SEPTEMBER 2017

FINAL

City of Hanford

Water System Master Plan

AKEL
ENGINEERING GROUP, INC.

ADOPTION RESOLUTION

AKEL
ENGINEERING GROUP, INC.

RESOLUTION NO. 17-55-R

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF HANFORD
ADOPTING THE HANFORD WATER SYSTEM MASTER PLAN, DATED SEPTEMBER 2017

At a regular meeting of the City Council of the City of Hanford, duly called and held on November 7, 2017 at 7:00 P.M., it was moved by Council Member Sorensen, and seconded by Council Member Mendes, and duly carried that the following resolution be adopted:

WHEREAS, to ensure that water system facilities are properly planned and constructed, the City of Hanford contracted with the consulting firms of Quad Knopf, Inc. and Zumwalt-Hansen & Associates to develop a Water System Master Plan to facilitate future urban growth; and

WHEREAS, the firms of Quad Knopf, Inc., and Zumwalt-Hansen & Associates, subcontracted with the firm of Akel Engineering Group, Inc., to prepare the Water System Master Plan and related studies; and

WHEREAS, the Water System Master Plan Report is organized in eight sections (1) Introduction; (2) Planning Area Characteristics; (3) System Performance and Design Criteria; (4) Existing Domestic Water Facilities; (5) Water Demands and Supply Characteristics; (6) Hydraulic Model Development; (7) Evaluation and Proposed Improvements: (8) Capital Improvement Program; and

WHEREAS, the Land Use Element, and the Public Facilities Element of the 2035 Hanford General Plan, adopted on April 24, 2017 by Resolution 17-21-R, provide specific statements supporting the development and implementation of a Water System Master Plan for planned urban growth; and

WHEREAS, THE City Council of the City of Hanford has determined that the proposed Water System Master Plan will incorporate and implement the new policies and concepts established in the adopted 2035 Hanford General Plan and is necessary for planned urban growth and development in the City of Hanford consistent with the 2035 General plan.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Hanford has determined that as a result of the proposed Master Plan, no new effects could occur, or new mitigation measures would be required that have not been addressed within the scope of the certified Environmental

Impact Report (SCH No. 2015041024) prepared for the 2035 General Plan Update. The Environmental Impact Report prepared for the 2035 General Plan was certified by Resolution 17-20-R, adopted on April 24, 2017, which included a Statement of Overriding Considerations and a Mitigation and Monitoring Program, herein incorporated by reference. The Program Environmental Impact Report adequately analyzed and addressed the Water System Master Plan.

NOW, THEREFORE, BE IT FURTHER RESOLVED that the City Council of the City of Hanford hereby adopts the Water System Master Plan dated September 2017.

This Resolution supersedes Resolution No. 96-60-R adopted November 19, 1996.

PASSED, ADOPTED, and APPROVED this 7th day of November, 2017, by the following vote:

AYES: Sue Sorensen, Justin Mendes, Francisco Ramirez, Morton Devine, David Ayers

NOES: ———

ABSTAIN: ———

ABSENT: ———

DAVID G. AYERS,
MAYOR of the City of Hanford

ATTEST:
JENNIFER GOMEZ,
CITY CLERK

STATE OF CALIFORNIA)
COUNTY OF KINGS) ss
CITY OF HANFORD)

I, JENNIFER GOMEZ, City Clerk of the City of Hanford, do hereby certify the foregoing Resolution was duly passed and adopted by the City Council of the City of Hanford at a regular meeting thereof held on the 7th day of November, 2017.

Dated: November 8, 2017

JENNIFER GOMEZ,
CITY CLERK

CITY OF HANFORD

2017

WATER SYSTEM MASTER PLAN

Final

September 2017

AKEL
ENGINEERING GROUP, INC.

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Smart Planning Our Water Resources

September 29, 2017

City of Hanford
319 Douty Street
Hanford CA, 93230

Attention: Lou Camara, P.E.
Director of Public Works

Subject: 2017 Water System Master Plan – Final Report

Dear Lou:

We are pleased to submit the final report for the City of Hanford Water System Master Plan. This master plan is a standalone document, though it was prepared as part of the integrated infrastructure master plans for the water, sewer, and storm drainage master plans. The master plan documents the following:

- Existing distribution system facilities, acceptable hydraulic performance criteria, and projected water demands consistent with the Planned Area Boundary
- Development and update of the City's GIS-based hydraulic water model.
- Capacity evaluation of the existing water system with improvements to mitigate existing deficiencies and to accommodate future growth.
- Capital Improvement Program (CIP) with an opinion of probable construction costs and suggestions for cost allocations to meet AB 1600.

We extend our thanks to you; John Doyel, Director of Public Utilities / City Engineer; Darlene Mata, Community Development Director; and other City staff whose courtesy and cooperation were valuable components in completing this study.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
Principal

Enclosure: Report

7433 N. FIRST STREET, SUITE 103 • FRESNO, CALIFORNIA 93720 • (559) 436-0600 • FAX (559) 436-0622
www.akeleng.com

Acknowledgements

City Council

David Ayers, Mayor

Sue Sorensen, Vice Mayor

Martin Devine

Francisco Ramirez

Justin Mendes

Management Personnel

Lou Camara, Director of Public Works

John Doyel, Director of Public Utilities / City Engineer

Darlene Mata, Community Development Director

Mike Cosenza, Utilities Superintendent

Other City Engineering, Planning, and Operations Staff

City of Hanford
Water System Master Plan

Table of Contents

Table of Contents

Table of Contents

FIGURES

TABLES

Table of Contents

APPENDICES

EXECUTIVE SUMMARY

This executive summary presents a brief background of the City's water distribution system, the planning area characteristics, the system performance and design criteria, the hydraulic model, and a capital improvement program.

The hydraulic model was used to evaluate the capacity adequacy of the existing distribution system and for recommending improvements to mitigate existing deficiencies, as well as servicing future growth. The prioritized capital improvement program accounts for growth throughout the Hanford Planning Area.

ES.1 STUDY OBJECTIVES

The City of Hanford recognizes the importance of planning, developing, and financing system facilities to provide reliable water service to existing customers and for servicing anticipated growth within the Hanford Planning Area, the City initiated the preparation of the 2017 Water System Master Plan (WSMP).

City Council approved Akel Engineering Group Inc. to prepare this master plan in November of 2013. This 2017 WSMP is intended to serve as a tool for planning and phasing the construction of future domestic water system infrastructure for the projected buildout of the City of Hanford. The 2017 WSMP evaluates the City's water system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the City.

The planning boundary and horizon for the master plan were developed in accordance with the City's recently adopted General Plan. Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan included the following tasks:

- Summarize the City's existing domestic water system facilities.
- Document growth planning assumptions and known future developments.
- Update the domestic water system performance criteria.
- Project future domestic water demands.
- Update the hydraulic model using available data.
- Evaluate the domestic water facilities to meet existing and projected demand requirements and fire flows.
- Perform a capacity analysis for major distribution mains.

- Perform a fire flow analysis.
- Recommend a capital improvement program (CIP) with an opinion of probable costs.
- Perform a capacity allocation analysis for cost sharing purposes.
- Develop a 2017 Water System Master Plan report.

ES.2 INTEGRATED APPROACH TO MASTER PLANNING

The City implemented an integrated master planning approach and contracted the services of Akel Engineering Group to prepare the following documents:

- Water System Master Plan
- Sewer System Master Plan
- Storm Drainage System Master Plan

While each of these reports is published as a standalone document, they have been coordinated for consistency with the City's General Plan. Additionally, each document has been cross referenced to reflect relevant analysis results with the other documents.

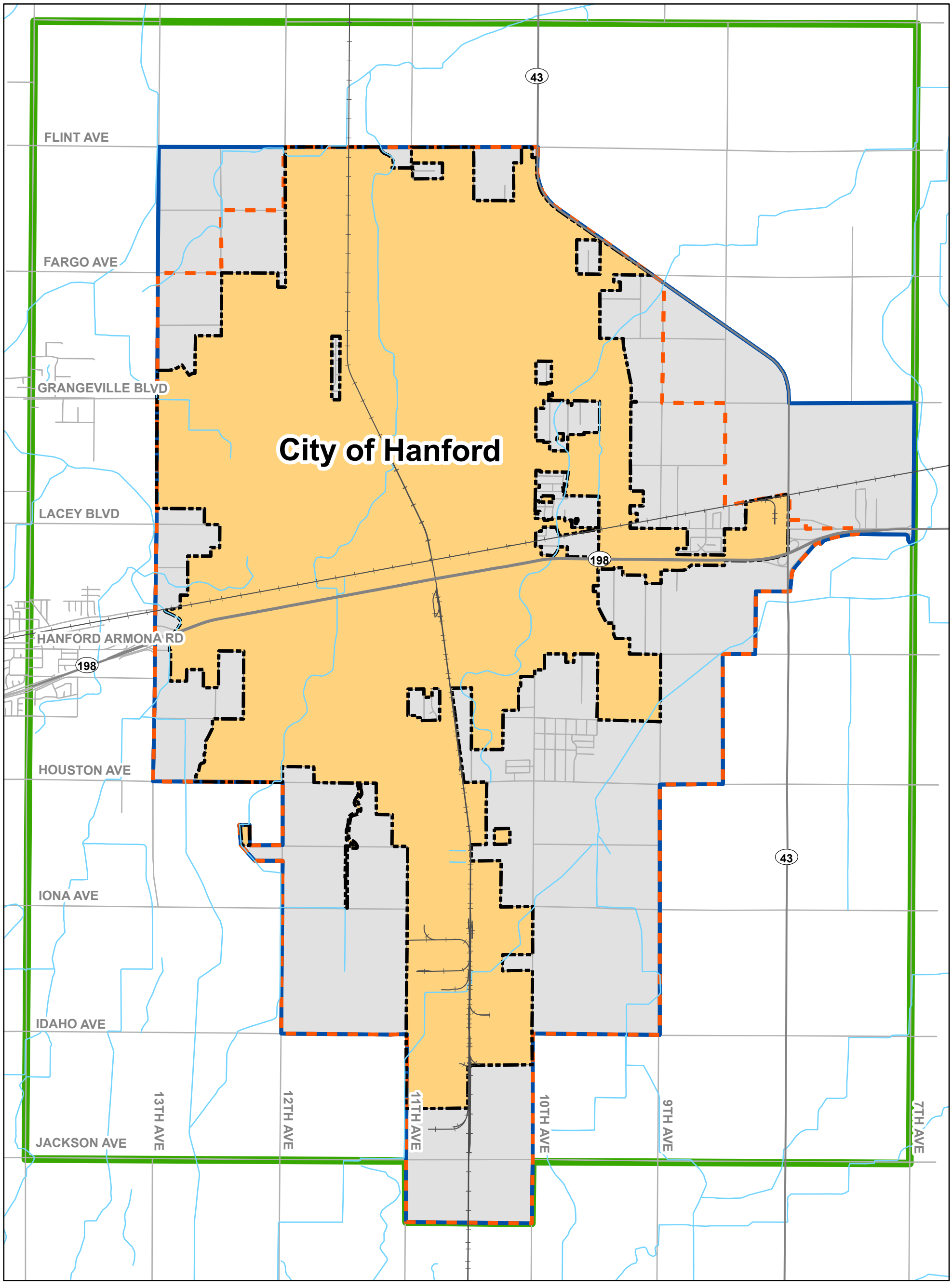
ES.3 STUDY AREA DESCRIPTION

The City is located in Kings County, approximately 30 miles southeast of the City of Fresno and 20 miles west of the City of Visalia (**Figure ES.1**). The City's closest neighbor, the City of Lemoore, is located 8 miles to the west. Highway 198 bisects the southern boundary of the City in the east-west direction, while Highway 43 is adjacent to the City's eastern boundary. In 2002, the City outlined the long-term Urban Growth Boundary (UGB), which was approved by City Council, and identified lands intended for future urbanization within the City service area.

The City operates and maintains a domestic water system that covers the majority of the area within the City Limits. Currently, water is supplied to the City's customers via groundwater wells located throughout the City.

ES.4 SYSTEM PERFORMANCE AND DESIGN CRITERIA

This report documents the City's performance and design criteria that were used for evaluating the domestic water system. The system performance and design criteria are used to establish guidelines for determining future water demands, evaluating existing domestic water facilities, and for sizing future facilities. **Table ES.1** documents the system performance and design criteria for the domestic water system. This criterion was used in the capacity evaluation and for sizing recommended improvements.



Legend

- Streets
- Waterways
- City Limits
- 2035 Growth Boundary
- Planned Area Boundary
- General Plan Study Area Boundary

N W GIS E S

0 0.25 0.5 1 Mile

Update: September 1, 2016

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AKEL ENGINEERING GROUP, INC.

ES. 1
Planning Area
Water System Master Plan
City of Hanford

Table ES.1 Planning and Design Criteria
Water System Master Plan
City of Hanford

Design Parameter	Criteria		
Supply	Supply to meet the greater of Maximum Day Demands plus Fire Flows or Peak Hour Demands		
	Firm capacity excludes largest well for possible maintenance and emergency		
Storage	Underground Aquifer with Adequate Power Generators at Wells		
	Main Pressure Zone: 25% of Maximum Day Demand		
	Industrial Pressure Zone: 14% of Maximum Day Demand + 3,500 gpm for 3 hours		
Distribution Mains	Distribution mains should be designed to meet the greater of:		
	1) Peak Hour Demand, or 2) Maximum Day Demand + Fire Flow		
	Criteria for existing and future pipelines include:		
	Maximum Pipeline Velocity: 10 feet per second (ft/sec)		
	Maximum Desirable Headloss: 8 feet per 1,000 feet (ft/kft)		
	Minimum pipe size of 8-inches for future		
Service Pressures	Maximum System Pressure	80 psi	
	Minimum Pressure during Maximum Day Demand	40 psi	
	Minimum Pressure during Peak Hour	30 psi	
	Minimum Residual Pressure (Fire Flow)	20 psi	
	Industrial Area Recommended Pressure	80 psi	
Demand Peaking Factors	**Main Pressure Zone**		
	Maximum Day Demand	1.75 x Average Day Demand	
	Peak Hour Demand	2.50 x Average Day Demand	
	Industrial Pressure Zone		
	Maximum Day Demand	2.00 x Average Day Demand	
	Peak Hour Demand	2.78 x Average Day Demand	
Fire Flows	Residential – Existing development	1,000 gpm for 2 hours	
	Residential – Recent and future developments	1,500 gpm for 2 hours	
	Commercial – Recent and future developments	2,500 gpm for 3 hours	
	Commercial – Older developments near downtown	3,000 gpm for 3 hours	
	Industrial – Recent and future developments	3,000 gpm for 3 hours	
	Industrial – Industrial park	3,500 gpm for 3 hours	
Urban Water Use Targets	2010 Baseline	215	gpdc
2015 Urban Water Management Plan	2015 Interim Target	197	gpdc
	2020 Target	179	gpdc
Demand Coefficients	Land Use Category	2016 WSMP (gpd/net acre)	
	Residential		
	Low Density Residential	1,810	gpd/acre
	Medium Density Residential	2,450	gpd/acre
	High Density Residential	3,260	gpd/acre
	Mixed Use		
	Office Residential	1,710	gpd/acre
	Neighborhood Mixed Use	1,550	gpd/acre
	Corridor Mixed Use	1,100	gpd/acre
	Downtown Mixed Use	3,510	gpd/acre
	Non-Residential		
	Neighborhood Commercial	650	gpd/acre
	Regional Commercial	820	gpd/acre
	Service Commercial	530	gpd/acre
	Highway Commercial	650	gpd/acre
	Office	1,060	gpd/acre
	Public Facilities	530	gpd/acre
	Light Industrial	610	gpd/acre
	Heavy Industrial	690	gpd/acre
	Educational Facilities	1,630	gpd/acre
	Open Space	2,690	gpd/acre

ES.5 EXISTING WATER SYSTEM OVERVIEW

The City's municipal water system consists of 14 active groundwater wells, 3 storage reservoirs that have a cumulative capacity of 3.50 MG, distribution mains, and fire hydrants. The City's generally flat topography slopes from northeast to southwest from approximately 255 feet in the northeast to approximately 225 feet in the southwest. With this generally flat topography, the City operates two pressure zones, with the primary pressure zone covering areas north of the Kings Industrial park and the remaining pressure zone serving the Kings Industrial park, located south of Iona Avenue.

The City's existing domestic water distribution system is shown in **Figure ES.2**, which displays the existing system by pipe sizes. This figure provides a general color coding for the distribution mains, as well as labeling the existing wells and the storage reservoir.

ES.6 EXISTING AND FUTURE DOMESTIC WATER DEMANDS

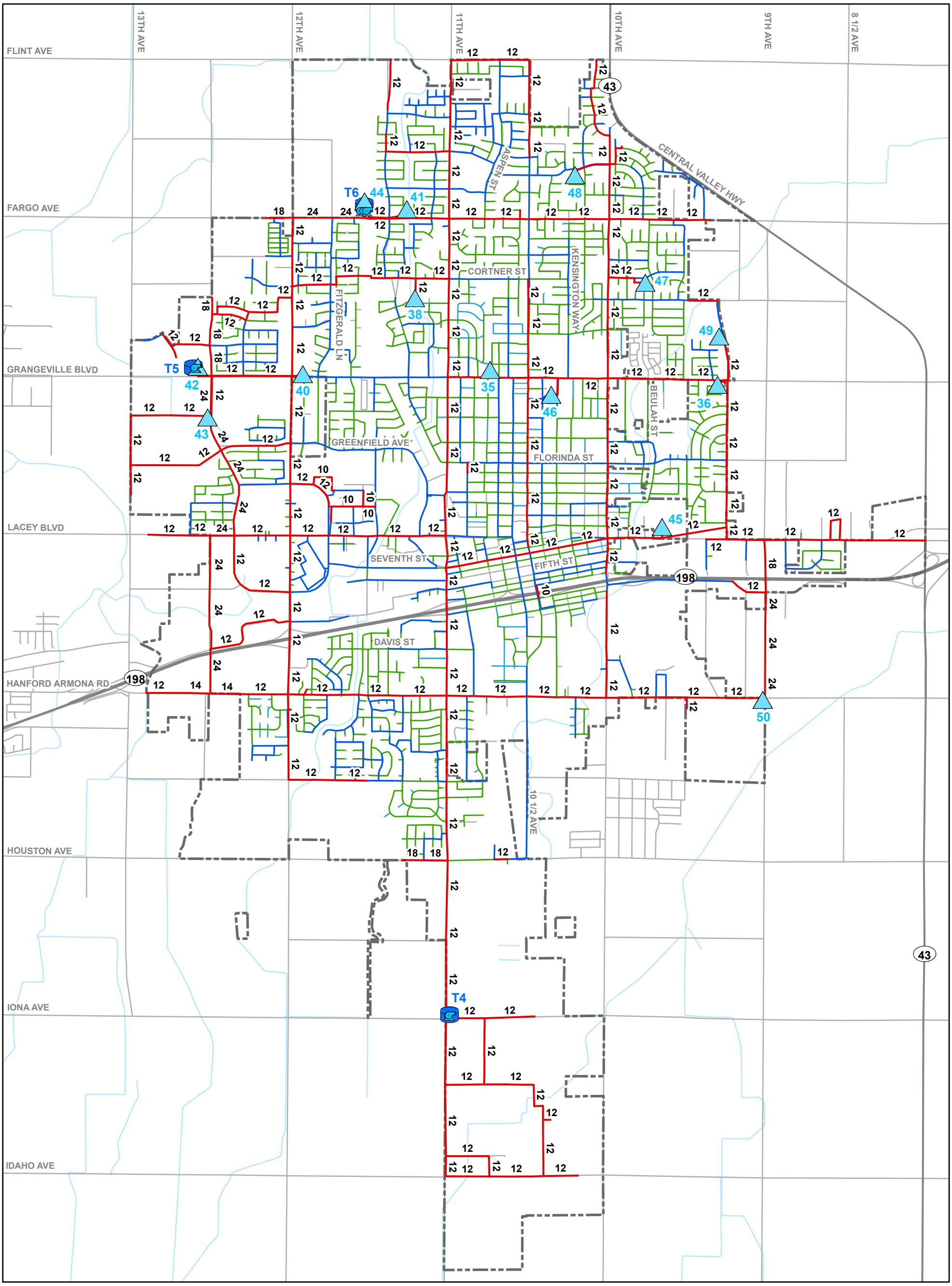
The existing demand distribution was obtained from the water billing records. Using GIS, each customer account was associated with parcel for the account and spatially joined to location in the hydraulic model representing the service location. The City's 2013 the average daily production was calculated at 12.1 MGD.

Future demands were projected using the unit factors discussed in a previous chapter for residential and non-residential land uses and for development in the Planned Area Boundary. **Table ES.2** organizes the future land use categories and their corresponding domestic water demands. The average day domestic water demands from existing and future developments is calculated at 22.3 MGD. These demands were used in sizing the future infrastructure facilities, including transmission mains, storage reservoirs, and pump stations. Demands were also used for allocating and reserving capacities in the existing or proposed facilities.

ES.7 HYDRAULIC MODEL DEVELOPMENT

Hydraulic network analysis has become an effectively powerful tool in many aspects of water distribution planning, design, operation, management, emergency response planning, system reliability analysis, fire flow analysis, and water quality evaluations. The City's hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

The City's previous model was developed using the Environmental Protection Agency's EPANET, which allows the use of a single modeling scenario, and basic simulation options for steady-state and extended period simulations. As part of this master plan, the hydraulic model has been updated and redeveloped into the GIS-based hydraulic model InfoWater by Innovyze. The model



Legend

Existing System

- Tanks
- Wells
- Pump Stations

Pipes By Size

- 4" and Smaller
- 6"
- 8"
- 10" and Larger

- City Limits
- Streets
- Highways
- Waterways

Update: June 27, 2017

0 0.25 0.5 1 Mile

N W GIS E S

ES. 2
Existing System by Pipe Sizes
Water System Master Plan
City of Hanford

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Table ES.2 Average Daily Water Demands
Water System Master Plan
City of Hanford

Land Use Classifications	Buildout Water Demands											
	Existing Development			Future Development to be Serviced within Planned Area Boundary								
	Within Service Area			Within Service Area			Planned Area Boundary				Total	
	Existing Development (net acre)	Water Unit Factor (gpd/net acre)	Average Daily Demand (gpd)	New Development (net acre)	Future Water Unit Factor (gpd/net acre)	Average Daily Demand (gpd)	Existing Development (net acre)	New Development (net acre)	Future Water Unit Factor (gpd/net acre)	Average Daily Demand (gpd)	Total Development within PAB (net acre)	Average Daily Demand (gpd)
Residential												
Low Density	2,837	1,900	5,390,015	1,026	1,900	1,949,510	539	1,401	1,900	3,687,132	5,804	11,026,658
Medium Density	498	2,240	1,115,209	225	2,240	504,025	35	312	2,240	777,612	1,070	2,396,845
High Density	84	3,100	261,950	73	3,100	227,202	0	64	3,100	198,130	222	687,282
Subtotal Residential	3,419		6,767,174	1,324		2,680,737	574	1,777		4,662,874	7,095	14,110,785
Mixed Use												
Office Residential	89	1,800	159,750	25	1,800	45,144	0	0	1,800	0	114	204,894
Neighborhood Mixed Use	12	1,450	17,951	42	1,450	60,656	0	15	1,450	22,407	70	101,014
Corridor Mixed Use	250	1,060	265,467	225	1,060	238,707	10	3	1,060	14,098	489	518,272
Downtown Mixed Use	81	3,430	276,218	42	3,430	145,363	0	0	3,430	0	123	421,581
Subtotal Mixed Use	432		719,386	334		489,871	10	18		36,505	795	1,245,762
Non-Residential												
Neighborhood Commercial	27	660	17,886	26	660	17,198	8	12	660	13,114	73	48,198
Regional Commercial	216	820	177,327	160	820	130,833	18	169	820	153,962	564	462,121
Service Commercial	103	530	54,325	54	530	28,397	56	63	530	63,048	275	145,771
Highway Commercial	48	660	31,416	68	660	44,609	16	16	660	21,193	147	97,218
Office	88	1,060	93,503	30	1,060	32,213	0	0	1,060	0	119	125,716
Light Industrial	105	610	64,209	61	610	36,911	83	557	610	390,449	806	491,569
Heavy Industrial	376	690	259,212	568	690	391,672	211	2,607	690	1,944,041	3,761	2,594,924
Airport Protection	0	0	0	125	0	0	111	563	0	0	799	0
Educational Facilities	445	1,630	725,872	117	1,630	190,123	11	97	1,630	175,078	669	1,091,073
Public Facilities	438	530	232,193	56	530	29,675	3	13	530	8,454	510	270,321
Open Space with Irrigation	16	2,690	42,314	45	2,690	119,866	0	121	2,690	326,674	182	488,854
Open Space without Irrigation	346	0	0	65	0	0	41	54	0	0	507	0
Interest Area	0	1,800	0	0	1,800	0	49	552	1,800	1,082,466	601	1,082,466
Subtotal Non-Residential	2,208		1,698,255	1,372		1,021,497	607	4,825		4,178,477	9,012	6,898,230
Totals	6,059		**9,184,815**	3,031		4,192,105	1,192	6,621		8,877,856	16,903	**22,254,777**

has an intuitive graphical interface and is directly integrated with ESRI's ArcGIS (GIS), providing a useful modeling tool linked to the newly developed City GIS.

ES.8 FIRE FLOW ANALYSIS

The fire flow analysis consisted of using the maximum day demand in the hydraulic model and applying hypothetical fire flows. The magnitude and duration of each fire flow was based on the governing land use type within proximity to the fire location. The criterion for fire flows was also summarized in the System Performance and Design Criteria chapter. The hydraulic model indicates that the City's existing distribution system performed adequately during the fire flow analysis, with the exceptions noted in the Evaluation and Proposed Improvements Chapter.

ES.9 STORAGE AND SUPPLY EVALUATION

The existing and future supply requirements were evaluated in accordance with the City's System Performance and Design Criteria. Based on the City's existing firm groundwater well capacity, the City is capable of meeting the existing maximum day demand; based on the anticipated future growth, the City will be required to construct 11 new wells by the buildout horizon of the Master Plan.

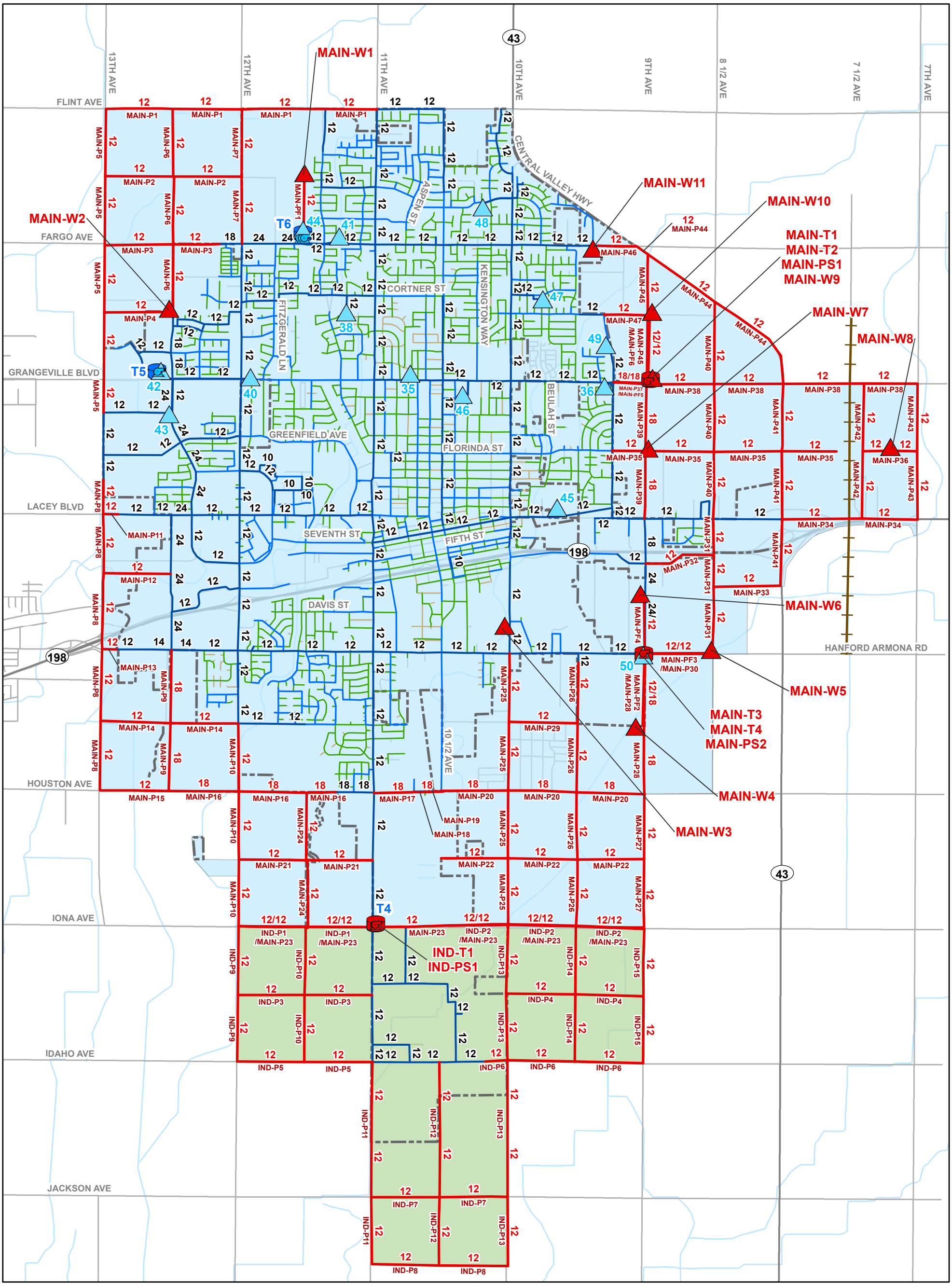
Existing storage requirements were identified for the City's two pressure zones and included the operational and fire storage components. The total City-wide required storage for existing domestic water demands is calculated at 5.8 MG. Future storage requirements were identified based on the anticipated future growth and will require an additional 5.4 MG of operational storage capacity.

ES.10 CAPITAL IMPROVEMENT PROGRAM

The Capital Improvement Program costs for the projects identified in this master plan for mitigating existing system deficiencies and for serving anticipated future growth throughout the City are summarized on **Table ES.3** and are graphically represented on **Figure ES.3**.

The estimated construction costs include the baseline costs plus **15 percent** contingency allowance to account for unforeseen events and unknown field conditions. Capital improvement costs include the estimated construction costs plus **15 percent** project-related costs (engineering design, project administration, construction management and inspection, and legal costs).

The costs in this Water System Master Plan were benchmarked using a 20-City national average Engineering News Record (ENR) Construction Cost Index (CCI) of 10,532, reflecting a date of January 2017. In total, the CIP includes approximately 70 miles of pipeline improvements, 11 new wells, five new storage reservoirs, and three new booster stations, with a project cost totaling over $95.2 million dollars.



