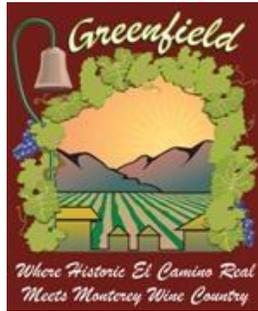


CITY OF GREENFIELD
POTABLE WATER DISTRIBUTION SYSTEM MASTER PLAN
UPDATE
May 2021



City Council
Mayor Lance Walker

Prepared By:

A handwritten signature in blue ink that reads "Steven G. Tanaka". The signature is fluid and cursive, with a long horizontal line extending to the right.

Steven G. Tanaka, P.E. 49779
Principal Civil Engineer



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List of Acronyms

AC	Asbestos Cement
ADD	Average Day Demand
AFY	Acre-Feet per Year
AWWA	American Water Works Association
“C” Factor	Hazen-Williams roughness coefficient
cfs	cubic feet per second
CI	Cast Iron
CIP	Capital Improvement Program
City	City of Greenfield
DI	Ductile Iron
ENR	Engineering News-Record
GIS	Geographic Information System
gal	Gallon
gpcd	gallons per capita per day
gpm	gallons per minute
hp	horse power
MG	million gallon
mgd	million gallons per day
N/A	Not Available
NFPA	National Fire Protection Agency
PF	Peaking Factor
PHD	Peak Hour Demand
Plan or WMP	Water Master Plan
PRV	Pressure Reducing Valve
PVC	Poly-Vinyl Chloride
SCADA	Supervisory Control and Data Acquisition
SWRCB-DDW	State Water Resources Control Board – Division of Drinking Water
UAW	Unaccounted-for-Water
UFC	Uniform Fire Code

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4. 2005-2025 Water System Capital Improvement Plan Update and Capacity Charge Study
5. 2015 Draft Urban Water Management Plan
6. 2011 Water Rate Study
7. 2012-2019 Annual Reports
8. 2015-2019 CCR Annual Water Quality Reports
9. 2012-2019 Water Production and Delivery Records
10. 2014 Water Contingency Plan
11. California Department of Public Health Water System Permit
12. Operation and Maintenance Manual for the City of Greenfield Water System
13. 1998 Draft Final EIR, Denise Duffy & Associates (Yanks Museum Project)
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15. McGraw Hill ENR Construction Cost Index of 10242 (March 2016), 11455 (August 2020)
16. Metcalf & Eddy design handbook “Wastewater Engineering, Treatment and Reuse, Fifth Addition”, 2014
17. Personal Communication with Tony Nisich, interim Public Works Director and Arturo Felix, Public Works Utilities Manager, Doug Pike, City Engineer
18. Pump Curves provided by the City of Greenfield
19. Draft Water Booster Pump Station Pressure Study, M.K. Nunley & Associates, February 2016

1: Introduction

The City of Greenfield (City) supplies water service and fire suppression to its customers throughout the City. As older infrastructure is replaced and new development projects are constructed, it is the City's goal to construct water improvements to meet the current and ultimate needs of the City. In order to facilitate this goal, and to adequately plan for the capital resources needed to meet this goal, the City in conjunction with Wallace Group, completed a comprehensive Water Master Plan (Plan or WMP) in 2016 that evaluated all aspects of the water distribution system and its ability to meet current and long-term needs of the City. In recent years, the City has seen significant growth potential, new industrial/commercial opportunities, and significant annexations that will require the City to update the WMP to address these new and upcoming changes. This WMP update will allow the City to continue to resourcefully and proactively plan for the future water service of the City of Greenfield. It is noted that the City is simultaneously in the process of preparing this Master Plan Update, the Wastewater Collection System Master Plan Update, and Wastewater Treatment Plant Master Plan.

Purpose of the Project

Preparation of the WMP Update will assist the City in prioritizing both current and future water system needs and set forth a mechanism for addressing those needs. The Plan accomplishes the following:

1. Addresses existing deficiencies within the water distribution system based on today's standards and requirements;
2. Addresses deficiencies within the water distribution system to meet future build-out needs, and in particular, addresses significant water demands placed on the City related to upcoming developments and recent significant annexations of land into the City; and
3. Provides a prioritized list of recommendations with associated hard and soft costs to complete identified water system capital improvement projects.

Authorization and Scope of Work

On June 11, 2019, the City authorized Wallace Group to prepare this comprehensive Water Master Plan Update (2019 WMP Update, WMP Update). This WMP Update was prepared in accordance with Wallace Group's proposal dated March 22, 2019. A summarized scope of work is as follows:

1. **Kick-Off Meeting, Project Review Meetings, Field Reviews and Operation Staff Interviews:** Coordinate and attend a kick-off meeting with key Team members and City staff. Immediately following the meeting, conduct an interview with the City's operations staff and a field investigation of the City's water tanks and pump stations to understand layouts and system operations.
2. **Existing Data Collection:** Obtain and review documents that will provide an understanding of the City's current water operations, recent and future planned development water demands and needs. City staff will provide the needed population projections based on City land use and zoning, General Plan, Association of Monterey Bay Area Governments (AMBAG) and other planning information.

3. **Preliminary Findings Memorandum:** Prepare a description and general inventory of the water, storage and distribution system based on review of plans, reports, studies and other City records, visits with staff and field inspections. We will document all parts of the existing water supply, storage and distribution system, including facilities, condition of equipment and system components, processes, and hydraulic requirements for existing water sources (water supply wells), reservoirs/storage tanks, booster pump stations, pressure zones, and distribution/transmission pipelines; document capital improvements and system expansions completed over the past 10-20 years, based on record drawings and other detailed information provided by City staff; and document compliance requirements for the City's operating permit issued by the State Division of Drinking Water (formerly California Department of Health Services).
4. **Water Model Development and Calibration:** Utilize present and future water demand information to model and determine water distribution system improvements including upsizing pipes, addition of new water mains to transport flows through the system within appropriate pressure levels to all areas within the system. Update the GIS database for water system infrastructure, and update water demands based on proposed developments and recent billing records, particularly for major new developments associated with cannabis.
5. **Water Storage and Supply Evaluation:** Identify and update current and future water reservoir storage requirements for operational (peak demand), emergency, and fire storage. Wallace Group will coordinate with the City, the City Fire Department (if required), and use the current Uniform Fire Code to ascertain, update and confirm fire flow requirements throughout the service area. We will evaluate the capacity and reliability of the City's water well network, with respect to meeting current and future demands. We will review scenarios when water wells and storage tanks are out of service due to needed repairs or servicing. We will factor in the new planned water storage tank, pumping station and well that will be included as part of the City's future water system with the development of the Pinnacles Development in the south Greenfield area.
6. **Develop Capital Improvement Program:** Evaluate the existing Water Distribution System and identify hydraulic deficiencies with maintenance and mitigation recommendations and identify the discrete system improvements needed to correct the deficiencies based upon Master Plan projected growth, and system design criteria. We will identify capital improvements to water supply, including potential need and timing for any additional reservoirs, pump stations, expanded waterline capacity, including updated recommendations to recognize recently completed CIPs (since adoption of the 2016 WMP) and new CIP requirements to support new developments throughout the City. We will update maps of the water system and summary tables indicating the locations, functional data (size, capacity, material, etc.), estimated costs and implementation timeframes of the improvements proposed for inclusion in the capital improvement plan. We will update the short and long term capital improvement plan from the 2016 WMP to address identified deficiencies including prioritization, alternatives, analysis, and schedule. This CIP will include a 5-year CIP for the purposes of subsequent water rate studies to be conducted by the City. Schedule and timing for projects identified for future build-out will be

based on water demand-based “triggers” corresponding to projected growth and population forecasts provided by the City.

7. **Staff Recommendations:** Provide recommendations for staffing and organizational structure for operation and maintenance of the system. We will provide suggestions for improvements to the City’s general approach to operation of the system.
8. **Regulatory Update:** Identify present and future regulatory concerns for the water supply facilities and distribution system.
9. **Prepare Water Master Plan Update Report:** Prepare the WMP Update. Wallace Group will prepare a Draft, Draft-Final for City Council approval and a Final Report.

Acknowledgements

Wallace Group thanks and gratefully acknowledges the following for their efforts, involvements, input and assistance in preparing this Water Master Plan:

City of Greenfield City Council:

Mayor **Lance Walker**
Mayor Pro-Tempore Yanelly Martinez
Council Member Angela Untalon
Council Member Andrew Tipton
Council Member Robert White

City of Greenfield City Staff:

Paul Wood	City Manager
John Alves	Public Works Director
Arturo Felix	Public Works Utilities Manager
Doug Pike (MNS)	City Engineer
Tony Nisich (MNS)	City Engineer

The following Wallace Group key team members were involved in the preparation of this Water Master Plan:

Steven G. Tanaka, PE	Principal Civil Engineer
Kari Wagner, PE	Principal Engineer
Kyle Anderson, PE	Senior Civil Engineer

2: Water Distribution System Overview

Chapter 2 provides a general overview of the features of the City’s water distribution system. The details regarding the various water system features are then presented in subsequent chapters.

Water Distribution System Background

The City owns and operates a water distribution system that is comprised of one distribution/pressure zone, two potable water storage tanks, and two pump stations. The City owns and operates 36 miles of water mains that span over 2.1 square miles to serve the City’s ~3,800 customers (connections). Table 2-1 provides a breakdown of the number of service connections by land use that the City’s distribution system serves (based on 2016 through 2018 delivery data). The existing water distribution system is shown on Figure 2-1. Figure 2-2 depicts the hydraulic profile of the City’s water system, which shows the elevations of key water system components, including the wells, two storage tanks and two booster stations. The single pressure zone serves the City residents water, at elevation ranges between 210 feet above mean sea level (MSL) to 335 feet MSL. Elevations of future developments are anticipated to be within this same elevation range.

Table 2-1. Service Connections by Land Use

Type	Number of Connections		
	2016	2017	2018
Single-Family Residential	3,095	3,125	3,139
Multi-Family Residential	341	343	336
Commercial/Institutional	134	137	151
Industrial	8	10	10
Landscape Irrigation	72	75	83
SUBTOTAL:	3,650	3,690	3,719
Other ^a	86	89	91
TOTAL:	3,736	3,779	3,810

^aFire suppression, street cleaning, line flushing, construction meters, temporary meters.

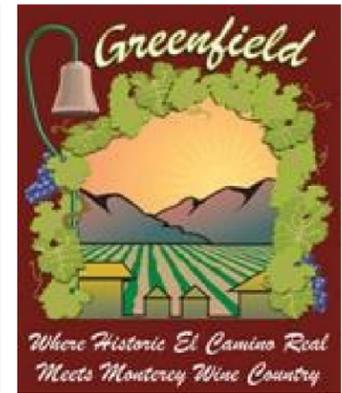
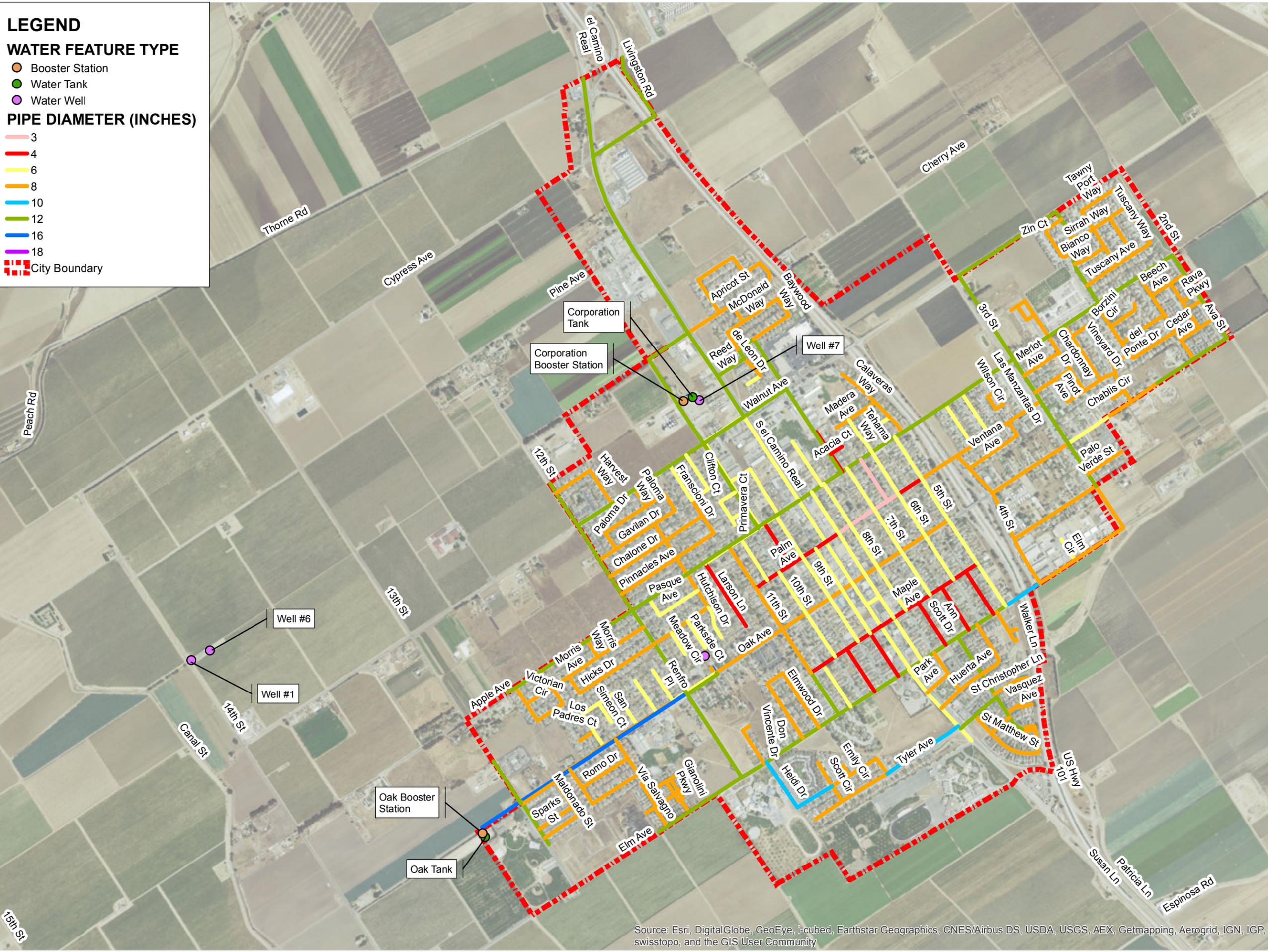
LEGEND

