: Surface Water Treatment Projects Construction Cost

Project Name	Project Description	Construction Cost	Construction Contingency (20%)	Engineering & Construction Management (15%)	Total Preliminary Cost Estimate
SW-6	Surface Water Storage (Planning)	--	--	--	$850,000[1]
SW-7	Surface Water Storage (Construction)	$1,550,000	$320,000	$280,000	$2,150,000

[1] Includes CEQA preparation.

3.6.5 Tank Improvement Projects

The Draft CIP lists two tank improvement projects, one for surge tank additions and one for renovations to the storage tank. Both projects are planned for FY 2015-16.

No new tank improvement projects are being proposed as a result of this Study.

3.7 Other Factors Affecting the Water System

The Social-Economic factors described below are intended to highlight a few topics that may have a current or future impact to the water system, and provide the City additional awareness and information.

3.7.1 Socio-Economic Factors

The community of Lindsay has a median household income (MHI) of $29,750[4] and is therefore considered a Disadvantaged Community (DAC)[5]. Additionally, DWR recognizes an 'affordability level' for services such as water, which is 1.5% of the community's MHI. This equates to approximately $37.19 per month as the upper limit of what water services should cost to be considered affordable. Utilizing the average water demand of 185 gpcd and an average household size of 3.87, as discussed above, the

[4] 2007-2011 American Community Survey 5-Year Estimates
[5] A DAC is identified as any community with an MHI less than 80% of the Statewide MHI. The DAC threshold is currently $48,706, as defined by DWR.

calculated average water use for a household is 21,777 gallons per month or 2,911 cubic feet (cf). The City charges $19.97[6] for the first 500cf and $1.02 per subsequent 100cf; this equates to an average household water bill of $44.57[7] per month, which is 1.8% of the community's MHI.

It is pertinent to understand why the monthly cost is relatively high as compared with MHI. This region has significantly limited and unreliable groundwater. Most of the groundwater has some form of contamination making the groundwater source unreliable. Therefore, the City has to rely on providing treated surface water which is substantially more costly than providing groundwater, and is the major contributor to the higher cost for water in the City.

3.7.2 Water Supply

As previously discussed, the City relies jointly on surface water and groundwater. There are substantial issues that affect both water supplies; however, the City relies on surface water as much as possible due to groundwater quality issues (discussed in Section 3.7.3) and overdraft concerns in the region as a whole. Surface water has had an increase in frequency of reduced allocations due to climate and restoration flows to the San Joaquin River.

The City's contracted allocation allows for them to receive as much as 2,500 acre-feet per year (afy), however, USBR maintains the right to reduce the allocation annually based on climate conditions (i.e. how much snowpack is in the Sierra Nevada mountains) and the amount of water permitted to flow to the San Joaquin River, based on the criteria set forth in the 2006 settlement agreement.

In the years between 1977 and 2006, the average annual allocation was 98%; however, in recent years between 2007 and 2013, the average allocation was 81%. The last two years have each seen a 50% reduction, due to low seasonal rainfall the region has experienced. The San Joaquin River Restoration has a varying effect on the allocation, ranging from 0% to 20% reduction, based on the water year classification. Figure 3-5 shows the historical allocation to the City of Lindsay and Table 3-15 shows the percent reduction experienced by the City due to the San Joaquin River Restoration. Table 3-16 illustrates the summer months supply during periods of surface water allocation reduction, accounting for only the present groundwater supply sources.

[6] For a 5/8" or 3/4" meter size; 1" meters have a base rate of $27.53 for the first 500 cf.
[7] Average monthly bill for a household with a 1" service is $54.69; 2.2% of the community's MHI