Legend

Proposed Improvements
- Tanks
- Wells
- Pump Stations
- Pipes
- High Speed Rail Alignment

Pressure Zones
- Main
- Industrial Park

Existing System
- Tanks
- Wells
- Pump Stations

Pipes By Size
- 4" and Smaller
- 6"
- 8"
- 10" and Larger

- City Limits
- Streets
- Highways
- Waterways

Update: June 27, 2017

0 0.25 0.5 1 Mile

N W E S

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ES. 3
Capital Improvement Program
Water System Master Plan
City of Hanford

Table ES.3 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements		Infrastructure Costs							Capital Improvement Costs				Suggested Cost Allocation		Cost Allocation	
				Existing Diameter (in)	New/Parallel/ Replace	Diameter (in)	Length (ft)	Number of Casings[1] Railroad	Highway	Canal/Slough	Unit Cost[2] ($/unit)	Infr. Cost ($)	Baseline Construction Costs ($)	Estimated Construction Costs[3] ($)	Land Acquisition Costs[4] ($)	Capital Improvement Costs[5] ($)	Existing Users (%)	Future Users (%)	Existing Users ($)	Future Users ($)
Pipeline Improvements																				
Main Pressure Zone																				
MAIN-P1	Pipeline	Flint Ave	From 11th Ave to 13th Ave	-	New	12	10,600	1		2	83	1,306,372	1,306,372	1,502,327		1,727,677	0%	100%	0	1,727,677
MAIN-P2	Pipeline	ROW	From approx 12th Ave to 13th Ave	-	New	12	5,350			1	83	586,956	586,956	674,999		776,249	0%	100%	0	776,249
MAIN-P3	Pipeline	Fargo Ave	From approx 270 ft w/o Corvina Pl to 13th Ave	-	New	12	4,475			1	83	513,986	513,986	591,084		679,747	0%	100%	0	679,747
MAIN-P4	Pipeline	ROW	From Centennial Dr to 13th Ave	-	New	12	2,700				83	225,163	225,163	258,937		297,778	0%	100%	0	297,778
MAIN-P5	Pipeline	13th Ave	From Flint Ave to approx 1,300 ft s/o Grangeville Blvd	-	New	12	11,900			2	83	1,273,983	1,273,983	1,465,081		1,684,843	0%	100%	0	1,684,843
MAIN-P6	Pipeline	Centennial Dr	From Flint Ave to approx 2,600 ft n/o Grangeville Blvd	-	New	12	7,975			2	83	946,664	946,664	1,088,663		1,251,963	0%	100%	0	1,251,963
MAIN-P7	Pipeline	12th Ave	From Flint Ave to Fargo Ave	-	New	12	5,275			1	83	580,701	580,701	667,806		767,977	0%	100%	0	767,977
MAIN-P8	Pipeline	13th Ave	From approx 1,350 ft n/o Lacey Blvd to Houston Ave	-	New	12	12,200		1	3	83	1,862,201	1,862,201	2,141,532		2,462,761	0%	100%	0	2,462,761
MAIN-P9	Pipeline	12 1/2 Ave	From Hanford Armona Rd to Houston Ave	-	New	18	5,525				159	880,543	880,543	1,012,625		1,164,519	40%	60%	465,807	698,711
MAIN-P10	Pipeline	12th Ave	From Hume Ave to Iona Ave	-	New	12	7,950			1	83	803,779	803,779	924,346		1,062,997	0%	100%	0	1,062,997
MAIN-P11	Pipeline	Lacey Blvd	From approx 600 ft e/o 13th Ave to 13th Ave	-	New	12	600				83	50,036	50,036	57,542		66,173	0%	100%	0	66,173
MAIN-P12	Pipeline	ROW	From 12 1/2 Ave to 13th Ave	-	New	12	2,625				83	218,908	218,908	251,744		289,506	0%	100%	0	289,506
MAIN-P13	Pipeline	Hanford Armona Rd	From approx 600 ft e/o 13th Ave to 13th Ave	-	New	12	575				83	47,951	47,951	55,144		63,416	0%	100%	0	63,416
MAIN-P14	Pipeline	Hume Ave	From 12th Ave to 13th Ave	-	New	12	5,400				83	450,325	450,325	517,874		595,555	0%	100%	0	595,555
MAIN-P15	Pipeline	Houston Ave	From approx 12 1/2 Ave to 13th Ave	-	New	12	2,700			1	83	365,963	365,963	420,857		483,986	40%	60%	193,594	290,391
MAIN-P16	Pipeline	Houston Ave	From 12 1/2 Ave to approx 700 ft w/o Courtright Dr	-	New	18	6,525			2	159	1,374,318	1,374,318	1,580,465		1,817,535	40%	60%	727,014	1,090,521
MAIN-P17	Pipeline	Houston Ave	From 11th Ave to approx 1,600 ft e/o 11th Ave	6	Replace	18	1,600				159	254,999	254,999	293,249		337,236	40%	60%	134,894	202,342
MAIN-P18	Pipeline	Houston Ave	From approx 1,600 ft e/o 11th Ave to approx 2,000 ft e/o 11th Ave	12	Replace	18	475				159	75,703	75,703	87,058		100,117	40%	60%	40,047	60,070
MAIN-P19	Pipeline	Houston Ave	From approx 2,000 ft e/o 11th Ave to 10 1/2 Ave	8	Replace	18	925				159	147,421	147,421	169,534		194,965	40%	60%	77,986	116,979
MAIN-P20	Pipeline	Houston Ave	From 10 1/2 Ave to 9th Ave	-	New	18	7,875			1	159	1,422,273	1,422,273	1,635,614		1,880,956	0%	100%	0	1,880,956
MAIN-P21	Pipeline	ROW	From 11th Ave to 12th Ave	-	New	12	5,250			2	83	719,416	719,416	827,329		951,428	20%	80%	190,286	761,142
MAIN-P22	Pipeline	ROW	From 9th Ave to 10 1/2 Ave	-	New	12	7,950	1		1	83	944,579	944,579	1,086,266		1,249,205	0%	100%	0	1,249,205
MAIN-P23	Pipeline	Iona Ave	From 9th Ave to 12th Ave	-	New	12	16,100	1		2	83	1,765,036	1,765,036	2,029,792		2,334,261	25%	75%	583,565	1,750,695
MAIN-P24	Pipeline	ROW	From Houston Ave to Iona Ave	-	New	12	5,275			1	83	580,701	580,701	667,806		767,977	0%	100%	0	767,977
MAIN-P25	Pipeline	10th Ave	From Hanford Armona Rd to Iona Ave	-	New	12	10,600				83	883,972	883,972	1,016,567		1,169,053	0%	100%	0	1,169,053
MAIN-P26	Pipeline	ROW	From approx 370 ft s/o Hanford Armona Rd to Iona Ave	-	New	12	10,325			3	83	1,283,439	1,283,439	1,475,954		1,697,347	40%	60%	678,939	1,018,408
MAIN-P27	Pipeline	9th Ave	From Houston Ave to Iona Ave	-	New	12	2,700				83	225,163	225,163	258,937		297,778	0%	100%	0	297,778
MAIN-P28	Pipeline	9th Ave	From Hanford Armona Rd to Houston Ave	-	New	18	5,500			1	159	1,043,759	1,043,759	1,200,323		1,380,371	0%	100%	0	1,380,371
MAIN-P29	Pipeline	ROW	From approx 700 ft e/o 9 3/4 Ave to 10th Ave	-	New	12	2,700				83	225,163	225,163	258,937		297,778	0%	100%	0	297,778
MAIN-P30	Pipeline	Hanford Armona Rd	From 8 1/2 Ave to 9th Ave	-	New	12	2,650			1	83	361,793	361,793	416,062		478,471	0%	100%	0	478,471
MAIN-P31	Pipeline	ROW	From Lacey Blvd to Hanford Armona Rd	-	New	12	5,300		1	1	83	1,005,186	1,005,186	1,155,964		1,329,358	0%	100%	0	1,329,358
MAIN-P32	Pipeline	Third St	From 9th Ave to 8 1/2 Ave	-	New	12	2,800				83	233,502	233,502	268,527		308,806	0%	100%	0	308,806
MAIN-P33	Pipeline	ROW	From HWY 43 to 8 1/2 Ave	-	New	12	2,625				83	218,908	218,908	251,744		289,506	0%	100%	0	289,506

Table ES.3 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements		Infrastructure Costs						Capital Improvement Costs				Suggested Cost Allocation		Cost Allocation	
				Existing Diameter	New/Parallel/ Replace	Diameter	Length	Number of Casings[1]			Unit Cost[2]	Infr. Cost	Baseline Construction Costs	Estimated Construction Costs[3]	Land Acquisition Costs[4]	Capital Improvement Costs[5]	Existing Users	Future Users	Existing Users	Future Users
				(in)		(in)	(ft)	Railroad	Highway	Canal/Slough	($/unit)	($)	($)	($)	($)	($)	(%)	(%)	($)	($)
MAIN-P34	Pipeline	Lacey Blvd	From approx 7th Ave to HWY 43	-	New	12	5,300				83	441,986	441,986	508,284		584,526	0%	100%	0	584,526
MAIN-P35	Pipeline	ROW	From 7th Ave to 9 1/4 Ave	-	New	12	8,775				83	731,778	731,778	841,545		967,777	0%	100%	0	967,777
MAIN-P36	Pipeline	ROW	From 7th Ave to approx 2,600 ft e/o HWY 43	-	New	12	2,125				83	177,211	177,211	203,793		234,362	0%	100%	0	234,362
MAIN-P37	Pipeline	Grangeville Blvd	From approx 1,300 ft e/o 9 1/4 Ave to 9 1/4 Ave	-	New	18	1,300				159	207,187	207,187	238,265		274,004	40%	60%	109,602	164,403
MAIN-P38	Pipeline	Grangeville Blvd	From 7th Ave to approx 1,300 ft e/o 9 1/4 Ave	-	New	12	10,625				83	886,057	886,057	1,018,965		1,171,810	0%	100%	0	1,171,810
MAIN-P39	Pipeline	9th Ave	From Grangeville Blvd to Lacey Blvd	-	New	18	5,300				159	844,684	844,684	971,387		1,117,095	0%	100%	0	1,117,095
MAIN-P40	Pipeline	8 1/2 Ave	From HWY 43 to Lacey Blvd	-	New	12	8,525	1			83	851,730	851,730	979,490		1,126,413	0%	100%	0	1,126,413
MAIN-P41	Pipeline	HWY 43	From Grangeville Blvd to approx 2,600 ft s/o Lacey Blvd	-	New	12	7,925	1	1		83	1,224,094	1,224,094	1,407,708		1,618,864	0%	100%	0	1,618,864
MAIN-P42	Pipeline	ROW	From Grangeville Blvd to Lacey Blvd	-	New	12	5,300	1			83	582,786	582,786	670,204		770,734	0%	100%	0	770,734
MAIN-P43	Pipeline	7th Ave	From Grangeville Blvd to Lacey Blvd	-	New	12	5,300	1			83	582,786	582,786	670,204		770,734	0%	100%	0	770,734
MAIN-P44	Pipeline	HWY 43	From Fargo Ave to Grangeville Blvd	-	New	12	8,250			1	83	828,797	828,797	953,116		1,096,084	0%	100%	0	1,096,084
MAIN-P45	Pipeline	9th Ave	From HWY 43 to Grangeville Blvd	-	New	12	5,100			1	83	566,107	566,107	651,023		748,677	0%	100%	0	748,677
MAIN-P46	Pipeline	Fargo Ave	From HWY 43 to approx 200 ft e/o Meadow View Rd	-	New	12	1,500				83	125,090	125,090	143,854		165,432	0%	100%	0	165,432
MAIN-P47	Pipeline	Leland Wy	From approx 1,700 ft e/o 9 1/4 Ave to 9th Ave	-	New	12	1,700				83	141,769	141,769	163,034		187,490	0%	100%	0	187,490
										Subtotal - Main Pressure Zone			**31,070,923**	**35,731,561**		**41,091,295**			**3,201,734**	**37,889,561**
Industrial Park Pressure Zone																				
IND-P1	Pipeline	Iona Ave	From 11th Ave to 12th Ave	-	New	12	5,250				83	437,816	437,816	503,489		579,012	0%	100%	0	579,012
IND-P2	Pipeline	Iona Ave	From 9th Ave to approx 2,340 ft w/o 10th Ave	-	New	12	7,675			2	83	921,646	921,646	1,059,892		1,218,876	0%	100%	0	1,218,876
IND-P3	Pipeline	ROW	From 11th Ave to 12th Ave	-	New	12	5,250				83	437,816	437,816	503,489		579,012	0%	100%	0	579,012
IND-P4	Pipeline	ROW	From 9th Ave to 10th Ave	-	New	12	5,375			1	83	589,040	589,040	677,396		779,006	0%	100%	0	779,006
IND-P5	Pipeline	Idaho Ave	From 11th Ave to 12th Ave	-	New	12	5,300				83	441,986	441,986	508,284		584,526	0%	100%	0	584,526
IND-P6	Pipeline	Idaho Ave	From 9th Ave to approx 860 ft w/o 10th Ave	-	New	12	6,175			1	83	655,755	655,755	754,119		867,236	0%	100%	0	867,236
IND-P7	Pipeline	Jackson Ave	From 10th Ave to 11th Ave	-	New	12	5,350	1			83	586,956	586,956	674,999		776,249	0%	100%	0	776,249
IND-P8	Pipeline	ROW	From 10th Ave to 11th Ave	-	New	12	5,325	1			83	584,871	584,871	672,601		773,492	0%	100%	0	773,492
IND-P9	Pipeline	12th Ave	From Iona Ave to Idaho Ave	-	New	12	5,300				83	441,986	441,986	508,284		584,526	0%	100%	0	584,526
IND-P10	Pipeline	ROW	From Iona Ave to Idaho Ave	-	New	12	5,375				83	448,240	448,240	515,476		592,798	0%	100%	0	592,798
IND-P11	Pipeline	11th Ave	From Idaho Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	7,925			1	83	801,694	801,694	921,948		1,060,240	0%	100%	0	1,060,240
IND-P12	Pipeline	ROW	From Idaho Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	7,975				83	665,064	665,064	764,823		879,547	0%	100%	0	879,547
IND-P13	Pipeline	10th Ave	From Iona Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	13,400			1	83	1,258,274	1,258,274	1,447,015		1,664,067	0%	100%	0	1,664,067
IND-P14	Pipeline	ROW	From Iona Ave to Idaho Ave	-	New	12	5,325				83	444,071	444,071	510,681		587,284	0%	100%	0	587,284
IND-P15	Pipeline	9th Ave	From Iona Ave to Idaho Ave	-	New	12	5,275			2	83	721,501	721,501	829,726		954,185	0%	100%	0	954,185
										Subtotal - Industrial Pressure Zone			**9,436,715**	**10,852,222**		**12,480,056**			**0**	**12,480,056**

Table ES.3 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements		Infrastructure Costs						Capital Improvement Costs				Suggested Cost Allocation		Cost Allocation	
				Existing Diameter	New/Parallel/ Replace	Diameter	Length	Number of Casings[1]			Unit Cost[2]	Infr. Cost	Baseline Construction Costs	Estimated Construction Costs[3]	Land Acquisition Costs[4]	Capital Improvement Costs[5]	Existing Users	Future Users	Existing Users	Future Users
				(in)		(in)	(ft)	Railroad	Highway	Canal/Slough	($/unit)	($)	($)	($)	($)	($)	(%)	(%)	($)	($)
Tank Feed Pipelines																				
MAIN-PF1	Pipeline	ROW	From approx 800 ft w/o the intersection of Julia Wy and Glacier Wy to approx 400 ft n/o Fargo Ave	-	New	12	2,325				83	193,890	193,890	222,974		256,420	0%	100%	0	256,420
MAIN-PF2	Pipeline	9th Ave	From Hanford Armona Rd to approx 2,800 ft s/o Hanford Armona Rd	-	New	12	2,825				83	235,587	235,587	270,925		311,564	0%	100%	0	311,564
MAIN-PF3	Pipeline	Hanford Armona Rd	From approx 2,700 ft e/o 9th Ave to 9th Ave	-	New	12	2,675				83	223,078	223,078	256,539		295,020	0%	100%	0	295,020
MAIN-PF4	Pipeline	9th Ave	From approx 2,400 ft n/o Hanford Armona Rd to Hanford Armona Rd	-	New	12	2,400				83	200,145	200,145	230,166		264,691	0%	100%	0	264,691
MAIN-PF5	Pipeline	Grangeville Blvd	From 9 1/4 Ave to 9th Ave	-	New	12	1,575				83	131,345	131,345	151,047		173,704	0%	100%	0	173,704
MAIN-PF6	Pipeline	9th Ave	From approx 2,600 ft n/o Grangeville Blvd to Grangeville Blvd	-	New	18	2,625				159	418,358	418,358	481,111		553,278	0%	100%	0	553,278
										Subtotal - Industrial Pressure Zone			**1,402,402**	**1,612,762**		**1,854,676**			**0**	**1,854,676**
										Subtotal - Pipeline Improvements			**41,910,039**	**48,196,545**		**55,426,027**			**3,201,734**	**52,224,293**
Groundwater Well Improvements						**Pump Capacity (gpm)**														
MAIN-W1	Groundwater Well	Approx 800 ft w/o the intersection of Julia Wy and Glacier Wy			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W2	Groundwater Well	Centennial Dr approx 2,600 ft n/o Grangeville Blvd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W3	Groundwater Well	10th Ave approx 1,100 ft n/o Hanford Armona Rd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W4	Groundwater Well	9th Ave approx 2,800 ft s/o Hanford Armona Rd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W5	Groundwater Well	8 1/2 Ave and Hanford Armona Rd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W6	Groundwater Well	9th Ave approx 2,400 ft n/o Hanford Armona Rd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W7	Groundwater Well	9th Ave and approx 2,600 ft s/o Grangeville Blvd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W8	Groundwater Well	ROW Approx 4,200 ft e/o 8th Avenue s/o Grangeville Blvd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W9	Groundwater Well	Grangeville Blvd and 9th Ave			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W10	Groundwater Well	Leland Way and 9th Ave			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W11	Groundwater Well	Fargo Ave and Meadow View Rd			New	1,500				-		905,300	905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
										Subtotal - Groundwater Well Improvements			**9,958,300**	**11,452,045**	**220,000**	**13,422,852**			**0**	**13,422,852**
Pump Station Improvements						**Firm Pump Station Capacity (gpm)**														
Main Pressure Zone																				
MAIN-PS1	Pump Station	Grangeville Blvd and 9th Ave			New	3 @ 3,100 gpm				-		3,041,965	3,041,965	3,498,260		4,022,999	60%	40%	2,413,799	1,609,200
MAIN-PS2	Pump Station	Hanford Armona Rd and 9th Ave			New	3 @ 3,100 gpm				-		3,041,965	3,041,965	3,498,260		4,022,999	0%	100%	0	4,022,999
										Subtotal - Main Pressure Zone			**6,083,930**	**6,996,520**		**8,045,998**			**2,413,799**	**5,632,198**
Industrial Park Pressure Zone						**Firm Pump Station Capacity (gpm)**														
IND-PS1	Pump Station	11th Ave and Iona Ave			Additional Capacity	4 @ 1,400 gpm				-		2,070,640	2,070,640	2,381,236		2,738,421	25%	75%	684,605	2,053,816
										Subtotal - Industrial Pressure Zone			**2,070,640**	**2,381,236**		**2,738,421**			**684,605**	**2,053,816**
										Subtotal - Pump Station Improvements			**8,154,570**	**9,377,756**		**10,784,419**			**3,098,405**	**7,686,014**

Table ES.3 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements: Existing Diameter (in)	Pipeline Improvements: New/Parallel/ Replace	Infrastructure Costs: Diameter (in)	Infrastructure Costs: Length (ft)	Infrastructure Costs: Number of Casings[1]: Railroad	Infrastructure Costs: Number of Casings[1]: Highway	Infrastructure Costs: Number of Casings[1]: Canal/Slough	Infrastructure Costs: Unit Cost[2] ($/unit)	Infrastructure Costs: Infr. Cost ($)	Capital Improvement Costs: Baseline Construction Costs ($)	Capital Improvement Costs: Estimated Construction Costs[3] ($)	Capital Improvement Costs: Land Acquisition Costs[4] ($)	Capital Improvement Costs: Capital Improvement Costs[5] ($)	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Cost Allocation: Existing Users ($)	Cost Allocation: Future Users ($)
Tank Improvements									Storage Tank Capacity (MG)											
Main Pressure Zone																				
MAIN-T1	Storage Tank	Grangeville Blvd and 9th Ave			New				1.5		-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	100%	0%	3,479,975	0
MAIN-T2	Storage Tank	Grangeville Blvd and 9th Ave			New				1.5		-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	0%	100%	0	3,479,975
MAIN-T3	Storage Tank	Hanford Armona Rd and 9th Ave			New				1.5		-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	0%	100%	0	3,479,975
MAIN-T4	Storage Tank	Hanford Armona Rd and 9th Ave			New				1.5		-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	0%	100%	0	3,479,975
											Subtotal - Main Pressure Zone		**10,316,748**	**11,864,260**	**240,000**	**13,919,899**			**3,479,975**	**10,439,924**
Industrial Park Pressure Zone									Storage Tank Capacity (MG)											
IND-T1	Storage Tank	11th Ave and Iona Ave			New				0.7		-	1,203,621	1,203,621	1,384,164	60,000	1,660,788	6%	94%	99,647	1,561,141
											Subtotal - Industrial Pressure Zone		**1,203,621**	**1,384,164**	**60,000**	**1,660,788**			**99,647**	**1,561,141**
											Subtotal - Storage Tank Improvements		**11,520,368**	**13,248,424**	**300,000**	**15,580,687**			**3,579,622**	**12,001,065**
Total Improvement Cost																				
											Pipeline Improvements		41,910,039	48,196,545	0	**55,426,027**			**3,201,734**	**52,224,293**
											Groundwater Wells		9,958,300	11,452,045	220,000	**13,422,852**			**0**	**13,422,852**
											Pump Stations		8,154,570	9,377,756	0	**10,784,419**			**3,098,405**	**7,686,014**
											Storage Tanks		11,520,368	13,248,424	300,000	**15,580,687**			**3,579,622**	**12,001,065**
											Total Improvement Costs		71,543,278	82,274,769	520,000	**95,213,985**			**9,879,761**	**85,334,224**

AKEL ENGINEERING GROUP, INC.

5/19/2017

Notes:

1. Casing diameter assumed at 20 inches greater than carrier pipe. Railroad and canal/slough casings assumed at a length of 200 feet; highway casings assumed at a length of 600 feet.
2. Unit costs based on a January 2017 ENR CCI of 10,532.
3. Baseline construction costs plus 15% to account for unforeseen events and unknown conditions.
4. It was assumed that new storage reservoirs would require 1.5 acres of land acquisition while new groundwater wells would require 0.5 acres of land acquisition.
5. Estimated construction cost and land acquisition cost plus 15% to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs

CHAPTER 1 - INTRODUCTION

This chapter provides a brief background of the City of Hanford's domestic water system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

1.1 BACKGROUND

The City of Hanford (City) is located approximately 30 miles southeast of the City of Fresno and 20 miles west of the City of Visalia (**Figure 1.1**). The City provides potable water service to approximately 56,000 residents, as well as commercial, industrial, and institutional accounts. The City operates a domestic water distribution system that consists of 14 groundwater wells, three storage reservoirs providing 3.5 million gallons (MG) total storage, and approximately 217 miles of distribution pipelines.

In 1996, the City developed a Water System Master Plan (WSMP) that identified capacity deficiencies in the existing water system and recommended improvements to alleviate existing deficiencies and serve future developments in the Hanford Planning Area.

Recognizing the importance of planning, developing, and financing system facilities to provide reliable water service to existing customers and for servicing anticipated growth within the Hanford Planning Area, the City initiated updating elements of the 1996 WSMP, to reflect current land use conditions.

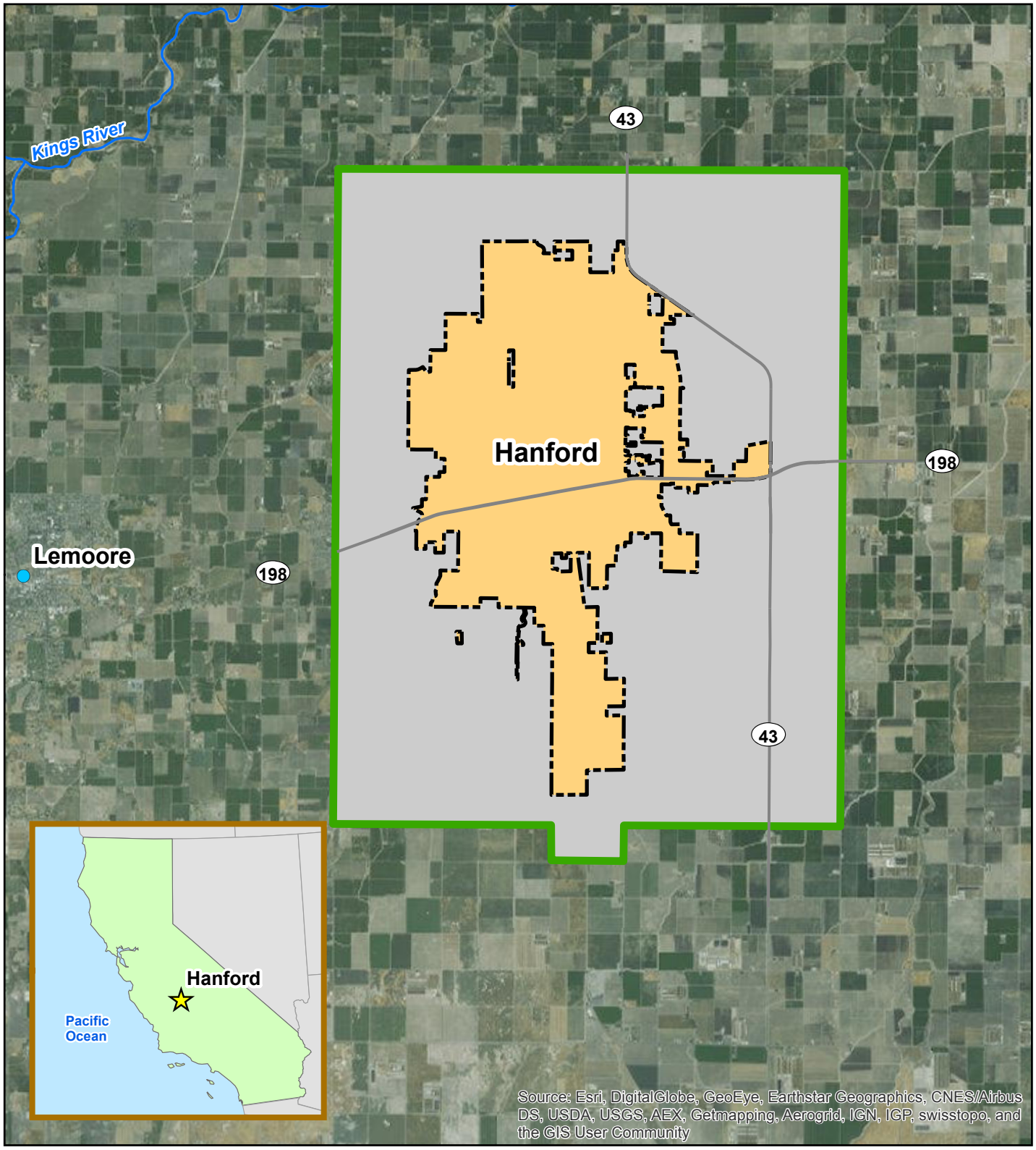
1.2 SCOPE OF WORK

City Council approved Akel Engineering Group Inc. to prepare this master plan in November of 2013. This 2017 WSMP is intended to serve as a tool for planning and phasing the construction of future domestic water system infrastructure for the projected buildout of the City of Hanford. The 2017 WSMP evaluates the City's water system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the City.

The planning boundary and horizon for the master plan were developed in accordance with the City's recently adopted General Plan. Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan included the following tasks:

- Summarize the City's existing domestic water system facilities
- Document growth planning assumptions and known future developments



Legend

- Cities
- City Limits Area
- General Plan Area
- Highways
- River

AKEL ENGINEERING GROUP, INC.

Update: January 18, 2016

0 0.5 1 2 Miles

N W GIS E S

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Figure 1.1
Regional Location Map

Water System Master Plan
City of Hanford

- Update the domestic water system performance criteria
- Project future domestic water demands
- Update the hydraulic model using available data
- Evaluate the domestic water facilities to meet existing and projected demand requirements and fire flows
- Perform a capacity analysis for major distribution mains
- Perform a fire flow analysis
- Recommend a capital improvement program (CIP) with an opinion of probable costs
- Perform a capacity allocation analysis for cost sharing purposes
- Develop a 2017 Water System Master Plan report

1.3 INTEGRATED APPROACH TO MASTER PLANNING

The City implemented an integrated master planning approach and contracted the services of Akel Engineering Group to prepare the following documents:

- Water System Master Plan
- Sewer Master Plan
- Storm Drainage System Master Plan

While each of these reports is published as a standalone document, they have been coordinated for consistency with the City's General Plan. Additionally, each document has been cross referenced to reflect relevant analysis results with the other documents.

1.4 PREVIOUS MASTER PLANS

The City's most recent water master plan was completed in 1996. This master plan included an evaluation of servicing growth to the Planned Area Boundary, evaluated existing demands and projected future demands, evaluated groundwater conditions and management, and recommended phased improvements to the water system for a horizon year of 2020.

1.5 RELEVANT REPORTS

The following lists relevant reports that were used in the completion of this master plan, as well as a brief description of each document:

- **2010 and 2015 Urban Water Management Plan (2010 UWMP and 2015 UWMP).** These plans establish benchmark per capita water usage and targets to achieve higher levels of water conservation for the sustainability of water supply sources. This includes adopting

an updated water shortage contingency plan, defining sources of supply, addressing supply reliability, and projecting sustainable supply yields and future demands.

1.6 REPORT ORGANIZATION

The water system master plan report contains the following chapters:

Chapter 1 - Introduction. This chapter provides a brief background of the City of Hanford's domestic water system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

Chapter 2 - Planning Areas Characteristics. This chapter presents a discussion of the planning area characteristics for this master plan and defines the land use classifications. The planning area is divided into several planning sub-areas, as established by the City's planning division.

Chapter 3 - System Performance and Design Criteria. This chapter provides a description of the City's existing domestic water system and facilities including the distribution mains, storage reservoirs, and existing wells.

Chapter 4 - Existing Domestic Water Facilities. This chapter presents the City's performance and design criteria, which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed distribution mains, storage reservoirs, and wells.

Chapter 5 - Water Demands and Supply Characteristics. This chapter summarizes the existing and future domestic water demands, and the diurnal pattern used for the hydraulic analysis.

Chapter 6 - Hydraulic Model Development. This chapter describes the development and calibration of the City's domestic water distribution system hydraulic model. The hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

Chapter 7 - Evaluation and Proposed Improvements. This section presents a summary of the domestic water system evaluation and identifies improvements needed to mitigate existing deficiencies, as well as improvements needed to expand the system and service growth.

Chapter 8 - Capital Improvement Program. This chapter provides a summary of the recommended domestic water system improvements to mitigate existing capacity deficiencies and to accommodate anticipated future growth. The chapter also presents the cost criteria and methodologies for developing the capital improvement program. Finally, a capacity allocation analysis, usually used for cost sharing purposes, is also included.

1.7 ACKNOWLEDGEMENTS

Obtaining the necessary information to successfully complete the analysis presented in this report, and developing the long-term strategy for mitigating the existing system deficiencies and

for accommodating future growth, was accomplished with the strong commitment and very active input from dedicated team members including:

- Lou Camara, Director of Public Works
- John Doyel, Director of Public Utilities / City Engineer
- Darlene Mata, Community Development Director
- Mike Cosenza, Utilities Superintendent
- QK Inc, General Plan Consultant
- John Zumwalt, City of Hanford Consultant

This report was prepared in conjunction with the General Plan Update, and included coordination with the QK and John Zumwalt, who were the General Plan consultants.

1.8 UNIT CONVERSIONS AND ABBREVIATIONS

Engineering units were used in reporting flow rates and volumes pertaining to the design and operation of various components of the domestic water distribution system. Where it was necessary to report values in smaller or larger quantities, different sets of units were used to describe the same parameter. Values reported in one set of units can be converted to another set of units by applying a multiplication factor. A list of multiplication factors for units used in this report is shown on **Table 1.1**.

Various abbreviations and acronyms were also used in this report to represent relevant water system terminologies and engineering units. A list of abbreviations and acronyms is included in **Table 1.2**.

1.9 GEOGRAPHIC INFORMATION SYSTEMS

This master planning effort made extensive use of Geographic Information Systems (GIS) technology, for completing the following tasks:

- Develop the physical characteristics of the hydraulic model (pipes and junctions, wells, and storage reservoirs).
- Allocate existing water demands, as extracted from the water billing records, and based on each user's physical address.
- Calculate and allocating future water demands, based on future developments water use.
- Extract ground elevations along the distribution mains from available contour maps.
- Generate maps and exhibits used in this master plan.