WATER FEATURE TYPE

- Booster Station
- Water Tank
- Water Well

PIPE DIAMETER (INCHES)

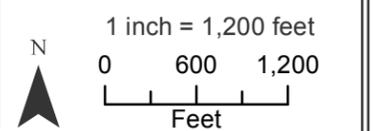
- 3
- 4
- 6
- 8
- 10
- 12
- 16
- 18
- City Boundary



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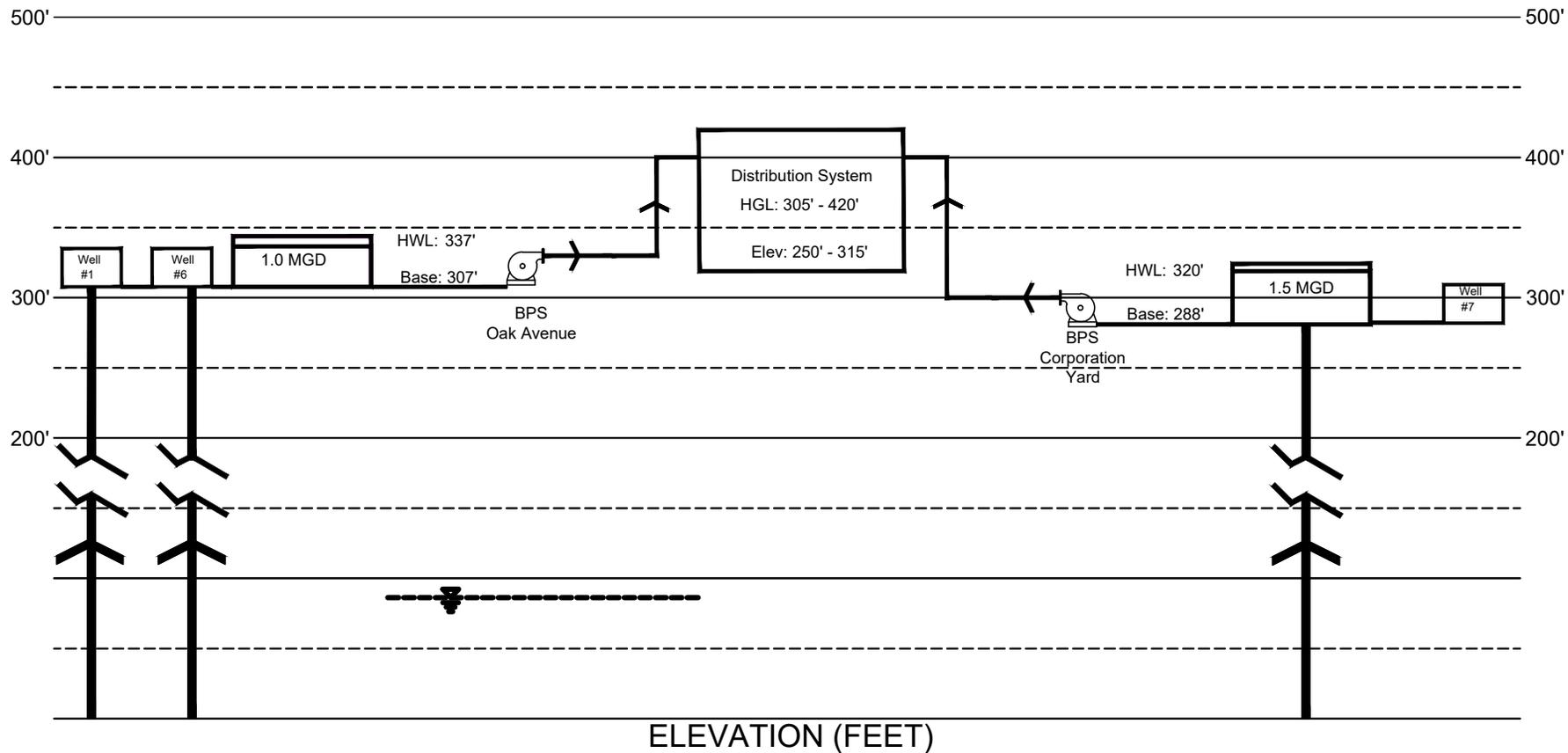
THIS MAP IS INTENDED FOR THE EXPRESSED USE OF THE CITY OF GREENFIELD AND DOES NOT CONSTITUTE A LEGAL DOCUMENT. WALLACE GROUP DID NOT PERFORM SURVEY SERVICES FOR THIS MAP. DATA COMPILED FROM MULTIPLE SOURCES.

**FIGURE 2-1
 EXISTING WATER
 DISTRIBUTION SYSTEM
 OVERVIEW**



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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*Well Depth Varies (~800')



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FIGURE 2-2
CITY OF GREENFIELD
WATER SYSTEM
 HYDRAULIC PROFILE

JOB No. : 1163-008
 DRAWING : 1163-008 HDYR P REL
 DRAWN BY: DJG
 DATE : 12/16/2020
 SCALE : NONE

3: Study Area Characteristics

Chapter 3 describes the study area characteristics germane to this Water System Master Plan Update for the City. Included in this chapter is a description of the various land uses in the service area, future development projections, and existing and future population projections. Future development is based on the 2005 General Plan Land Use Element, recent annexations and identified future growth areas provided by City Staff.

Population

The City relies on the Association of Monterey Bay Area Government (AMBAG) regional growth forecasts for population projections through the master plan planning period. As referenced from the City's 2015 (draft) Urban Water Management Plan, the City is expected to reach a population of 25,000 by Year 2040. Refer to Table 3-1 and Figure 3-1 for tabular and graphic portrayals of the City's population projection. However, recently annexed developments such as the Pinnacles, the Yanks, Las Vinas Subdivision, Miramonte Subdivision and planned areas outside City limits (Consolidation Areas, farm housing units outside of City limits), may not be represented in future population growth projections for the City. In addition, population was added to address farm worker housing within The Vines development; 112 high density residential units were projected with a household density of 8 per unit. For the purposes of this master plan update, population equivalents for developments recently annexed into the City limits (Pinnacles, Las Vinas Residential, Miramar Residential) and the Consolidation Areas, with the exception of The Yanks, have been added to the AMBAG population estimates. The adjusted population growth projections are shown in Figure 3-1, and summarized in Table 3-2. It is noted that there will be no new net permanent population as a result of the Yanks Development; however, water and sewer demands for the Yanks Development will be added to the future water and sewer flow projections, by incorporating these demands in to the per capita water demands and wastewater flows. Furthermore, employment from

Table 3-1. Greenfield Population Projections

Year	Population	
	AMBAG	AMBAG Plus Recent Annexations
2015	17,147	17,147
2020	18,200	19,513
2025	19,400	21,500
2030	20,400	24,075
2035	22,600	27,325
2040	25,000	30,250

Table 3-2. Population Expected for Recently Annexed Areas

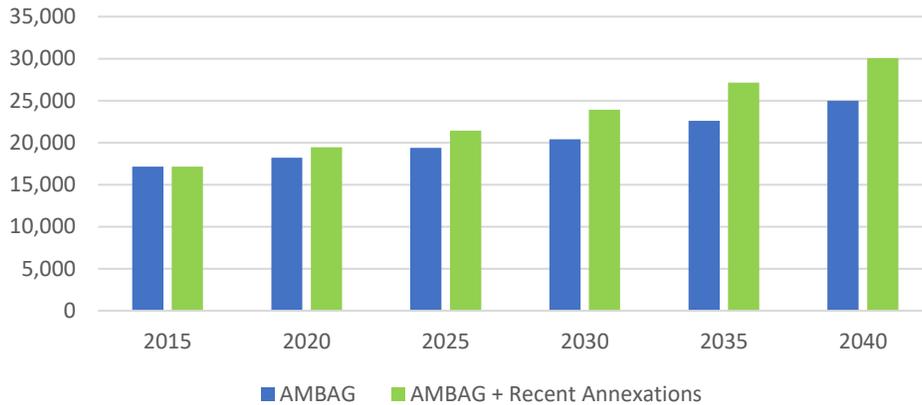
Development	Units	Unit Type	Population ^a
Miramonte	166	SFR	796.8
Pinnacles	286	SFR	1373
	208	MFR	998
Las Vinas	182	SFR	873.6
The Vines/Avila Farm Worker Housing ^b	112	MFR	896
Consolidation Areas	39		312
TOTAL:			5,250

^aHousehold density of 8 used, except for Avila Farm Worker Housing as noted.

^bHousehold density of 8 used.

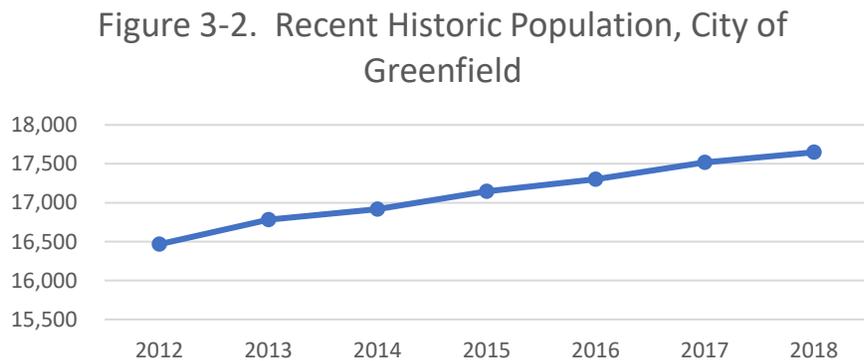
the Yanks Development will support population increases throughout the City, whether from within existing developed residential areas of the City, or within new development areas.

Figure 3-1. Greenfield Population Projections



Although the City's historic growth rate from 1970 to 2000 ranged between 4.5% to 5.5% over this 30 year period, the population growth rate is projected to maintain a lower growth rate of around 1.5% per year. This growth projection is lower than the projection used in the 2016 Water Master Plan, which projected a population of 28,400 by Year 2035. Figure 3-2 shows the recent historic population trend for the City of Greenfield. It is noted that this population projection is representative of growth within the City's current City Limits.

Figure 3-2. Recent Historic Population, City of Greenfield



Land Use

The City of Greenfield is located in the Salinas Valley in Monterey County. Founded in 1905 and incorporated in 1947, Greenfield is centered in a highly productive agricultural region. Figure 3-3 illustrates the City's recently updated boundary, shows the existing Land Use Designations per the 2005 General Plan, recent annexations and planned developments throughout the City. Table 3-3 summarizes the Land Use Designations and Projections (from the 2005 General Plan, plus recent updates), including recent annexations for major developments such as The Yanks, Pinnacles, Mira Monte Residential Development, and others. This table provides a breakdown of acreage designated for each land use.

Future Development

The City's Community Development Department provided a summary of the future development anticipated within the City. Much of this development is moving forward, and a number of parcels have been annexed into the City as indicated previously. A summary of future and pending developments are included in Tables 3-4 and 3-5. There will also be a number of cannabis facilities that will develop within the City in the coming years, as summarized in Table 3-5.