Figure 3-5: Historical USBR Allocation

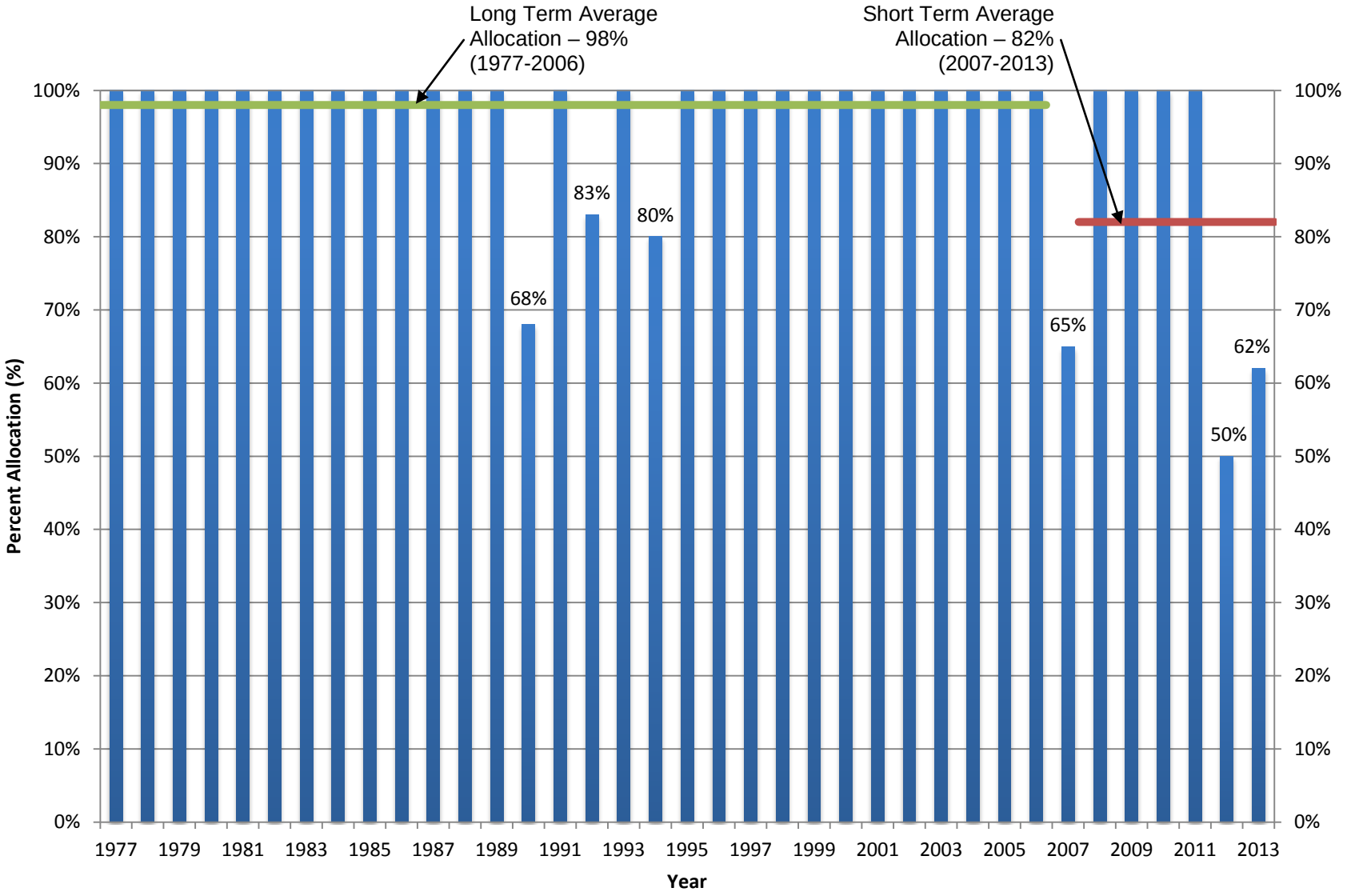


Table 3-15: Reduced USBR Allocation Due to San Joaquin River Restoration

Water Year Classification	Reduction	
	(afy)	(%)
Wet	0	0%
Normal-wet	0	0%
Normal-dry	195	8%
Dry	510	20%
Critical-High	430	17%
Critical-Low	130	5%

Table 3-16: Reduced Summer Months Supply

Reduced Summer Months Supply[1]		
	(MGD)	**(gpm)**
Firm Capacity[2]	3.82	2,475
Total Capacity	5.29	3,675

Notes:
1 Accounts for 50% Allocation in Surface Water Supply
2 Excludes Well 15 (largest capacity well) for maintenance, water quality or other scenarios.

3.7.3 Water Quality

The City has several existing groundwater quality issues they are contending with, including DBCP, Perchlorate and nitrate contaminations.

- Well 14 is currently active but has had exceedances of the Maximum Contaminant Level (MCL) for DBCP, on the City plans to install a Granular Active Carbon (GAC) treatment system to reduce the level of DBCP in the supply to achieve consistent MCL compliance.
- Well 15 has experienced positive results for coliform and, as a result, the City has issued “Boil Water” advisories for users in close proximity to this supply source. The City intends to add additional piping, as shown in Table 3-10, to increase chlorine contact time to alleviate this problem.
- Well 11 is inactive due to exceedances of the MCL for Perchlorate. The well will remain on inactive ‘emergency use only’ status until a proposed project to blend the water to reduce the Perchlorate to below the MCL level is funded and implemented.

In addition to existing water quality concerns, there are several contaminants that may become critical in the near future.

- Hexavalent Chromium (Cr6) does not have a primary MCL; however it is regulated under the total chromium MCL. In July, 2011, the Office of Environmental Health Hazard Assessment (OEHHA) established a Public Health

Goal (PHG) for Cr6 at 0.02 µg/L. The availability of a PHG for the constituent allows OEHHA to initiate the MCL process to be initiated. A draft MCL for Cr6 is anticipated in 2013. Depending on the adopted MCL, there may be an impact to City wells potential treatment methods include reverse osmosis or ion exchange.

- 1,2,3-Trichloropropane (1,2,3-TCP) does not have a primary MCL; however a PHG of 0.0007 µg/L was established in 2009, which allowed OEHHA to initiate the process of establishing an MCL. OEHHA anticipates having a draft MCL for public comment available in 2014. 1,2,3-TCP and DBCP are often found together, therefore it is anticipated that, given the City's history of DBCP MCL exceedances, there may be an impact to City wells once the MCL is established.
- Disinfection Byproducts (DBPs), as discussed in Section 3.3.1, are found in varying concentrations. Currently, the City is not in violation for DBPs due to the practice of averaging the concentrations across the entire system; however, Stage 2 regulations will require that each individual well location and the SWTP meet the MCL. Without modifications to the system, it is likely certain areas will be out of compliance.

APPENDIX