Table 1.1 Unit Conversions

Water System Master Plan
City of Hanford

Volume Unit Calculations		
To Convert From:	**To:**	**Multiply by:**
acre feet	gallons	325,851
acre feet	cubic feet	43,560
acre feet	million gallons	0.3259
cubic feet	gallons	7.481
cubic feet	acre feet	2.296×10^{-5}
cubic feet	million gallons	7.481×10^{-6}
gallons	cubic feet	0.1337
gallons	acre feet	3.069×10^{-6}
gallons	million gallons	1×10^{-6}
million gallons	gallons	1,000,000
million gallons	cubic feet	133,672
million gallons	acre feet	3.069
Flow Rate Calculations		
To Convert From:	**To:**	**Multiply By:**
ac-ft/yr	mgd	8.93×10^{-4}
ac-ft/yr	cfs	1.381×10^{-3}
ac-ft/yr	gpm	0.621
ac-ft/yr	gpd	892.7
cfs	mgd	0.646
cfs	gpm	448.8
cfs	ac-ft/yr	724
cfs	gpd	646300
gpd	mgd	1×10^{-6}
gpd	cfs	1.547×10^{-6}
gpd	gpm	6.944×10^{-4}
gpd	ac-ft/yr	1.12×10^{-3}
gpm	mgd	1.44×10^{-3}
gpm	cfs	2.228×10^{-3}
gpm	ac-ft/yr	1.61
gpm	gpd	1,440
mgd	cfs	1.547
mgd	gpm	694.4
mgd	ac-ft/yr	1,120
mgd	gpd	1,000,000

Table 1.2 Abbreviations and Acronyms

Water System Master Plan
City of Hanford

Abbreviation	Expansion	Abbreviation	Expansion
2010 UWMP	2010 Urban Water Management Plan	GIS	Geographic Information Systems
2015 UWMP	2015 Urban Water Management Plan	gpd	gallons per day
1996 WSMP	1996 Water System Master Plan	gpdc	gallons per day per capita
2017 WSMP	2017 Water System Master Plan	gpm	gallons per minute
AACE International	Association for the Advancement of Cost Engineering	hp	horsepower
AC	acre	HGL	hydraulic grade line
ACP	Asbestos Cement Pipe	HWL	high water level
ADD	average day demand	in	inch
Akel	Akel Engineering Group, Inc.	KCWD	Kings County Water District
CCI	Construction Cost Index	LAFCO	Local Agency Formation Commission
CDPH	California Department of Public Health	LF	linear feet
cfs	cubic feet per second	MDD	maximum day demand
CI	cast iron pipe	MG	million gallons
CIB	Capital Improvement Budget	MGD	million gallons per day
CIP	Capital Improvement Program	MMD	maximum month demand
City	City of Hanford	NFPA	National Fire Protection Association
DIP	Ductile Iron Pipe	PHD	peak hour demand
DU	dwelling unit	PRV	pressure reducing valve
EDU	equivalent dwelling unit	psi	pounds per square inch
ENR	Engineering News Record	ROW	Right of Way
EPA	Environmental Protection Agency	SCADA	Supervisory Control and Data Acquisition
EPS	Extended Period Simulation	SOI	Sphere of Influence
FRC	Facility Reserve Charge	TBD	to be determined
ft	feet	ULL	Urban Limit Line
fps	feet per second	WSMP	Water System Master Plan
FY	Fiscal Year		

CHAPTER 2 - PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of the planning area characteristics for this master plan and defines the land use classifications. The planning area is divided into several planning sub-areas, as established by the City's 2017 General Plan update.

2.1 STUDY AREA DESCRIPTION

The City is located in Kings County, approximately 30 miles southeast of the City of Fresno and 20 miles west of the City of Visalia (**Figure 2.1**). The City's closest neighbor, the City of Lemoore, is located 8 miles to the west. Highway 198 bisects the southern boundary of the City in the east-west direction, while Highway 43 is adjacent to the City's eastern boundary. In 2002, the City outlined the long-term Urban Growth Boundary (UGB), which was approved by City Council, and identified lands intended for future urbanization within the City service area.

The City operates and maintains a domestic water system that covers the majority of the area within the City Limits. Currently, water is supplied to the City's customers via groundwater wells located throughout the City.

2.2 PLANNING AREA BOUNDARIES

The City's 2017 General Plan update designates two boundaries for defining urban expansion:

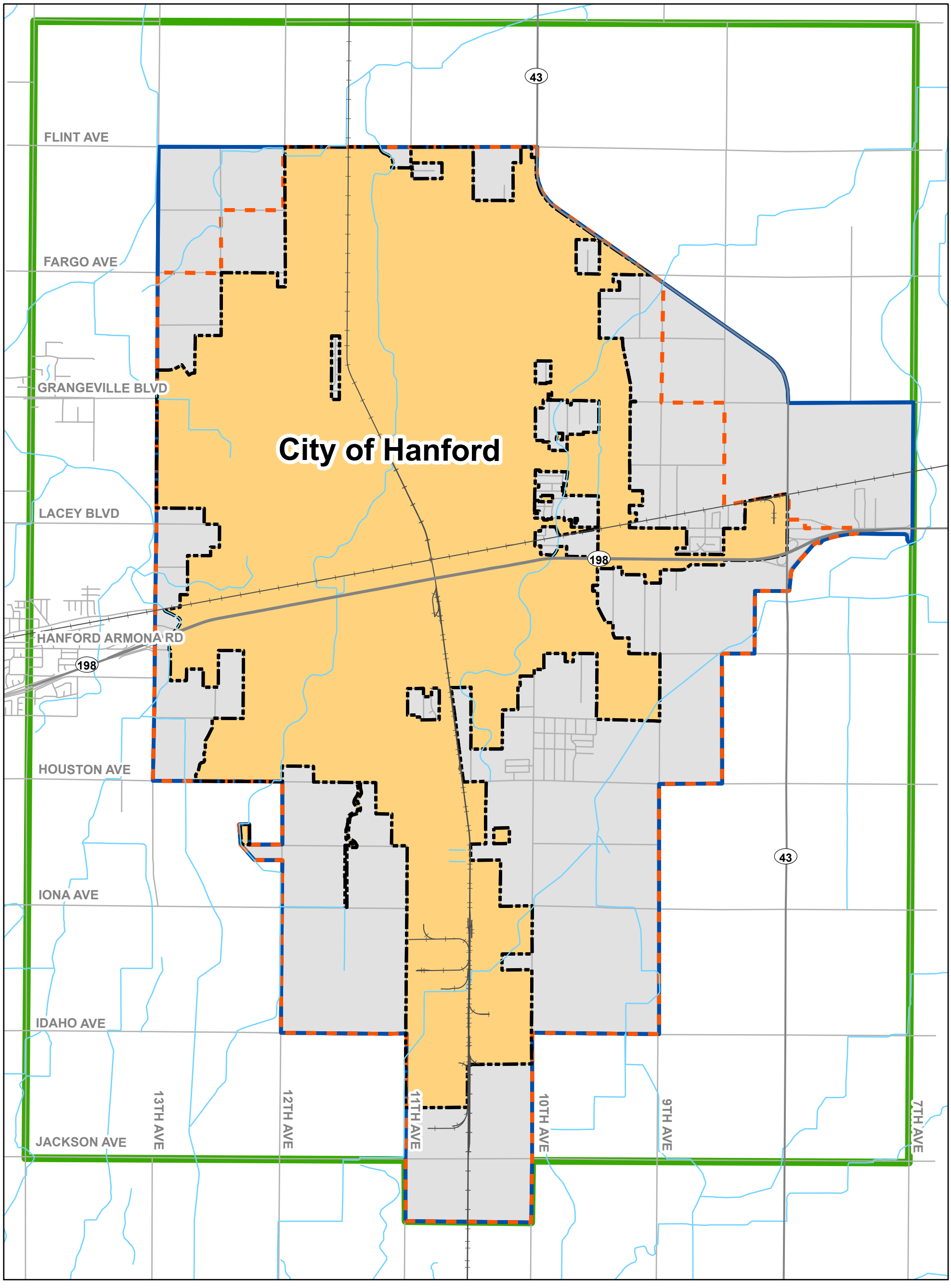
- **Planned Area Boundary:** This boundary serves as the maximum extent of the area planned for urban development.
- **2035 Growth Boundary:** This boundary serves as the extent of development with urban uses planned to occur during the 2015 to 2035 planning period.

It should be noted that for the purposes of this master plan, City Staff has requested improvements to be sized to account for the development of the Planned Area Boundary. Based on growth assumptions consistent with the 2017 General Plan Update, buildout of the Planned Area Boundary is not expected until approximately 2050.

2.3 WATER SERVICE AREA AND LAND USE

The City's water system services residential and non-residential lands within the City limits, as summarized on **Table 2.1**. This service area includes:

- 6,059 net acres of developed lands inside the City limits.
- 2,765 net acres of undeveloped lands inside the City limits.
- 265 net acres of underutilized lands inside the City limits that are expected to redevelop.



Legend

- Streets
- Waterways
- City Limits
- 2035 Growth Boundary
- Planned Area Boundary
- General Plan Study Area Boundary

Update: September 1, 2016

0 0.25 0.5 1 Mile

N W GIS E S

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Figure 2.1
Planning Area
Water System Master Plan
City of Hanford

Table 2.1 Existing and Future Development
Water System Master Plan
City of Hanford

Land Use Classification	Existing Service Area				2035 Growth Boundary				Planned Area Boundary				Total in 2035 Growth Boundary	Total in Planned Area Boundary
	Developed (net acres)	Undeveloped (net acres)	Underutilized (net acres)	*Subtotal* (net acres)	Developed (net acres)	Undeveloped (net acres)	Underutilized (net acres)	*Subtotal* (net acres)	Developed (net acres)	Undeveloped (net acres)	Underutilized (net acres)	*Subtotal* (net acres)	(net acres)	(net acres)
Residential														
Low Density	2,837	991	35	3,863	476	790	82	1,348	63	529	0	592	5,211	5,804
Medium Density	498	220	5	723	35	215	21	271	0	72	4	76	994	1,070
High Density	84	65	8	158	0	38	0	38	0	26	0	26	196	222
Subtotal - Residential	3,419	1,276	48	4,744	511	1,043	103	1,657	63	627	4	694	6,401	7,095
Mixed Use														
Office Residential	89	20	5	114	0	0	0	0	0	0	0	0	114	114
Neighborhood Mixed Use	12	42	0	54	0	15	0	15	0	0	0	0	70	70
Corridor Mixed Use	250	139	86	476	10	3	0	13	0	0	0	0	489	489
Downtown Mixed Use	81	15	28	123	0	0	0	0	0	0	0	0	123	123
Subtotal - Mixed Use	432	216	119	767	10	18	0	29	0	0	0	0	795	795
Non-Residential														
Neighborhood Commercial	27	26	0	53	8	11	1	20	0	0	0	0	73	73
Regional Commercial	216	154	6	376	0	0	0	0	18	163	6	188	376	564
Service Commercial	103	47	7	156	56	63	0	119	0	0	0	0	275	275
Highway Commercial	48	68	0	115	16	4	12	32	0	0	0	0	147	147
Office	88	30	1	119	0	0	0	0	0	0	0	0	119	119
Light Industrial	105	20	40	166	83	520	36	640	0	0	0	0	806	806
Heavy Industrial	376	535	33	943	211	2,380	227	2,817	0	0	0	0	3,761	3,761
Airport Protection	0	125	0	125	111	501	63	674	0	0	0	0	799	799
Educational Facilities	445	110	7	562	11	17	0	28	0	80	0	80	590	669
Public Facliities	438	56	0	494	3	13	0	16	0	0	0	0	510	510
Open Space	362	105	4	471	41	159	0	200	0	17	0	17	671	688
Open Space with Irrigation	16	41	4		0	105	0		0	17	0			
Open Space without Irrigation	346	65	0		41	54	0		0	0	0			
Interest Area	0	0	0	0	0	0	0	0	49	509	43	601	0	601
Subtotal - Non-Residential	2,208	1,274	98	3,580	539	3,668	340	4,547	68	769	49	886	8,127	9,012
Total														
	6,059	2,765	265	9,090	1,060	4,729	443	6,233	131	1,396	53	1,580	**15,323**	**16,903**

The existing land use statistics were based on the land use information developed for the recently adopted General Plan (**Appendix A**). The land use is shown graphically on **Figure 2.2**. The land use information included developed and undeveloped areas, which were classified into the following subtypes:

- Net Area. Net areas are typically fully developed, and exclude street and other associated right of ways.
- Gross Area. Gross areas are typically large undeveloped parcels, which may be subdivided in future developments. Part of these areas will include street and other right of ways.

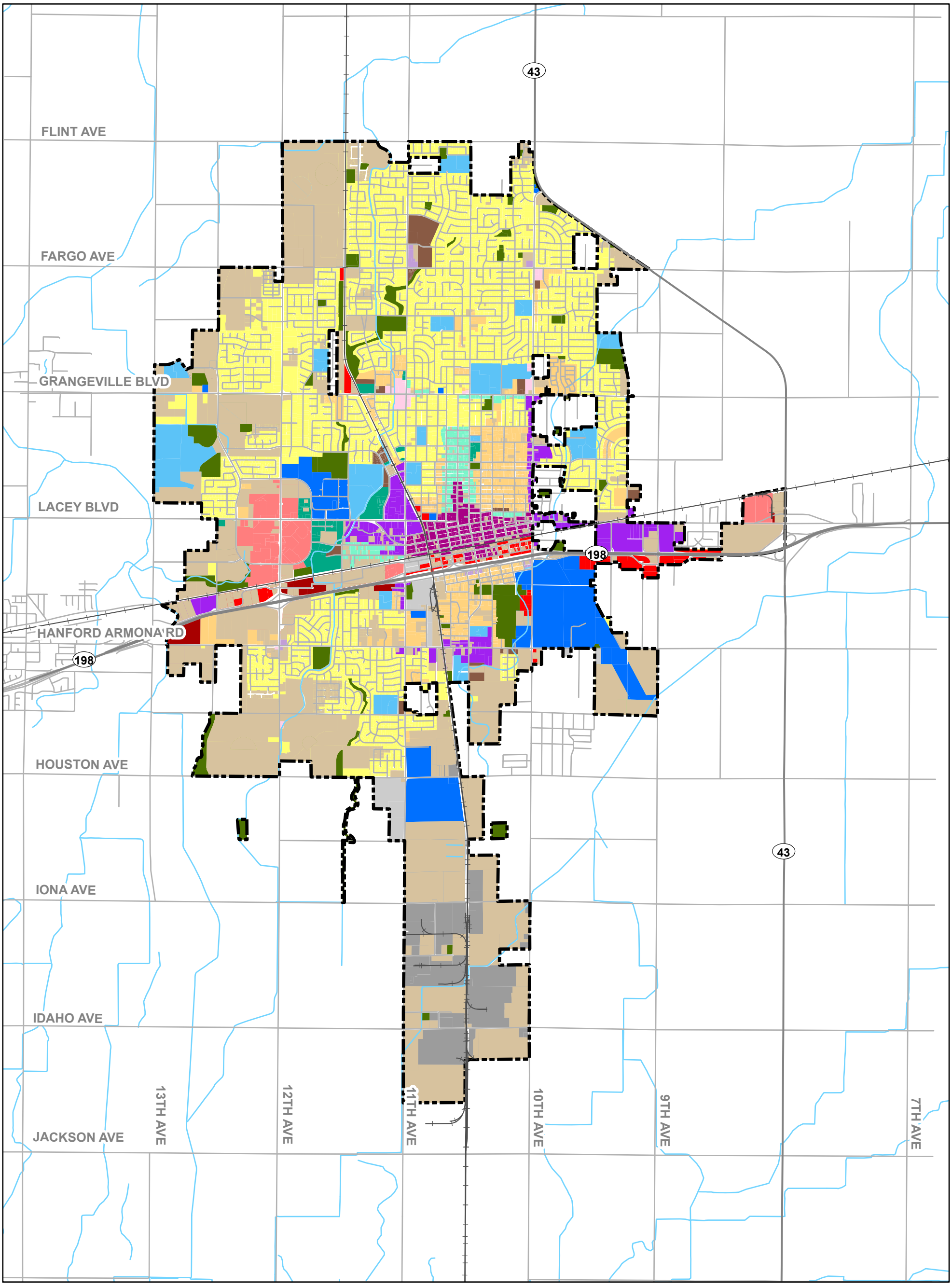
For the purpose of this master plan, existing and future land use was consolidated into net acres. In order to convert the areas that were identified as gross areas to net areas, the following reduction factors were applied:

- Single Family Residential land use types: 1 gross acre = 0.80 net acre
- Multi-Family Residential / Mixed Use land use types: 1 gross acre = 0.85 net acre
- Commercial / Industrial land use types: 1 gross acre = 0.90 net acre

The City's general plan anticipates approximately 16,900 net acres of residential and non-residential development at ultimate buildout of the Planned Area Boundary. The land use designations utilized in this master plan are consistent with the Land Use Element of the City's General Plan, as shown on **Figure 2.3**.

2.4 HISTORICAL AND FUTURE GROWTH

The City's historical and projected population data are presented in **Table 2.2**. The historical information was extracted from the previous master plan and California Department of Finance documents. The City's 2017 General Plan Update anticipates future growth of approximately 2.1 percent per year, which is slightly greater than historical trends approximately 2.0 percent per year. The 2017 General Plan Update is planning for a 2035 population of 90,000. **Table 2.2** documents the historical population from 2010 to 2015 and the projected population by year to the buildout master plan horizon of 2050. This horizon reflects the buildout of the Planned Area Boundary.



Legend

- Low Density Residential
- Medium Density Residential
- High Density Residential
- Neighborhood Commercial
- Regional Commercial
- Service Commercial
- Highway Commercial
- Office Residential
- Office
- Light Industrial
- Heavy Industrial
- Neighborhood Mixed Use
- Corridor Mixed Use
- Downtown Mixed Use
- Airport Protection
- Open Space
- Educational Facilities
- Public Facilities
- Interest Area
- Vacant/Agriculture
- City Limits
- Streets
- Waterways

N W E S

0 0.25 0.5 1 Mile

Update: July 1, 2016

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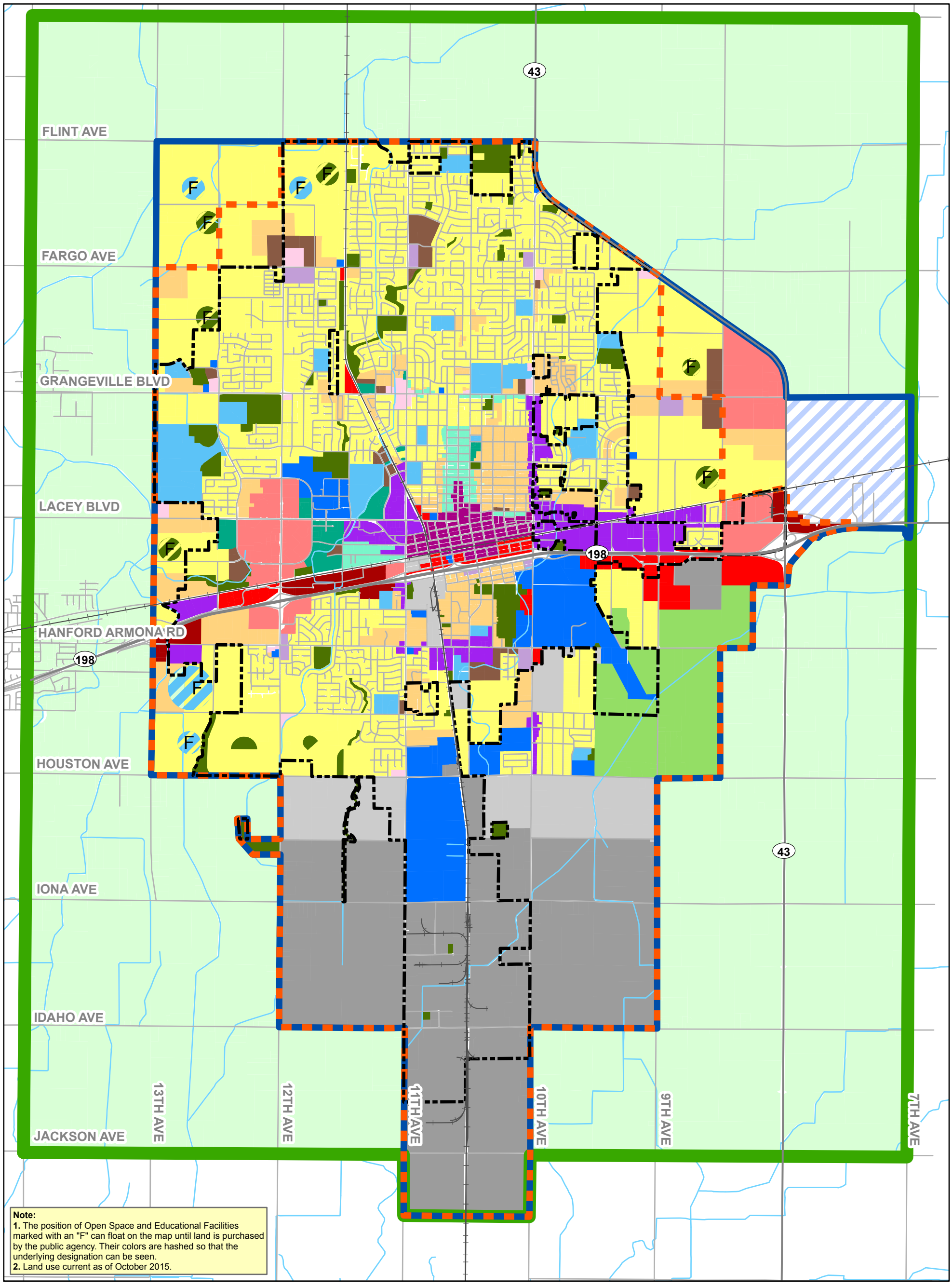
Figure 2.2
Existing Land Use
Water System Master Plan
City of Hanford



Legend

- Low Density Residential
- Medium Density Residential
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- Neighborhood Commercial
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- Highway Commercial
- Office Residential
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- Light Industrial
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- Public Facilities
- Interest Area
- City Limits
- 2035 Growth Boundary
- Planned Area Boundary
- General Plan Study Area Boundary
- Streets
- Highways
- Waterways

N W GIS E S

0 0.25 0.5 1 Mile

Update: July 7, 2016

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Figure 2.3
2035 General Plan Land Use

Water System Master Plan
City of Hanford

Table 2.2 Historical and Projected Population

Water System Master Plan

City of Hanford

Year	Population	Annual Growth(%)
Historical		
2010	53,967	-
2011	54,146	0.3%
2012	54,541	0.7%
2013	54,513	-0.1%
2014	54,727	0.4%
2015	55,337	1.1%
Projected		
2016	57,070	3.1%
2017	58,803	3.0%
2018	60,536	2.9%
2019	62,270	2.9%
2020	64,003	2.8%
2021	65,736	2.7%
2022	67,469	2.6%
2023	69,202	2.6%
2024	70,935	2.5%
2025	72,669	2.4%
2026	74,402	2.4%
2027	76,135	2.3%
2028	77,868	2.3%
2029	79,601	2.2%
2030	81,334	2.2%
2031	83,067	2.1%
2032	84,801	2.1%
2033	86,534	2.0%
2034	88,267	2.0%
2035	**90,000**	2.0%
2036	91,890	2.1%
2037	93,820	2.1%
2038	95,790	2.1%
2039	97,801	2.1%
2040	99,855	2.1%
2041	101,952	2.1%
2042	104,093	2.1%
2043	106,279	2.1%
2044	108,511	2.1%
2045	110,790	2.1%
2046	113,116	2.1%
2047	115,492	2.1%
2048	117,917	2.1%
2049	120,393	2.1%
2050	**122,922**	2.1%

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10/26/2016

Note :

1. 2035 population based on 2016 General Plan buildout population of 90,000.

CHAPTER 3 - SYSTEM PERFORMANCE AND DESIGN CRITERIA

This chapter presents the City's performance and design criteria, which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed distribution mains, storage reservoirs, and wells.

3.1 HISTORICAL WATER USE TRENDS

The historical domestic water consumption per capita was calculated to determine the average water use per capita per day. This was accomplished by dividing the City's historical water production, based on production records received from City staff, by the historical population for the respective year.

The City's historical per capita consumption factors, for the period 2000-2015, are listed in **Table 3.1**. The City's per capita consumption has generally remained unchanged during the 2000-2015 period. Recently, and due to the intense drought and corresponding water shortage measures from 2012-2015, water use per capita has decreased. It is expected that the water shortage contingency measures and the continued installation of water service meters will result in a continued downward trend is water use. **Table 3.2** lists the last three years of monthly water production in the City.

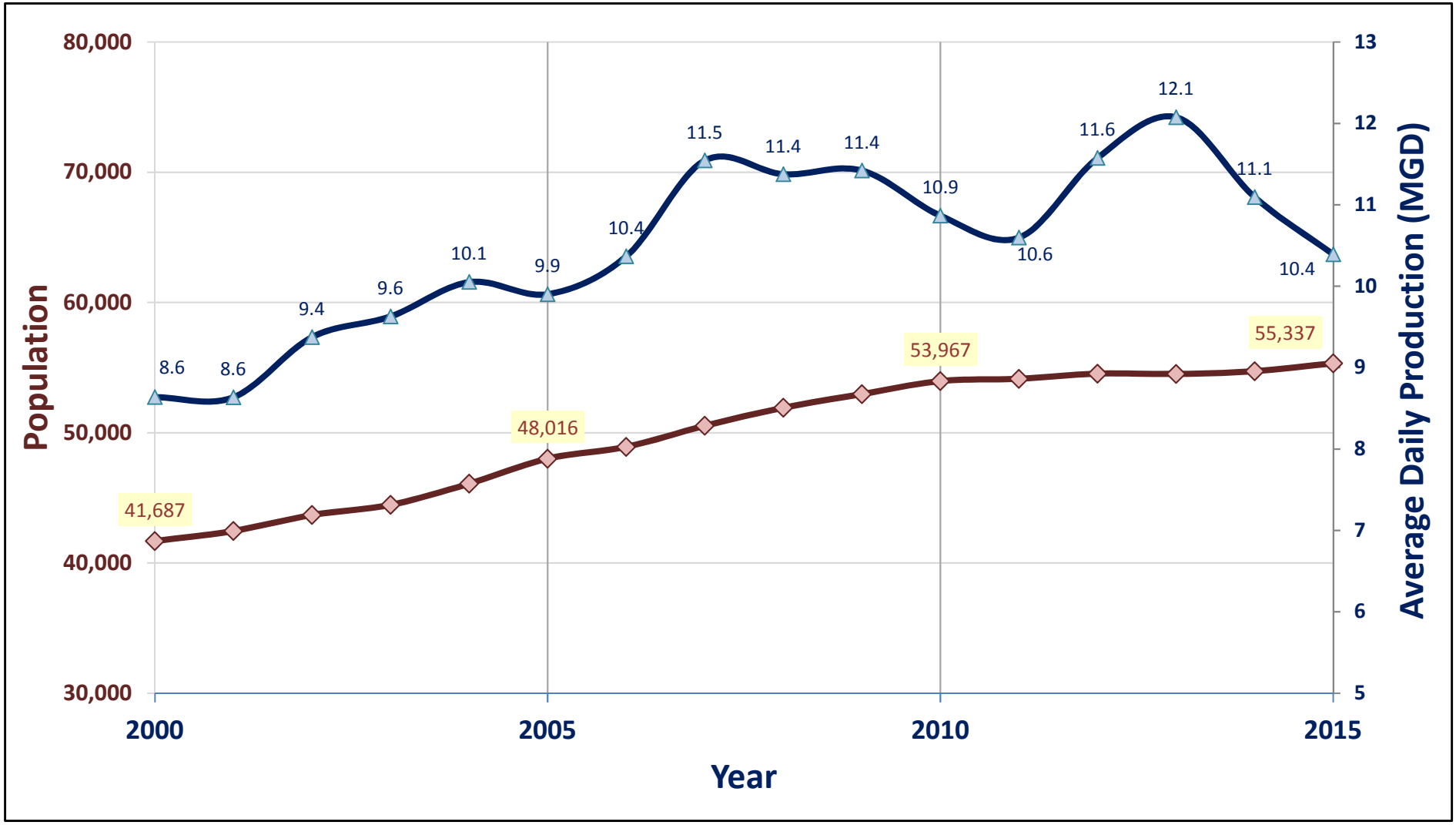
Consistent with the 1996 WSMP, this master plan did not use per capita consumption to project future domestic water demands, but rather calculated domestic water demands for residential and non-residential land uses based on land use demand factors and net acreages. To generalize trends in the City's water use, per capita water use was documented. **Figure 3.1** displays the historical population in relation to average daily water production. **Figure 3.2** displays a comparison in the per capita water use and average daily water production.

3.2 SUPPLY CRITERIA

In determining the adequacy of the domestic 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.

Ideally, a water distribution system should be operated at a constant water supply rate with consistent supply from the water source. On the day of maximum demand, it is desirable to maintain a water supply rate equal to the maximum day rate. Water required for peak hour demands or for fire flows would come from storage.

As the City is currently using groundwater wells as a sole source of supply, groundwater should be viewed as a sustainable resource; supply wells should be capable of meeting the greater of



LEGEND

Population

Average Daily Production (MGD)

June 12, 2016

Figure 3.1

Historical Population vs. Average Daily Production

Water System Master Plan

City of Hanford

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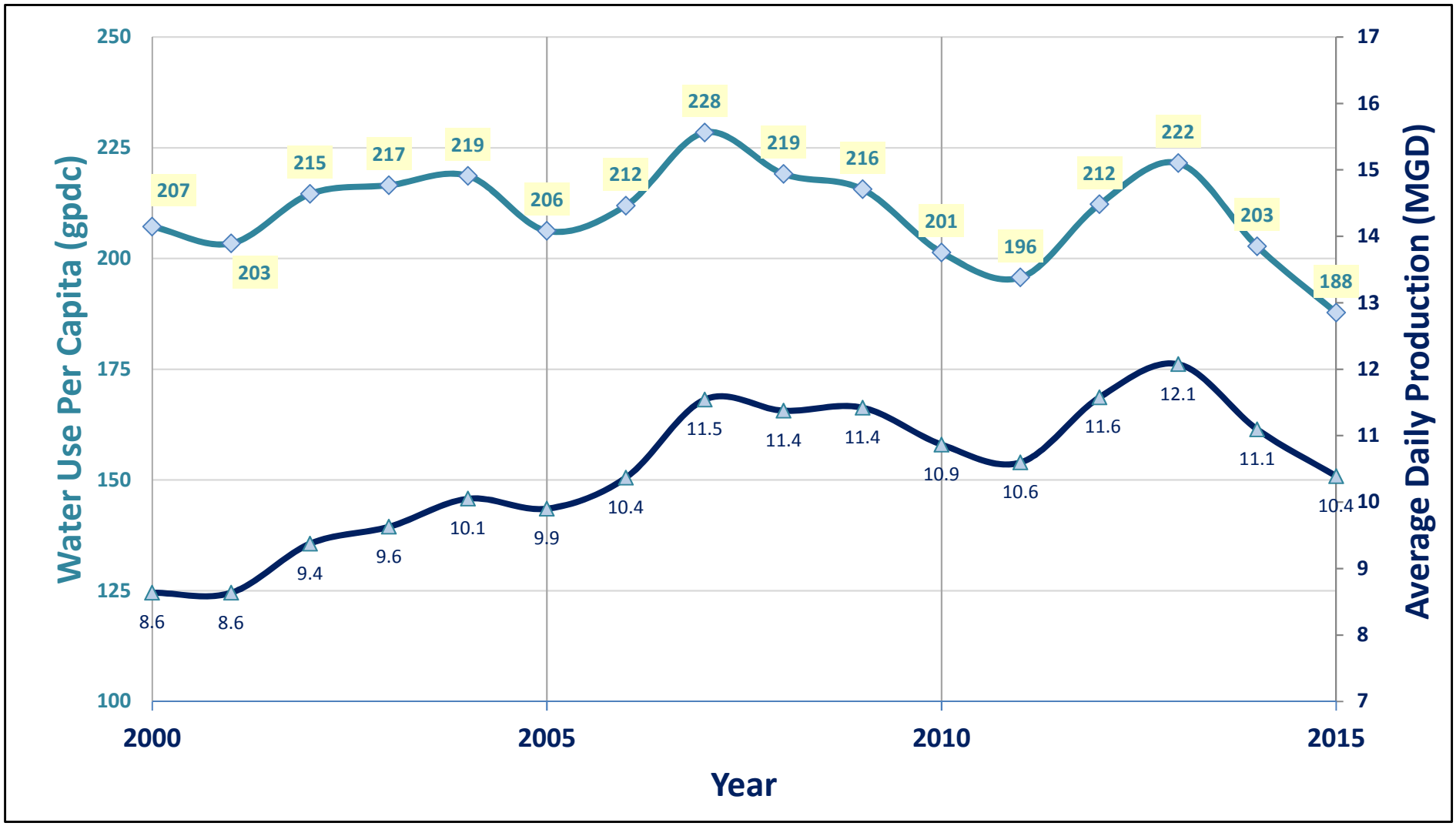

LEGEND

Water Use Per Capita (gpdc)

Average Daily Production (MGD)

June 12, 2016

Figure 3.2

Water Use Per Capita vs. Average Daily Production

Water System Master Plan

City of Hanford

AKEL ENGINEERING GROUP, INC.