Table 3-3 Land Use Designations and Projections Within City Limits

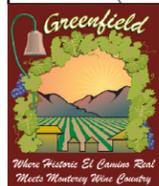
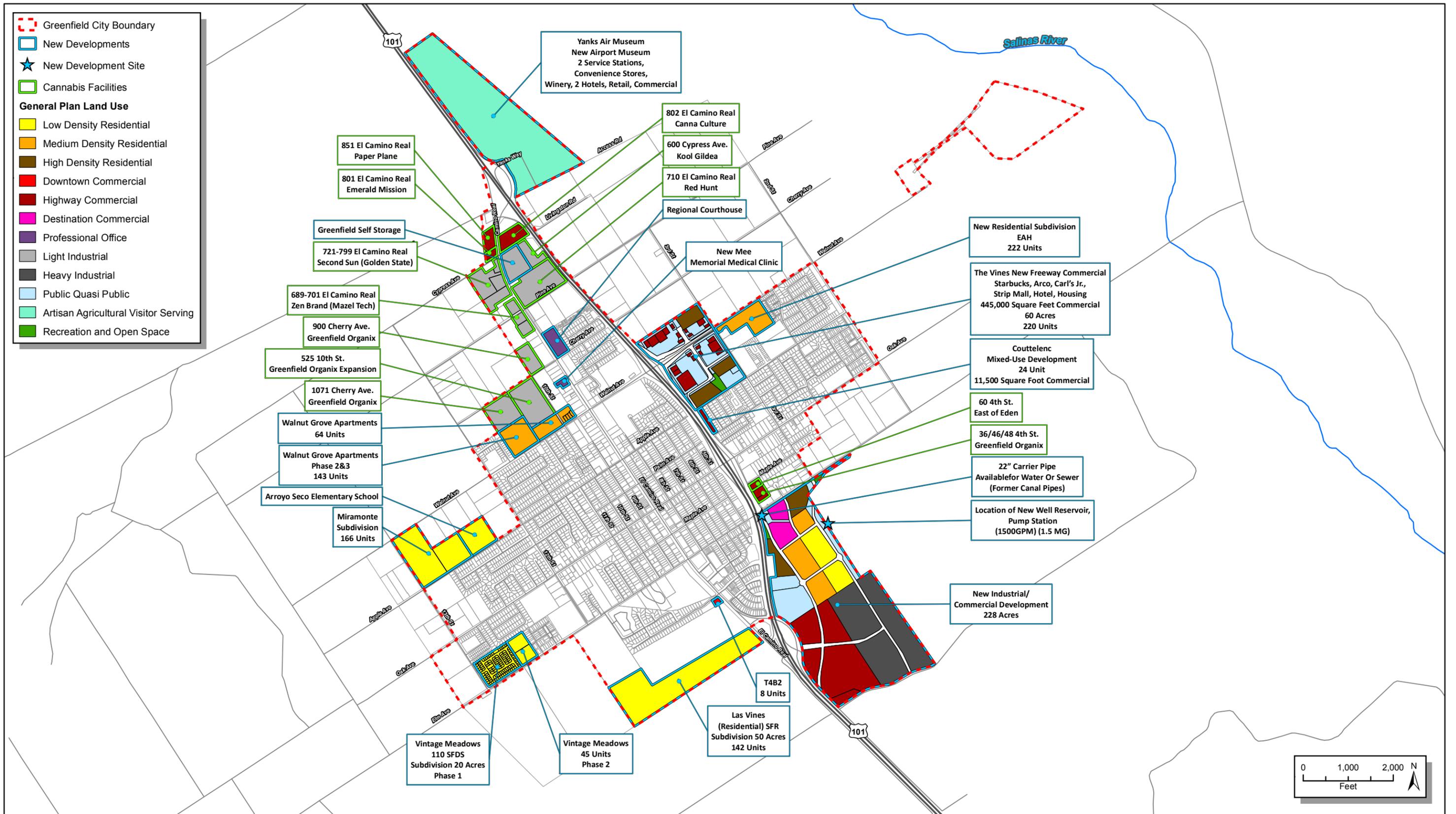
General Plan Land Use	Land Use/Zoning Within City Limits, Acres		
	Total Acreage Within City Limits	Future Development Within City Limits ^a	Future Development Description
Low Density Residential	183	113.7	Miramonte, Vintage Meadows, Las Vinas, Pinnacles
Medium Density Residential	244	19.4	Pinnacles
High Density Residential	47	41.9 ^b	EAH, Walnut Grove Phase 2, Pinnacles
Neighborhood Commercial	6		
Downtown Commercial	41	0.6 ^c	T4B2
Highway Commercial	89	54.2 ^c	Pinnacles, The Vines (portions already completed), Couttelenc
Professional Office	21	5.4	Regional Courthouse, Mee Memorial Medical Clinic
Light Industrial	105	7.6 ^c	Greenfield Self Storage
Heavy Industrial	65	65	Pinnacles
Public Quasi Public	240	17	Arroyo Seco Elementary School, Pinnacles Elementary School
Recreation and Open Space	44	16.6	Pinnacles, The Vines
Artisan/Agricultural Visitor	125	108	Yanks Museum
Destination Commercial	9	8.8	Pinnacles
Cannabis	15 ^d	54	4 Acres zoned Highway Commercial; 5 acres zoned Downtown Commercial; Remainder Zoned Light Industrial
TOTAL	1,234	512	

^aProjected future growth remaining within City Limits (new development, see Table 4). In-fill was assumed to be minor and is not included in this estimate.

^bNote, for Walnut Grove Apartments Phase 2 and EAH, land is zoned medium density, but was listed as high density due to proposed density of units proposed.

^cLand zoned light commercial, Highway Commercial, Gateway/Mixed Use, but planned for cannabis facilities are projected as a separate item later in this table.

^d900 Cherry Avenue, 1071 Cherry Avenue (existing).



**FIGURE 3-3
GREENFIELD NEW AND PROPOSED
DEVELOPMENTS SINCE 2016**

Table 3-4. Summary of Future/Pending Developments, City of Greenfield

Proposed Development	Current Land Use/Zoning	Acreage	No. of Units/Description
Mee Memorial Medical Clinic	Professional Office	1	
Walnut Grove Apts Phase 1	MDR ^a	6.5	207 (12.5 DU/acre) ^a
Walnut Grove Apts Phase 2 and 3	MDR ^a	10	
Regional Courthouse	Professional Office	4.4	100 Employees
Greenfield Self-Storage	Light Industrial	7.6	
Arroyo Seco Elementary School	LFR	9.4	
Miramonte Subdivision Units ^b	LDR	28	150 Units (5.9 DU/acre)
Apple Avenue Consolidation Area	Outside Planning Area & City Limits	--	19 Units (water service only) ^c
Walnut Avenue Consolidation Area	Outside Planning Area & City Limits	--	20 Units (water service only) ^c
Vintage Meadows	LDR	20	155 (5.2 DU/acre)
Las Vinas	LDR	50	182 (2.8 DU/acre)
T4B2	Downtown Commercial	0.6	8 units
Pinnacles ^b	Downtown Commercial/Heavy Industrial	228	Industrial, Residential, Commercial (LDR, 6.5 DU/acre; MDR 9.5 DU/acre; HDR, 20 DU/acre)
Couttelenc Mixed Use	Highway Commercial	1.5	11,500 SF Commercial
The Vines (New Freeway Commercial)	Walnut Avenue Specific Plan Area/Regional Commercial	60	Starbucks, ARCO, Carl's Jr., Strip Mall, Hotel, Housing 220 Units ^d , 220,000 SF Commercial
New Residential Subdivision EAH (Walnut at 3rd, SE Corner)	MFR ^d	11	222 (20 DU/acre) ^e
Yanks Museum ^b	Artisan Agricultural Visitor Serving	135	Airport, museum, 2 service stations, convenience stores, winery, 2 hotels, retail commercial

^aThe Walnut Grove Apartments have a density of 12+ DU/acre, consistent with zoning for HDR development.

^bRecently annexed into the City.

^cAlthough wastewater service is not anticipated at this time, the sewer model will address potential impacts should this area be provided wastewater service in the future.

^dIncludes Avila Farm Housing, 112 units with estimated household density of 8.

^eEAH has a density of 20 DU/acre, consistent with HDR development.

Table 3-5. Cannabis Facilities in Greenfield - Existing and Proposed

Proposed Development	Current Land Use/Zoning	Acreage	No. of Units/Description
Paper Plane - 851 ECR	Highway Commercial	3	Pending
801 ECR - Emerald Mission	Highway Commercial	1	Pending
Canna Culture - 802 ECR	Gateway and Mixed Use	5	Pending
Kool Gildea - 600 Cypress	Light Industrial	4	Pending
Redhunt & Auric Valley - 710 ECR	Light Industrial	15	Approved
Golden State - 799 ECR	Light Industrial	13	Pending
Golden State - 721 ECR	Light Industrial		Approved
Zen Brand - 689, 699, 701 ECR	Light Industrial	5	Pending
Greenfield Organix - 900 Cherry ^a	Light Industrial	5	In operation
Greenfield Organix - 1071 Cherry ^a	Light Industrial	10	In operation/recently completed
Greenfield Organix II - 525 10th Street	Light Industrial	15	Pending
East of Eden - 60 4th Street (Existing Building)	Highway Commercial	1 Acre (In Existing Building)	Pending ^b
Green Organix - 36/46/48 4th Street (Existing Building)_	Highway Commercial	2 Acres (In Existing Building)	Pending ^b

^aExisting Cannabis facilities, in operation.

^bThese facilities are not expected to impact water demands due to their size and nature, with operations limited to existing buildings. However, no information was available to assess such potential impacts.

General Plan Land Use Designations

As part of this master plan update, Wallace Group reviewed the City's general plan, and compared new and proposed developments to current land/use zoning, as a means of determining whether some densification of development may be occurring, and if so, where water demand and sewer flows may need to be adjusted in the model to accommodate such demands. Some key zoning aspects are as follows:

- Low Density Residential (LDR) – up to 7 DU per acre, maximum parcel size 6,000 SF.
- Medium Density Residential (MDR) - 1 to 7 DU per acre, minimum parcel size 2,900 SF. Refer to Table 4, Walnut Grove Apartments, which are high density residential units being developed on lands zoned MDR. Concentration of water demands and wastewater flows for these parcels will be based on the proposed development (High Density Residential apartments) as opposed to MDR single family homes.
- High Density Residential (HDR) - 10 to 21 DU/acre, primarily geared towards multi-family and apartments.
- Light Industrial - uses such as processing, packaging, machining, repair, fabrication, distribution, warehousing and storage, research and development, and other such uses. It is noted that most cannabis facilities will be developed on commercial and industrial zoned lands. Based on review of the 900 Cherry Avenue cannabis water demands, the intensity of water use is higher than what would normally be seen for the given land use. Further discussion of this is expanded upon in the discussion of future demands.
- Heavy Industrial - similar type uses as light industrial, except that such uses may incur undesirable impacts such as noise, dust, odor and vibration. These land designations would be placed well away from residential areas and commercial areas to minimize such impacts.
- Highway Commercial - broad range of commercial and service activities requiring convenient vehicular access and adequate parking. It is noted that Canna Culture, Emerald Mission and Paper Plane (cannabis) facilities will be developed on lands zoned highway commercial.

Considerations for Specific Developments

Consolidation Areas (Farm Housing). There will be 39 units of consolidation farm housing in western Greenfield. These two areas are outside City limits, and the City will provide potable water service to these units, but not sanitary service. Thus, these units are expected to be served by on-site wastewater system(s). The regulatory aspects of serving these units with on-site treatment systems is not part of this master plan study. However, Wallace Group recommends that this master plan model and evaluate the potential for wastewater flows from these housing units, in the event that they will be served by the City municipal wastewater plant in future years. We propose to project water demands and sewer flows based on the following assumptions:

- Household Density is assumed to be same as what was used for Walnut Avenue Apartments, 3-bedroom apartment, at 8 persons per unit.
- The consolidation areas (39 units total) will be anticipated to be fully "built out" by Year 2025.
- Potable Water:
 - The farm housing units will have little to no irrigation demand.
 - Potable water demand is projected at 80 gpcd (see Table 4-6 regarding water use/unit factors) based on current calculated residential per capita water demands throughout the City. This will be slightly conservative in that this per capita demand, that is representative of City domestic demand (metered dwelling units), incorporates outdoor demand.
- Wastewater Demand will be projected at 60 gpcd, similar for City-wide population estimates of wastewater flow.

Pinnacles, Yanks, Las Vinas and Mira Monte Residential Development. These development areas, recently annexed into the City limits, will be addressed as follows:

- Pinnacles, Las Vinas and Mira Monte developments. Calculated population will be added to the published AMBAG population estimates, as it is assumed that the AMBAG population forecasts do not include these recent developments. This population augmentation will then project water demands and wastewater flows.
- Yanks. There will not be permanent population associated with the Yanks development, but the water demands (up to 68,000 gpd) will be projected based on an added buffer to the recommended per capita demand. Likewise, the sewer collection system demand of 62,000 gpd ultimate, will be incorporated into the overall per capita demand for wastewater. It is noted that employment at The Yanks will likely be supported by permanent residents predominantly from the City of Greenfield.

For other developments listed in Tables 3-4 and 3-5, including The Vines Development (Walnut Area Specific Plan Area), water demands and sewer flows will be applied to the corresponding models based on unit factors developed in this preliminary findings memorandum. Additional demands to the models will include water demands and wastewater flows from The Avila farm worker housing, estimated at 112 units with a household density of 8 per unit (population 896). As noted earlier, population estimates for recent annexations were added to the AMBAG population projections used in Table 3-1.

Cannabis. Most cannabis facilities will be developed on lands zoned light industrial. A review of statewide water demand data for light industrial development indicates that demands are typically between 500 and 2,000 gpd/SF with the lower range between 500 and 1,000 gpd/SF being more prevalent. However, actual demands are dependent on the specific nature of the light industrial facility proposed. In the 2016 City of Greenfield Water System Master Plan, a unit demand factor of 1,278 gpd/connection (400 gpd/acre) was applied to parcels zoned light industrial. Based on water meter data provided by the City, the Cherry Avenue cannabis facility water demand for the first year of operation was calculated at 2,700 gpd/acre (approximately 3 AFY/acre) which is similar to the water demand for golf course/turf irrigation). Thus, the proposed cannabis facilities have a much larger water demand than the modeled demand from the 2016 Master Plan. Wallace Group recommends adding the difference in intensity (2,300 gpd/acre) to the projected per capita water demands, and also adjusting the distribution of water demands in the water model to address potential hydraulic impacts from these cannabis facilities. The total combined acreage of light industrial lands expected for cannabis is 69 acres. This results in an increased water demand for light industrial of 69 acres x 2,300 gpd/acre, or approximately 160,000 gallons of water usage per day. This results in a per capita water demand increase of 6 gpcd, which has been accounted for in overall water demand projections.

Wastewater generation overall for the City is assumed to be adequate to project wastewater flows from the cannabis facilities. However, a review of specific internal operations should be conducted by the City to understand to what degree greenhouse drains may be contributing to wastewater flow and the nature and quality of wastewater generated. The 900 and 1071 Cherry Avenue cannabis facilities have reverse osmosis units to reduce total dissolved solids (TDS) in the irrigation water used, and discharge brine waste directly to the sewer. Also, we understand that the facility allows drainage from the

irrigation operations to discharge to the sewer. These operational practices may impact both the quantity and quality of the wastewater to the collection system. For this master plan, general assumptions will be used to estimate the volume of wastewater flow coming from the cannabis facilities.