Table 3.1 Historical Water Production and Maximum Day Peaking Factors (2000 - 2015)

Water System Master Plan
City of Hanford

Year	Population[1]	% Increase	Historical Water Production											Average Daily Water Use per Capita[2]
			Annual Production[2]			% Increase	Monthly Production[2]				Daily Production (Historical)[3]			
							Average	Maximum	Max-to-Avg Ratio	Month of Occurrence	Average	Maximum	Max-to-Avg Ratio	
			(AFY)	(MG)	(gpm)		(MGM)	(MGM)			(MGD)	(MGD)		(gpdc)
2000	41,687	1%	9,675	3,153	6,008	-2%	262	421	1.61	July	8.6			207
2001	42,462	2%	9,674	3,152	6,007	0%	263	418	1.59	August	8.6			203
2002	43,689	3%	10,501	3,422	6,521	9%	285	473	1.66	July	9.4			215
2003	44,466	2%	10,785	3,514	6,698	3%	293	496	1.69	July	9.6	17.3	1.79	217
2004	46,096	4%	11,289	3,679	7,011	5%	306	506	1.65	July	10.1	18.1	1.80	219
2005	48,016	4%	11,091	3,614	6,888	-2%	301	522	1.73	July	9.9	18.5	1.86	206
2006	48,920	2%	11,613	3,784	7,212	5%	315	496	1.57	July	10.4	18.3	1.76	212
2007	50,534	3%	12,932	4,214	8,030	11%	351	560	1.59	July	11.5	19.7	1.70	228
2008	51,922	3%	12,742	4,152	7,913	-1%	346	524	1.52	August	11.4	19.4	1.71	219
2009	52,970	2%	12,793	4,169	7,944	0%	347	561	1.62	July	11.4	20.1	1.76	216
2010	53,967	2%	12,171	3,966	7,558	-5%	331	561	1.70	July	10.9	19.8	1.82	201
2011	54,146	0%	11,870	3,868	7,371	-2%	322	529	1.64	July	10.6	18.9	1.78	196
2012	54,541	1%	12,966	4,225	8,052	9%	352	550	1.56	July	11.6	20.3	1.75	212
2013	54,513	0%	13,526	4,407	8,400	4%	367	569	1.55	July	12.1	20.3	1.68	222
2014	54,727	0%	12,427	4,049	7,717	-8%	337	563	1.67	June	11.1	25.9[4]	2.33	203
2015	55,337	1%	11,640	3,793	7,228	-6%	316	510	1.61	August	10.4	19.2	1.85	188
Maximum Day Demand Peaking Factor														
1996 Water System Master Plan													**1.75**	
2017 Water System Master Plan[5]													**1.75**	

AKEL ENGINEERING GROUP, INC.

10/27/2016

Notes:

1. Source: California Department of Finance, Demographic Research Unit, E-5 and E-8
2. Source: City of Hanford, Public Water Systems Statistics Reports
3. Source: Water Production Reports received from City staff 10/27/2016.
4. Due to required extreme flushing during summer months this Maximum Daily Demand value does not reflect the City-wide domestic consumption.
5. After reviewing the historical peaking factors with City staff, Akel Engineering Group was directed to use the same maximum day demand peaking factors adopted in the previous master plan.

Table 3.2 Historical Monthly Water Production (2013-2015)

Water System Master Plan

City of Hanford

Month	2013			2014			2015		
	Monthly		Peaking Factor	Monthly		Peaking Factor	Monthly		Peaking Factor
	Production (MGM)	Percent of Annual (%)	Month to Avg Factor	Production (MGM)	Percent of Annual (%)	Month to Avg Factor	Production (MGM)	Percent of Annual (%)	Month to Avg Factor
January	181	4%	0.49	201	5%	0.55	177	4%	0.48
February	177	4%	0.48	168	4%	0.46	146	3%	0.40
March	259	6%	0.70	290	7%	0.79	239	5%	0.65
April	366	8%	1.00	340	8%	0.93	275	6%	0.75
May	471	11%	1.28	399	9%	1.09	420	10%	1.14
June	529	12%	1.44	563	13%	1.53	476	11%	1.30
July	569	13%	1.55	472	11%	1.29	496	11%	1.35
August	541	12%	1.47	399	9%	1.09	510	12%	1.39
September	461	10%	1.25	477	11%	1.30	389	9%	1.06
October	379	9%	1.03	284	6%	0.77	287	7%	0.78
November	267	6%	0.73	226	5%	0.62	199	5%	0.54
December	209	5%	0.57	229	5%	0.62	178	4%	0.48
Total	**4,407**			**4,049**			**3,793**		
Average Value	**367**			**337**			**316**		
Maximum Value	**569**		**1.55**	**563**		**1.53**	**510**		**1.39**
Average Daily (mgd)	**12.1**			**11.1**			**10.4**		

AKEL ENGINEERING GROUP, INC.

6/30/2016

Note:

1. Source: "Residential Water Worksheet" received from City staff April 22, 2016.

maximum day demands plus fire flows or peak hour demand. Design criteria for water supply are documented on **Table 3.3**.

3.3 STORAGE CRITERIA

The intent of domestic water storage is to provide supply for operational equalization, fire protection, and other emergencies, such as power outages or supply outages. Operational or equalization storage provides the difference in quantity between the customer's peak hour demands and the system's available reliable supply.

3.3.1 Typical Storage Criteria

Typical storage criteria consist of three main elements: operational, emergency, and fire flow.

- **Operational Storage**

Operational or equalization storage capacity is necessary to reduce the variations imposed on the supply system by daily demand fluctuations. Peak hour demands may require up to 2 times the amount of maximum day supply capacity. With storage in place, this increase in demand can be met by the operational storage rather than by increasing production from the supply sources.

Equalization storage also stabilizes system pressures for enhancing the service. Equalization storage requirements typically range from 25 percent to 50 percent of maximum day demand.

- **Emergency Storage**

Emergency storage is the volume of water stored to meet demand during emergency situations such as pipe failures, distribution main failures, pump failures, power outages, natural disasters, or other cases in which the supply sources are not able to meet the demand condition.

The amount of water reserved for emergencies is determined by policies adopted by the City and is based on an assessment of the costs and benefits including the desired degree of system reliability, risk during an emergency situation, economic considerations, and water quality concerns.

In California, the amount of emergency storage reserve in municipal water systems is usually between 50 percent and 100 percent of the maximum day demand.

- **Total Storage Requirement**

The total storage is the summation of operational (equalization), fire, and emergency storage requirements as follows:

Qs = 25% - 50% MDD (operational) + fire flow (varies) + 25% - 50% MDD (emergency)

Table 3.3 Planning and Design Criteria
Water System Master Plan
City of Hanford

Design Parameter	Criteria		
Supply	Supply to meet the greater of Maximum Day Demands plus Fire Flows or Peak Hour Demands		
	Firm capacity excludes largest well for possible maintenance and emergency		
Storage	Underground Aquifer with Adequate Power Generators at Wells		
	Main Pressure Zone: 25% of Maximum Day Demand		
	Industrial Pressure Zone: 14% of Maximum Day Demand + 3,500 gpm for 3 hours		
Distribution Mains	Distribution mains should be designed to meet the greater of:		
	1) Peak Hour Demand, or 2) Maximum Day Demand + Fire Flow		
	Criteria for existing and future pipelines include:		
	Maximum Pipeline Velocity: 10 feet per second (ft/sec)		
	Maximum Desirable Headloss: 8 feet per 1,000 feet (ft/kft)		
	Minimum pipe size of 8-inches for future		
Service Pressures	Maximum System Pressure	80 psi	
	Minimum Pressure during Maximum Day Demand	40 psi	
	Minimum Pressure during Peak Hour	30 psi	
	Minimum Residual Pressure (Fire Flow)	20 psi	
	Industrial Area Recommended Pressure	80 psi	
Demand Peaking Factors	**Main Pressure Zone**		
	Maximum Day Demand	1.75 x Average Day Demand	
	Peak Hour Demand	2.50 x Average Day Demand	
	Industrial Pressure Zone		
	Maximum Day Demand	2.00 x Average Day Demand	
	Peak Hour Demand	2.78 x Average Day Demand	
Fire Flows	Residential – Existing development	1,000 gpm for 2 hours	
	Residential – Recent and future developments	1,500 gpm for 2 hours	
	Commercial – Recent and future developments	2,500 gpm for 3 hours	
	Commercial – Older developments near downtown	3,000 gpm for 3 hours	
	Industrial – Recent and future developments	3,000 gpm for 3 hours	
	Industrial – Industrial park	3,500 gpm for 3 hours	
Urban Water Use Targets	2010 Baseline	215	gpdc
2015 Urban Water Management Plan	2015 Interim Target	197	gpdc
	2020 Target	179	gpdc
Demand Coefficients	Land Use Category	2016 WSMP (gpd/net acre)	
	Residential		
	Low Density Residential	1,810	gpd/acre
	Medium Density Residential	2,450	gpd/acre
	High Density Residential	3,260	gpd/acre
	Mixed Use		
	Office Residential	1,710	gpd/acre
	Neighborhood Mixed Use	1,550	gpd/acre
	Corridor Mixed Use	1,100	gpd/acre
	Downtown Mixed Use	3,510	gpd/acre
	Non-Residential		
	Neighborhood Commercial	650	gpd/acre
	Regional Commercial	820	gpd/acre
	Service Commercial	530	gpd/acre
	Highway Commercial	650	gpd/acre
	Office	1,060	gpd/acre
	Public Facilities	530	gpd/acre
	Light Industrial	610	gpd/acre
	Heavy Industrial	690	gpd/acre
	Educational Facilities	1,630	gpd/acre
	Open Space	2,690	gpd/acre

where:

Qs is the Total Required Storage, in gallons

MDD is the Maximum Day Demand, in gallons

3.3.2 Main Pressure Zone Storage Criteria

For the City, the groundwater aquifer is considered available storage as long as the supply wells are designed to the greater of maximum day demand plus fire flow or peak hour demands. For the Main Pressure Zone, the City criteria require an additional storage capacity of 25% of maximum day demand (**Table 3.3**). The pressure zones are defined in detail in a later chapter. The City's Main Pressure Zone total storage requirement is summarized as follows:

Qs = 25% MDD (operational)

3.3.3 Industrial Park Pressure Zone Storage Criteria

For the Industrial Park Pressure Zone the City requires the storage of a portion of maximum day demand plus fire flow demands. The pressure zones are defined in detail in a later chapter. The total storage requirement for the Industrial Park Pressure Zone is summarized as follows:

Qs = 14% MDD (operational) + 3,500 gallons per minute (gpm) for 3 hours (fire flow)

3.4 PRESSURE CRITERIA

Acceptable service pressures within distribution systems vary depending on City criteria and pressure zone topography. It is essential that the water pressure in a consumer's residence or place of business be maintained within an acceptable range. Low pressures below 30 psi can cause undesirable flow reductions when multiple faucets or water using appliances are used at once.

Excessively high pressures can cause faucets to leak and valve seats to wear out prematurely. Additionally, high service pressures can cause unnecessarily high flow rates, which can result in wasted water and high utility bills. The criteria for pressures in the domestic water system include the following:

- Maximum pressure, usually experienced during low demands and winter months
- Minimum pressure, usually experienced during peak hour demands and summer months
- Minimum pressure during fire flows and during the maximum day demand

The American Water Works Association Manual on Computer Modeling and Water Distribution System (AWWA M-32) indicates that maximum pressures are usually in the range of 90-110 pounds per square inch (psi). In some communities, the maximum pressure may be limited to 80 psi to mitigate the impact on internal plumbing. In this case, the distribution system is usually

sized for the higher pressures, and individual pressure-reducing valves are installed on service lines where the pressure may be exceeded.

The minimum acceptable pressure is usually in the range of 40-50 psi, which generally provides for sufficient pressures for second story fixtures. When backflow preventers are required, they may reduce the pressures by approximately 5-15 psi. The recommended minimum pressure during fire flows is 20 psi, as established by the National Fire Protection Association (NFPA).

The City's pressure criteria are summarized as follows:

City Pressure Zone

- Maximum pressure: 80 psi
- Minimum pressure:
    - Maximum Day Demand: 40 psi
    - Peak Hour Demand, existing development: 30 psi
    - Peak Hour Demand, future development: 40 psi
    - Maximum Day Demand + Fire Flow: 20 psi

Industrial Pressure Zone

- Recommended Operating Pressure: 80 psi

3.5 UNIT FACTORS

Domestic water demand unit factors are coefficients commonly used in planning level analysis to estimate future average daily demands for areas with predetermined land uses. The unit factors are multiplied by the number of dwelling units or net acreages for residential categories, and by the net acreages for non-residential categories, to yield the average daily demand projections.

There are several methods for developing the unit factors. This analysis relied on the City's 2013 water consumption billing records, which lists the monthly water consumption per customer account throughout the City, to estimate the unit factors within the City service area.

The total domestic water demand was calculated from the consumption data. The demand was adjusted to balance with current production records, and to account for transmission main losses and vacancies in existing land uses. The demand unit factor was then calculated using the total water production and total number of residential and non-residential land use acreages. The existing unit factor analysis is shown on **Table 3.4**.

Table 3.4 Water Demand Unit Factor Analysis
Water System Master Plan
City of Hanford

Land Use Classification	Existing Development within Service Area	Existing Demand Generating Development within Service Area	Existing Average Daily Water Demand Unit factors						
			2013 Production		2013 Production at 100% Occupancy			2013 Water Unit Factor	
			Production (w/o Vacancy Rate)		Vacancy Rate[1]	Projected Production at 100% Occupancy		Recommended Factor	Balance Using Recommended Unit Factor
	(net acres)	(net acres)	(gpd/net acres)	(gpd)	(%)	(gpd/net acres)	(gpd)	(gpd/net acres)	(gpd)
Residential									
Low Density	2,837	2,837	2,325	6,595,676	6.4%	2,474	7,017,800	2,480	7,035,388
Medium Density	498	498	2,750	1,369,118	6.4%	2,926	1,456,741	2,930	1,458,733
High Density	84	84	3,800	321,100	6.4%	4,043	341,650	4,050	342,225
Subtotal Residential	3,419	3,419		8,285,894			8,816,191		8,836,346
Mixed use									
Office Residential	89	89	2,200	195,250	6.4%	2,341	207,746	2,350	208,563
Neighborhood Mixed Use	12	12	1,775	21,975	6.4%	1,889	23,381	1,890	23,398
Corridor Mixed Use	250	250	1,300	325,573	6.4%	1,383	346,410	1,390	348,113
Downtown Mixed Use	81	81	4,200	338,226	6.4%	4,469	359,872	4,470	359,969
Subtotal Mixed Use	432	432		881,024			937,409		940,043
Non-Residential									
Neighborhood Commercial	27	27	800	21,680	6.4%	851	23,068	860	23,306
Regional Commercial	216	216	1,000	216,252	6.4%	1,064	230,092	1,070	231,390
Service Commercial	103	103	650	66,625	6.4%	692	70,889	700	71,750
Highway Commercial	48	48	800	38,080	6.4%	851	40,517	860	40,936
Office	88	88	1,300	114,673	6.4%	1,383	122,012	1,390	122,612
Light Industrial	105	105	750	78,945	6.4%	798	83,997	800	84,208
Heavy Industrial	376	376	850	319,320	6.4%	904	339,756	910	341,860
Airport Protection	0	0	0	0	6.4%	0	0	0	0
Educational Facilities	445	445	2,000	890,640	6.4%	2,128	947,641	2,130	948,532
Public Facilities	438	438	650	284,765	6.4%	692	302,990	700	306,670
Open Space	346	260	3,300	857,068	0.0%	3,300	857,068	3,300	857,068
Interest Area	0	0	0	0	0.0%	0	0	0	0
Subtotal Non-Residential	2,192	2,106		2,888,047			3,018,030		3,028,331
	6,044	5,957		**12,054,965**			12,771,630		**12,804,719**

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Note:
1. Residential vacancy rate extracted from California Department of Finance Sheet E-5 published 2016.

It should be noted that additional water conservation is expected for residential land uses with the completion and implementation of water metering. Water conservation was taken into account for residential water uses, and the future water use factors were decreased accordingly.

Anticipated increases in land use densities, as identified in the General Plan, are assumed to be offset by future water conservation efforts. Existing non-residential factors were slightly lower than normal, and were adjusted for future scenarios to apply a level of conservancy when projecting future demands.

3.6 SEASONAL DEMANDS AND PEAKING FACTORS

Domestic water demands within municipal water systems vary with the time of day and month of the year. It is necessary to quantify this variability in demand so that the water distribution system can be evaluated and designed to provide reliable water service under these variable demand conditions.

Water use conditions that are of particular importance to water distribution systems include the average day demand (ADD), the maximum month demand (MMD), the maximum day demand (MDD), the peak hour demand (PHD), and the winter demand.

The average day demand represents the annual water demand, divided by 365 days, since it is expressed in daily units. The winter demand typically represents the low month water demands and is used for simulating water quality analysis.

3.6.1 Maximum Month Demand

The MMD is the highest demand that occurs within a calendar month during a year. The City's MMD usually occurs in the summer months in either July or August. The MMD is used primarily in the evaluation of supply capabilities.

Historical monthly water production records, obtained for the period between 2000 and 2015 (**Table 3.1**), indicate the maximum month to average month ratio ranging between 1.52 and 1.73. Over the reviewed period, this ratio neither showed significant increasing or decreasing trends. Therefore, an MMD factor of 1.70 was deemed representative of trends in the City of Hanford. This is a slight increase in the peaking factor of 1.60 used in the 1996 WSMP. The following equation is recommended for estimating the maximum month demand, given the average day demand:

Maximum Month Demand = **1.70** x Average Day Demand

3.6.2 Maximum Day Demand

The MDD is the highest demand that occurs within a 24 hour day during a year. The City's MDD, which usually occurs during the summer months, is typically used for the evaluation and design of storage facilities, distribution mains, pump stations, and pressure reducing valves. The MDD,

when combined with fire flows, is one of the highest demands that these facilities should be able to service while maintaining acceptable pressures within the system.

The historical maximum day demands were obtained from the City's water production records. Groundwater well production records indicate the date of occurrence and magnitude of the maximum day demand for each calendar year, as listed in **Table 3.1**. The maximum day to average day demand ratios for the period between 2003 and 2015 ranged from 1.68 to 2.33.

City staff indicated that the observed high peaking factor of 2.33 was attributed to a 2014 flushing event that coincided with peak demand periods. After reviewing the historical peaking factors with City staff, Akel Engineering Group was directed to use the same maximum day demand peaking factors adopted in the previous master plan. These factors for the Main Pressure Zone and the Industrial Park Pressure Zone are summarized as follows:

Main Pressure Zone. The following equation is then used to estimate the maximum day demand for the Main Pressure Zone, given the average day demand:

Maximum Day Demand = **1.75** x Average Day Demand

Industrial Park Pressure Zone. The following equation is then used to estimate the maximum day demand for the Industrial Park Pressure Zone, given the average day demand:

Maximum Day Demand = **2.00** x Average Day Demand

3.6.3 Peak Hour Demand

The PHD is another high demand condition that is used in the evaluation and design of water distribution systems. The peak hour demand is the highest demand that occurs within a one hour period during a year. The peak hour demand is considered to be the largest single measure of the maximum demand placed on the distribution system. The peak hour demand is often compared to the maximum day demand plus fire flow to determine the largest demand imposed on the system for the purpose of evaluating distribution mains.

Main Pressure Zone. For the Main Pressure Zone, an industry standard peak hour to maximum day ratio of 1.50 was applied to the maximum day demand to yield the peak hour demand ratio of 2.50, which is consistent with the 1996 WSMP. The peak hour demand can then be calculated using the average day demand and the following equation:

Peak Hour Demand = **2.50** x Average Day Demand

Industrial Park Pressure Zone. For the Industrial Park Pressure Zone, a peak hour peaking factor of 2.78 was utilized, consistent with the 1996 WSMP. The following equation is then used to estimate the peak hour demand for the Industrial Park Pressure Zone, given the average day demand:

Peak Hour Demand = **2.78** x Average Day Demand

3.7 FIRE FLOWS

Fire flows are typically based on land use, with the potential for increased fire flow based on the building type. The following are the criteria for fire flows:

- Residential: 1,000 gpm for two hours
- Residential (Recent and Future Developments): 1,500 gpm for two hours
- Commercial (Recent and Future Developments): 2,500 gpm for three hours
- Commercial (Older Developments near Downtown): 3,000 gpm for three hours
- Industrial Park Area: 3,500 gpm for three hours

It should be noted that following review with City staff, and receiving approval of the fire marshal, the master planning fire flow criteria for Industrial developments has been decreased from the 1996 WSMP requirement of 5,000 gpm.

3.8 TRANSMISSION AND DISTRIBUTION MAIN CRITERIA

Transmission and distribution mains are usually designed to convey the maximum expected flow condition. In municipal water systems, this condition is usually the greater of either the peak hour demand or the maximum day demand plus fire flow. The hydrodynamics of pipe flow create two additional parameters that are taken into consideration when evaluating or sizing water mains: head loss and velocity.

Head loss is a loss of energy within pipes that is caused by the frictional effects of the inside surface of the pipe and friction within the moving fluid itself. Head loss creates a loss in pressure which is undesirable in water distribution systems. Head loss, by itself, is not an important factor as long as the pressure criterion has not been violated. However, high head loss may be an indicator that the pipe is nearing the limit of its carrying capacity and may not have sufficient capacity to perform under stringent conditions. The maximum head loss in any pipe is 8 feet per 1,000 feet of pipe.

Since high flow velocities can cause damage to pipes and lead to high head loss, it is desirable to keep the velocity below a predetermined limit. The City criterion for maximum pipeline velocity is 10 feet per second while the City criterion for maximum desirable pipeline headloss is 8 feet per 1,000 feet. A summary of the criteria pertaining to transmission and distribution mains is included in **Table 3.3**.

CHAPTER 4 - EXISTING DOMESTIC WATER FACILITIES

This chapter provides a description of the City's existing domestic water system and facilities including the distribution mains, storage reservoirs, and existing wells.

4.1 EXISTING WATER SYSTEM OVERVIEW

The City's municipal water system consists of 14 active groundwater wells, 3 storage reservoirs that have a cumulative capacity of 3.50 MG, distribution mains, and fire hydrants. The City's generally flat topography slopes from northeast to southwest from approximately 255 feet in the northeast to approximately 225 feet in the southwest. With this generally flat topography, the City operates two pressure zones, with the primary pressure zone covering areas north of the Kings Industrial park and the remaining pressure zone serving the Kings Industrial park, located south of Iona Avenue.

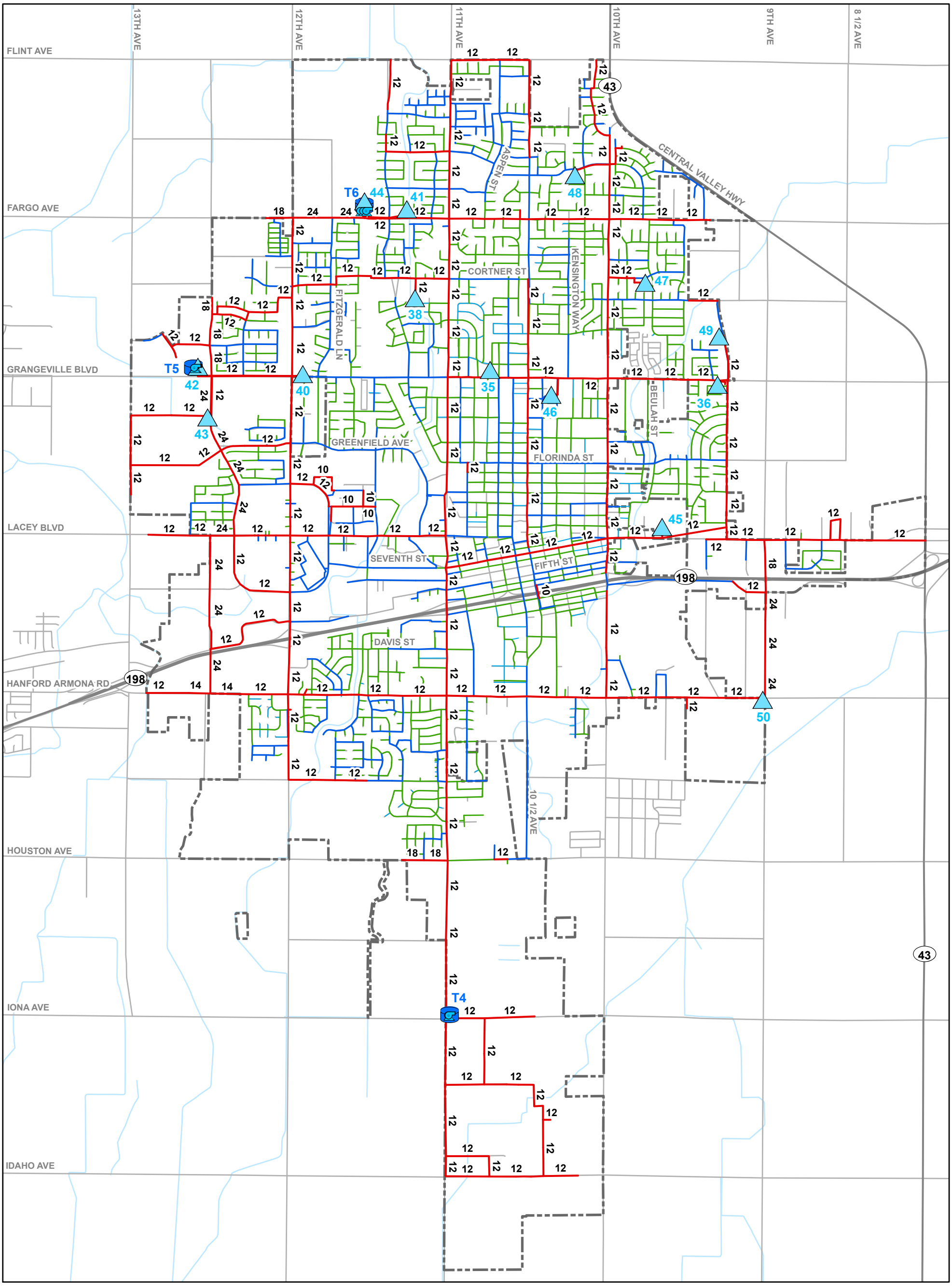
The City's existing domestic water distribution system is shown in **Figure 4.1**, which displays the existing system by pipe sizes. This figure provides a general color coding for the distribution mains, as well as labeling the existing wells and the storage reservoir.

4.2 PRESSURE ZONES

The City's existing water system serves lands ranging in elevation from 255 feet in the northeast to approximately 225 feet in the southwest. The City is divided into two distinct pressure zones. The pressure zones allow operational flexibility within each unique service area. The pressures are described as follows:

- **City Pressure Zone:** This pressure zone intended to serve existing and future users north of Iona Avenue. The hydraulic grade line for this pressure zone is controlled by various wells and the pump station sites located at the intersection of BNSF Railway and Fargo Avenue and 500 feet west of the intersection of Centennial Drive and Grangeville Boulevard. At buildout, this pressure zone serves elevation ranging from approximately 225 feet to 255 feet.

- **Industrial Park Pressure Zone:** This pressure zone is bound to the north by Iona Avenue and extends to the boundary of the City's Planned Area Boundary in the south. This pressure zone is intended to serve existing and future industrial users, and is pressure controlled by a pump station site located at the intersection of 11th Avenue and Iona Avenue. At buildout, this pressure zone will serve elevations ranging from approximately 215 feet to 225 feet at buildout.



Legend

Existing System

- Tanks
- Wells
- Pump Stations

Pipes By Size

- 4" and Smaller
- 6"
- 8"
- 10" and Larger

- City Limits
- Streets
- Highways
- Waterways

Update: June 27, 2017

0 0.25 0.5 1 Mile

N W GIS E S

Figure 4.1
Existing System by Pipe Sizes

Water System Master Plan
City of Hanford

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File Path: P:\xGIS\GIS_Projects\Hanford\2016\Water\Final\Hardcopy\HF_Fig4-1_ExistSys_062717.mxd

4.3 SOURCE OF SUPPLY

The City currently uses groundwater as the sole source of supply. There are currently 14 active groundwater wells in the City that have been used for supply (**Table 4.1**). The rated capacities for the existing groundwater wells were extracted from the City's 2010 UWMP as well as information provided by City staff. It should be noted that, over time, well efficiencies may vary based on equipment conditions and groundwater levels. In periods of prolonged drought, well efficiency ratings may decrease due to a decline in groundwater levels. The opposite may occur in wet periods; well efficiencies can increase while the groundwater levels recover. As such, the City should monitor the well efficiencies on a frequent basis to adequately manage the groundwater supply. If periods of prolonged drought persist, it may be necessary to construct additional wells to maintain adequate supply capacity. **Table 4.1** lists the City's current total rated supply at approximately 34.9 million gallons per day (mgd). Consistent with the system performance and design criteria the firm capacity was calculated as the capacity with the largest well out of service and is equal to 32.0 mgd.

4.4 TRANSMISSION AND DISTRIBUTION PIPELINES

Groundwater is pumped directly into the City's distribution system through more than 215 miles of pipeline. The City's sole source of supply is groundwater, which is distributed throughout the domestic water system. The distribution mains are generally 12-inches in diameter and smaller, and convey water to the consumer service connections. The City's transmission mains are generally 18-inches in diameter and larger, and convey water from the sources of supply to the distribution mains.

An inventory of the existing modeled pipes, extracted from the GIS-based hydraulic model, is included in **Table 4.2**. For each pipe diameter, the inventory lists the length in feet, as well as the total length in units of miles.

4.5 STORAGE RESERVOIRS

Storage reservoirs are typically incorporated in the water system to provide water supply for operation during periods of high demand, for meeting fire flow requirements, and for other emergencies, as defined in the City's planning criteria. The City currently operates four storage reservoirs, with a combined storage volume of 3.5 MG (**Table 4.3**). Each tank is briefly discussed in the following:

- **Tank 4** is a 0.5 MG ground level steel storage tank at the intersection of 11th Avenue and Iona Avenue that serves the Industrial Park to satisfy normal domestic demands plus fire flows. The tank is filled from the Main Pressure Zone through an altitude valve connected to a 12-inch pipeline on 11th Avenue. Booster pumps supply the Industrial Park Pressure Zone from the tank, maintaining a downstream pressure of approximately 80 psi. The tank can be bypassed to serve the Industrial Park Pressure Zone in the event of an emergency or for normal tank maintenance.

Table 4.1 Existing Groundwater Supply Capacity

Water System Master Plan

City of Hanford

Supply Well	Rated Capacity[1]		Additional Information					
			Year Installed[1]	HP[1]	Head[2]	Specific Yield	Ground Elevation	Casing Depth[1]
	(gpm)	(MGD)		(HP)	(ft)		(ft)	(ft)
35	1,200	1.7	1987	100	416			1,500
36	1,200	1.7	1987	100				1,500
38	1,200	1.7	1993	150	299			1,460
40	2,000	2.9	1997	250	236			1,440
41	2,000	2.9	1998	250	284			1,440
42	2,000	2.9	2000	250	326			1,320
43	2,000	2.9	2006	250	278			1,530
44	2,000	2.9	2009	250	287			1,540
45	1,750	2.5	2008	250	434			1,580
46	2,000	2.9	2009	250	381			1,634
47	2,000	2.9	2009	250	399			1,700
48	1,800	2.6	2009	250	409			1,700
49	1,600	2.3	2009	250	426			1,550
50	1,500	2.2	2016	300	585			1,530
Total and Firm Supply Capacity								
Total Supply Capacity	**24,250**	**34.9**						
Firm Capacity (Excluding largest well)	**22,250**	**32.0**						

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Notes:

1. Source: City of Hanford, 2010 Urban Water Management Plan, Table 4.1.
2. Source: "Water Well Facilities Record", City of Hanford Utility Division, received March 8, 2014.
3. Source: Southern California Edison Tests received from City staff March 8, 2014.

Table 4.2 Existing Modeled Pipe Inventory

Water System Master Plan

City of Hanford

Pipe Size	Length	
(in)	(feet)	(miles)
2	1,648	0.3
4	43,706	8.3
6	522,428	98.9
8	304,289	57.6
10	4,316	0.8
12	239,710	45.4
14	1,997	0.4
18	7,502	1.4
24	18,250	3.5
30	221	0.0
Total	**1,144,067**	**216.7**

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Table 4.3 Existing Storage Reservoirs

Water System Master Plan

City of Hanford

Reservoir	Location	Capacity[1,2] (MG)	Serviced Pressure Zone	Construction Type[1,2]	Tank Height[3] (ft)	Diameter[3] (ft)	Pump Station Capacity[2] (gpm)	Ground Elevation (ft)
T-4	11th Ave. & Iona	**0.5**	Industrial	Ground-level Steel	24	60	2,800	231
T-5[4]	Grangeville Blvd & Centennial Dr.	**2.0**	City	2 Ground-level Steel	30	107	11,000	240
T-6	Fargo Ave. at the BNSF Railroad	**1.0**	City	Ground-level Steel	28	75	6,600	252
		3.50						

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Notes:

1. Sources: City of Hanford, 1996 Water System Master Plan, Table 2-4
2. Source: "Special Facilities Record", City of Hanford Utility Division, received April 22, 2014
3. Source: City of Hanford Hydraulic Model received March 14, 2014
4. Storage reservoir T-5 composed of two interconnected 1.0 MG storage reservoirs.

- **Tank 5** is composed of two interconnected 1.0 MG ground level steel storage tanks at the intersection of Grangeville Boulevard and Centennial Drive that serve the Main Pressure Zone to satisfy normal domestic demands. The tanks are directly filled from wells 40, 42, and 43, which are controlled by SCADA to maintain set levels within the tanks. Booster pumps supply the Main Pressure Zone from the tanks and are controlled by SCADA to turn on and off based on specific downstream pressures.

- **Tank 6** is a 1.0 MG ground level steel storage tank at the intersection Fargo Avenue and the BNSF railroad that serves the Main Pressure Zone to satisfy normal domestic demands. The tank is filled from wells 41 and 44, which are controlled by SCADA to maintain set levels within the tanks. Booster pumps supply the Main Pressure Zone from the tanks and are controlled by SCADA to turn on and off based on specific downstream pressures.

Pump Stations

The City's hydraulic grade is maintained by groundwater wells that discharge directly into the distribution system as well as pump stations that pump water from ground-level storage tanks to the distribution system. The City's existing pump stations are summarized on **Table 4.4** and described below.

Industrial Park Pressure Zone

- Tank 4: The Tank 4 pump station is comprised of one 800 gpm pump and two 1,000 gpm pumps, for a total pump station capacity of 2,800 gpm. The 800 gpm pump is intended to provide the operational demands and operates based on a variable frequency drive, which maintains a downstream pressure of 80 psi. The two 1,000 gpm pumps are intended to provide additional flow capacity in the event of a fire.

Main Pressure Zone

- Tank 5: The Tank 5 pump station is comprised of five individual 2,200 gpm pumps, for a total pump station capacity of 11,000 gpm. This pump station draws water from Tank 5, which is filled by groundwater wells 40, 42, and 43, and discharges directly into the distribution system.

- Tank 6: The Tank 6 pump station is comprised of three individual 2,200 gpm pumps, for a total pump station capacity of 6,600 gpm. This pump station draws water from Tank 6, which is filled by groundwater wells 41 and 44, and discharges directly into the distribution system.

Table 4.4 Existing Pump Stations

Water System Master Plan

City of Hanford

Pump Station	Pump Station Information				Pump Information		
	Total Pump Capacity [1]		No. of Pumps	Pressure Zone	Pump No.	Individual Horsepower	Design
	(gpm)	(mgd)				(hp)	(gpm)
Tank 4	**2,800**	4.03	3	Industrial	1	VFD[2]	800
					2	60	1,000
					3	60	1,000
Tank 5	**11,000**	15.84	5	City	1	125	2,200
					2	125	2,200
					3	125	2,200
					4	125	2,200
					5	125	2,200
Tank 6	**6,600**	9.50	3	City	1	125	2,200
					2	125	2,200
					3	125	2,200

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1/26/2016

Notes:

1. Source: "Special Facilities Record", City of Hanford Utilities Division, received April 22, 2014.
2. VFD = Variable Frequency Drive

CHAPTER 5 – WATER DEMANDS AND SUPPLY CHARACTERISTICS

This chapter summarizes the existing and future domestic water demands, and the diurnal pattern used for the hydraulic analysis.

5.1 EXISTING DOMESTIC WATER DEMANDS

The existing water demands used for this master plan were based on the City's 2013 water consumption billing records, which included the monthly demands for each customer account throughout the City, as well as total annual production. These existing water demands in this analysis are adjusted to match the annual production records and account for system losses.

The existing demand distribution was obtained from the water billing records. Using GIS, each customer account was associated with parcel for the account and spatially joined to location in the hydraulic model representing the service location.

The demands extracted from the water billing records are lower than the total demands listed in the annual production records due to system losses that occurred between the groundwater wells and customer service connections. The total domestic water demands were increased proportionally to reflect the total 2013 production and account for pipeline losses. The City's 2013 the average daily production was calculated at 12.1 MGD.

5.2 FUTURE DOMESTIC WATER DEMANDS

Future demands were projected using the unit factors discussed in a previous chapter for residential and non-residential land uses and for development in the Planned Area Boundary. **Table 5.1** organizes the future land use categories and their corresponding domestic water demands. The average day domestic water demands from existing and future developments is calculated at 22.3 MGD. These demands were used in sizing the future infrastructure facilities, including transmission mains, storage reservoirs, and pump stations. Demands were also used for allocating and reserving capacities in the existing or proposed facilities.

It should be noted that the future demands account for continued conservation and meeting the 2015 UWMP established 20x2020 target. As such, the existing land use water demands are shown lower in **Table 5.1** than current water billing indicates.

5.3 MAXIMUM DAY AND PEAK HOUR DEMANDS

The maximum day and peak hour demands for the existing and future demands were calculated using the average day demands and City peaking factor criteria. The maximum day to average

Table 5.1 Average Daily Water Demands
Water System Master Plan
City of Hanford

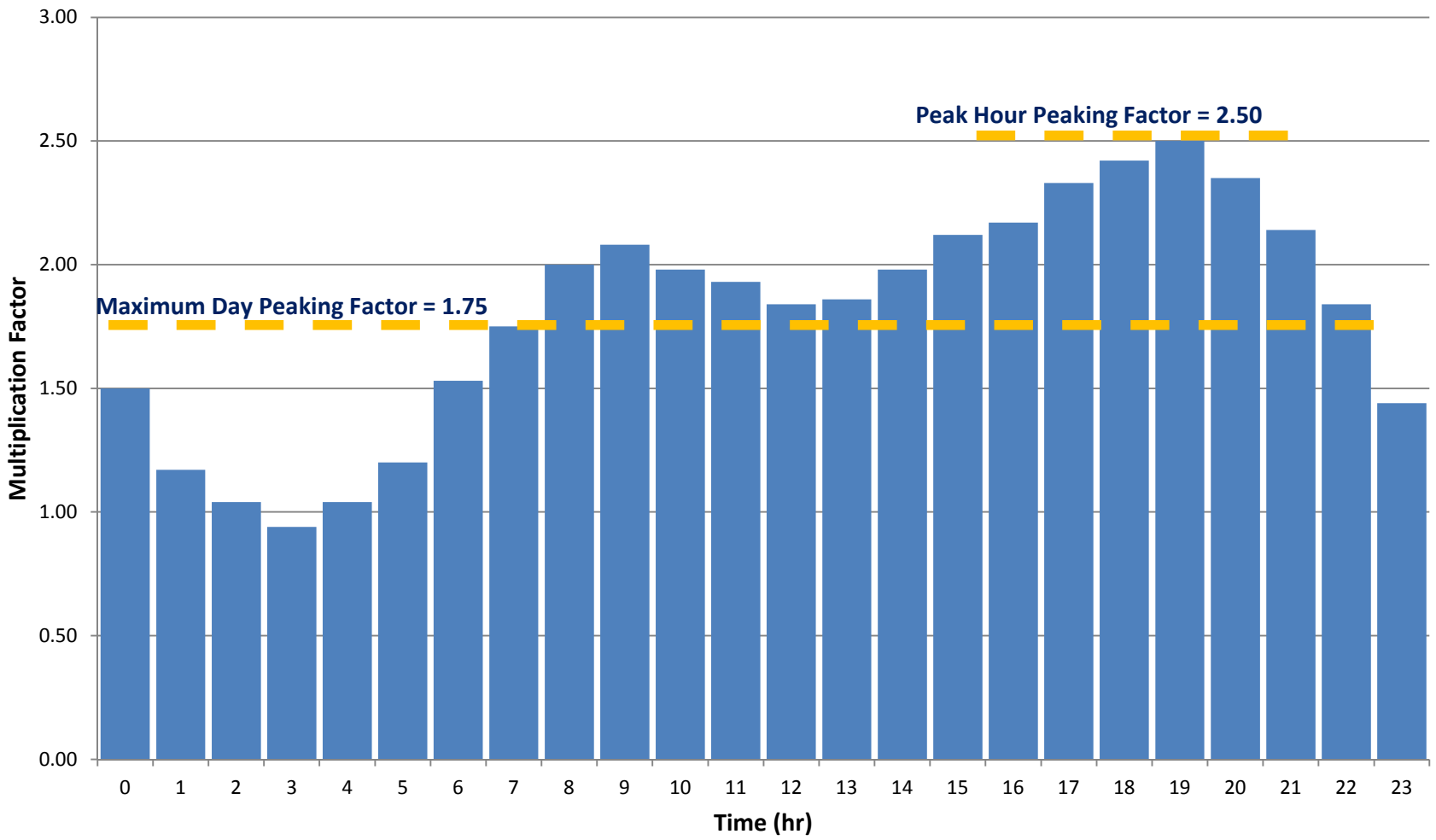
Land Use Classifications	Buildout Water Demands											
	Existing Development			Future Development to be Serviced within Planned Area Boundary								
	Within Service Area			Within Service Area			Planned Area Boundary				Total	
	Existing Development (net acre)	Water Unit Factor (gpd/net acre)	Average Daily Demand (gpd)	New Development (net acre)	Future Water Unit Factor (gpd/net acre)	Average Daily Demand (gpd)	Existing Development (net acre)	New Development (net acre)	Future Water Unit Factor (gpd/net acre)	Average Daily Demand (gpd)	Total Development within PAB (net acre)	Average Daily Demand (gpd)
Residential												
Low Density	2,837	1,900	5,390,015	1,026	1,900	1,949,510	539	1,401	1,900	3,687,132	5,804	11,026,658
Medium Density	498	2,240	1,115,209	225	2,240	504,025	35	312	2,240	777,612	1,070	2,396,845
High Density	84	3,100	261,950	73	3,100	227,202	0	64	3,100	198,130	222	687,282
Subtotal Residential	3,419		6,767,174	1,324		2,680,737	574	1,777		4,662,874	7,095	14,110,785
Mixed Use												
Office Residential	89	1,800	159,750	25	1,800	45,144	0	0	1,800	0	114	204,894
Neighborhood Mixed Use	12	1,450	17,951	42	1,450	60,656	0	15	1,450	22,407	70	101,014
Corridor Mixed Use	250	1,060	265,467	225	1,060	238,707	10	3	1,060	14,098	489	518,272
Downtown Mixed Use	81	3,430	276,218	42	3,430	145,363	0	0	3,430	0	123	421,581
Subtotal Mixed Use	432		719,386	334		489,871	10	18		36,505	795	1,245,762
Non-Residential												
Neighborhood Commercial	27	660	17,886	26	660	17,198	8	12	660	13,114	73	48,198
Regional Commercial	216	820	177,327	160	820	130,833	18	169	820	153,962	564	462,121
Service Commercial	103	530	54,325	54	530	28,397	56	63	530	63,048	275	145,771
Highway Commercial	48	660	31,416	68	660	44,609	16	16	660	21,193	147	97,218
Office	88	1,060	93,503	30	1,060	32,213	0	0	1,060	0	119	125,716
Light Industrial	105	610	64,209	61	610	36,911	83	557	610	390,449	806	491,569
Heavy Industrial	376	690	259,212	568	690	391,672	211	2,607	690	1,944,041	3,761	2,594,924
Airport Protection	0	0	0	125	0	0	111	563	0	0	799	0
Educational Facilities	445	1,630	725,872	117	1,630	190,123	11	97	1,630	175,078	669	1,091,073
Public Facilities	438	530	232,193	56	530	29,675	3	13	530	8,454	510	270,321
Open Space with Irrigation	16	2,690	42,314	45	2,690	119,866	0	121	2,690	326,674	182	488,854
Open Space without Irrigation	346	0	0	65	0	0	41	54	0	0	507	0
Interest Area	0	1,800	0	0	1,800	0	49	552	1,800	1,082,466	601	1,082,466
Subtotal Non-Residential	2,208		1,698,255	1,372		1,021,497	607	4,825		4,178,477	9,012	6,898,230
Totals	6,059		**9,184,815**	3,031		4,192,105	1,192	6,621		8,877,856	16,903	**22,254,777**

day ratio of 1.75, and peak hour to average day ratio of 2.5, were applied to the average day demands to obtain estimates of the higher demand conditions.

The maximum day and peak hour demand estimates for existing and future demand years are listed in **Table 5.2**, and are based on the buildout of the Planned Area Boundary as discussed in a previous chapter. The 2013 maximum day and peak hour demands at 100 percent occupancy are calculated at 21.1 MGD and 30.2 MGD, respectively. The projected total maximum day demand and peak hour demand for the buildout of the Planned Area Boundary at 100 percent occupancy are 38.5 MGD and 55.0 MGD respectively.

5.4 DIURNAL DEMAND PATTERNS

Water demands vary with the time of day and by account type according to the land use designation. These fluctuations were accounted for in the modeling effort and evaluation of the water distribution system. The diurnal demand patterns affect the water levels in storage reservoirs and amount of flow through distribution mains. A diurnal curve (**Figure 5.1**) was used to model the demand patterns of existing customers. This demand pattern was extracted from the previous City water system hydraulic model, and is based on actual pumping records for the City's groundwater wells and pump stations. The peaks in the diurnal pattern match the peaking factors recommended in this master plan.



LEGEND

October 26, 2016

Figure 5.1
Diurnal Pattern
Water System Master Plan
City of Hanford

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Table 5.2 Projected Future Water Requirements

Water System Master Plan
City of Hanford

Year	Population	Annual Growth	Future Water Requirements		
			Aveage Day Demand	Maximum Day Demand	Peak Hour Demand
		(%)	(MGD)	(MGD)	(MGD)
Historical					
2010	53,967		10.9	19.0	27.2
2011	54,146	0.3%	10.6	18.5	26.5
2012	54,541	0.7%	11.6	20.3	28.9
2013	54,513	-0.1%	12.1	21.1	30.2
2014	54,727	0.4%	11.1	19.4	27.7
2015	55,337	1.1%	10.4	18.2	26.0
Projected					
2016	57,070	3.1%	11.0	19.3	27.6
2017	58,803	3.0%	11.2	19.5	27.9
2018	60,536	2.9%	11.3	19.7	28.2
2019	62,270	2.9%	11.4	19.9	28.4
2020	64,003	2.8%	11.5	20.0	28.6
2021	65,736	2.7%	11.8	20.6	29.4
2022	67,469	2.6%	12.1	21.1	30.2
2023	69,202	2.6%	12.4	21.7	31.0
2024	70,935	2.5%	12.7	22.2	31.7
2025	72,669	2.4%	13.0	22.8	32.5
2026	74,402	2.4%	13.3	23.3	33.3
2027	76,135	2.3%	13.6	23.8	34.1
2028	77,868	2.3%	13.9	24.4	34.8
2029	79,601	2.2%	14.2	24.9	35.6
2030	**81,334**	2.2%	**14.6**	25.5	36.4
2031	83,067	2.1%	14.9	26.0	37.2
2032	84,801	2.1%	15.2	26.6	37.9
2033	86,534	2.0%	15.5	27.1	38.7
2034	88,267	2.0%	15.8	27.6	39.5
2035	90,000	2.0%	16.1	28.2	40.3
2036	91,890	2.1%	16.4	28.8	41.1
2037	93,820	2.1%	16.8	29.4	42.0
2038	95,790	2.1%	17.1	30.0	42.9
2039	97,801	2.1%	17.5	30.6	43.8
2040	99,855	2.1%	17.9	31.3	44.7
2041	101,952	2.1%	18.2	31.9	45.6
2042	104,093	2.1%	18.6	32.6	46.6
2043	106,279	2.1%	19.0	33.3	47.6
2044	108,511	2.1%	19.4	34.0	48.6
2045	110,790	2.1%	19.8	34.7	49.6
2046	113,116	2.1%	20.2	35.4	50.6
2047	115,492	2.1%	20.7	36.2	51.7
2048	117,917	2.1%	21.1	36.9	52.8
2049	120,393	2.1%	21.6	37.7	53.9
2050	**122,922**	2.1%	**22.0**	38.5	55.0

CHAPTER 6 - HYDRAULIC MODEL DEVELOPMENT

This chapter describes the development and calibration of the City's domestic water distribution system hydraulic model. The hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.1 OVERVIEW

Hydraulic network analysis has become an effectively powerful tool in many aspects of water distribution planning, design, operation, management, emergency response planning, system reliability analysis, fire flow analysis, and water quality evaluations. The City's hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.2 MODEL SELECTION

The City's hydraulic model combines information on the physical characteristics of the water system (pipelines, groundwater wells, and storage reservoir) and operational characteristics (how they operate). The hydraulic model then performs calculations and solves series of equations to simulate flows in pipes and calculate pressures at nodes or junctions.

There are several network analysis software products that are released by different manufacturers, which can equally perform the hydraulic analysis satisfactorily. The selection of particular software depends on user preferences, the distribution system's unique requirements, and the costs for purchasing and maintaining the software.

The City's previous model was developed using the Environmental Protection Agency's EPANET, which allows the use of a single modeling scenario, and basic simulation options for steady-state and extended period simulations. As part of this master plan, the hydraulic model has been updated and redeveloped into the GIS-based hydraulic model InfoWater by Innovyze. The model has an intuitive graphical interface and is directly integrated with ESRI's ArcGIS (GIS), providing a useful modeling tool linked to the newly developed City GIS.

6.3 HYDRAULIC MODEL DEVELOPMENT

Developing the hydraulic model included digitizing and quality control, developing pipe and node databases, and water demand allocation.

6.3.1 Pipes and Nodes

Computer modeling requires the compilation of large numerical databases that enable data input into the model. Detailed physical aspects, such as pipe size, pipe elevation, and pipe lengths,

contribute to the accuracy of the model.

Pipes and nodes represent the physical aspect of the system within the model. A node is a computer representation of a place where demand may be allocated into the hydraulic system, while a pipe represents the distribution and transmission aspect of the water demand. In addition, reservoir dimensions and capacities, and groundwater well capacity and design head, were also included in the hydraulic model.

6.3.2 Digitizing and Quality Control

The City's existing domestic water distribution system was digitized in GIS using several sources of data and various levels of quality control. The data sources included the City's existing system as maintained by staff in AutoCAD, as well as the previously developed hydraulic model and subsequent updates.

The City's hydraulic model was redeveloped in H2OMap Water. The existing EPANET hydraulic model was used as a basis for the update, and the model was digitized to the existing street centerlines. The City currently maintains an inventory of the existing system in AutoCAD maps, and the maps were used to verify the update. GIS-based maps were provided to City staff after digitizing was complete, and the pipe diameters and locations were verified for accuracy.

6.3.3 Demand Allocation

Demand allocation consists of assigning water demand values to the appropriate nodes in the model. The goal is to distribute the demands throughout the model to best represent actual system response.

Allocating demands to nodes within the hydraulic model required multiple steps, incorporating the efficiency and capabilities of GIS and hydraulic modeling software. For existing demands, using GIS, each customer account was geocoded at its approximate service location. The existing demand for each customer account was then distributed to the nearest water model node.

Domestic water demands from each anticipated future development, as presented in a previous chapter, were also allocated to the model for the purpose of sizing the required future facilities. The demands from the greater Planned Area Boundary were allocated based on proposed land use and the land use acreages. As many of the areas were very large in size, demands were allocated evenly to the demand nodes within each area. Infill areas, redevelopment areas, and vacant lands were also included in the future demand allocation.

6.4 MODEL CALIBRATION

Model calibration is intended to instill a reasonable level of confidence in the pressures and flows simulated, and the field results measured in SCADA. Model calibration generally consists of comparing model predictions to field measured results and making necessary adjustments. The hydraulic model incorporated water system SCADA controls as provided by City staff (**Table 6.1**).

Table 6.1 SCADA Operational Control Summary

Water System Master Plan

City of Hanford

Pump ID	Operational Setpoints		
	Control Parameter	On	Off
Groundwater Wells			
35	Pump Pressure	38 psi	55 psi
36	Pump Pressure	40 psi	63 psi
38	Pump Pressure	45 psi	58 psi
40	Tank 5 Level	12'	21'
41	Tank 6 Level	12'	21'
42	Tank 5 Level	12'	23'
43	Tank 5 Level	12'	17'
44	Tank 6 Level	12'	23'
45	Pump Pressure	45 psi	60 psi
46	Pump Pressure	40 psi	62 psi
47	Pump Pressure	42 psi	58 psi
48	Pump Pressure	42 psi	58 psi
49	Pump Pressure	42 psi	58 psi
Pump Stations			
Tank 4	Variable Speed Pump Pressure	80 psi	
Tank 5	Pump Pressure	48 psi	62 psi
Tank 6	Pump Pressure	50 psi	62 psi

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4/27/2017

Notes:

1. Groundwater well and pump station controls received from City staff April 22, 2014.

Fire flow records for the months of February, April, May, August, and November in 2013 were also provided and consulted during the model development.

As a suggested enhancement to the hydraulic model, City staff may consider adding a more thorough calibration for extended period simulations. This process includes detailing SCADA pressures and flow measurements at the wells and pump stations, and calibrating the hydraulic model to those conditions. This also includes installing teleloggers at key locations throughout the system.

CHAPTER 7 - EVALUATION AND PROPOSED IMPROVEMENTS

This section presents a summary of the domestic water system evaluation and identifies improvements needed to mitigate existing deficiencies, as well as improvements needed to expand the system and service growth.

7.1 OVERVIEW

The hydraulic model was used for evaluating the distribution system for capacity deficiencies during peak hour demand and during maximum day demands in conjunction with fire flows; the analysis duration was established at 24 hours for analysis.

The criteria used for evaluating the capacity adequacy of the domestic water distribution system facilities (transmission mains, storage reservoirs, and pump stations) were discussed and summarized in the System Performance and Design Criteria chapter.

7.2 LOW PRESSURE ANALYSIS

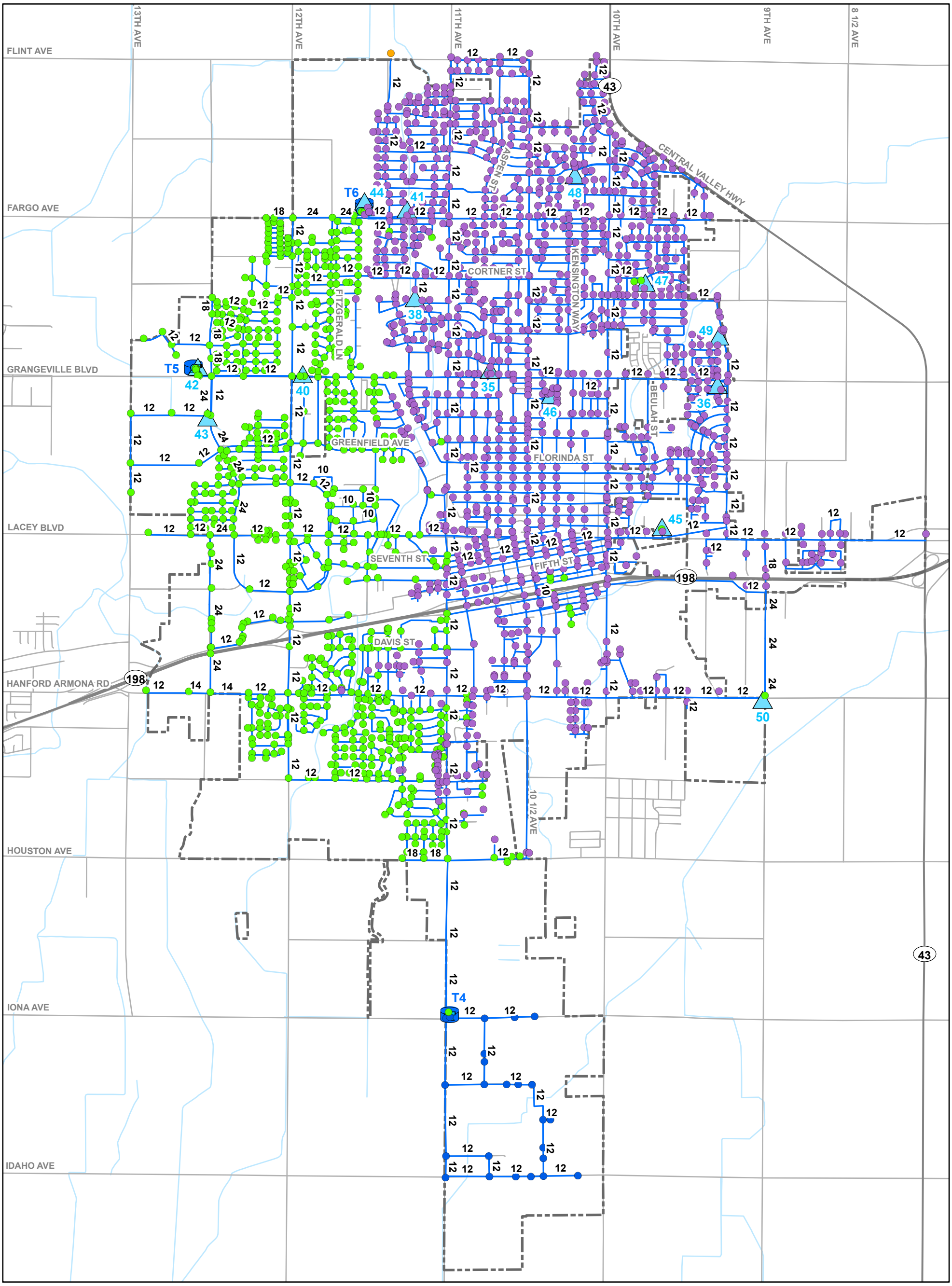
The hydraulic model was used to determine if the existing domestic water distribution system meets the City's System Performance and Design Criteria, as discussed in a previous chapter. During maximum day demands the minimum pressure requirement is 40 psi, while during the peak hour demand, the minimum pressure requirement is 30 psi. The hydraulic analysis yielded no deficiencies for low pressure under maximum day or peak hour operating conditions. The results of the low pressure analysis are summarized on **Figure 7.1** and **Figure 7.2**.

7.3 FIRE FLOW ANALYSIS

The fire flow analysis consisted of using the maximum day demand in the hydraulic model and applying hypothetical fire flows. The magnitude and duration of each fire flow was based on the governing land use type within proximity to the fire location. The criterion for fire flows was also summarized in the System Performance and Design Criteria chapter.

The hydraulic model indicates that the City's existing distribution system performed adequately during the fire flow analysis, as summarized on **Figure 7.3** and **Figure 7.4**. In residential and non-residential areas serviced by older 4-inch and 6-inch pipelines, the hydraulic model indicated fire flow pressures below the minimum residual pressure of 20 psi. It is the recommendation of this master plan that 4-inch and 6-inch diameter pipelines in non-residential areas be replaced with at least 8-inch pipelines. Older 8-inch pipelines may be replaced in kind, pending fire flow analysis and approval by the City engineer.

It should be noted that the Industrial Park indicates fire flow deficiencies throughout the area. This is due to inadequate storage. The pipelines are capable of meeting the City's criteria.



Legend

Junction Pressures (psi)

- < 40
- 40 - 45
- 45 - 55
- 55 - 65
- > 65

Existing System

- Tanks
- Wells
- Pump Stations
- Pipes

- City Limits
- Streets
- Highways
- Waterways

Update: June 27, 2017

0 0.25 0.5 1 Mile

N W GIS E S

Figure 7.1
Maximum Day Demand Pressures

Water System Master Plan
City of Hanford

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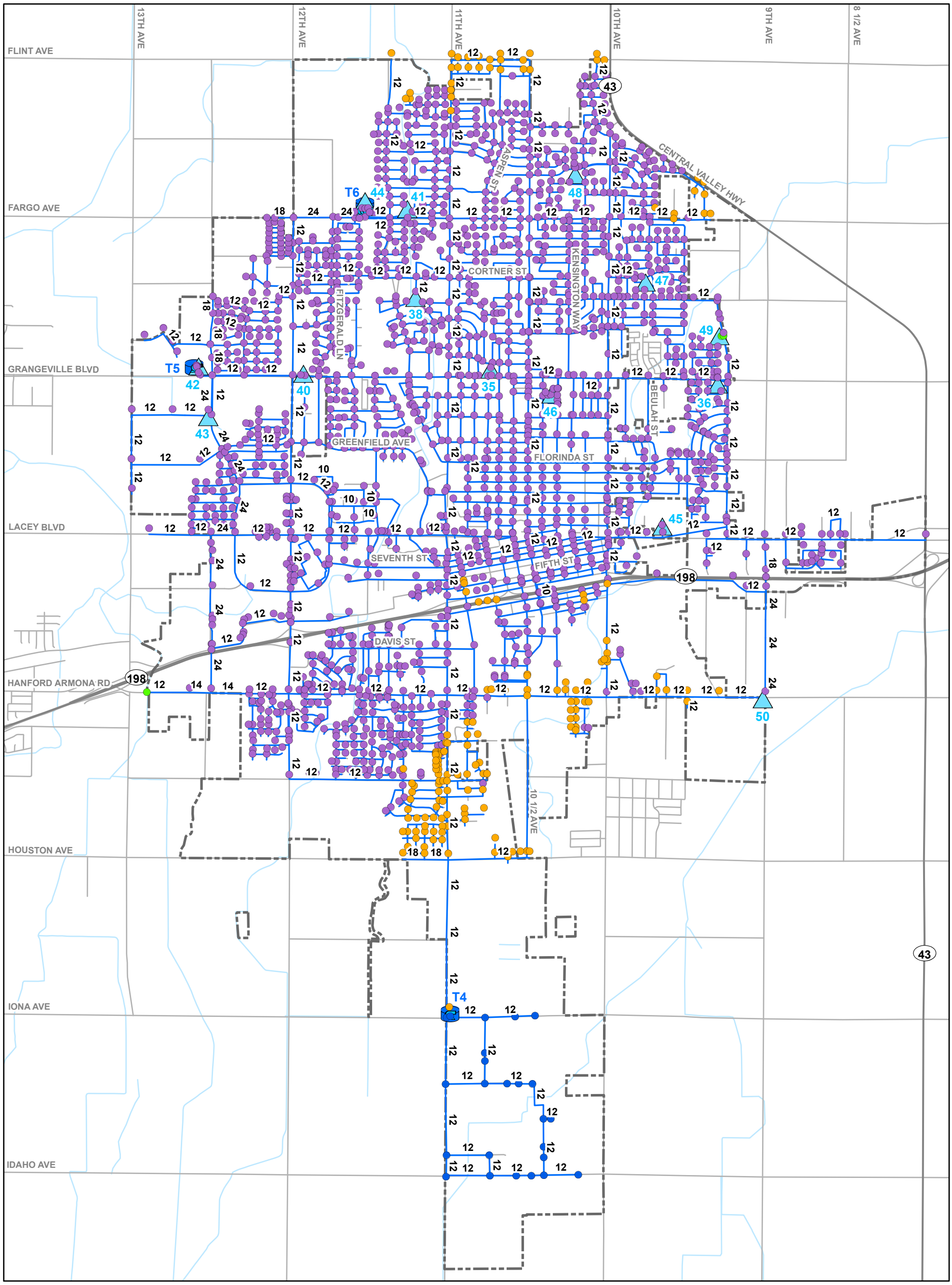

Legend

Junction Pressures (psi)