Walnut Grove Apartments. The Walnut Grove Apartments will be developed on land zoned medium density residential. The proposed density of these apartments is approximately 14 DU/per acre, which is closer to high density residential. It is assumed that the AMBAG population estimate covers the population increase from the complex. However, this denser development for the Phase 2 apartments could result in a population increase of 200 persons or more above what the property is zoned for (MDR). Although the overall population estimate addresses overall water demand and wastewater flows, the densification of this development will be incorporated into both the water and sewer models with respect to how water demand and sewer flows are distributed.

FUTURE GROWTH AREAS

The City has identified areas in the northeast area of the City as future growth areas. There are two distinct areas as shown on Figure 3-4. These areas are not within City limits or the Sphere of Influence, but have potential for annexation into the City in future years. This is a significant area, and may need to be addressed as part of future master plan updates. The areas are described as follows:

- Future Study Area. This area is comprised of 281 acres, and does not have defined zoning/land use designations.
- Other Development Area. This area shown on Figure 3-4 is comprised of 157 acres. This land does have zoning/land use defined in the General Plan (based on GIS data provided by the City); however, this area is not incorporated into the City.

This future potential area is significant, in total this area is 438 acres, and is equivalent to 39% of the current developed lands within the City. If this area is combined with the total Master Plan “build-out” and planned development areas, the combined master plan development area plus this Future Growth Area, has the potential to see the City grow by 60% over the existing City development of current.

This master plan update includes a “broad brush” modeling and impact analysis of this potential future growth area (discussed below), and how it may impact water and sewer infrastructure needs. Using the City’s current water demand and sewer flows, and based on existing land area, general demands were projected for the Future Study Area and Other Zoned Area of the City. The unit demands per acre are presented in Table 3-6, and are based on the existing City demands divided by existing City acreage (1,234 acres) that is developed. These unit demands will be input into the water and sewer models, and general model runs will be conducted to determine how such development demands may impact existing infrastructure.

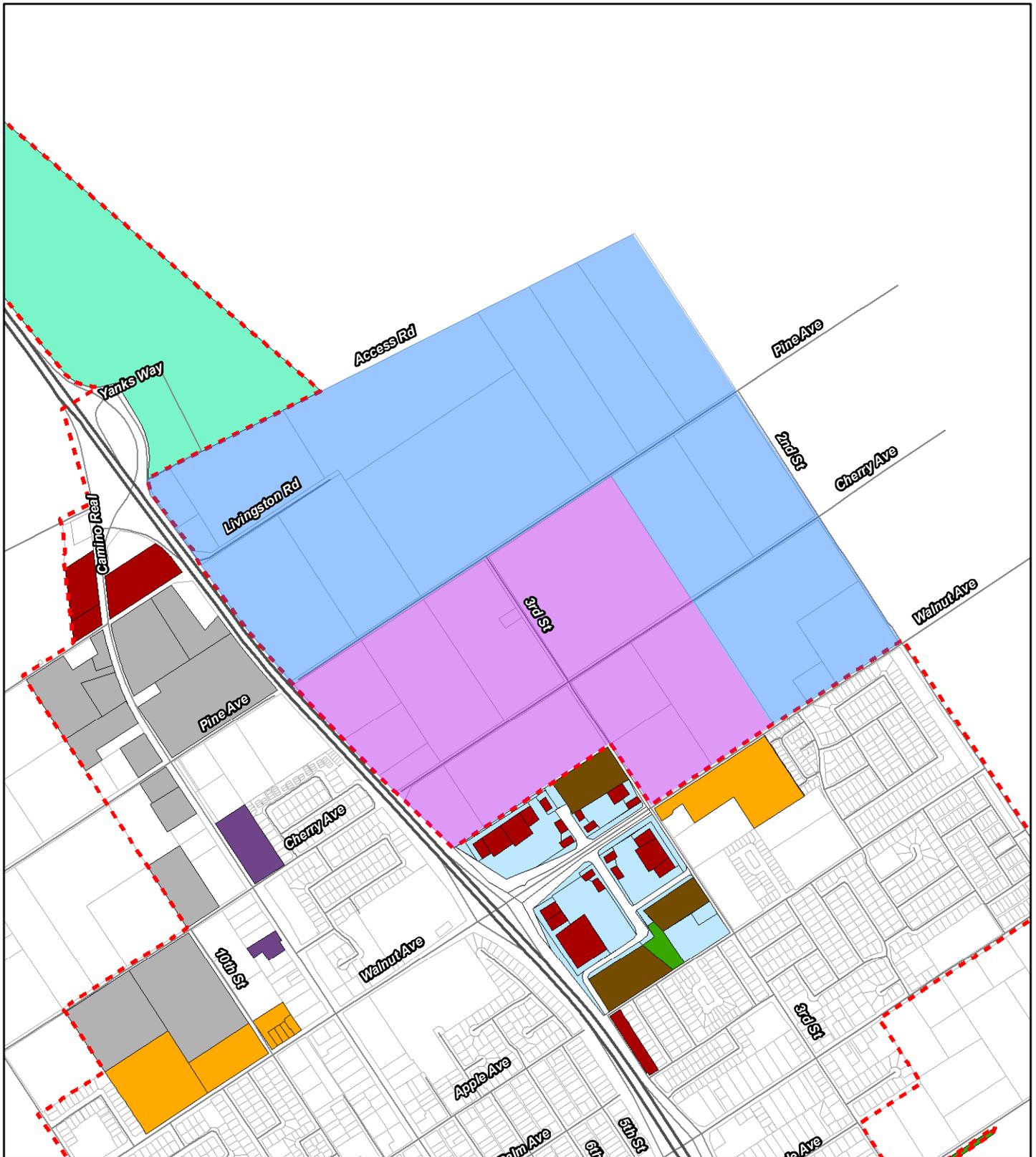


Figure 3-4 Potential Future Development Areas



- Future Study Area (281 Ac)
- Other Development Area (157 Ac)
- Greenfield City Boundary
- Parcels

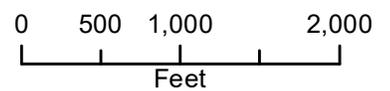


Table 3-6. Unit Demands for Water/Wastewater

Existing City Water and Sewer	Existing Demand/Flow, mgd	Demand, gpd/acre	Development Area Demand (438 acres)
Water Demand	1.55	1,256	0.55 mgd
Sewer Flow	1.0	810	0.36 mgd

Future Growth Area Considerations

Water demands from Table 3-6 were added to the future water demand model run, with water demand being added to existing water main infrastructure at 3rd and Walnut Street. The model demands were run without any new freeway undercrossings of new water mains. These “broad brush” findings are presented in this Chapter 3.

If this future growth area (shown in Figure 3-4) is annexed into the City and developed in the future, the following considerations are listed as follows:

- The existing water main infrastructure can support this future development, without the need for a new water main undercrossing in the north area of the City.
- The fire safety component of water storage is already addressed with other storage recommendations in this master plan; however, emergency and operational storage will need to be increased depending on what fraction of this development supports residential development. It is estimated that additional water storage needs may vary from 0.5 million to 1.0 million gallons depending on future land use.
- If there is a suitable location for a new water well in this area, and if the hydrogeology supports a new water supply well in this area, the City should consider adding one more water well in this area, with a pumping capacity of 500 to 1,000 gpm. This recommendation will depend on the final capacity of the new recommended Well #8 to be located near existing Wells #1 and #6, on 14th Street between Cherry and Walnut Avenues. This additional well will still allow maximum day demand for the entire City to be met, with the largest well out of service.

4: Water Demand

Chapter 4 describes the existing and projected water demands for the City. The water demand forecasts will form the basis for identifying existing and future system needs and analyzing deficiencies.

General water demand and production definitions used in this report are defined as follows:

Water Consumption – The amount of water consumed (as measured directly through customer meters).

Water Production – The amount of water produced by the City’s water supply sources.

Unaccounted-for-Water (UAW) – the difference between the quantity of water produced and the amount of water consumed (as measured directly through customer meters).

Historical Water Demand

Demand data was provided by the City for the Years 2016, 2017, and 2018. The prior data from 2009 through 2015 (as presented in the 2016 water master plan) is also presented for comparison purposes. The historical demands are summarized in Table 4-1, and the recent water demand data is shown in Table 4-2.

Table 4-1. Summary of Historical Water Demands

Year	Total Production (ac-ft)	Total Metered Consumption (ac-ft)	UAW (ac-ft)	UAW (%)
2009	2,020	1,965	55.3	2.7
2010	1,938	1,897	41.2	2.1
2011	1,866	1,850	16.1	0.9
2012	1,905	1,935	-30.2	-1.6
2013	1,967	1,893	74.0	3.8
2014	1,795	1,734	60.5	3.4
2015	1,536	1,461	75.2	4.9
Average	1,939	1,908	31.3	1.6

Unaccounted for Water

The City’s UAW historically has ranged between -1.6 to 3.8 percent, with an average of 1.6 percent, as noted in Table 4-1. The AWWA Manual 32 states that municipal ranges for UAW are typically between 10 and 15 percent. The City of Greenfield’s UAW average during these prior years was well below the range, thus they have been keeping system losses to a minimum.

UAW should be minimized where possible since it requires the City’s resources to produce water, but is not being accounted for and thus revenue is not being collected. UAW is typically generated from

several sources including leaking pipes, water used for fires, water main flushing, and faulty or un-calibrated meters.

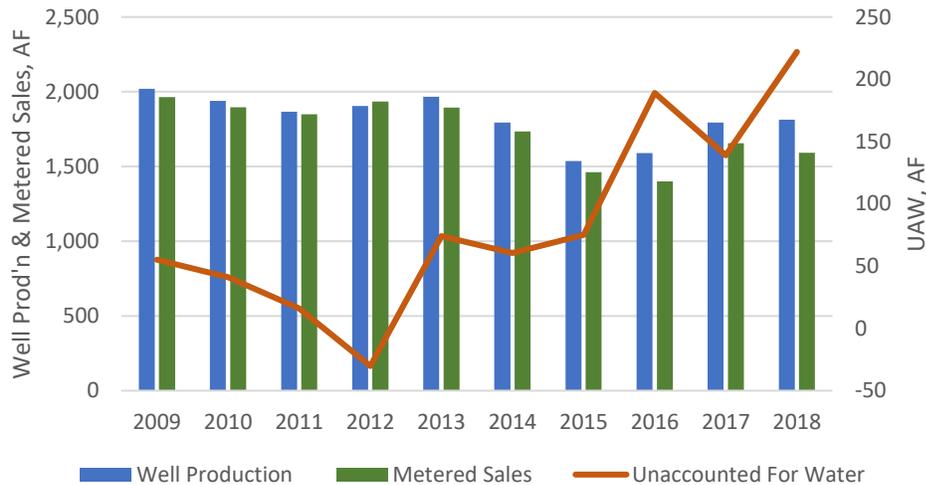
For the years 2016 through 2018, there has been a significant increase in UAW. This information is presented graphically on Figure 4-1. Although this percentage is within expected ranges for municipalities, the City should review their water operations and determine what has changed since 2015 and earlier. One possible source of the UAW may be related to construction water usage in recent years, especially because

Table 4-2. Summary of Water Production, Sales and UAW, 2016 to 2018

Year	Total Production (ac-ft)	Total Metered Consumption (ac-ft)	UAW (ac-ft)	UAW (%)
2016	1,589	1,400	189	11.9%
2017	1,795	1,656	139	7.7%
2018	1,814	1,592	222	12.2%
Average	1,733	1,549	183	10.6%

discrepancies between water produced and water sold appear to occur throughout the year, not just during summer/irrigation season. A uniform or consistent difference between water sales and production would be indicative of meter reading error; however, the UAW appears to vary from month to month.

Figure 4-1. Summary of Water Production, Sales and UAW



Water Demand Categories

The production noted in Tables 4-1 and 4-2 includes all customers within the City. The City has substantial commercial/industrial and residential growth anticipated for the future, as presented in Chapter 3. In order to gain a better understanding of the water demands for future growth, the total production has been broken down into the following categories, for use in distribution water demands in the hydraulic model:

1. Residential: Includes single family residential, multi-family residential, apartments, duplexes and mobile home parks
2. Commercial: Includes commercial, restaurants, Government facilities, schools, churches, hotels/motels
3. Industrial
4. Landscape Irrigation: Includes all parks and open-space
5. Other: Includes government, fire protection and any additional users not categorized above.

Table 4-3 provides a summary of the average daily demands broken into the categories listed above from meter records for calendar year 2017 – 2018, with 12% factor for UAW, and the estimated quantity or unit for each category. Table 4-3 also provides a use factor for the categories provided, which can further be used to estimate water demands for future growth.

Table 4-3. Existing Water Demand Factors

Use Category	Consumption (gpd)	Quantity or Units	Demand Factor
Residential	1,223,082	17,583 Persons	67 gpcd
Commercial	108,134	144 Connections	750 gpd/connection
Industrial	12,572	9 Connections	1,257 gpd/connection
Landscape Irrigation	127,153	28 Acres	3,474 gpd/acre
Other	18,684	1,252 Acres	2,172 gpd/acre

^aQuantities, excluding residential population, obtained from the City’s General Plan GIS data. Residential population based on average population between 2016-2018.

^bIncludes allowance for 12% unaccounted for water.

^cActual daily water consumption is not known at this time, since limited data is available.

Hydraulic Demand Parameters

Water system demands are important characteristics of water systems, as these parameters are used to size pumping, storage, and distribution system facilities. Each community’s water system exhibits unique characteristics that must be calculated and identified in order to better evaluate existing and future water distribution system requirements. The City has a total of 3,810 customer accounts as of Year 2018. A summary of water service accounts is provided in Table 4-4.