- < 35
- 35 - 45
- 45 - 55
- 55 - 65
- > 65

Existing System

- Tanks
- Wells
- Pump Stations
- Pipes

- City Limits
- Streets
- Highways
- Waterways

Update: June 27, 2017

0 0.25 0.5 1 Mile

N W GIS E S

Figure 7.2
Peak Hour Demand Pressures

Water System Master Plan
City of Hanford

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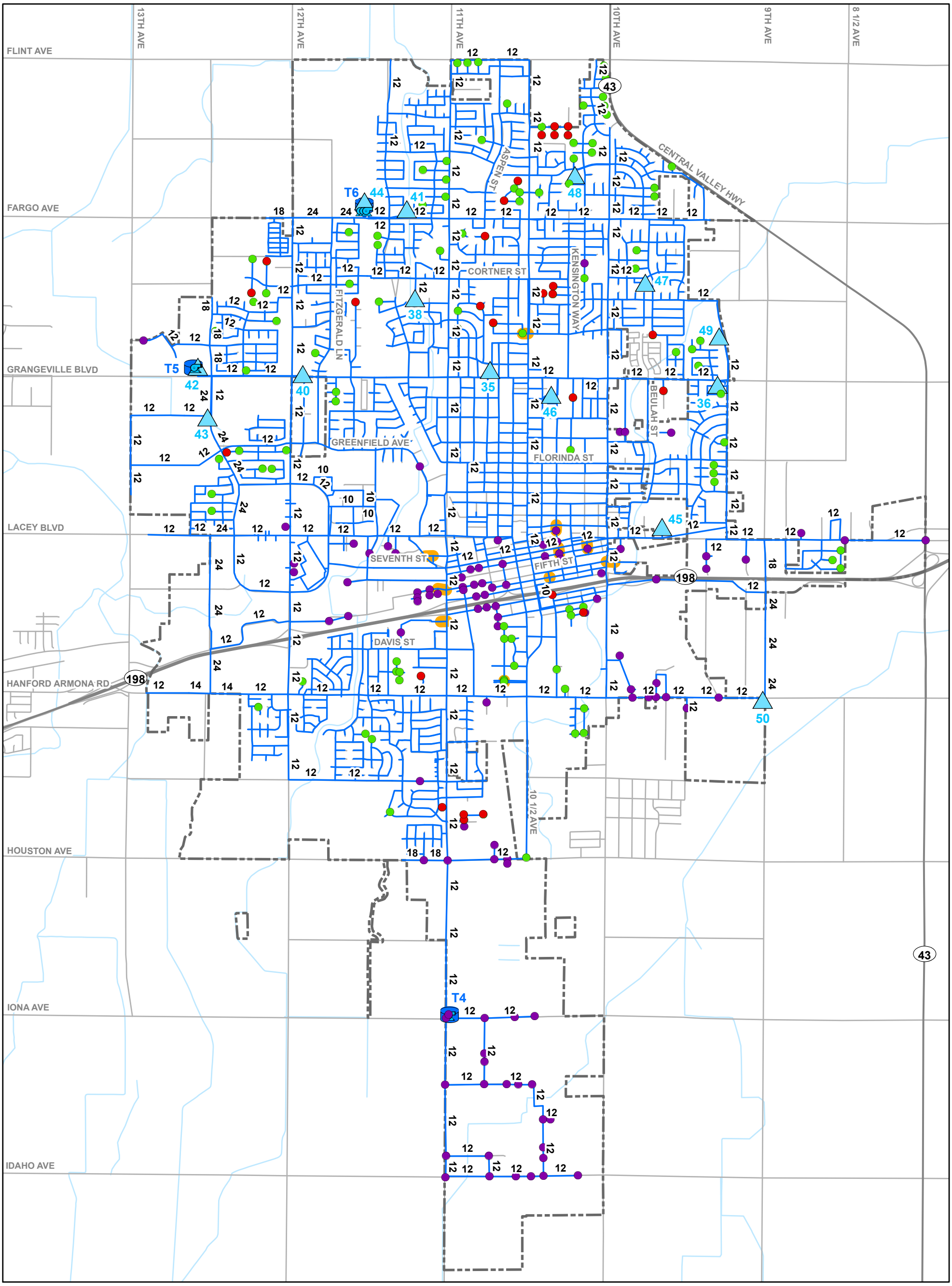

Legend

Junction Fire Flow Pressures < 20 psi

- Residential 1,000 gpm
- Residential 1,500 gpm
- Commercial & Industrial
- Pipe Velocities > 15 ft/s

Existing System

- Tanks
- Wells
- Pump Stations
- Pipes

- City Limits
- Streets
- Highways
- Waterways

N W GIS E S

0 0.25 0.5 1 Mile

Update: June 27, 2017

Figure 7.3
Fire Flow Analysis

Water System Master Plan
City of Hanford

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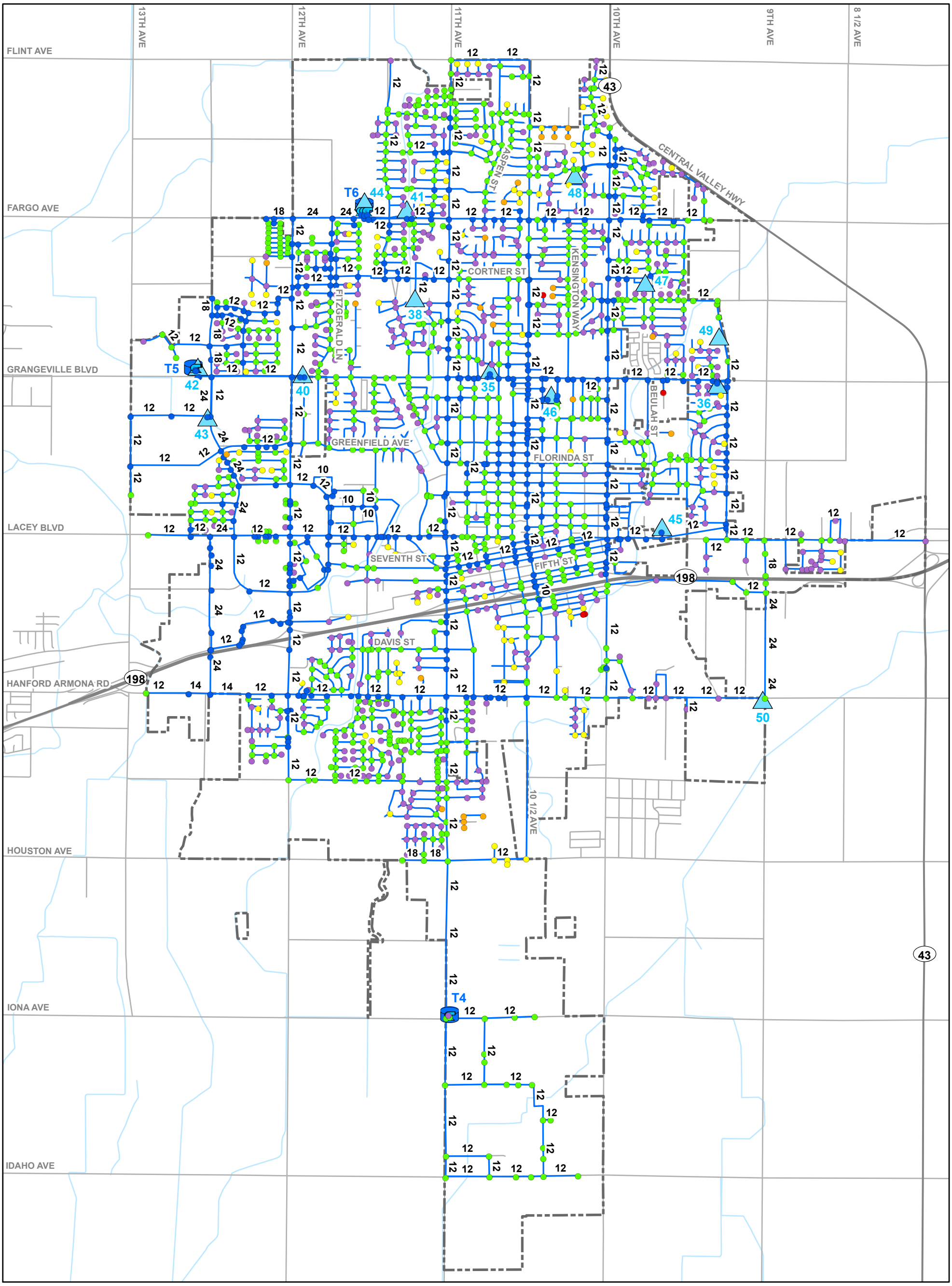
13TH AVE
12TH AVE
11TH AVE
10TH AVE
9TH AVE
8 1/2 AVE
FLINT AVE
FARGO AVE
GRANGEVILLE BLVD
LACEY BLVD
HANFORD ARMONA RD
HOUSTON AVE
IONA AVE
IDAHO AVE
CENTRAL VALLEY HWY
ASPEN ST
CORTNER ST
KENSINGTON WAY
FITZGERALD LN
GREENFIELD AVE
FLORIDA ST
BEULAH ST
SEVENTH ST
FIFTH ST
DAVIS ST
10 1/2 AVE
198
43
T6
T5
T4
38
35
40
41
42
43
44
45
46
47
48
49
50
Legend
Available Fire Flow (gpm)
< 500
500 - 1,000
1,000 - 1,500
1,500 - 2,500
2,500 - 5,000
> 5,000
Existing System
Tanks
Wells
Pump Stations
Pipes
City Limits
Streets
Highways
Waterways
Update: June 27, 2017
0 0.25 0.5 1 Mile
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Figure 7.4
Available Fire Flow
Water System Master Plan
City of Hanford

7.4 STORAGE ANALYSIS

The City's current practice considers the groundwater aquifer as the available storage as long as the supply wells are designed to meet the peak hour demands. During electrical outages, it is desired that emergency generators are installed on wells to meet the average day demand requirements. As groundwater supply is seen as a sustainable resource, the groundwater aquifer storage is adequate for meeting the existing storage requirements of the City.

7.4.1 Existing Storage Requirements

Existing storage requirements were identified for each pressure zone and are summarized on **Table 7.1.** The table lists the existing domestic water demands and identifies the operational and fire storage requirement for each zone.

The table also lists the total required storage for existing domestic water demands at 5.8 MG.

7.4.2 Future Storage Requirements

Future storage requirements were identified based on the City's anticipated development through the horizon of the master plan and are shown on **Table 7.1**. The table lists the future domestic water demands and identifies the operational and fire storage requirement for each zone.

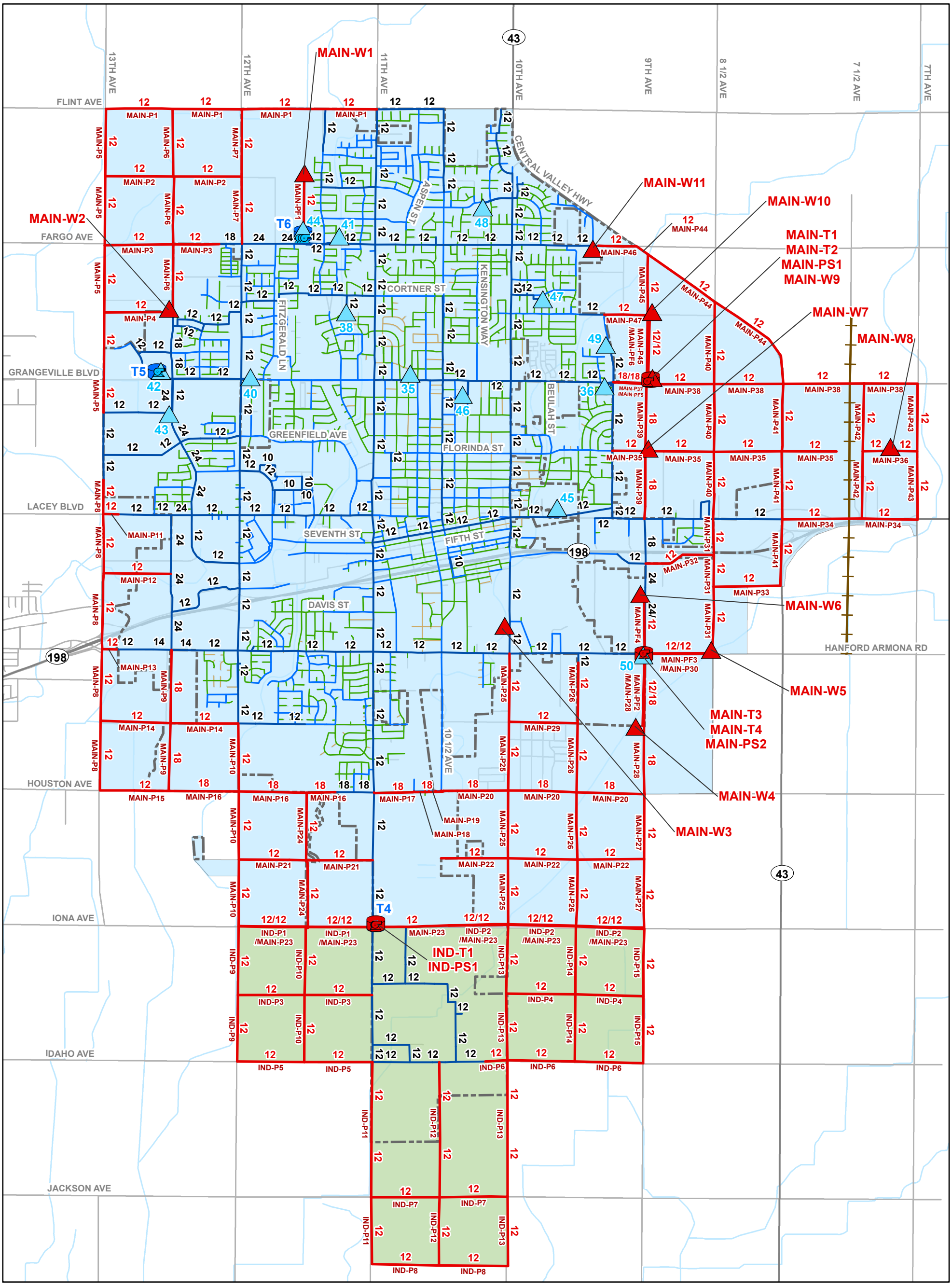
The table also lists the total required storage for future domestic water demands at 6.1 MG.

7.4.3 Recommended New Storage Facilities

The existing and future storage requirements, shown on **Table 7.1**, were compared with existing City storage facilities in each zone and the required storage facility improvements were identified and listed on **Table 7.2**. The table lists existing storage facilities for each zone, identifies existing storage capacity deficiencies, and identifies future storage capacity requirements to meet the needs from future developments identified in this master plan.

The proposed storage reservoirs, which are summarized on **Table 7.3** and shown graphically on **Figure 7.5**, are described as follows:

- **Northeast Storage Facility.** This proposed storage facility consists of two new 1.5 MG ground-level storage tanks, MAIN-T1 and MAIN-T2, located at the intersection of 9th Avenue and Grangeville Boulevard. It should be noted that these storage reservoirs are intended to provide storage requirements for future development and are recommended for phased construction. Upon the construction of the first 1.5 MG storage tank it is recommended that existing groundwater wells 36 and 49 be connected to the planned tank; this connection will involve the construction of pipeline improvement MAIN-PF4. There is an existing 12-inch in 9 ¼ Avenue that was constructed for the purpose of routing water supply to this new storage facility.



Legend

Proposed Improvements
- Tanks
- Wells
- Pump Stations
- Pipes
- High Speed Rail Alignment

Pressure Zones
- Main
- Industrial Park

Existing System
- Tanks
- Wells
- Pump Stations

Pipes By Size
- 4" and Smaller
- 6"
- 8"
- 10" and Larger

- City Limits
- Streets
- Highways
- Waterways

Update: June 27, 2017

0 0.25 0.5 1 Mile

N W E S

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Figure 7.5
Schedule of Improvements

Water System Master Plan
City of Hanford

Table 7.1 Storage Requirements

Water System Master Plan
City of Hanford

Pressure Zone	Water Demands		Water Storage Requirements		
	Average Day Demand (mgd)	Maximum Day Demand[1] (mgd)	Operational (MG)	Fire Protection (MG)	Total, By Pressure Zone (MG)
Existing					
Industrial Park Zone	0.4	0.8	0.11	0.63	0.74
Main Zone	11.7	20.4	5.10	0.00	5.10
Total	**12.1**	**21.2**	**5.21**	**0.63**	**5.84**
Future					
Industrial Park Zone	1.8	3.7	0.52	0.63	1.15
Main Zone	11.2	19.6	4.91	0.00	4.91
Total	**13.1**	**23.3**	**5.43**	**0.63**	**6.06**

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1/30/2017

Note:

1. Total required Storage, by pressure zone:

   Industrial Park Zone = Operational + Fire = 14% of Maximum Day Demand + 3,500 gpm for 3 hours

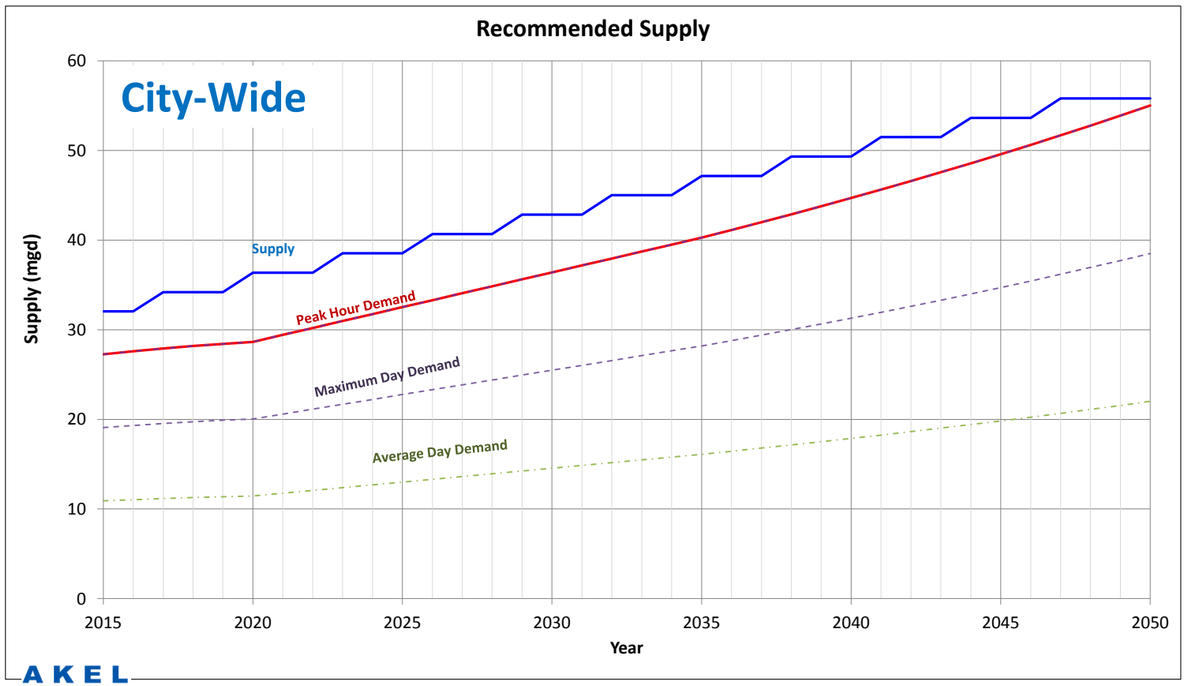
   Main Zone = Operational = 25% Maximum Day Demand

Table 7.2 Recommended Supply and Storage Capacity

Water System Master Plan

City of Hanford

Demand and Supply	Criteria	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Population Forecasting (City-Wide)																																					
Projected Annual Growth Rate		1.11%	3.13%	3.04%	2.95%	2.86%	2.78%	2.71%	2.64%	2.57%	2.50%	2.44%	2.39%	2.33%	2.28%	2.23%	2.18%	2.13%	2.09%	2.04%	2.00%	1.96%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%
Projected Population		55,337	57,070	58,803	60,536	62,270	64,003	65,736	67,469	69,202	70,935	72,669	74,402	76,135	77,868	79,601	81,334	83,067	84,801	86,534	88,267	90,000	91,890	93,820	95,790	97,801	99,855	101,952	104,093	106,279	108,511	110,790	113,116	115,492	117,917	120,393	122,922
Projected Demands		(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)
City-Wide - Average Day Demands	Per Capita Consumption: 197 gpcd (2015-2019) 179 gpcd (2020-2035)	10.9	11.0	11.2	11.3	11.4	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.6	13.9	14.2	14.6	14.9	15.2	15.5	15.8	16.1	16.4	16.8	17.1	17.5	17.9	18.2	18.6	19.0	19.4	19.8	20.2	20.7	21.1	21.6	22.0
City-Wide - Maximum Day Demands	1.75 times the Average Day Demand	19.1	19.3	19.5	19.7	19.9	20.0	20.6	21.1	21.7	22.2	22.8	23.3	23.8	24.4	24.9	25.5	26.0	26.6	27.1	27.6	28.2	28.8	29.4	30.0	30.6	31.3	31.9	32.6	33.3	34.0	34.7	35.4	36.2	36.9	37.7	38.5
City-Wide - Peak Hour Demands	2.50 times the Average Day Demand	27.3	27.6	27.9	28.2	28.4	28.6	29.4	30.2	31.0	31.7	32.5	33.3	34.1	34.8	35.6	36.4	37.2	37.9	38.7	39.5	40.3	41.1	42.0	42.9	43.8	44.7	45.6	46.6	47.6	48.6	49.6	50.6	51.7	52.8	53.9	55.0
Supply Requirements		(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)
City Required Supply	Supply to meet greater of City's Maximum Day Demands plus Fire Flows or Peak Hour Demands	27.3	27.6	27.9	28.2	28.4	28.6	29.4	30.2	31.0	31.7	32.5	33.3	34.1	34.8	35.6	36.4	37.2	37.9	38.7	39.5	40.3	41.1	42.0	42.9	43.8	44.7	45.6	46.6	47.6	48.6	49.6	50.6	51.7	52.8	53.9	55.0
Available Total Supply	Total groundwater well capacity	34.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Available Firm Supply	Groundwater well capacity with largest well out of service	32.0																																			
No. of New Wells	Minimum capacity of 2.2 mgd (1,500 gpm)			1			1			1			1			1			1			1			1			1			1			1			
Recommended Total Supply	Meets Required Supply (above)	32.0	32.0	34.2	34.2	34.2	36.4	36.4	36.4	38.5	38.5	38.5	40.7	40.7	40.7	42.8	42.8	42.8	45.0	45.0	45.0	47.2	47.2	47.2	49.3	49.3	49.3	51.5	51.5	51.5	53.6	53.6	53.6	55.8	55.8	55.8	55.8
Storage Requirements		(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)
Main Pressure Zone																																					
Main Zone Storage Criteria	Storage Capacity equal to 25% of Maximum Day Demand	4.6	4.7	4.8	4.9	5.1	5.2	5.3	5.4	5.5	5.6	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.6	6.7	6.8	6.9	7.0	7.1	7.3	7.4	7.5	7.6	7.7	7.8	8.0	8.1	8.2	8.3	8.4	8.5	8.7
2015 Available Storage Capacity	Total Main Zone Storage Capacity in 2015	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recommended Staged Upgrade	Assumed typical Future Tank Capacity at 1.5 MG		1.5							1.5						1.5												1.5									
Main Zone Total Storage	Meets Storage Criteria (above)	3.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.0	6.0	6.0	6.0	6.0	6.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Industrial Park Pressure Zone																																					
Industrial Park Zone MDD		0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9
Industrial Park Zone Storage Criteria	Storage Capacity equal to 14% of Maximum Day Demand plus Fire Flow (3,500 gpm for 3 hours)	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2
2015 Available Storage Capacity	Total Industrial Park Zone Storage Capacity in 2015	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recommended Staged Upgrade					0.7																																
Industrial Park Zone Total Storage	Meets Storage Criteria (above)	0.5	0.5	0.5	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2



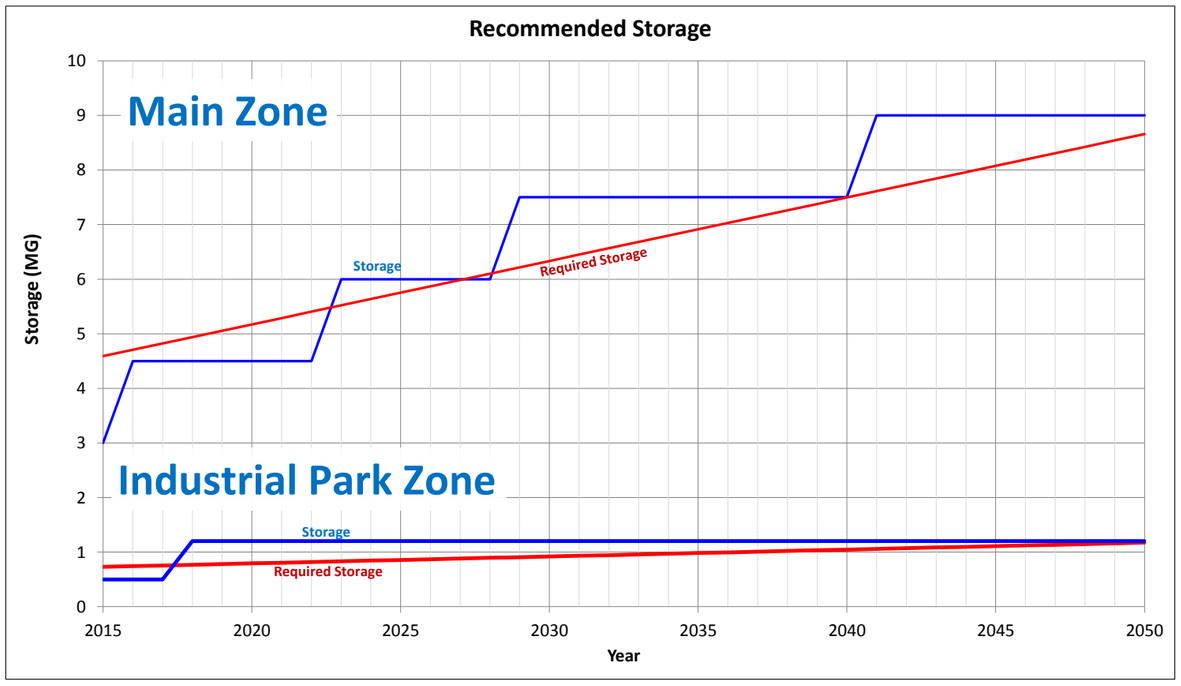


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Table 7.3 Proposed Storage Reservoirs

Water System Master Plan

City of Hanford

Reservoir	Bottom Elevation (ft)	Volume (MG)	Height (ft)	Diameter (ft)
Industrial Park Pressure Zone				
11th Ave and Iona Ave	231	0.7	24	60
Main Pressure Zone				
9th Ave and Grangeville Blvd	254	1.5	24	105
9th Ave and Grangeville Blvd	254	1.5	24	105
9th Ave and Hanford Armona Rd	243	1.5	24	105
9th Ave and Hanford Armona Rd	243	1.5	24	105
Total		**6.7**		

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- **Southeast Storage Facility:** This proposed storage facility consists of two new 1.5 MG ground-level storage tanks, MAIN-T3 and MAIN-T4, located at the intersection of 9th Avenue and Hanford-Armona Road. It should be noted that these storage reservoirs are intended to provide storage requirements for future development and are recommended for phased construction.

- **Industrial Park Storage Expansion: IND-T1:** This proposed storage facility expansion consists of one new 0.7 MG storage tank at the existing Industrial Park storage site, at the intersection of 11th Avenue and Iona Avenue. This tank is recommended for immediate construction and is intended to mitigate an existing storage deficiency as well as providing for the storage requirements of future development.

7.5 WATER SUPPLY ANALYSIS

The City's existing and buildout water supply requirements are summarized on Table 7.4 and Table 7.5, respectively. Based on the buildout water supply requirements the construction of 11 new groundwater wells is required. In order to provide for annually increasing demands, it is recommended a new groundwater well is constructed every three to four years as summarized on Table 7.2. It should be noted that this master plan assumes a future groundwater well capacity of 1,500 gpm; actual groundwater well capacity will vary based on site specific conditions. The specific groundwater well improvements are described as follows:

- **MAIN-W1**: This groundwater well is located approximately 800 feet west of the intersection of Julia Way and Glacier Way. This well is planned to discharge to the existing Tank 6 storage facility.

- **MAIN-W2**: This groundwater well is located on Centennial Drive, approximately 2,600 feet north of the Grangeville Boulevard. This well is planned to discharge directly into the distribution system.

- **MAIN-W3**: This groundwater well is located on 10th Avenue, approximately 1,100 feet north of the Hanford Armona Road. This well is planned to discharge directly into the distribution system.

- **MAIN-W4**: This groundwater well is located on 9th Avenue, approximately 2,800 feet south of Hanford Armona Road. This well is planned to discharge to the proposed southeast storage facility.

- **MAIN-W5**: This groundwater well is located at the intersection of 8 ½ Avenue and Hanford Armona Road. This well is planned to discharge to the proposed southeast storage facility.

Table 7.4 Existing Well Capacity Analysis

Water System Master Plan

City of Hanford

Well Supply Capacity	
Existing Wells Discharging to Distribution System	20.5 mgd
Existing Wells Discharging to Tanks	14.4 mgd
Total Well Capacity	34.9 mgd
Firm Well Capacity	**32 mgd**
Existing Demand	
Peak Hour	**30.2 mgd**
Existing Well Capacity Analysis	
Required Firm Capacity[1]	30.2 mgd
Existing Firm Well Capacity	32 mgd
Surplus/Deficit	**1.8 mgd**

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Notes:

1. City-wide demands equal to Main Pressure Zone plus Industrial Park Pressure Zone.

Table 7.5 Future Well Capacity Analysis

Water System Master Plan

City of Hanford

Well Supply Capacity	
Existing Wells Discharging to Distribution System	14.3 mgd
Existing Wells Discharging to Tanks[1]	20.6 mgd
Total Well Capacity	34.9 mgd
Firm Well Capacity	**32 mgd**
Buildout Demand	
Peak Hour	**54.9 mgd**
Future Well Capacity Analysis	
Required Firm Capacity[2]	54.9 mgd
Existing Firm Well Capacity	32 mgd
Surplus/Deficit	**-22.8 mgd**
Recommended Well Capacity	
11 additional wells[3] (1,500 gpm each)	**23.8 mgd**

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Notes:

1. Wells 36 and 49 are planned for replumbing to discharge into proposed tanks Main-T1/Main-T2. Well 50 is planned for replumbing to discharge into proposed tanks Main-T3/Main-T4.
2. City-wide demands equal to Main Pressure Zone plus Industrial Park Pressure Zone.
3. The 11 additional wells are further categorized as follows:
   - Six wells are planned to discharge directly to tanks
   - Five wells are planned to discharge directly to distribution system.

- **MAIN-W6**: This groundwater well is located on 9th Avenue, approximately 2,400 feet north of Hanford Armona Road. This well is planned to discharge to the proposed southeast storage facility.

- **MAIN-W7**: This groundwater well is located on 9th Avenue approximately 2,600 feet south of Grangeville Boulevard. This well is planned to discharge directly into the distribution system.

- **MAIN-W8**: This groundwater well is located on right-of-way, approximately 4,200 feet east of 8th Avenue, between Grangeville Boulevard and Lacey Boulevard. This well is planned to discharge directly into the distribution system.

- **MAIN-W9**: This groundwater well is located at the intersection of 9th Avenue and Grangeville Boulevard. This well is planned to discharge to the proposed northeast storage facility.

- **MAIN-W10**: This groundwater well is located approximately at the intersection of Leland Way 9th Avenue. This well is planned to discharge to the proposed northeast storage facility.

- **MAIN-W11**: This groundwater well is located at the intersection of Fargo Avenue and Meadow View Road. This well is planned to discharge directly into the distribution system.

7.6 PUMP STATION ANALYSIS

Pump stations were sized to convey the required flow based on the specific pressure zone criteria, which are summarized as follows:

- **Main Pressure Zone:** Pump stations serving the Main Pressure Zone must have a firm capacity greater than or equal to the sum of the groundwater wells tributary to the ground-level storage tanks as well as the difference between the system-wide peak hour and maximum day demands.

- **Industrial Park Pressure Zone:** The industrial park pump station must have a firm capacity equal to the sum of the Industrial Park Pressure Zone peak hour demand as well as a 3,500 gpm fire flow.

The existing and future pump station capacity analyses are summarized on **Table 7.6** and **Table 7.7**, respectively. In order to meet the future pump station capacity requirements the following improvements are recommended:

- **Northeast Pump Station.** This pump station is associated with the Northeast Storage Facility, located at the intersection of 9th Avenue and Grangeville Boulevard. A preliminary pump layout suggests a firm capacity of 9,300 gpm which includes three 3,100 gpm duty pumps.

Table 7.6 Existing Pump Station Capacity Analysis

Water System Master Plan

City of Hanford

Existing Pump Station Capacity		
	Main Pressure Zone (mgd)	Industrial Park Pressure Zone (mgd)
Total Capacity	25.3	4.0
Firm Capacity	22.2	2.6

Existing Demand		
Demand Condition	Main Pressure Zone (mgd)	Industrial Park Pressure Zone (mgd)
Average Day	11.7	0.4
Maximum Day	20.4	0.8
Peak Hour	29.1	1.1

Existing Pump Station Capacity Analysis		
	Main Pressure Zone[1] (mgd)	Industrial Park Pressure Zone[2] (mgd)
Required Firm Capacity	23.1	6.1
Existing Firm Capacity	22.2	2.6
Surplus/Deficit	**-1.0**	**-3.6**

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Notes:

1. Required Main Pressure Zone pump station capacity is equal to the sum of items a) and b), described as follows:
   a) Difference between Peak Hour Demand and Maximum Day Demand
   b) Total capacity of wells discharging directly to tanks
2. Required Industrial Park Pressure Zone pump station capacity is equal to the sum of items a) and b), described as follows:
   a) Peak Hour Demand
   b) 3,500 gpm fire flow

Table 7.7 Future Pump Station Capacity Analysis

Water System Master Plan

City of Hanford

Existing Pump Station Capacity	Main Pressure Zone (mgd)	Industrial Park Pressure Zone (mgd)
Total Capacity	25.3	4.0
Firm Capacity	22.2	2.6
Buildout Demand		
Demand Condition	**Main Pressure Zone (mgd)**	**Industrial Park Pressure Zone (mgd)**
Average Day	19.8	1.9
Maximum Day	34.6	3.9
Peak Hour	49.5	5.4
Future Pump Station Capacity Analysis		
	Main Pressure Zone[1] (mgd)	**Industrial Park Pressure Zone[2] (mgd)**
Required Firm Capacity	48.4	10.4
Existing Firm Capacity	22.2	2.6
Surplus/Deficit	**-26.2**	**-7.8**
Recommended Pump Station Capacity		
	Main Pressure Zone	**Industrial Park Pressure Zone**
	26.8 mgd 2 New Pump Stations 2 x (3 @ 3,100 gpm)	**8.1 mgd Existing Pump Station Upgrade** 4 @ 1,400 gpm

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Notes:

1. Required Main Pressure Zone pump station capacity is equal to the sum of items a) and b), described as follows:
   a) Difference between Peak Hour Demand and Maximum Day Demand
   b) Total capacity of wells discharging directly to tanks
2. Required Industrial Park Pressure Zone pump station capacity is equal to the sum of items a) and b), described as follows:
   a) Peak Hour Demand
   b) 3,500 gpm fire flow

- **Southeast Pump Station.** This pump station is associated with the Northeast Storage Facility, located at the intersection of 9th Avenue and Hanford-Armona Road. A preliminary pump layout suggests a firm capacity of 9,200 gpm which includes three 3,100 gpm duty pumps.

- **Industrial Park Pump Station Expansion:** The existing Industrial Park pump station is undersized to provide the required Industrial Park fire flow. In order to mitigate this deficiency and meet the additional pump station capacity requirements for the future development additional pumps are recommended; a preliminary pump layout suggests the construction of four 1,400 gpm duty pumps.

7.7 DISTRUBUTION AND TRANSMISSION MAIN ANALYSIS

This master plan evaluated the water system pipeline requirements to service the Planned Area Boundary at buildout of the General Plan, which are summarized on **Table 7.8** and shown graphically on **Figure 7.5**. The following sections document the improvements required for future growth.

Distribution System: The future system distribution grid generally consists of a 12-inch looped network spaced approximately every half-mile. The improvements planned for the purpose of expanding the City's distribution and transmission system are summarized as follows:

Main Pressure Zone

- **MAIN-P1**: Construct a new 12-inch pipeline in Flint Avenue between 11th Avenue and 13th Avenue. It should be noted that this improvement includes one railroad crossing and two canal crossings.

- **MAIN-P2**: Construct a new 12-inch pipeline in right-of-way between 12th Avenue and 13th Avenue. This improvement includes one canal crossing.

- **MAIN-P3**: Construct a new 12-inch pipeline in Fargo Avenue between approximately 440 feet west of Corvina Place and 13th Avenue. This improvement includes one canal crossing.

- **MAIN-P4**: Construct a new 12-inch pipeline in right-of-way between Centennial Drive Avenue and 13th Avenue.

- **MAIN-P5**: Construct a new 12-inch pipeline in 13th Avenue between Flint Avenue and approximately 1,300 feet south of Grangeville Boulevard. This improvement includes two canal crossings.

Table 7.8 Schedule of Improvements

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements						
				Existing Diameter (in)	New/Parallel/ Replace	Diameter (in)	Length (ft)	Number of Casings		
								Railroad	Highway	Canal / Slough
Pipeline Improvements										
Main Pressure Zone										
MAIN-P1	Pipeline	Flint Ave	From 11th Ave to 13th Ave	-	New	12	10,600	1		2
MAIN-P2	Pipeline	ROW	From approx 12th Ave to 13th Ave	-	New	12	5,350			1
MAIN-P3	Pipeline	Fargo Ave	From approx 270 ft w/o Corvina Pl to 13th Ave	-	New	12	4,475			1
MAIN-P4	Pipeline	ROW	From Centennial Dr to 13th Ave	-	New	12	2,700			
MAIN-P5	Pipeline	13th Ave	From Flint Ave to approx 1,300 ft s/o Grangeville Blvd	-	New	12	11,900			2
MAIN-P6	Pipeline	Centennial Dr	From Flint Ave to approx 2,600 ft n/o Grangeville Blvd	-	New	12	7,975			2
MAIN-P7	Pipeline	12th Ave	From Flint Ave to Fargo Ave	-	New	12	5,275			1
MAIN-P8	Pipeline	13th Ave	From approx 1,350 ft n/o Lacey Blvd to Houston Ave	-	New	12	12,200		1	3
MAIN-P9	Pipeline	12 1/2 Ave	From Hanford Armona Rd to Houston Ave	-	New	18	5,525			
MAIN-P10	Pipeline	12th Ave	From Hume Ave to Iona Ave	-	New	12	7,950			1
MAIN-P11	Pipeline	Lacey Blvd	From approx 600 ft e/o 13th Ave to 13th Ave	-	New	12	600			
MAIN-P12	Pipeline	ROW	From 12 1/2 Ave to 13th Ave	-	New	12	2,625			
MAIN-P13	Pipeline	Hanford Armona Rd	From approx 600 ft e/o 13th Ave to 13th Ave	-	New	12	575			
MAIN-P14	Pipeline	Hume Ave	From 12th Ave to 13th Ave	-	New	12	5,400			
MAIN-P15	Pipeline	Houston Ave	From approx 12 1/2 Ave to 13th Ave	-	New	12	2,700			1
MAIN-P16	Pipeline	Houston Ave	From 12 1/2 Ave to approx 700 ft w/o Courtright Dr	-	New	18	6,525			2
MAIN-P17	Pipeline	Houston Ave	From 11th Ave to approx 1,600 ft e/o 11th Ave	6	Replace	18	1,600			
MAIN-P18	Pipeline	Houston Ave	From approx 1,600 ft e/o 11th Ave to approx 2,000 ft e/o 11th Ave	12	Replace	18	475			
MAIN-P19	Pipeline	Houston Ave	From approx 2,000 ft e/o 11th Ave to 10 1/2 Ave	8	Replace	18	925			
MAIN-P20	Pipeline	Houston Ave	From 10 1/2 Ave to 9th Ave	-	New	18	7,875			1
MAIN-P21	Pipeline	ROW	From 11th Ave to 12th Ave	-	New	12	5,250			2
MAIN-P22	Pipeline	ROW	From 9th Ave to 10 1/2 Ave	-	New	12	7,950	1		1
MAIN-P23	Pipeline	Iona Ave	From 9th Ave to 12th Ave	-	New	12	16,100	1		2
MAIN-P24	Pipeline	ROW	From Houston Ave to Iona Ave	-	New	12	5,275			1
MAIN-P25	Pipeline	10th Ave	From Hanford Armona Rd to Iona Ave	-	New	12	10,600			
MAIN-P26	Pipeline	ROW	From approx 370 ft s/o Hanford Armona Rd to Iona Ave	-	New	12	10,325			3
MAIN-P27	Pipeline	9th Ave	From Houston Ave to Iona Ave	-	New	12	5,225			
MAIN-P28	Pipeline	9th Ave	From Hanford Armona Rd to Houston Ave	-	New	18	5,500			1
MAIN-P29	Pipeline	ROW	From approx 700 ft e/o 9 3/4 Ave to 10th Ave	-	New	12	2,700			
MAIN-P30	Pipeline	Hanford Armona Rd	From 8 1/2 Ave to 9th Ave	-	New	12	2,650			1
MAIN-P31	Pipeline	ROW	From Lacey Blvd to Hanford Armona Rd	-	New	12	5,300		1	1
MAIN-P32	Pipeline	Third St	From 9th Ave to 8 1/2 Ave	-	New	12	2,800			
MAIN-P33	Pipeline	ROW	From HWY 43 to 8 1/2 Ave	-	New	12	2,625			
MAIN-P34	Pipeline	Lacey Blvd	From approx 7th Ave to HWY 43	-	New	12	5,300			

Table 7.8 Schedule of Improvements

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements						
				Existing Diameter (in)	New/Parallel/ Replace	Diameter (in)	Length (ft)	Number of Casings		
								Railroad	Highway	Canal / Slough
MAIN-P35	Pipeline	ROW	From 7th Ave to 9 1/4 Ave	-	New	12	8,775			
MAIN-P36	Pipeline	ROW	From 7th Ave to approx 2,600 ft e/o HWY 43	-	New	12	2,125			
MAIN-P37	Pipeline	Grangeville Blvd	From approx 1,300 ft e/o 9 1/4 Ave to 9 1/4 Ave	-	New	18	1,300			
MAIN-P38	Pipeline	Grangeville Blvd	From 7th Ave to approx 1,300 ft e/o 9 1/4 Ave	-	New	12	10,625			
MAIN-P39	Pipeline	9th Ave	From Grangeville Blvd to Lacey Blvd	-	New	18	5,300			
MAIN-P40	Pipeline	8 1/2 Ave	From HWY 43 to Lacey Blvd	-	New	12	8,525	1		
MAIN-P41	Pipeline	HWY 43	From Grangeville Blvd to approx 2,600 ft s/o Lacey Blvd	-	New	12	7,925	1	1	
MAIN-P42	Pipeline	ROW	From Grangeville Blvd to Lacey Blvd	-	New	12	5,300	1		
MAIN-P43	Pipeline	7th Ave	From Grangeville Blvd to Lacey Blvd	-	New	12	5,300	1		
MAIN-P44	Pipeline	HWY 43	From Fargo Ave to Grangeville Blvd	-	New	12	8,250			1
MAIN-P45	Pipeline	9th Ave	From HWY 43 to Grangeville Blvd	-	New	12	5,100			1
MAIN-P46	Pipeline	Fargo Ave	From HWY 43 to approx 200 ft e/o Meadow View Rd	-	New	12	1,500			
MAIN-P47	Pipeline	Leland Wy	From approx 1,700 ft e/o 9 1/4 Ave to 9th Ave	-	New	12	1,700			
Industrial Park Pressure Zone										
IND-P1	Pipeline	Iona Ave	From 11th Ave to 12th Ave	-	New	12	5,250			
IND-P2	Pipeline	Iona Ave	From 9th Ave to approx 2,340 ft w/o 10th Ave	-	New	12	7,675			2
IND-P3	Pipeline	ROW	From 11th Ave to 12th Ave	-	New	12	5,250			
IND-P4	Pipeline	ROW	From 9th Ave to 10th Ave	-	New	12	5,375			1
IND-P5	Pipeline	Idaho Ave	From 11th Ave to 12th Ave	-	New	12	5,300			
IND-P6	Pipeline	Idaho Ave	From 9th Ave to approx 860 ft w/o 10th Ave	-	New	12	6,175			1
IND-P7	Pipeline	Jackson Ave	From 10th Ave to 11th Ave	-	New	12	5,350	1		
IND-P8	Pipeline	ROW	From 10th Ave to 11th Ave	-	New	12	5,325	1		
IND-P9	Pipeline	12th Ave	From Iona Ave to Idaho Ave	-	New	12	5,300			
IND-P10	Pipeline	ROW	From Iona Ave to Idaho Ave	-	New	12	5,375			
IND-P11	Pipeline	11th Ave	From Idaho Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	7,925			1
IND-P12	Pipeline	ROW	From Idaho Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	7,975			
IND-P13	Pipeline	10th Ave	From Iona Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	13,400			1
IND-P14	Pipeline	ROW	From Iona Ave to Idaho Ave	-	New	12	5,325			
IND-P15	Pipeline	9th Ave	From Iona Ave to Idaho Ave	-	New	12	5,275			2
Tank Feed Pipelines										
MAIN-PF1	Pipeline	ROW	From approx 800 ft w/o the intersection of Julia Wy and Glacier Wy to approx 400 ft n/o Fargo Ave	-	New	12	2,325			
MAIN-PF2	Pipeline	9th Ave	From Hanford Armona Rd to approx 2,800 ft s/o Hanford Armona Rd	-	New	12	2,825			
MAIN-PF3	Pipeline	Hanford Armona Rd	From approx 2,700 ft e/o 9th Ave to 9th Ave	-	New	12	2,675			
MAIN-PF4	Pipeline	9th Ave	From approx 2,400 ft n/o Hanford Armona Rd to Hanford Armona Rd	-	New	12	2,400			
MAIN-PF5	Pipeline	Grangeville Blvd	From 9 1/4 Ave to 9th Ave	-	New	12	1,575			
MAIN-PF6	Pipeline	9th Ave	From approx 2,600 ft n/o Grangeville Blvd to Grangeville Blvd	-	New	18	2,625			

Table 7.8 Schedule of Improvements

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements						
				Existing Diameter (in)	New/Parallel/ Replace	Diameter (in)	Length (ft)	Number of Casings: Railroad	Highway	Canal / Slough
Groundwater Well Improvements						Pump Capacity (gpm)				
MAIN-W1	Groundwater Well	Approx 800 ft w/o the intersection of Julia Wy and Glacier Wy			New	1,500				
MAIN-W2	Groundwater Well	Centennial Dr approx 2,600 ft n/o Grangeville Blvd			New	1,500				
MAIN-W3	Groundwater Well	10th Ave approx 1,100 ft n/o Hanford Armona Rd			New	1,500				
MAIN-W4	Groundwater Well	9th Ave approx 2,800 ft s/o Hanford Armona Rd			New	1,500				
MAIN-W5	Groundwater Well	8 1/2 Ave and Hanford Armona Rd			New	1,500				
MAIN-W6	Groundwater Well	9th Ave approx 2,400 ft n/o Hanford Armona Rd			New	1,500				
MAIN-W7	Groundwater Well	9th Ave and approx 2,600 ft s/o Grangeville Blvd			New	1,500				
MAIN-W8	Groundwater Well	ROW Approx 4,200 ft e/o 8th Avenue s/o Grangeville Blvd			New	1,500				
MAIN-W9	Groundwater Well	Grangeville Blvd and 9th Ave			New	1,500				
MAIN-W10	Groundwater Well	Leland Way and 9th Ave			New	1,500				
MAIN-W11	Groundwater Well	Fargo Ave and Meadow View Rd			New	1,500				
Pump Station Improvements						Firm Booster Station Capacity				
Main Pressure Zone										
MAIN-PS1	Booster Station	Grangeville Blvd and 9th Ave			New	3 @ 3,100 gpm				
MAIN-PS2	Booster Station	Hanford Armona Rd and 9th Ave			New	3 @ 3,100 gpm				
Industrial Park Pressure Zone						Firm Booster Station Capacity				
IND-PS1	Booster Station	11th Ave and Iona Ave			Additional Capacity	4 @ 1,400 gpm				
Tank Improvements						Storage Tank Capacity (M				
Main Pressure Zone										
MAIN-T1	Storage Tank	Grangeville Blvd and 9th Ave			New	1.5				
MAIN-T2	Storage Tank	Grangeville Blvd and 9th Ave			New	1.5				
MAIN-T3	Storage Tank	Hanford Armona Rd and 9th Ave			New	1.5				
MAIN-T4	Storage Tank	Hanford Armona Rd and 9th Ave			New	1.5				
Industrial Park Pressure Zone						Storage Tank Capacity (M				
IND-T1	Storage Tank	11th Ave and Iona Ave			New	0.7				

- **MAIN-P6**: Construct a new 12-inch pipeline in Centennial Boulevard between Flint Avenue and approximately 2,600 feet north of Grangeville Boulevard. This improvement includes two canal crossings.
- **MAIN-P7**: Construct a new 12-inch pipeline in 12th Avenue between Flint Avenue and Fargo. This improvement includes one canal crossing.
- **MAIN-P8**: Construct a new 12-inch pipeline in 13th Avenue between approximately 1,350 feet north of Lacy Boulevard and Houston Avenue. This improvement includes one highway crossing and three canal crossings.
- **MAIN-P9**: Construct a new 18-inch pipeline in 12½ Avenue between Hanford Armona Road and Houston Avenue.
- **MAIN-P10**: Construct a new 12-inch pipeline in 12th Avenue between Hume Avenue and Iona Avenue. This improvement includes one canal crossing.
- **MAIN-P11**: Construct a new 12-inch pipeline in Lacey Boulevard between approximately 600 feet east of 13th Avenue and 13th Avenue.
- **MAIN-P12**: Construct a new 12-inch pipeline in right-of-way between 12½ Avenue and 13th Avenue.
- **MAIN-P13**: Construct a new 12-inch pipeline in Hanford Armona Road between 600 feet east of 13th Avenue and 13th Avenue.
- **MAIN-P14**: Construct a new 12-inch pipeline in Hume Avenue between 12th Avenue and 13th Avenue.
- **MAIN-P15**: Construct a new 12-inch pipeline in Houston Avenue between 12½ Avenue and 13th Avenue. This improvement includes one canal crossing.
- **MAIN-P16**: Construct a new 18-inch pipeline in Houston Avenue between 12½ Avenue and approximately 700 feet west of Courtright Drive. This improvement includes two canal crossings.
- **MAIN-P17**: Replace an existing 6-inch pipeline in Houston Avenue between 11th Avenue and approximately 1,600 feet east of 11th Avenue with a new 18-inch pipeline.
- **MAIN-P18**: Replace an existing 12-inch pipeline in Houston Avenue between approximately 1,600 feet east of 11th Avenue and approximately 2,000 feet east of 11th Avenue with a new 18-inch pipeline.
- **MAIN-P19**: Replace an existing 8-inch pipeline in Houston Avenue between approximately 2,000 feet east of 11th Avenue and 10½ Avenue with a new 18-inch pipeline.

- **MAIN-P20**: Construct a new 18-inch pipeline in Houston Avenue between 10½ Avenue and 9th Avenue.
- **MAIN-P21**: Construct a new 12-inch pipeline in right-of-way between 11th Avenue and 12th Avenue. This improvement includes two canal crossings.
- **MAIN-P22**: Construct a new 12-inch pipeline in right-of-way between 9th Avenue and 10½ Avenue This improvement includes one railroad crossing and one canal crossing.
- **MAIN-P23**: Construct a new 12-inch pipeline in Iona Avenue between 9th Avenue and 12th Avenue. This improvement includes one railroad crossing and two canal crossings.
- **MAIN-P24**: Construct a new 12-inch pipeline in right-of-way between Houston Avenue and Iona Avenue. This improvement includes one canal crossing.
- **MAIN-P25**: Construct a new 12-inch pipeline in 10th Avenue between Hanford Armona Road and Iona Avenue.
- **MAIN-P26**: Construct a new 12-inch pipeline in right-of-way between approximately 370 feet south of Hanford Armona Road to Iona Avenue. This improvement includes three canal crossings.
- **MAIN-P27:** Construct a new 12-inch pipeline in 9th Avenue between Houston Avenue and Iona Avenue.
- **MAIN-P28**: Construct a new 18-inch pipeline in 9th Avenue between Hanford Armona Road and Houston Avenue. This improvement includes one canal crossing.
- **MAIN-P29**: Construct a new 12-inch pipeline in right-of-way between approximately 700 feet east of 9¾ Avenue and 10th Avenue.
- **MAIN-P30**: Construct a new 12-inch pipeline in Hanford Armona Road between 8½ Avenue Road and 9th Avenue. This improvement includes one canal crossing.
- **MAIN-P31**: Construct a new 12-inch pipeline in right-of-way between Lacey Boulevard and Hanford Armona Road. This improvement includes one highway crossing and one canal crossing.
- **MAIN-P32**: Construct a new 12-inch pipeline in Third Street between 9th Avenue and 8½ Avenue.
- **MAIN-P33**: Construct a new 12-inch pipeline in right-of-way between Highway 43 and 8½ Avenue.

- **MAIN-P34**: Construct a new 12-inch pipeline in Lacey Boulevard between 7th Avenue and Highway 43.
- **MAIN-P35**: Construct a new 12-inch pipeline in right-of-way between approximately 2,500 feet east of Highway 43 and 9¼ Avenue.
- **MAIN-P36**: Construct a new 12-inch pipeline in right-of-way between 7th Avenue and approximately 2,600 feet east of Highway 43.
- **MAIN-P37**: Construct a new 18-inch pipeline in Grangeville Boulevard between approximately 1,300 feet east of 9¼ Avenue and 9¼ Avenue.
- **MAIN-P38**: Construct a new 12-inch pipeline in Grangeville Boulevard between 7th Avenue and approximately 1,300 feet east of 9¼ Avenue.
- **MAIN-P39**: Construct a new 18-inch pipeline in 9th Avenue between Grangeville Boulevard and Lacey Boulevard.
- **MAIN-P40**: Construct a new 12-inch pipeline in 8½ Avenue between Highway 43 and Lacey Boulevard. This improvement includes one railroad crossing.
- **MAIN-P41**: Construct a new 12-inch pipeline in Highway 43 between Grangeville Boulevard and approximately 2,600 feet south of Lacey Boulevard. This improvement includes one railroad crossing and one highway crossing.
- **MAIN-P42**: Construct a new 12-inch pipeline in right-of-way between Grangeville Boulevard and Lacey Boulevard. This improvement includes one railroad crossing.
- **MAIN-P43**: Construct a new 12-inch pipeline in 7th Avenue between Grangeville Boulevard and Lacey Boulevard. This improvement includes one railroad crossing.
- **MAIN-P44**: Construct a new 12-inch pipeline in Highway 43 between Fargo Avenue and Grangeville Boulevard. This improvement includes one canal crossing.
- **MAIN-P45**: Construct a new 12-inch pipeline in 9th Avenue between Highway 43 and Grangeville Boulevard. This improvement includes one canal crossing.
- **MAIN-P46**: Construct a new 12-inch pipeline in Fargo Avenue between Highway 43 and approximately 200 feet east of Meadow View Road.
- **MAIN-P47**: Construct a new 12-inch pipeline in Leland Way between approximately 1,700 feet east of 9¼ Avenue and 9th Avenue. This improvement includes one canal crossing.

Industrial Park Pressure Zone

- **IND-P1**: Construct a new 12-inch pipeline in Iona Avenue between 11th Avenue and 12th Avenue.
- I**ND-P2**: Construct a new 12-inch pipeline in Iona Avenue between 9th Avenue and approximately 2,340 feet west of 10th Avenue. This improvement includes two canal crossings.
- **IND-P3**: Construct a new 12-inch pipeline in right-of-way between 11th Avenue and 12th Avenue.
- **IND-P4**: Construct a new 12-inch pipeline in right-of-way between 9th Avenue and 10th Avenue. This improvement includes one canal crossing.
- **IND-P5**: Construct a new 12-inch pipeline in Idaho Avenue between 11th Avenue and 12th Avenue.
- **IND-P6**: Construct a new 12-inch pipeline in Idaho Avenue between 9th Avenue and approximately 860 feet west of 10th Avenue. This improvement includes one canal crossing.
- **IND-P7**: Construct a new 12-inch pipeline in Jackson Avenue between 10th Avenue and 11th Avenue. This improvement includes one railroad crossing.
- **IND-P8**: Construct a new 12-inch pipeline in right-of-way between 10th Avenue and 11th Avenue. This improvement includes one railroad crossing.
- **IND-P9**: Construct a new 12-inch pipeline in 12th Avenue between Iona Avenue and Idaho Avenue.
- **IND-P10**: Construct a new 12-inch pipeline in right-of-way between Iona Avenue and Idaho Avenue.
- **IND-P11**: Construct a new 12-inch pipeline in 11th Avenue between Idaho Avenue and approximately 8,000 feet south of Idaho Avenue. This improvement includes one canal crossing.
- **IND-P12**: Construct a new 12-inch pipeline in right-of-way between Idaho Avenue and approximately 8,000 feet south of Idaho Avenue.
- **IND-P13**: Construct a new 12-inch pipeline in 10th Avenue between Iona Avenue and approximately 8,000 feet south of Idaho Avenue. This improvement includes one canal crossing.

- **IND-P14**: Construct a new 12-inch pipeline in right-of-way between Iona Avenue and Idaho Avenue.

- **IND-P15**: Construct a new 12-inch pipeline in 9th Avenue between Iona Avenue and Idaho Avenue. This improvement includes two canal crossings.

Tank Feed Pipelines

- **MAIN-PF1**: Construct a new 12-inch pipeline in right-of-way between approximately 800 feet west of the intersection of Julia Way and Glacier Way and approximately 400 feet north of Fargo Avenue.

- **MAIN-PF2**: Construct a new 12-inch pipeline in 9th Avenue between Hanford Armona Road and approximately 2,800 feet south of Hanford Armona Road.

- **MAIN-PF3**: Construct a new 12-inch pipeline in Hanford Armona Road between approximately 2,700 east of 9th Avenue and 9th Avenue.

- **MAIN-PF4**: Construct a new 12-inch pipeline in 9th Avenue between approximately 2,400 feet north of Hanford Armona Road and Hanford Armona Road.

- **MAIN-PF5**: Construct a new 18-inch pipeline in Grangeville Boulevard between 9¼ Avenue and 9th Avenue. This pipeline is sized to carry the flow of existing groundwater wells 36 and 49 and is recommended for construction with the proposed tank MAIN-T1.

- **MAIN-PF6**: Construct a new 12-inch pipeline in 9th Avenue between approximately 2,600 feet north of Grangeville Boulevard and Grangeville Boulevard.

Transmission System: The transmission system to service future users throughout the Planned Area Boundary consists of 18-inch and 24-inch pipelines along 9th Avenue, Houston Avenue, right-of-way between 12th Avenue and 13th Avenue, and Centennial Drive. The transmission mains are described in more detail below:

- **Northeast-Southeast Transmission Main.** This north-south transmission main is approximately 3 miles long and is intended to convey water between the future tank locations in the northeast and the southeast region of the City. It should be noted that approximately one mile of this transmission has already been constructed.

  The transmission main begins at the intersection of 9th Avenue and Grangeville Boulevard and continues south to Lacey Boulevard where it reaches the previously constructed section of transmission main. The proposed transmission begins again at the intersection of Hanford Armona Road and 9th Avenue before terminating at Houston Avenue.

  The proposed portions of this transmission main consist of improvements MAIN-P28 and MAIN-P39.

- **East-West Transmission Main.** This east-west transmission main is approximately 3.5 miles long and is intended to convey water between the southeast and the southwest regions of the City. It should be noted that approximately one-quarter mile of this transmission main has already been constructed.

  The transmission main begins at the intersection of 9th Avenue and Houston Avenue and continues westward 11th Avenue where it reaches the previously constructed section of transmission main. The proposed transmission begins again west of the intersection of Houston Avenue and Courtright Avenue before terminating one-half mile west of 12th Avenue.

  The proposed portions of this transmission main consist of improvements MAIN-P16, MAIN-P17, MAIN-P18, MAIN-P19, and MAIN-P20; these improvements include two canal crossings.

- **Northwest-Southwest Transmission Main.** This north-south transmission main is approximately 3.5 miles long and is intended to convey water between the northwest and the southwest regions of the City. It should be noted that approximately 2.5 miles of this transmission main has already been constructed.

  The transmission main begins at Houston Avenue approximately one-half mile west of 12th Avenue and continues northward to Hanford Armona Road where it reaches the previously constructed section of transmission main. The proposed portion of this transmission main consists of improvement MAIN-P9.

CHAPTER 8 – CAPITAL IMPROVEMENT PROGRAM

This chapter provides a summary of the recommended domestic water system improvements to mitigate existing capacity deficiencies and to accommodate anticipated future growth. The chapter also presents the cost criteria and methodologies for developing the capital improvement program. Finally, a capacity allocation analysis, usually used for cost sharing purposes, is also included.

8.1 COST ESTIMATE ACCURACY

Cost estimates presented in the CIP were prepared for general master planning purposes and, where relevant, for further project evaluation. Final costs of a project will depend on several factors including the final project scope, costs of labor and material, and market conditions during construction.

The Association for the Advancement of Cost Engineering (AACE International), formerly known as the American Association of Cost Engineers has defined three classifications of assessing project costs. These classifications are presented in order of increasing accuracy: Order of Magnitude, Budget, and Definitive.

- **Order of Magnitude Estimate.** This classification is also known as an “original estimate”, “study estimate”, or “preliminary estimate”, and is generally intended for master plans and studies.

  This estimate is not supported with detailed engineering data about the specific project, and its accuracy is dependent on historical data and cost indexes. It is generally expected that this estimate would be accurate within -30 percent to +50 percent.

- **Budget Estimate.** This classification is also known as an “official estimate” and generally intended for predesign studies. This estimate is prepared to include flow sheets and equipment layouts and details. It is generally expected that this estimate would be accurate within -15 percent to +30 percent.

- **Definitive Estimate.** This classification is also known as a “final estimate” and prepared during the time of contract bidding. The data includes complete plot plans and elevations, equipment data sheets, and complete specifications. It is generally expected that this estimate would be accurate within -5 percent to + 15 percent.

Costs developed in this study should be considered “Order of Magnitude” and have an expected accuracy range of **-30 percent** and **+50 percent**.

8.2 COST ESTIMATE METHODOLOGY

Cost estimates presented in this chapter are opinions of probable construction and other relevant costs developed from several sources including cost curves, Akel experience on other master planning projects, and input from City staff. Where appropriate, costs were escalated to reflect the more current Engineering News-Record (ENR) Construction Cost Index (CCI).

This section documents the unit costs used in developing the opinion of probable construction costs, the CCI, the land acquisition costs, and markups to account for construction contingency and other project related costs.

8.2.1 Unit Costs

The unit cost estimates used in developing the Capital Improvement Program are summarized on **Table 8.1**. Domestic water pipeline unit costs are based on length of pipes, in feet. Storage reservoir unit costs are based on capacity in MG. Pump station costs are based on an equation that replaces the pump curve.

The unit costs are intended for developing the Order of Magnitude estimate and do not account for site specific conditions, labor and material costs during the time of construction, final project scope, implementation schedule, detailed utility and topography surveys for reservoir sites, investigation of alternative routings for pipes, and other various factors. The capital improvement program included in this report accounts for construction and project-related contingencies as described in this chapter.

8.2.2 Construction Cost Index

Costs estimated in this study are adjusted utilizing the ENR CCI, which is widely used in the engineering and construction industries.

The costs in this Water System Master Plan were benchmarked using a 20-City national average ENR CCI of 10,532, reflecting a date of January 2017.

8.2.3 Land Acquisition

Construction of pipelines is generally assumed to be within existing or future street right-of-ways. A land acquisition fee for the construction of storage reservoirs and pump stations was assumed based on recent land acquisitions. It was assumed that new tank sites will require 3 acres, which includes all recommended tank and pump station improvements.

8.2.4 Construction Contingency Allowance

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore, construction contingencies were used. The estimated construction costs in this master plan include a **15 percent** contingency allowance to account for unforeseen events and unknown field conditions.

Table 8.1 Unit Costs

Water System Master Plan
City of Hanford

Pipelines	
Diameter (in)	**($/lineal foot)**
8	$65
10	$78
12	$83
16	$131
18	$159
20	$167
24	$200
30	$256
36	$310
Pump Stations	
Estimated Pumping Station Project Cost = $1.9 * 10^{(0.7583*\log(Q)+3.1951)}$; where Q is in gpm	
Casings[2]	
Estimated casing costs are based on $22 per inch diameter per linear foot	
Groundwater Wells	
1,500 gpm each	$905,300
Storage Reservoirs	
Tank Volume (MG)	**($/gallon)**
≤ 1.0 MG	$2.15
1.1 MG - 3.0 MG	$1.72
3.1 MG - 5.0 MG	$1.24
> 5.0 MG	$0.92
Land Acquisition	**($/acre)**
Land Acquisition	$40,000

Notes :

1. Unit costs based on January 2017 ENR CCI of 10532.
2. Casing size assumed at 20 inches larger than carrier pipe.

8.2.5 Project Related Costs

The capital improvement costs also account for project-related costs, comprising of engineering design, project administration (developer and City staff), construction management and inspection, and legal costs. The project related costs in this master plan were estimated by applying an additional **15 percent** to the estimated construction costs.

8.3 CAPITAL IMPROVEMENT PROGRAM

This section documents the capital improvement program and the cost allocation for existing and future users.