Average Day Demand (ADD)

The ADD is the average water production needed to meet the daily demand, which is calculated over the year. This demand is generally determined by production records. Table 4-2 provides a summary of the ADD for 2016 through 2018, which equates to 1,733 AFY (1.55 mgd).

Maximum Day Demand (MDD)

The MDD is the maximum daily production of water needed to meet the peak day demand of the year. Typically, MDD occurs during the summer as a result of increased irrigation demand and is determined by reviewing daily production records. A review of the City’s daily production data showed occasional anomalies that make it difficult to determine the maximum day. Per the California Code of Regulations (CCR), Title 22, Division 4, Chapter 16, Article 2, Section B.2.A - B.2.C, if daily production data is not available for the most recent ten years, MDD can be calculated by identifying the month with the highest production during the most recent ten year period and multiplying the average daily usage for that month by a factor of 1.5. Even though there are not 10 years of historical daily production records available, review of the 2016 through 2018 daily production data shows a maximum day to average day production peaking factor of 1.7 to 1.8. Wallace Group recommends using a maximum day peaking factor of 2.0, which results in a maximum day (at existing average day demand) of 3.1 mgd.

Table 4-4. Summary of City Metered Water Accounts

Type	No. of Connections		
	2016	2017	2018
Single-Family Residential	3,095	3,125	3,139
Multi-Family Residential	341	343	336
Commercial/Institutional	134	137	151
Industrial	8	10	10
Landscape Irrigation	72	75	83
SUBTOTAL:	3,650	3,690	3,719
Other ^a	86	89	91
TOTAL:	3,736	3,779	3,810

^aFire suppression, street cleaning, line flushing, construction meters, temporary meters.

Peak Hour Demand (PHD)

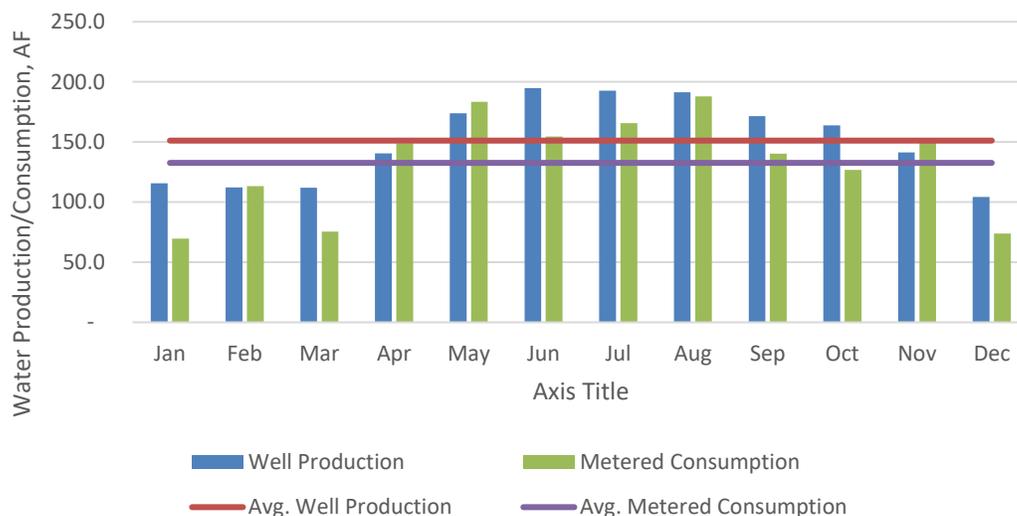
The PHD of the system is critical in sizing water mains and pumping facilities. During PHD, customers will generally experience low service pressures in areas with undersized mains and/or lack of looped distribution water mains. The PHD is generally determined by calculating the specific demand within the day, by monitoring tank levels and pumping records. In many municipal systems, the exact calculation of this parameter is difficult to ascertain.

The City does not maintain hourly production records, which would be used to determine PHD. Per the California Code of Regulations (CCR), Title 22, Division 4, Chapter 16, Article 2, Section B.2.A - B.2.C, if hourly production data is not available for the most recent ten years, PHD can be calculated by multiplying the average hourly flow during MDD (2,153 gpm) by 1.5. Using the CCR methodology, the PHD for the City was 3,229 gpm. This equates to a peak hour factor of 3.0, which could be fairly low given the size of the City. However, the peak hour factor generally reduces as the size of the municipality grows in size. Thus, the true peak hour factor is likely in the range of 3.0 to 4.0. Wallace Group recommends a conservative peak hour factor of 4.0 for this master plan update. This peaking factor will be used moving forward through 2040 Build-out, and most likely will reduce somewhat as population grows, thus this will be a conservative parameter to use in the water model.

Maximum Month Demand (MMD)

The MMD factor will not be critical for the water model update, but it is important for the City to understand on the water production side of the equation. Seasonal demand variations can be significant, especially during the summer months when peak irrigation occurs. In evaluating the Year 2017 and 2018 production/consumption data, the peak month demand factor ranged from 1.3 to 1.4. However, it is noted that cannabis facilities may have significant peak month demands, as shown by 900 Cherry Avenue cannabis facility, which has a peak month factor of 3.0. However, this peak month coincided with facility startup (March 2018) and may not be truly representative of peak month demands on an on-going basis. Moving forward, the City will need to continue to collect water demand information from major commercial facilities such as cannabis. Figure 4-2 provides a summary of water production and metered use throughout the 2018 Year.

Figure 4-2. Year 2018 Water Production & Metered Consumption by Month



FUTURE WATER DEMANDS

Future water demands are generally projected by determining present-day demand, and projecting to the future based on population projections. In some cases, unit demand factors are used to project water demands for specific development areas. Refer to the prior discussion on recent developments, and how such demands will be modeled. To project water demands into the future, the existing per capita water demands are developed as a basis for projecting future ADD, MDD and

Table 4-5. City-Wide Per Capita Water Consumption

Year	Population	Total City-Wide Metered Water Demand		Per Capita Water Consumption, gpcd,
		AF	gpd	
2012	16,466	1,935	1,727,570	104.9
2013	16,784	1,893	1,690,072	100.7
2014	16,919	1,734	1,548,117	91.5
2015	17,147	1,461	1,304,382	76.1
2016	17,300	1,400	1,249,921	72.2
2017	17,517	1,656	1,478,478	84.4
2018	17,648	1,592	1,421,339	80.5
AVG		1,667	1,488,554	87.2

PHD in the water model. Table 4-5 summarizes the per capita water demand based on City-wide meter data. The resulting per capita water demand averages 87.2 gpcd for the Years 2012 through 2018, with the lowest per capita demand being 72 gpcd during the height of the drought. For planning purposes, the City-wide per capita water demand recommended for the master plan is **95 gpcd**. This per capita water demand projection is sufficient to cover the major additions including the Yanks (68,000 gpd) and higher intensity demands of the cannabis facilities (estimated at a delta/difference of 160,000 gpd). Combined, using a future population of 30,135, the impact of these demands increases the overall per capita water demand by 8 gpcd. This value represents the water used by a single person, incorporating ALL uses throughout the City, including residential, commercial, industrial, recreational/parks/irrigation, and other uses. However, it must also be emphasized that this value is based on actual metered water consumption. To equate this to overall water production required to meet this demand, this should be increased by a factor of 12% to factor in unaccounted for water. Thus, the final recommended per capita water demand required for production of potable water, is **106 gpcd**.

Table 4-6 shows the same metered water data, but specifically for metered residential use. The resulting per capita residential component water demand averages 76.3 gpcd for the Years 2012 through 2018, with the lowest per capita demand being 63 gpcd during the height of the drought. For planning purposes, the City-wide per capita water demand (residential only) recommended for the master plan is **80 gpcd**. This value represents the residential component of water used by a single person. However, it must also be emphasized that this value is based on actual metered water consumption. To equate this to overall water production required to meet this demand, this should be increased by a factor of 12% to account for unaccounted for water. Thus, the final recommended per capita residential water demand required for production of potable water, is **90 gpcd**.

Table 4-6. City-Wide Domestic Per Capita Water Consumption

Year	Population	Total Domestic Metered Water Demand		Per Capita Water Consumption, gpcd, average
		AF	gpd	
2012	16,466	1,719	1,534,279	93.2
2013	16,784	1,629	1,454,669	86.7
2014	16,919	1,520	1,357,325	80.2
2015	17,147	NA	NA	NA
2016	17,300	1,222	1,090,940	63.1
2017	17,517	1,370	1,223,082	69.8
2018	17,648	1,281	1,143,470	64.8
AVG		1,457	1,300,628	76.3

Existing and Future Water Demands

Based on the above water analysis, the future water demands are projected and summarized in Table 4-7. The future average day demand was computed based on a build-out population of 30,250 residents, with a corresponding production demand of 106

Table 4-7. Summary of Existing and Future Water Demands

EXISTING DEMAND	ADD	MDD	PHD
gpm	1,076	2,153	4,306
gpd	1,550,000	3,100,000	6,200,000
mgd	1.55	3.10	6.20
Peaking Factor	---	2.00	4.00
FUTURE DEMAND	ADD	MDD	PHD
gpm	2,227	4,453	8,907
gpd	3,206,500	6,413,000	12,826,000
mgd	3.21	6.41	12.83

gpcd. This overall per capita production water demand accounts for the estimated 68,000 gpd from the Yanks development, plus projected water demands for cannabis facilities (160,000 gpd beyond that expected for light industrial water demand). For future demands, the same peaking factors developed for existing demands, was applied to future demand projections.

5: Water Supply and Water Quality

Chapter 5 provides an overview of the City’s water supply and water quality requirements. In addition, it provides an evaluation of the City’s existing wells with regards to: reliability and redundancy, well pumping rates and standby power needs.

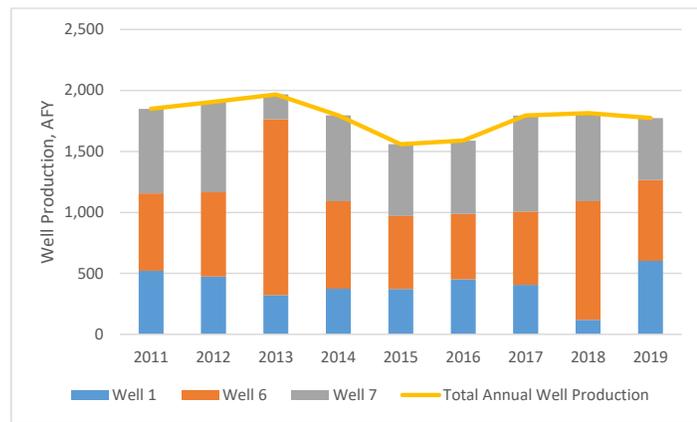
Introduction

The City currently obtains its water supply exclusively from groundwater. Currently, three wells (well # 1, well # 6 and Well # 7) operate to extract water from the underlying groundwater basin and pump it to two at-grade water storage tanks. A summary of each well is provided below. Table 5-1 provides a summary of Wells 1, 6 and 7. Table 5-2 provides a summary of production by well. Figure 5-1 provides this same summary in graphic form.

Wells 1 and 6

Wells 1 and 6 are located at the intersection of Cherry Avenue and 14th street. Both wells are the only supply source for the Oak tank and booster station. Water is injected with sodium hypochlorite (12.5%) to provide residual disinfection at the well site prior to entering the distribution system. Wells 1 and 6 can either be used to fill the Oak tank or to back feed through the water distribution system to fill the Corporation tank. Wells 1 and 6 currently are producing approximately 2,500 gpm combined flow. At the time of field review of existing water facilities, on December 3, 2020, Well #6 was out of service due to failed pump bowls.

Figure 5-1. Annual Well Production



Well 7

Well 7 is located in the City’s corporation yard, on 10th Street between Cherry Avenue and Walnut Avenue and was installed in 2009. Well 7 is the primary supply source for the City’s corporation yard tank and booster station. Water is injected with sodium hypochlorite (12.5%) to provide residual disinfection at the well site prior to entering the Corporation Tank. Well # 7 is currently producing approximately 1,800 gpm.

Table 5-1. Supply Well Summary

Parameter	Well # 1	Well # 6	Well # 7
Year Installed	1978	1997	2009
Well Depth, feet	883	880	870
Screened Interval, feet	313-863	320-670 720-870	540-860
Pump/Well Capacity, gpm	1000	1500 ^a	1800
Standby Power	Yes	Yes	Yes

^aDesign flow capacity 2,000 gpm based on well driller's report.

Table 5-2 Production Data By Well

Year	Well 1		Well 6		Well 7		Total
	ac-ft	% of Total Production	ac-ft	% of Total	ac-ft	% of Total	ac-ft
2011	521	28%	635	34%	693	37%	1,849
2012	474	25%	691	36%	740	39%	1,905
2013	322	16%	1,442	73%	203	10%	1,967
2014	374	21%	718	40%	703	39%	1,795
2015	372	24%	598	38%	589	38%	1,559
2016	451	28%	537	34%	600	38%	1,589
2017	407	23%	600	33%	788	44%	1,795
2018	120	7%	971	54%	723	40%	1,814
2019	602	34%	664	37%	507	29%	1,773
Average	405	23%	762	43%	616	35%	1,783

Supply Redundancy

In the event of a system failure, per California Water Works Standards, it is recommended that the City of Greenfield maintain adequate production facilities to accommodate the future maximum day demand (MDD) with the largest production well out of service. Table 5-3 analyzes the City of Greenfield's ability to meet this criterion. Presently, the City can meet maximum day demand with the largest well out of service, but only by a small margin. In the future, without an additional well, the City will not be able to meet this criterion.

In November/December 2020, the City experienced Well #6 out of service as mentioned above. Even though this event was not during maximum day demand conditions, the City still expressed some

concerns of water supply availability with only Wells 1 and 7 in operation. This emphasizes the importance of needing additional water supply redundancy in the City’s water system.