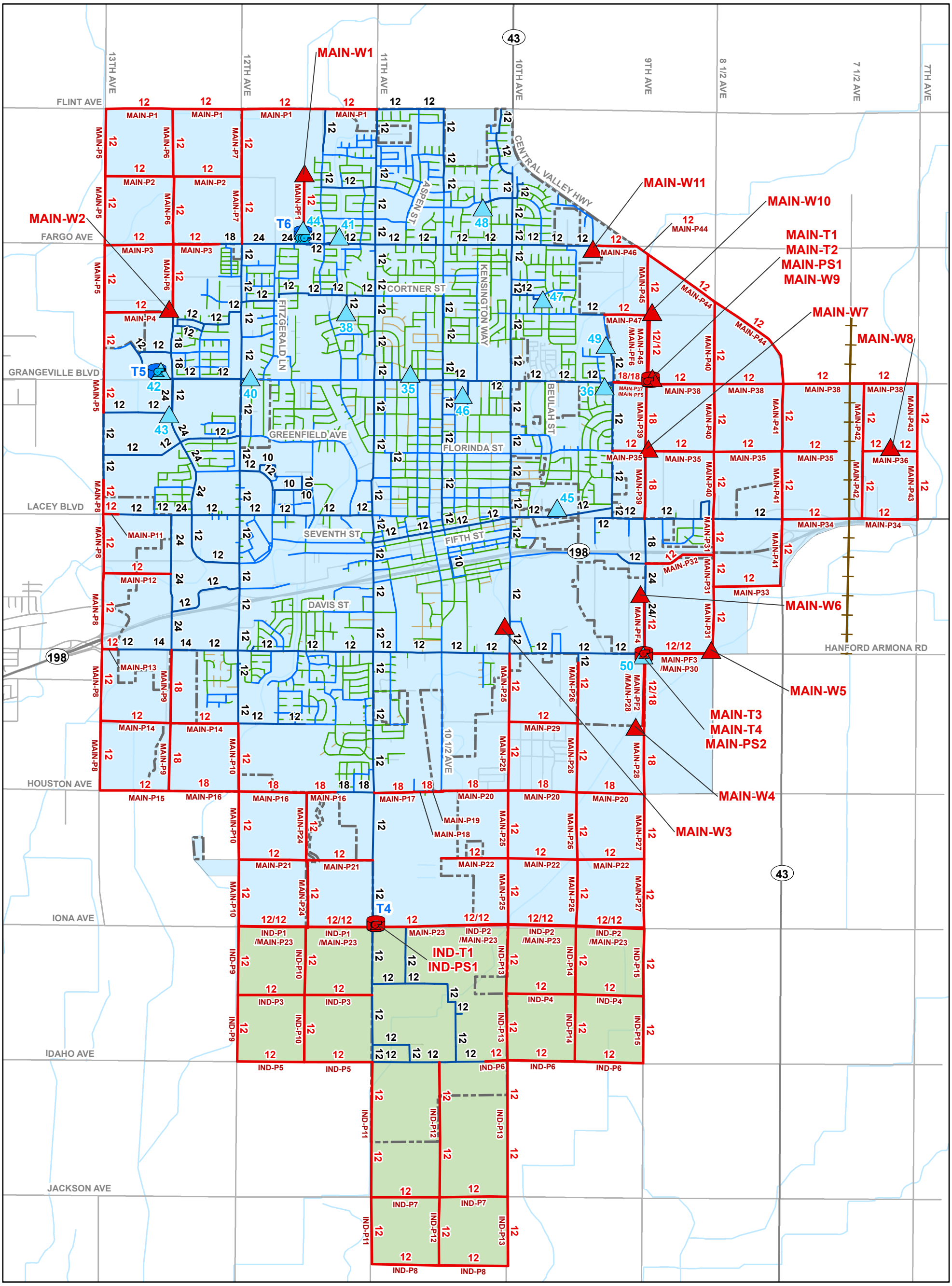
8.3.1 Capital Improvements Program Costs

The Capital Improvement Program costs for the projects identified in this master plan for mitigating existing system deficiencies and for serving anticipated future growth throughout the City are summarized on **Table 8.2**.

Each improvement was assigned a unique coded identifier associated with the improvement type, which corresponds to the summary figure (**Figure 8.1**) that shows the location and identifiers of each improvement. The suggested capital improvement costs include the contingencies discussed in a previous section.

8.3.2 Recommended Cost Allocation Analysis

Cost allocation analysis is needed to identify improvement funding sources, and to establish a nexus between development impact fees and improvements needed to service growth. In compliance with the provisions of Assembly Bill AB 1600, the analysis differentiates between the project needs of servicing existing users and for those required to service anticipated future developments. The cost responsibility is based on model parameters for existing and future land use, and may change depending on the nature of development. **Table 8.2** lists each improvement, and separates the cost by responsibility between existing and future users.



Legend

Proposed Improvements
- Tanks
- Wells
- Pump Stations
- Pipes
- High Speed Rail Alignment

Pressure Zones
- Main
- Industrial Park

Existing System
- Tanks
- Wells
- Pump Stations

Pipes By Size
- 4" and Smaller
- 6"
- 8"
- 10" and Larger

- City Limits
- Streets
- Highways
- Waterways

Update: June 27, 2017

0 0.25 0.5 1 Mile

N W E S

Figure 8.1
Capital Improvement Program
Water System Master Plan
City of Hanford

AKEL ENGINEERING GROUP, INC.

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Table 8.2 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements		Infrastructure Costs							Capital Improvement Costs				Suggested Cost Allocation		Cost Allocation	
				Existing Diameter (in)	New/Parallel/ Replace	Diameter (in)	Length (ft)	Number of Casings[1] Railroad	Number of Casings[1] Highway	Number of Casings[1] Canal/Slough	Unit Cost[2] ($/unit)	Infr. Cost ($)	Baseline Construction Costs ($)	Estimated Construction Costs[3] ($)	Land Acquisition Costs[4] ($)	Capital Improvement Costs[5] ($)	Existing Users (%)	Future Users (%)	Existing Users ($)	Future Users ($)
Pipeline Improvements																				
Main Pressure Zone																				
MAIN-P1	Pipeline	Flint Ave	From 11th Ave to 13th Ave	-	New	12	10,600	1		2	83	1,306,372	1,306,372	1,502,327		1,727,677	0%	100%	0	1,727,677
MAIN-P2	Pipeline	ROW	From approx 12th Ave to 13th Ave	-	New	12	5,350			1	83	586,956	586,956	674,999		776,249	0%	100%	0	776,249
MAIN-P3	Pipeline	Fargo Ave	From approx 270 ft w/o Corvina Pl to 13th Ave	-	New	12	4,475			1	83	513,986	513,986	591,084		679,747	0%	100%	0	679,747
MAIN-P4	Pipeline	ROW	From Centennial Dr to 13th Ave	-	New	12	2,700				83	225,163	225,163	258,937		297,778	0%	100%	0	297,778
MAIN-P5	Pipeline	13th Ave	From Flint Ave to approx 1,300 ft s/o Grangeville Blvd	-	New	12	11,900			2	83	1,273,983	1,273,983	1,465,081		1,684,843	0%	100%	0	1,684,843
MAIN-P6	Pipeline	Centennial Dr	From Flint Ave to approx 2,600 ft n/o Grangeville Blvd	-	New	12	7,975			2	83	946,664	946,664	1,088,663		1,251,963	0%	100%	0	1,251,963
MAIN-P7	Pipeline	12th Ave	From Flint Ave to Fargo Ave	-	New	12	5,275			1	83	580,701	580,701	667,806		767,977	0%	100%	0	767,977
MAIN-P8	Pipeline	13th Ave	From approx 1,350 ft n/o Lacey Blvd to Houston Ave	-	New	12	12,200		1	3	83	1,862,201	1,862,201	2,141,532		2,462,761	0%	100%	0	2,462,761
MAIN-P9	Pipeline	12 1/2 Ave	From Hanford Armona Rd to Houston Ave	-	New	18	5,525				159	880,543	880,543	1,012,625		1,164,519	40%	60%	465,807	698,711
MAIN-P10	Pipeline	12th Ave	From Hume Ave to Iona Ave	-	New	12	7,950			1	83	803,779	803,779	924,346		1,062,997	0%	100%	0	1,062,997
MAIN-P11	Pipeline	Lacey Blvd	From approx 600 ft e/o 13th Ave to 13th Ave	-	New	12	600				83	50,036	50,036	57,542		66,173	0%	100%	0	66,173
MAIN-P12	Pipeline	ROW	From 12 1/2 Ave to 13th Ave	-	New	12	2,625				83	218,908	218,908	251,744		289,506	0%	100%	0	289,506
MAIN-P13	Pipeline	Hanford Armona Rd	From approx 600 ft e/o 13th Ave to 13th Ave	-	New	12	575				83	47,951	47,951	55,144		63,416	0%	100%	0	63,416
MAIN-P14	Pipeline	Hume Ave	From 12th Ave to 13th Ave	-	New	12	5,400				83	450,325	450,325	517,874		595,555	0%	100%	0	595,555
MAIN-P15	Pipeline	Houston Ave	From approx 12 1/2 Ave to 13th Ave	-	New	12	2,700			1	83	365,963	365,963	420,857		483,986	40%	60%	193,594	290,391
MAIN-P16	Pipeline	Houston Ave	From 12 1/2 Ave to approx 700 ft w/o Courtright Dr	-	New	18	6,525			2	159	1,374,318	1,374,318	1,580,465		1,817,535	40%	60%	727,014	1,090,521
MAIN-P17	Pipeline	Houston Ave	From 11th Ave to approx 1,600 ft e/o 11th Ave	6	Replace	18	1,600				159	254,999	254,999	293,249		337,236	40%	60%	134,894	202,342
MAIN-P18	Pipeline	Houston Ave	From approx 1,600 ft e/o 11th Ave to approx 2,000 ft e/o 11th Ave	12	Replace	18	475				159	75,703	75,703	87,058		100,117	40%	60%	40,047	60,070
MAIN-P19	Pipeline	Houston Ave	From approx 2,000 ft e/o 11th Ave to 10 1/2 Ave	8	Replace	18	925				159	147,421	147,421	169,534		194,965	40%	60%	77,986	116,979
MAIN-P20	Pipeline	Houston Ave	From 10 1/2 Ave to 9th Ave	-	New	18	7,875			1	159	1,422,273	1,422,273	1,635,614		1,880,956	0%	100%	0	1,880,956
MAIN-P21	Pipeline	ROW	From 11th Ave to 12th Ave	-	New	12	5,250			2	83	719,416	719,416	827,329		951,428	20%	80%	190,286	761,142
MAIN-P22	Pipeline	ROW	From 9th Ave to 10 1/2 Ave	-	New	12	7,950	1		1	83	944,579	944,579	1,086,266		1,249,205	0%	100%	0	1,249,205
MAIN-P23	Pipeline	Iona Ave	From 9th Ave to 12th Ave	-	New	12	16,100	1		2	83	1,765,036	1,765,036	2,029,792		2,334,261	25%	75%	583,565	1,750,695
MAIN-P24	Pipeline	ROW	From Houston Ave to Iona Ave	-	New	12	5,275			1	83	580,701	580,701	667,806		767,977	0%	100%	0	767,977
MAIN-P25	Pipeline	10th Ave	From Hanford Armona Rd to Iona Ave	-	New	12	10,600				83	883,972	883,972	1,016,567		1,169,053	0%	100%	0	1,169,053
MAIN-P26	Pipeline	ROW	From approx 370 ft s/o Hanford Armona Rd to Iona Ave	-	New	12	10,325			3	83	1,283,439	1,283,439	1,475,954		1,697,347	40%	60%	678,939	1,018,408
MAIN-P27	Pipeline	9th Ave	From Houston Ave to Iona Ave	-	New	12	2,700				83	225,163	225,163	258,937		297,778	0%	100%	0	297,778
MAIN-P28	Pipeline	9th Ave	From Hanford Armona Rd to Houston Ave	-	New	18	5,500			1	159	1,043,759	1,043,759	1,200,323		1,380,371	0%	100%	0	1,380,371
MAIN-P29	Pipeline	ROW	From approx 700 ft e/o 9 3/4 Ave to 10th Ave	-	New	12	2,700				83	225,163	225,163	258,937		297,778	0%	100%	0	297,778
MAIN-P30	Pipeline	Hanford Armona Rd	From 8 1/2 Ave to 9th Ave	-	New	12	2,650			1	83	361,793	361,793	416,062		478,471	0%	100%	0	478,471
MAIN-P31	Pipeline	ROW	From Lacey Blvd to Hanford Armona Rd	-	New	12	5,300		1	1	83	1,005,186	1,005,186	1,155,964		1,329,358	0%	100%	0	1,329,358
MAIN-P32	Pipeline	Third St	From 9th Ave to 8 1/2 Ave	-	New	12	2,800				83	233,502	233,502	268,527		308,806	0%	100%	0	308,806
MAIN-P33	Pipeline	ROW	From HWY 43 to 8 1/2 Ave	-	New	12	2,625				83	218,908	218,908	251,744		289,506	0%	100%	0	289,506

Table 8.2 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements		Infrastructure Costs							Capital Improvement Costs				Suggested Cost Allocation		Cost Allocation	
				Existing Diameter	New/Parallel/ Replace	Diameter	Length	Number of Casings[1]			Unit Cost[2]	Infr. Cost	Baseline Construction Costs	Estimated Construction Costs[3]	Land Acquisition Costs[4]	Capital Improvement Costs[5]	Existing Users	Future Users	Existing Users	Future Users
				(in)		(in)	(ft)	Railroad	Highway	Canal/Slough	($/unit)	($)	($)	($)	($)	($)	(%)	(%)	($)	($)
MAIN-P34	Pipeline	Lacey Blvd	From approx 7th Ave to HWY 43	-	New	12	5,300				83	441,986	441,986	508,284		584,526	0%	100%	0	584,526
MAIN-P35	Pipeline	ROW	From 7th Ave to 9 1/4 Ave	-	New	12	8,775				83	731,778	731,778	841,545		967,777	0%	100%	0	967,777
MAIN-P36	Pipeline	ROW	From 7th Ave to approx 2,600 ft e/o HWY 43	-	New	12	2,125				83	177,211	177,211	203,793		234,362	0%	100%	0	234,362
MAIN-P37	Pipeline	Grangeville Blvd	From approx 1,300 ft e/o 9 1/4 Ave to 9 1/4 Ave	-	New	18	1,300				159	207,187	207,187	238,265		274,004	40%	60%	109,602	164,403
MAIN-P38	Pipeline	Grangeville Blvd	From 7th Ave to approx 1,300 ft e/o 9 1/4 Ave	-	New	12	10,625				83	886,057	886,057	1,018,965		1,171,810	0%	100%	0	1,171,810
MAIN-P39	Pipeline	9th Ave	From Grangeville Blvd to Lacey Blvd	-	New	18	5,300				159	844,684	844,684	971,387		1,117,095	0%	100%	0	1,117,095
MAIN-P40	Pipeline	8 1/2 Ave	From HWY 43 to Lacey Blvd	-	New	12	8,525	1			83	851,730	851,730	979,490		1,126,413	0%	100%	0	1,126,413
MAIN-P41	Pipeline	HWY 43	From Grangeville Blvd to approx 2,600 ft s/o Lacey Blvd	-	New	12	7,925	1	1		83	1,224,094	1,224,094	1,407,708		1,618,864	0%	100%	0	1,618,864
MAIN-P42	Pipeline	ROW	From Grangeville Blvd to Lacey Blvd	-	New	12	5,300	1			83	582,786	582,786	670,204		770,734	0%	100%	0	770,734
MAIN-P43	Pipeline	7th Ave	From Grangeville Blvd to Lacey Blvd	-	New	12	5,300	1			83	582,786	582,786	670,204		770,734	0%	100%	0	770,734
MAIN-P44	Pipeline	HWY 43	From Fargo Ave to Grangeville Blvd	-	New	12	8,250			1	83	828,797	828,797	953,116		1,096,084	0%	100%	0	1,096,084
MAIN-P45	Pipeline	9th Ave	From HWY 43 to Grangeville Blvd	-	New	12	5,100			1	83	566,107	566,107	651,023		748,677	0%	100%	0	748,677
MAIN-P46	Pipeline	Fargo Ave	From HWY 43 to approx 200 ft e/o Meadow View Rd	-	New	12	1,500				83	125,090	125,090	143,854		165,432	0%	100%	0	165,432
MAIN-P47	Pipeline	Leland Wy	From approx 1,700 ft e/o 9 1/4 Ave to 9th Ave	-	New	12	1,700				83	141,769	141,769	163,034		187,490	0%	100%	0	187,490
										Subtotal - Main Pressure Zone			**31,070,923**	**35,731,561**		**41,091,295**			**3,201,734**	**37,889,561**
Industrial Park Pressure Zone																				
IND-P1	Pipeline	Iona Ave	From 11th Ave to 12th Ave	-	New	12	5,250				83	437,816	437,816	503,489		579,012	0%	100%	0	579,012
IND-P2	Pipeline	Iona Ave	From 9th Ave to approx 2,340 ft w/o 10th Ave	-	New	12	7,675			2	83	921,646	921,646	1,059,892		1,218,876	0%	100%	0	1,218,876
IND-P3	Pipeline	ROW	From 11th Ave to 12th Ave	-	New	12	5,250				83	437,816	437,816	503,489		579,012	0%	100%	0	579,012
IND-P4	Pipeline	ROW	From 9th Ave to 10th Ave	-	New	12	5,375			1	83	589,040	589,040	677,396		779,006	0%	100%	0	779,006
IND-P5	Pipeline	Idaho Ave	From 11th Ave to 12th Ave	-	New	12	5,300				83	441,986	441,986	508,284		584,526	0%	100%	0	584,526
IND-P6	Pipeline	Idaho Ave	From 9th Ave to approx 860 ft w/o 10th Ave	-	New	12	6,175			1	83	655,755	655,755	754,119		867,236	0%	100%	0	867,236
IND-P7	Pipeline	Jackson Ave	From 10th Ave to 11th Ave	-	New	12	5,350	1			83	586,956	586,956	674,999		776,249	0%	100%	0	776,249
IND-P8	Pipeline	ROW	From 10th Ave to 11th Ave	-	New	12	5,325	1			83	584,871	584,871	672,601		773,492	0%	100%	0	773,492
IND-P9	Pipeline	12th Ave	From Iona Ave to Idaho Ave	-	New	12	5,300				83	441,986	441,986	508,284		584,526	0%	100%	0	584,526
IND-P10	Pipeline	ROW	From Iona Ave to Idaho Ave	-	New	12	5,375				83	448,240	448,240	515,476		592,798	0%	100%	0	592,798
IND-P11	Pipeline	11th Ave	From Idaho Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	7,925			1	83	801,694	801,694	921,948		1,060,240	0%	100%	0	1,060,240
IND-P12	Pipeline	ROW	From Idaho Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	7,975				83	665,064	665,064	764,823		879,547	0%	100%	0	879,547
IND-P13	Pipeline	10th Ave	From Iona Ave to approx 8,000 ft s/o Idaho Ave	-	New	12	13,400			1	83	1,258,274	1,258,274	1,447,015		1,664,067	0%	100%	0	1,664,067
IND-P14	Pipeline	ROW	From Iona Ave to Idaho Ave	-	New	12	5,325				83	444,071	444,071	510,681		587,284	0%	100%	0	587,284
IND-P15	Pipeline	9th Ave	From Iona Ave to Idaho Ave	-	New	12	5,275			2	83	721,501	721,501	829,726		954,185	0%	100%	0	954,185
										Subtotal - Industrial Pressure Zone			**9,436,715**	**10,852,222**		**12,480,056**			**0**	**12,480,056**

Table 8.2 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements		Infrastructure Costs							Capital Improvement Costs				Suggested Cost Allocation		Cost Allocation	
				Existing Diameter	New/Parallel/ Replace	Diameter	Length	Number of Casings[1]			Unit Cost[2]	Infr. Cost	Baseline Construction Costs	Estimated Construction Costs[3]	Land Acquisition Costs[4]	Capital Improvement Costs[5]	Existing Users	Future Users	Existing Users	Future Users
				(in)		(in)	(ft)	Railroad	Highway	Canal/Slough	($/unit)	($)	($)	($)	($)	($)	(%)	(%)	($)	($)
Tank Feed Pipelines																				
MAIN-PF1	Pipeline	ROW	From approx 800 ft w/o the intersection of Julia Wy and Glacier Wy to approx 400 ft n/o Fargo Ave	-	New	12	2,325				83	193,890	193,890	222,974		256,420	0%	100%	0	256,420
MAIN-PF2	Pipeline	9th Ave	From Hanford Armona Rd to approx 2,800 ft s/o Hanford Armona Rd	-	New	12	2,825				83	235,587	235,587	270,925		311,564	0%	100%	0	311,564
MAIN-PF3	Pipeline	Hanford Armona Rd	From approx 2,700 ft e/o 9th Ave to 9th Ave	-	New	12	2,675				83	223,078	223,078	256,539		295,020	0%	100%	0	295,020
MAIN-PF4	Pipeline	9th Ave	From approx 2,400 ft n/o Hanford Armona Rd to Hanford Armona Rd	-	New	12	2,400				83	200,145	200,145	230,166		264,691	0%	100%	0	264,691
MAIN-PF5	Pipeline	Grangeville Blvd	From 9 1/4 Ave to 9th Ave	-	New	12	1,575				83	131,345	131,345	151,047		173,704	0%	100%	0	173,704
MAIN-PF6	Pipeline	9th Ave	From approx 2,600 ft n/o Grangeville Blvd to Grangeville Blvd	-	New	18	2,625				159	418,358	418,358	481,111		553,278	0%	100%	0	553,278
										Subtotal - Industrial Pressure Zone			**1,402,402**	**1,612,762**		**1,854,676**			**0**	**1,854,676**
										Subtotal - Pipeline Improvements			**41,910,039**	**48,196,545**		**55,426,027**			**3,201,734**	**52,224,293**
Groundwater Well Improvements						**Pump Capacity (gpm)**														
MAIN-W1	Groundwater Well	Approx 800 ft w/o the intersection of Julia Wy and Glacier Wy			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W2	Groundwater Well	Centennial Dr approx 2,600 ft n/o Grangeville Blvd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W3	Groundwater Well	10th Ave approx 1,100 ft n/o Hanford Armona Rd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W4	Groundwater Well	9th Ave approx 2,800 ft s/o Hanford Armona Rd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W5	Groundwater Well	8 1/2 Ave and Hanford Armona Rd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W6	Groundwater Well	9th Ave approx 2,400 ft n/o Hanford Armona Rd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W7	Groundwater Well	9th Ave and approx 2,600 ft s/o Grangeville Blvd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W8	Groundwater Well	ROW Approx 4,200 ft e/o 8th Avenue s/o Grangeville Blvd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W9	Groundwater Well	Grangeville Blvd and 9th Ave			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W10	Groundwater Well	Leland Way and 9th Ave			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
MAIN-W11	Groundwater Well	Fargo Ave and Meadow View Rd			New	1,500				-	905,300		905,300	1,041,095	20,000	1,220,259	0%	100%	0	1,220,259
										Subtotal - Groundwater Well Improvements			**9,958,300**	**11,452,045**	**220,000**	**13,422,852**			**0**	**13,422,852**
Pump Station Improvements						**Firm Pump Station Capacity (gpm)**														
Main Pressure Zone																				
MAIN-PS1	Pump Station	Grangeville Blvd and 9th Ave			New	3 @ 3,100 gpm				-	3,041,965		3,041,965	3,498,260		4,022,999	60%	40%	2,413,799	1,609,200
MAIN-PS2	Pump Station	Hanford Armona Rd and 9th Ave			New	3 @ 3,100 gpm				-	3,041,965		3,041,965	3,498,260		4,022,999	0%	100%	0	4,022,999
										Subtotal - Main Pressure Zone			**6,083,930**	**6,996,520**		**8,045,998**			**2,413,799**	**5,632,198**
Industrial Park Pressure Zone						**Firm Pump Station Capacity (gpm)**														
IND-PS1	Pump Station	11th Ave and Iona Ave			Additional Capacity	4 @ 1,400 gpm				-	2,070,640		2,070,640	2,381,236		2,738,421	25%	75%	684,605	2,053,816
										Subtotal - Industrial Pressure Zone			**2,070,640**	**2,381,236**		**2,738,421**			**684,605**	**2,053,816**
										Subtotal - Pump Station Improvements			**8,154,570**	**9,377,756**		**10,784,419**			**3,098,405**	**7,686,014**

Table 8.2 Capital Improvement Program

Water System Master Plan
City of Hanford

Improv. No.	Improv. Type	Alignment	Limits	Pipeline Improvements: Existing Diameter (in)	Pipeline Improvements: New/Parallel/ Replace	Infrastructure Costs: Diameter (in)	Infrastructure Costs: Length (ft)	Infrastructure Costs: Number of Casings[1]: Railroad	Highway	Canal/Slough	Infrastructure Costs: Unit Cost[2] ($/unit)	Infrastructure Costs: Infr. Cost ($)	Capital Improvement Costs: Baseline Construction Costs ($)	Capital Improvement Costs: Estimated Construction Costs[3] ($)	Capital Improvement Costs: Land Acquisition Costs[4] ($)	Capital Improvement Costs: Capital Improvement Costs[5] ($)	Suggested Cost Allocation: Existing Users (%)	Suggested Cost Allocation: Future Users (%)	Cost Allocation: Existing Users ($)	Cost Allocation: Future Users ($)
Tank Improvements																				
Main Pressure Zone								**Storage Tank Capacity (MG)**												
MAIN-T1	Storage Tank	Grangeville Blvd and 9th Ave			New			1.5			-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	100%	0%	3,479,975	0
MAIN-T2	Storage Tank	Grangeville Blvd and 9th Ave			New			1.5			-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	0%	100%	0	3,479,975
MAIN-T3	Storage Tank	Hanford Armona Rd and 9th Ave			New			1.5			-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	0%	100%	0	3,479,975
MAIN-T4	Storage Tank	Hanford Armona Rd and 9th Ave			New			1.5			-	2,579,187	2,579,187	2,966,065	60,000	3,479,975	0%	100%	0	3,479,975
											Subtotal - Main Pressure Zone		**10,316,748**	**11,864,260**	**240,000**	**13,919,899**			**3,479,975**	**10,439,924**
Industrial Park Pressure Zone								**Storage Tank Capacity (MG)**												
IND-T1	Storage Tank	11th Ave and Iona Ave			New			0.7			-	1,203,621	1,203,621	1,384,164	60,000	1,660,788	6%	94%	99,647	1,561,141
											Subtotal - Industrial Pressure Zone		**1,203,621**	**1,384,164**	**60,000**	**1,660,788**			**99,647**	**1,561,141**
											Subtotal - Storage Tank Improvements		**11,520,368**	**13,248,424**	**300,000**	**15,580,687**			**3,579,622**	**12,001,065**
Total Improvement Cost																				
											Pipeline Improvements		41,910,039	48,196,545	0	**55,426,027**			**3,201,734**	**52,224,293**
											Groundwater Wells		9,958,300	11,452,045	220,000	**13,422,852**			**0**	**13,422,852**
											Pump Stations		8,154,570	9,377,756	0	**10,784,419**			**3,098,405**	**7,686,014**
											Storage Tanks		11,520,368	13,248,424	300,000	**15,580,687**			**3,579,622**	**12,001,065**
											Total Improvement Costs		71,543,278	82,274,769	520,000	**95,213,985**			**9,879,761**	**85,334,224**

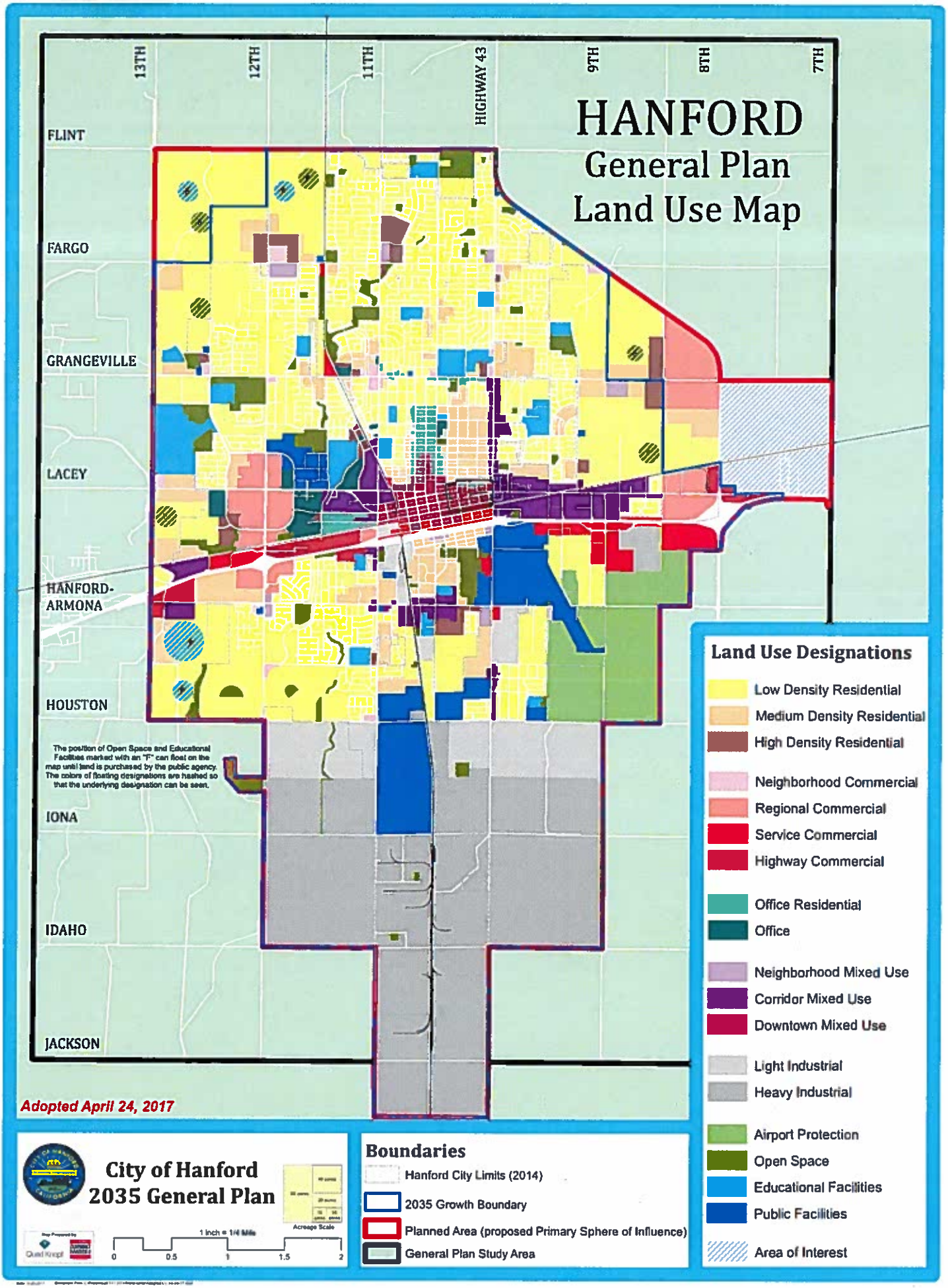
AKEL ENGINEERING GROUP, INC.

5/19/2017

Notes:
1. Casing diameter assumed at 20 inches greater than carrier pipe. Railroad and canal/slough casings assumed at a length of 200 feet; highway casings assumed at a length of 600 feet.
2. Unit costs based on a January 2017 ENR CCI of 10,532.
3. Baseline construction costs plus 15% to account for unforeseen events and unknown conditions.
4. It was assumed that new storage reservoirs would require 1.5 acres of land acquisition while new groundwater wells would require 0.5 acres of land acquisition.
5. Estimated construction cost and land acquisition cost plus 15% to cover other costs including: engineering design, project administration (developer and City staff), construction management and inspection, and legal costs

APPENDIX A

General Plan Land Use Map


HANFORD
General Plan
Land Use Map
13TH
12TH
11TH
HIGHWAY 43
9TH
8TH
7TH
FLINT
FARGO
GRANGEVILLE
LACEY
HANFORD-
ARMONA
HOUSTON
IONA
IDAHO
JACKSON
The position of Open Space and Educational Facilities marked with an "F" can float on the map until land is purchased by the public agency. The colors of floating designations are hashed so that the underlying designation can be seen.
Land Use Designations
Low Density Residential
Medium Density Residential
High Density Residential
Neighborhood Commercial
Regional Commercial
Service Commercial
Highway Commercial
Office Residential
Office
Neighborhood Mixed Use
Corridor Mixed Use
Downtown Mixed Use
Light Industrial
Heavy Industrial
Airport Protection
Open Space
Educational Facilities
Public Facilities
Area of Interest
Adopted April 24, 2017
City of Hanford
2035 General Plan
Boundaries
Hanford City Limits (2014)
2035 Growth Boundary
Planned Area (proposed Primary Sphere of Influence)
General Plan Study Area
1 inch = 1/4 Mile
0
0.5
1
1.5
2