Table 5-3. Supply Redundancy Evaluation

	Total Well Supply	Largest Well Out of Service	Total Available Supply w/ Largest Well Out of Service	Max Day Demand	Supply Surplus/(Deficit)
	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)
Existing	4,300	1,800	2,500	2,153	347
Future	4,300	1,800	2,500	4,453	(1,953)

Power Redundancy

Power availability is a critical consideration when assessing municipal water supply. The City of Greenfield currently relies on electricity as a primary power source to all three wells. All three of the City’s wells are equipped with permanent emergency generators. Therefore, in the event of a regional power outage, uninterrupted delivery of service to City of Greenfield users and emergency fire response is maintained. Combined well production from the three wells is 4,300 gpm. Comparison against existing and future Average Day Demand (Table 4-7), reveals a narrow surplus of 347 gpm under existing MDD, and a deficit of 1,953 gpm under future MDD conditions. In addition, storage tanks with a combined capacity of 2.5 MG (7.7 AF) will assist in offsetting MDD and PHD.

Supply Recommendations

Review of the City of Greenfield’s water production capabilities resulting from their existing wells indicates that the City of Greenfield water supply is marginal with respect to existing maximum day conditions (largest well out of service), and has a supply deficit under future maximum day demand conditions. At least one additional well is needed to meet the minimum criteria set forth by the California Water Works Standards. As part of the Pinnacles Development in South Greenfield, the Developer will be required to construct a 1,500 gpm well, corresponding booster station and 1.5 MG water storage tank. Based on information provided by the City, the east side of the City is not the best place to construction a new water well from a water production/water quality perspective. Thus, the City has recommended that the new well be placed near existing Wells 1 and 6 on the west side of the City (14th Street between Cherry and Walnut Avenues). These three supply wells would be used to directly fill the Oak Tank, or feed directly into the water distribution system.

Water Quality

This section describes the water quality parameters associated with the City’s water supplies. The City receives water from one water source (Salinas Valley Groundwater Basin), extracted from three water wells (Wells 1, 6 and 7). After chlorination, water from Wells 1 and 6 either fill the Oak tank directly, or

water is back fed through the distribution system to fill the Corporation tank. Water from Well 7 is fed directly into the Corporation Yard tank.

The City has indicated that occasional positive bacteria results have been seen at Well #6, and Well #1. The cause of the bacteria readings is not known at this time. The City should continue to track samples and results to identify any trends. The City should also review their sampling protocol for the wells, and verify that all visible piping is not leaking. If the City has not had videos of the existing well casings, this should be scheduled to verify if there might be any issues with the well casing, particular in the upper reaches where the sanitary seal exists.

Drinking Water Standards

Drinking water standards are established by the United States Environmental Protection Agency (EPA) and by the California Division of Drinking Water (formerly California Department of Health Services). These federal and state agencies are responsible for ensuring that all public water systems are in compliance with the Safe Drinking Water Act (SDWA). The State of California may adopt drinking water standards equal to, or more stringent than federal standards.

State and Federal water standards fall into two categories:

- Primary Standards relate specifically to the health of the community as it might be affected by the water supply. Mandatory maximum contaminant levels (MCLs) are established for specific constituents.
- State Secondary Standards relate to aesthetic qualities of the water including taste, odor, color and some minerals. In California, maximum contaminant levels (MCLs) are also established for these secondary constituents.

Tables 5-4 and 5-5 list the current MCLs which the City must meet, along with other water quality parameters (secondary aesthetic standards). The results are based on the 2018 Consumer Confidence Report (CCR). The results indicate the City's water supplies meet all primary and secondary standards. However, it is noted that a number of secondary water quality data was not available in the 2018 CCR. Table 5-6 shows a summary of the City's lead and copper sampling in the water distribution system, which also shows compliance with the Lead and Copper Rule.

Table 5-4. Primary Drinking Water Standards and Water Quality

CONTAMINANT^a	M.C.L.^a	MCLG PHG	2018 Consumer Confidence Report
Aluminum ^b	1000	N/A	ND ^b
Antimony ^b	6	6	ND ^b
Arsenic	10	0.004	0.7
Barium	1000	2000	50
Beryllium	4	4	ND
Cadmium ^b	5	5	ND ^b
Chromium	50	100	3.3
Cyanide	150		ND
Hexavalent Chromium	10	0.02	1.8
Fluoride	2000	1000	130
Gross Alpha Particle Activity, pCi/L	15	15	1.55
Combined Radium, pCi/L	5	5	0.06
Uranium, pCi/L	20	20	5.4
Mercury ^b	2	2	ND ^b
Nickel ^b	100	100	ND ^b
Nitrate (as NO ₃), mg/L	45	45	1.68
Nitrite (as N), mg/L	1	1	0.29
Selenium	50	50	1.0
Thallium ^b	2	0.5	ND ^b
Total Trihalomethanes	80	---	2.47
Haloacetic Acids	60	---	0.56
Total Coliform Bacteria	0	0	0
Fecal Coliform Bacteria	0	0	0

^aUnits expressed in micrograms per liter, except where noted.

^bFrom 2014 Consumer Confidence Report. Current Data not available.

Notes:

ug/L=micrograms per liter (ppb)

Mg/L=milligrams per liter (ppm)

MCL=maximum contaminant level

ND=non-detect

pCi/L=picocuries per liter

PHG=public health goal

Table 5-5. Secondary Drinking Water Standards and Water Quality

CONTAMINANT, (units)	M.C.L. ^a		2018 Consumer Confidence Report
	Recommended	Upper	
Aluminum, mg/L	<0.2	0.2	Not Available
Chloride, mg/L	250	500	53
Color, color units	15	15	ND
Copper, mg/L	<1	1	Not Available
Corrosivity (LI)	Non-Corrosive		Not Available
Foaming agents (MBAS), mg/L	0.5		ND
Iron	300	300	14.7
Manganese	50	50	Not Available
MTBE, mg/L	0.005		Not Available
Odor – Threshold	3	3	Not Available
Silver, mg/L	0.1		Not Available
Sulfate, mg/L	250	500	153
Total Dissolved Solids, mg/L	500	1000	542
Turbidity (NTU)	5	5	0.15
Zinc, mg/L	5	5	Not Available

^aUnits expressed in micrograms per liter, except where noted.

Notes:

ug/L=micrograms per liter (ppb)

Mg/L=milligrams per liter (ppm)

MCL=maximum contaminant level

NTU=nephelometric turbidity units

ND=non-detect

pCi/L=picocuries per liter

PHG=public health goal

LI=Langelier's Index

Table 5-6. Summary of Lead and Copper Water System Sampling Results

Constituent	No. Samples Collected	90th Percentile Level	No. of Sites Exceeding Action Level	Action Level	PHG
Lead, ug/L	48	ND	0	15	0.2
Copper, mg/L	48	0.13	0	1.3	0.2

6: Water Storage

Chapter 6 describes the existing and projected water storage requirements for the City. Adequate water storage is critical to deliver water reliably to customers, and to provide fire storage for life safety.

Existing Water Storage Facilities

The City owns and operates two potable water storage tanks. The locations of these facilities are identified on Figure 2-1. Table 6-1 summarizes each of the water storage facilities.

Table 6-1. Summary of the Existing Water Storage Facilities

Water Storage Facility	~Year Installed	Material	Diameter	Base Elevation	Approximate Overflow Elevation	Top of Outlet Pipe Elevation	Total Volume	Useable Volume
			(ft)	(ft)	(ft)	(ft)	(MG) ¹	(MG) ²
Oak	1987	Steel	75	307	337.25	308.5	1	0.95
Corporation	2009	Steel	90	288	320	289.5	1.5	1.45
Total Useable Volume								2.40

¹Total Volume is based on the volume of water between the overflow elevation and the base elevation of the tank or reservoir.

²Useable Volume is based on the volume of water between the overflow elevation and the top of outlet pipe elevation of the tank or reservoir.

Existing and Future Storage Analysis

It is recommended that sufficient useable storage volume be maintained for emergency, fire, and operational needs within the City’s water storage tanks. For the purposes of this report, the groundwater wells will not be considered in the storage analysis.

Un-useable Storage

Un-useable storage is the volume of water that is below the top of the outlet pipe to the bottom of the tank. This water cannot be used without the use of a sump pump and therefore is not included in the overall volume of the tank. The fraction of un-usable water storage is relatively small, at 4% of the total storage volume.

Emergency Storage

Emergency storage is intended to provide for conditions such as extended power outages, pump failures, and similar problems. Most water planners accept that during emergencies, supply per capita may be reduced to minimum levels. Typically, on that basis, an emergency storage volume of 50

Table 6-2. Emergency Storage Recommendations

	Population	gpcd	Storage, gallons
Existing	17,648	50	2,647,200
Future	30,050	50	4,507,500

gpcd for three days is accepted as a reasonable value. Table 6-2 provides a summary of the emergency storage recommendations for the existing and future population for the City.

Fire Storage

Fire storage is the volume of water needed to control an anticipated fire in a building or group of buildings. The determination of this storage is based upon the most stringent zoning within the City, and the required fire flow and duration per the City Fire Department and the Uniform Fire Code (UFC). The flow rate and duration of the required fire flow varies greatly with the type of development and whether or not the buildings have sprinkler systems. The required fire flow for the City based on the most stringent land use is provided in Table 6-3. It is Wallace Group’s understanding that all future cannabis facilities will be sprinklered. A summary of the fire flow requirements by zoning is provided in Chapter 8, Table 8-3.

Table 6-3. Fire Storage Recommendations

	Fire Flow, gpm	Duration, hours	Storage, gallons
Existing	4,000	4	960,000
Future	4,000	4	960,000

Operational Storage

Operational storage is the amount of water needed to equalize the daily supply and demand. Without this storage, water production facilities would be required to be sized large enough to meet the instantaneous peak demands of the system. With adequate operational storage, booster stations can operate at the daily average rate, while storage facilities meet the hourly peaks. AWWA M-32 recommends operational storage of 20 to 25 percent of average day demand, or up to 15 percent of the maximum day demand. Based on the more stringent criteria for the City being 15 percent of max day demand, the recommended operational storage for existing conditions is summarized for each zone in Table 6-4.

Table 6-4. Operational Storage Recommendations

	MDD, gpd	Storage Criteria	Storage, gallons
Existing	3,100,000	15% of MDD	465,000
Future	6,370,600	15% of MDD	955,590

Storage Summary

The useable storage recommended for each distribution zone as noted previously is based on a summation of the emergency, fire, and operational storage recommendations as shown in the adjacent figure.

Table 6-5 provides a summary of the storage recommendations for existing conditions. As noted in Table 6-5, the City has deficient storage under both existing and future conditions.

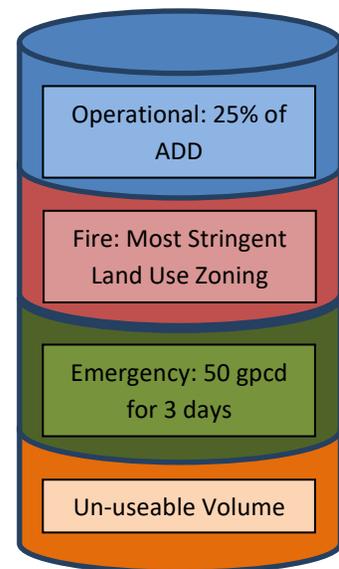


Table 6-5. Required Storage Summary

Storage Summary, gallons						
	Emergency	Fire	Operational	Total Recommended	Total Available	Surplus/(Deficit)
Existing	2,647,200	960,000	465,000	4,072,000	2,400,000	(1,672,000)
Future ^a	4,507,500	960,000	955,590	6,423,000	2,400,000	(4,023,000)
Future ^b	4,507,500	960,000	955,590	6,423,000	3,900,000	(2,523,000)
Future ^c	4,507,500	960,000	955,590	6,423,000	5,400,000	(1,023,000)
Future ^d	4,507,500	960,000	955,590	6,423,000	6,400,000	(23,000)

^aWithout "Pinnacles" Storage Tank (1.5 MG)

^bWith "Pinnacles" Storage Tank (1.5 MG)

^cWith Corp Yard Storage Tank (1.5 MG "sister" tank)

^dWith North City Storage Tank (1.0 MG)

Storage Recommendations

Review of the City of Greenfield’s existing water storage facilities indicates that the City of Greenfield has a storage deficit under both existing and future conditions. Additional tanks are needed to meet the minimum criteria set forth in this chapter. The City is already planning to have the Developer for the Pinnacles Development provide a new 1.5 MG water storage tank in the south area of the City. This is reflected in Table 6-5 above.

Even with the addition of a future 1.5 MG water storage tank (the “Pinnacles” storage tank), the City will see a future deficit of 1 MG in storage. The City has a footprint available at the Corporation Yard for a second 1.5 MG tank (sister tank) adjacent to the existing tank. The City should continue to plan for providing a tank at this location, provide at least one more tank of 1.0 MG at another location in the City, to fulfill ultimate build-out water storage needs.

Cannabis Facility Storage Considerations

With the magnitude of the future cannabis facilities that will be implemented within the City in the coming years, it is possible that the variability of demands, and the collective total demands on the water system may warrant consideration of overall storage impacts to the City. At this time, with very limited data available on the only two active cannabis facilities in the City, total water supply/demand and storage impacts cannot be definitively determined. However, based on one full year of data from the 900 Cherry Avenue cannabis facility, a lot of information can be extracted as to possible demands and peaking factors. It will be important for the City to trend all cannabis facilities and continue to assess the impacts that these facilities may have on the City’s water system.

A water storage analysis was conducted to see what the magnitude of storage is from a future build-out of 69 acres of cannabis facilities. Based on preliminary water data from the 900 Cherry Avenue cannabis facility, the following potential water demands can be surmised:

- Total water demand, ~2,700 gpd/acre (3 AFY/acre)
- Total water demand (all cannabis facilities combined), 186,000 gpd (5.8% of total City-wide demand)
- Above demand is equivalent to population of 1,758 (based on 106 gpcd)
- Peak month demand, 3.0 x ADD
- Maximum Day Demand, 4.0 x ADD

Using the same criteria used for overall City-wide storage, the collective storage component generated from cannabis facilities alone would be 430,000 gallons. Depending on future refinements of this analysis, the City can attribute approximately 0.5 MG of storage to the cannabis industry. The City should use this preliminary analysis as a basis for assessing potential impacts and conditions of approval for all cannabis facilities.

Other Existing Tank Considerations

On November 3, 2020, Wallace Group and the City reviewed both the Oak and Corporation tanks. The following items were noted:

- Oak Tank:
 - This tank does not meet current Division of Drinking Water regulations for earthquake safety, as was noted in the 2016 Water Master Plan. This tank should have a seismic evaluation completed. Flexible couplings or double ball expansion joints should be considered to be installed where appropriate to bring the tank into compliance with current Division of Drinking Water requirements.
 - Inlet/Outlet. The tank has separate inlets and outlets; however, the placement of these two penetrations does not promote good tank mixing and turn-over. The existing configuration allows for stagnant water to collect, and the tank to be subject to some thermal stratification. We understand the City has an existing mixing system on the tank, but that it was not operational at the time of the site visit.
 - The Tank does not have sufficient overflow capacity to keep the tank from over-filling. This may possibly be due to the rodent screens on the outlet, which are providing adequate protection for this purpose, but may be restricting flow rate at the overflow.
 - Based on the 2019 Dive Inspection Report, the overflow is not of sufficient size to handle overflow at the tank filling rate. The City should review recommendations in the ATS Tank Inspection Report and consider modifications to the overflow to allow adequate overflow rates.
 - Based on the 2019 Dive Inspection Report, no roof fall protection is available beyond the roof hatch.

- Based on the ATS 2019 Dive Inspection Report, it is recommended that the City schedule tank sediment removal approximately every two years. This tank had approximately 1 inch of sediment removed across the bottom of the tank. Some areas in the tank, sediment was up to 3 inches thick.
- Corporation Tank:
 - Inlet/Outlet. The tank has separate inlets and outlets; however, the placement of these two penetrations does not promote good tank mixing and turn-over. The existing configuration allows for stagnant water to collect, and the tank to be subject to some thermal stratification. We understand the City has an existing mixing system on the tank, but that it was not operational at the time of the site visit.
 - Similar to the Oak Tank, no roof fall protection is available beyond the roof hatch. It was also noted that the roof surface between the vent and the edge railing does not have any non-slip surface for slip protection.

Overall Storage Recommendations

Based on the analysis discussed above, the City's storage supplies are not sufficient to meet the future needs of the City. The following are the storage recommendations based on emergency, fire, and operational needs as well as long term operations and maintenance needs.

1. **Corporation Yard Tank:** Construct an additional 1.5 million gallon tank in the City's Corporation yard at the location that was designated as a future tank site.
2. **Pinnacles Tank:** Construct a new 1.5 MG water storage tank at the Pinnacles Development area.
3. **North Area of City:** Construct a new 1.0 to 1.5 MG MG water storage tank in the area of the Yanks Development (if the Corporation Yard Tank is not constructed).
4. **Tank Improvements.** As noted earlier in this Chapter, several physical improvements to the existing tanks are warranted:
 - For both tanks, ensure there is adequate safety tie-off provisions beyond the tank ladders.
 - Maintain the existing tank mixers (Gridbee) on both tanks. Wallace Group will recommend CIPs for future replacement of these devices. Small equipment such as these mixers likely have a shorter life span, on the order of 10 years.
 - For both tanks, ensure that level controls are in working order to ensure the tanks do not overfill on a regular basis.
 - For both tanks, consider if flexible pipe connections, such as EBAA-Iron Double Ball Flex Joints, can be installed to improve pipe seismic performance at the pipe-to-tank connections.
 - Oak Tank. Modify the tank overflow to ensure it has adequate capacity to discharge the maximum tank filling rate.
 - Corporation Tank. L-Brackets that attach the vent to the tank are corroded and need replacement. The City should have this condition evaluated by a corrosion engineer and determine if the corrosion is considered accelerated and/or related to dissimilar metals or other conditions that can be remedied.

5. **Operation and Maintenance Considerations:** The City should continue to maintain a program of on-going routine inspections of the interior and exterior coatings of the tanks, and also schedule regular tank cleaning. In order to ensure protection of the City's storage assets, coating systems must be maintained. Interior coatings (epoxy) have a track record of lasting 15 years, plus or minus depending on service conditions, and polyurethane coatings can last up to 20 years.

7: Water Pump Stations

Chapter 7 describes the existing pump stations and provides a summary of the recommended capital improvements for the pump stations.

Pump Stations

The City owns and operates two (2) water booster pumping stations. Both of the pump stations are on the distribution side of the storage tanks and provide pressure continuously to the distribution system. Table 7-1 summarizes the function of each of the pump stations. Table 7-2 summarizes the design characteristics of each of the pump stations.

Table 7-1. Pump Station Characteristics Summary

Pump Station	Function	Number of Pumps	Discharge HGL ¹ (ft)	TDH at Design Capacity ² (ft)	Pumping Capacity (#@gpm)	Permanent Back-up Generator On-Site
Oak	Boosts water from Oak Storage Tank into Distribution System	4	~415	2-90, 2-108	2@700, 2@1200	Yes
Corporation	Boosts water from Corporation Storage Tank into Distribution System	4	~420	160	4@500	Yes

¹HGL – Hydraulic Grade Line

²TDH – Total Dynamic Head

Corporation Booster Pump Station

The Corporation Booster Pump Station is located in the City’s corporation yard, on 10th Street between Cherry Avenue and Walnut Avenue and was installed in 2009. The pump station is fed from the 1.5 MG Corporation Yard water storage tank and contains four (4) identical 500 GPM pumps. The purpose of the Corporation Pump Station is to sustain flow and pressure on-demand (in the water distribution system), and to provide fire flow to the City. At the time of the November 3, 2020 site visit, all four booster pumps were operating properly, and the discharge pressure at the Booster Pump Station was observed to be 60 psi.

Oak Booster Pump Station

The Oak Booster Pump Station is located at Patriot Park on Oak Avenue between 13th Street and 14th Street and was installed in 1980. The booster pump station is fed from the 1.0 MG Oak water storage tank and contains two (2) 700 GPM pumps and two (2) 1,200 GPM pumps. Each pump is controlled by variable frequency drives (VFDs). The purpose of the Oak Pump Booster Station is to sustain flow and pressure on-demand, and to provide fire flow to the City. At the time of the field review on November

3, 2020, Oak Booster Pumps 3 and 4 were both out of service. With Pumps 1 and 2 in operation, discharge pressure was observed to be 52 psi. Wallace Group expressed concerns as to whether fire flow conditions could be met with both of the larger booster pumps out of service. **The water model was run with both large booster pumps out of service, and the ability to meet fire flow demand throughout the City was noted to be deficient.** The City will need to keep this in mind if both large pumps are required to be out of service at the same time again.

Table 7-2. Pump Station Summary

Pump Station	Oak		Corporation
Date of Installation/ Upgrades	1980		2009
	Pumps 1&2	Pumps 3&4	All Pumps
RPM	1760	1800	1775
Phase	3	3	3
HP	19.6	40	30
Voltage	460	460	460
Pump Make & Model	Peerless 8X8X16.50	FloWay BKH (Serial No. 12060-1-1)	FloWay VTP (Serial No. 64582-1-1)
Impeller Dia., (Inches)	Unknown	Unknown	Unknown
Suction/Discharge Dia. (Inches)	8/8	8/8	8/6
Design Flow (gpm)	700	1200	500
Head (ft)	90	108	160

Prior Studies

In the fall of 2015, the City retained the services of a consultant (M.K. Nunley & Associates) to evaluate the two existing booster pump stations, following a number of water main breaks and leaks noted over the year. There was concern that the operations of the two booster stations may be causing momentary excessive pressures in the water system. A draft technical memorandum was prepared and provided to the City in February 2016. As part of the consultant's analysis and recommendations, operational testing was recommended, and initial field tests were conducted. However, the testing was conducted for a brief time, and results were insufficient to be conclusive. At this time, the City continues to operate both booster stations manually.

Pump Station Recommendations

It is recommended that the City resume and complete the operational testing program recommended by MKN, and report results to the consultant. This will allow further refinement of this Study, and development of detailed recommendations to address operational/controls issues with the two booster

stations. The City should also inspect and service pressure relief valves at each pump station routinely, verify and check installation, set points and operational functionality.

The City should also schedule routine maintenance and inspections for all pumping equipment, to reduce the chance for multiple pumps out of service at any one time. This is especially important for the larger pumps at the Oak Booster Station, for which both larger pumps must be operational in order to meet fire flow requirements.

8: Water Distribution System Analysis

Chapter 8 describes the existing water distribution system, water model development and calibration, design criteria, and overall system performances.

Water Distribution System

The City owns and operates a water distribution system that is comprised of one distribution pressure zone, two potable water storage tanks, and two pump stations. The City owns and operates 36 miles of water mains that span over 2.1 square miles to serve the City's ~3700 customers (connections). The existing water distribution system is shown in Figure 2-1. An inventory of the existing water main network by diameter is summarized in Table 8-1. Table 8-2 provides a summary of the existing water main inventory by material. Understanding material type is valuable as material types impact the water main's life expectancy.

Table 8-1. Existing Water Main Inventory by Diameter

Diameter (Inches)	Length	
	Feet	Miles
3	1,592	0.3
4	10,108	1.9
6	39,880	7.6
8	80,916	15.3
10	2,936	0.6
12	51,240	9.7
16	3,974	0.8
18	53	0.01
Total	190,699	36.1

Table 8-2. Existing Water Main Inventory by Material

Material	Length	
	Feet	Miles
Asbestos Cement	38,921	7.4
Cast Iron	35,263	6.7
Ductile Iron	698	0.1
PVC	115,817	21.9
Total	190,699	36.1

Water System Design Requirements

In 2015/2016, a hydraulic model was developed and calibrated to analyze the City's distribution system under existing and future conditions. The design requirements used to evaluate and identify deficiencies in the water distribution system relate primarily to the flow and pressure delivered by the system to the customers. SWRCB-DDW (previously CDPH) regulates the requirements for minimum system pressures within a water distribution system. Per the existing Waterworks Standards, Chapter 16, Section 64602, and last updated March 9, 2008 by the CDPH:

- a) Each distribution system shall be operated in a manner to assure that the minimum operating pressure in the water main at the user service line connection, throughout the distribution system, is not less than 20 pounds per square (psi) inch at all times.
- b) Each new distribution system that expands the existing system service connections by more than 20 percent or that may otherwise adversely affect the distribution system pressure shall be designed to provide a minimum operating pressure throughout the new distribution system of not less than 40 psi at all times excluding fire flow.

Ideally, normal operating (static) pressures should be within the range of 40 to 80 psi. This is the range that most people find comfortable and will serve most fire sprinkler systems. For the existing system, the design criteria for this water master plan is to recommend average day, maximum day, and peak hour pressures to be no less than 40 psi. This falls in line with Waterworks' intention for new water distribution systems or existing systems to be expanded.

It should be noted that prior to this CDPH update in 2008, the required system pressure under all conditions except fire flow was 30 psi. As noted in b) above, unless the City expands the system, the existing service pressure can be "grand-fathered in" to the former 30 psi standard. However, when completing the water model analysis, the water system was analyzed to maintain 40 psi throughout the entire distribution system.

Pressures higher than 80 psi are acceptable within the distribution system, but should be reduced to 80 psi or lower at the service connection to prevent water hammer effects or leakage through washers and seats within a home. Reducing system pressure also helps to conserve water within the home. Pressures greater than 80 psi were not identified anywhere within the City.

It is also recommended to maintain water pressure within the distribution system at or below a maximum ceiling of 150 psi. Residual pressures throughout the entire distribution system under fire flow conditions shall be maintained at a minimum of 20 psi. No service pressure at or above 150 psi were noted.

The flow requirements examined in the hydraulic model include average day demand, peak hour demand, and fire flow plus maximum day demand. The various flow scenarios are summarized as follows:

Average Day Demand (ADD): This flow condition is used to evaluate the system subject to the most common conditions. The existing demands were assigned throughout the distribution

system by zone, based on the demands noted in Chapter 4. In addition, all pumps at both booster stations were assumed to be operating under the current operational settings.

Peak Hour Demand (PHD): This demand condition is used to identify system deficiencies at the maximum domestic use. A peaking factor per Table 4-4 of this report was applied to average day demand to obtain peak hour demand. In addition, all pumps at both booster stations were assumed to be operating under the current operational settings.

Fire Flow (FF) Plus Maximum Day Demand (MDD): This demand condition is used to identify system deficiencies under fire flow conditions. A peaking factor per Table 4-3 of this report was applied to average day demand to obtain maximum day demand. In addition, all pumps at both booster stations were assumed to be operating under the current operational settings. Residential, commercial, industrial, hotel, church and school fire flow requirements were established based on the Greenfield Fire Protection District’s requirements as well as the current Uniform Fire Code (UFC). In accordance with UFC requirements, no more than 1,000 gpm will be extracted from any single hydrant. In addition, only one fire flow is modeled at any one time.

Based on prior correspondence with the local Fire Department (email on January 28, 2016), Table 8-3 provides a summary of the fire flow requirements that were utilized to identify both hydraulic deficiencies throughout the water distribution system as well as to determine fire storage requirements (see Table 6-3).

Table 8-3. Fire Flow Requirements by Zoning

Zoning	Fire Flow (gpm)	Duration (hours)	Notes
Residential (low and medium density)	1,500	2	
Residential (high density)	2,000	2	
Neighborhood Commercial	1,500	2	Commercial businesses within residential neighborhoods
Commercial	2,500	2	All other commercial not identified in Neighborhood or Big Box
Big Box Commercial	4,000	4	Large square footage commercial buildings
Industrial	4,000	4	
Hotels	4,000	4	
Churches	2,500	2	
Schools	2,500	2	

The following parameters were employed to identify conditions for each run of the model:

1. Domestic pressures below 40 psi for ADD, MDD, and PHD
2. Pipeline velocities exceeding five feet per second (fps) at ADD, MDD, and PHD are identified. In general, velocities higher than five fps create excessive pressure losses.
3. Pipeline velocities exceeding 10 fps during fire flow conditions plus MDD are identified. Pipelines near the source of the fire are identified if velocities exceeded 15 fps.
4. During fire flow model runs, service pressures below 20 psi at any node within the distribution system were identified.

The hydraulic parameters and design criteria for the evaluation of the City's water system are summarized in Table 8-4.

Water Model Development

In order to evaluate the performance of the existing water system, identify deficiencies in the network, and recommend improvements, a computer hydraulic model was developed as part of the 2016 Water Master Plan. This model was developed using the Bentley WaterCAD V8i computer program. The hydraulic model was calibrated as part of the original master plan development, and additional calibration of the model is not deemed necessary as part of this update. The results of this calibration process were presented in the 2016 Water Master Plan.

Table 8-5 provides a summary of the Hazen-Williams roughness coefficients ("C" factor) for the water mains used in the hydraulic model. The "C" Factor was adjusted for various water mains as part of the calibration process.

Model Calibration

The hydraulic model was calibrated using field hydrant testing that was conducted on December 2, 2015 and January 29, 2016.

The water system was analyzed in the model by simulating the field fire flow tests and comparing the resulting modeled pressures with those observed in the field. Adjustments to pipe friction factors (Hazen-Williams coefficient) were made in to calibrate the model.

Existing System Performance

The performance of the City's water distribution system was evaluated under existing ADD, PHD, and Fire Flow plus MDD to identify where the deficiencies are within the system. Recommendations for system upgrades based on the analysis described in this chapter can be found in Chapter 9.

Table 8-4. Summary of Hydraulic Parameters and Design Criteria

Hydraulic Parameters and Design Criteria	Value	Standard
Fire Flow Requirements	See Table 8-3	Uniform Fire Code and City of Greenfield Standards
Maximum Day Demand Factor	2.0 times ADD	City of Greenfield Daily Well Production Records (2006-2018) and CCR, Title 22, Division 4, Chapter 16, Article 2, Section B.2.A - B.2.C
Peak Hour Demand Factor	4.0	City of Greenfield Daily Well Production Records (2006-2018) and CCR, Title 22, Division 4, Chapter 16, Article 2, Section B.2.A - B.2.C
Minimum System Pressure at ADD, MDD, and PHD	40 psi	California State Water Resources Control Board, Drinking Water Division
Maximum System Pressure at ADD, MDD, and PHD	150 psi (80 psi at water service recommended. Install service PRV if above 80 psi)	
Minimum System Pressure at FF plus MDD	20 psi	
Maximum Pipeline Velocity at ADD, MDD, and PHD	<5 fps	
Maximum Pipeline Velocity at FF	< 10 fps (<15 fps near source of fire)	
Fire Hydrant Spacing	Residential: Maximum 500-feet, except at dead-end streets, it shall be no more than 400-feet Commercial: Maximum 250-feet	Recommended Standard
Pipe Diameter	All new water mains must be 8-inch or greater.	Recommended Standard
Valving	No shut down of greater than 500 feet in high-value districts or greater than 800 feet in other sections.	Recommended Standard

Specific Distribution System Improvements – Existing Conditions

The following distribution system deficiencies were noted under existing conditions:

- Several of the smallest diameter pipes were targeted for replacement and upsizing to ensure adequate service and fire flows, including the additional of fire hydrants where noted deficient. These improvements are identified as Priority 1 CIPs 1-1 through 1-4 in Chapter 9.
- Priority 2 pipeline CIP upgrades were identified, and include minor pressure or service deficiencies, of lesser priority than the above Priority 1 CIPs. Various pipeline upgrades are listed as CIPs 2-1 through 2-6.
- Priority 3 pipeline CIP replacements/upgrades are listed in detail in Chapter 9, and consist of older pipes (asbestos cement pipe, cast iron pipe) and smaller diameter pipes (less than 8 inch diameter) that will eventually require replacement. These pipes should be replaced in later years, and budget should be earmarked annually for these various replacements. Some of the replacements may be prompted by line breaks, loss of pressure and other service related issues, and can be further prioritized by the City as the needs arise.

Future System Performance

The performance of the City’s water distribution system was evaluated under future demand conditions. The model was evaluated under ADD, PHD, and Fire Flow plus MDD. The water distribution system was modeled with all of the proposed projects that were identified as existing deficiencies completed. Recommendations for future system upgrades based on the analysis described in this chapter can in found in Chapter 9.

Table 8-5. Modeled Hazen-William’s “C” Factors

Material	“C” Factor
Asbestos Cement	130
Cast Iron	100
Ductile Iron	120
PVC	140

Since the timeframe for the construction of future development is unknown, it is recommended that as development is proposed, an evaluation be completed to identify which of the recommended projects are required to be completed to adequately serve the proposed development. This may dictate the priority and timing of a recommended CIP projects in the future.

Specific Distribution System Improvements – Future Conditions

The following distribution system deficiencies were noted under future conditions:

- Elm Avenue, from 5th Street to 4th Street. The existing 10” ACP should be upgraded to 12” pipe in future years, corresponding to anticipated industrial development in this area.
- Oak Avenue, 3rd Street to 2nd Street. The existing 6”, 8” and 12” pipes should be upgraded to 16” pipe in future years, corresponding to anticipated industrial development in this area.
- 3rd Street, from Maple Avenue to Oak Avenue. The existing 8” pipe should be upgraded to 12” pipe in future years, corresponding to anticipated industrial development in this area.
- El Camino Real, Cherry Avenue to Pine Avenue. The existing 12” pipe should in El Camino Real should be upgraded to 16” to meet future industrial demands and fire flow conditions. A parallel pipe to the existing 12” water main could also be considered in lieu of replacement of this water main.
- El Camino Real, Tyler Street to South End of Existing Water System. This existing 6” pipe should be upsized to 8” diameter in future years to accommodate future residential development in the south/southwest area of the City.

9: Summary of Recommendations

This chapter summarizes the City's recommended master plan capital improvement projects (CIPs) to meet existing and future needs, and the master plan improvement program to assist in the financial planning aspects of implementing the recommended improvements. The improvements are described as first, second and third priorities.

Recommended Master Plan Improvement Projects

Based on the hydraulic model, along with recommendations for storage and supply well upgrades and upgrades due to operational needs, a series of master plan improvement projects have been identified. The projects have been classified into the following four categories:

- **First priority:** First priority projects are a result of significant health and safety concerns, including substandard pressures and fire flows during any demand situation (or system outages, equipment repairs). These projects are recommended to be completed within five years and are all identified as existing deficiencies within the City's water system. These projects are scheduled within the first 5 years of the 10-year CIP program. These projects are all identified as existing deficiencies within the City's water system.
- **Second priority:** Second priority projects address sections of the City's water system that are experiencing slightly substandard pressures and/or fire flows, but are not as critical as first priority projects. These priority 2 projects are scheduled for the remaining 5 years of the 10-Year CIP period. These projects are also existing deficiencies within the City's existing water system, but not necessarily driven by future development.
- **Third Priority:** The priority 3 projects consist mainly of older water mains that eventually require replacement. However, you will notice that those identified CIPs that include a combination of older pipe (ACP or Cast Iron) and are under-sized, are considered of higher priority than others, and therefore are scheduled within the first several years. The remaining pipe replacements were not singled out as specific project CIPs for the purposes of the 10-year CIP, but instead it is recommended that the City earmark an annual budget for older water main replacements. These projects are also existing deficiencies within the City's existing water system, not driven by future development.
- **Future Projects:** As development projects occur throughout the City, the future projects should be identified and completed to address these deficiencies prior to the proposed development being constructed. It is noted that some future CIPs listed, may be required conditions of approval for future Developers/Developments. Also, the proposed land uses, distribution system layout, demands and fire flow requirements should be re-evaluated for each project in the planning stage to confirm assumptions made for the purpose of this Water Master Plan are accurate and confirm that no additional upgrades will be required.

Water Distribution System Priorities

Water distribution piping upgrades and priorities are further defined in the following subsections. As part of on-going capital improvements throughout the City’s water distribution system, the City should anticipate and budget for routine asset replacements focused on aged and under-sized pipes, and older pipes of cast iron and asbestos cement. Older cast iron pipes have a tendency to lose hydraulic efficiency due to tuberculation, and asbestos cement pipe is known to be brittle and prone to cracking and main breaks. As part of the 10-Year CIP developed for the rate study in 2016, a summary table of pipeline replacement projects and corresponding priorities was developed; this table has been updated and is included as Table 9-1. The locations of these pipelines, which are third priority projects to be done in later years, are shown on Figure 9-5. It is noted that Figure 9-5 shows only the 6” and smaller cast iron and ACP pipes, and 4” PVC pipe that are under-sized.

Table 9-1. Summary of Pipeline Upgrades by Pipe Size, Material and Priority

Material	Diameter (in)	Length (ft)	Replacement Material	Replacement Diameter (in)
Cast Iron	3	1,592	PVC	8
	4	8,326	PVC	8
	6	17,617	PVC	8
	8	4,924	PVC	8
Asbestos Cement	4	1,616	PVC	8
	6	15,454	PVC	8
	8	10,889	PVC	8
	10	547	PVC	10
	12	7,033	PVC	12
	16	3,794	DIP	16
PVC	4	175	PVC	8

The pipeline replacement priorities are summarized as follows:

- Yellow, undersized mains of any pipe material. These are considered a higher priority and should be completed within the first 5 years.
- Orange, marginally undersized pipelines of cast iron and asbestos cement. These pipelines will eventually need replacement, and should be prioritized by hydraulic deficiency and frequency of main breaks.
- Green. These 8” asbestos cement and cast iron water mains are of lesser priority, and can be targeted last for replacement. As with the smaller water mains, these pipelines are reaching the end of their service life and eventually need to be replaced. However, such replacement can be deferred to later years, on an as needed basis.
- Blue. These asbestos cement pipelines should be replaced eventually, but may be deferred to later years, and/or as needed. However, planned preventative maintenance/replacement would always be preferred over a rushed replacement due to failure.

First Priority Master Plan Improvement Projects

First Priority Projects have the highest health and safety deficiencies within the distribution system. Typically, these deficiencies are identified due to fire flow capacities that are less than 50% of the required fire flow. First priority projects were determined using the following criteria:

- Pressures below 30 psi during ADD, MDD, PHD
- Velocities greater than 5 fps during ADD, MDD, PHD
- Fire flows that cannot meet a minimum of 50% of the required fire flow

Second Priority Master Plan Improvement Projects

Second Priority Projects have the second highest health and safety deficiencies within the distribution system. Typically, these deficiencies are identified due to fire flow capacities that are between 50% and 75% of the required fire flow. Second priority projects were determined using the following criteria:

- Pressures below 40 psi during ADD, MDD, PHD
- Fire flows that cannot meet between 50% and 75% of the required fire flow

Third Priority Master Plan Improvement Projects

Third Priority Projects have minor deficiencies within the distribution system. Typically, these deficiencies are identified due to fire flow capacities that are between 75% and 100% of the required fire flow. In addition, third priority projects are those projects that are recommended because the water main doesn't meet current day standards such as minimum pipe diameter or material. Third priority projects were determined using the following criteria:

- Fire flows that cannot meet between 75% and 100% of the required fire flow
- Water mains that do not meet current design standards (i.e. 4-inch water mains) that were not identified as hydraulic deficiencies

Master Plan Improvement Project Ranking and Costs

First, Second, Third and Future Priority Master Plan Improvement Projects were ranked to determine what priority the recommended projects should be constructed. The ranking was based on severity of the deficiency, the size of the community the deficiency impacts, and cost. Figures 9-1 through 9-5 illustrate the location of each of the proposed Master Plan Improvement Projects. Tables 9-2 through 9-5 provide a summary of all the recommended Master Plan Improvement Projects in order of ranking for first, second, third and future priority projects, respectively. These Tables also provide estimates of the construction and "soft" costs for each project. The project costs are based on engineering judgment, confirmed bid prices for similar work in the area, consultation with vendors and contractors, established budgetary unit prices for the work, and other reliable sources. The cost estimates are approximate and should be used for planning purposes only. Actual project costs will vary depending upon economic conditions at time of construction. These costs are based on 2020 dollars (McGraw-Hill ENR Construction Cost Index of 11455, August 2020) and need to be escalated to the year or years scheduled for the construction (escalated to midpoint of construction). Table 9-2 provides a summary of the cost per lineal foot used to develop the construction costs for the water main upgrade projects.

Table 9-2. Unit Cost for Construction of Water Mains

Size (Inches)	Replacement Material	Replacement Cost per Linear Foot (Year 2020)
8	PVC	\$175
12	PVC	\$200
16	Ductile Iron	\$250

¹ All PVC pipes are pressure class 165 unless otherwise stated.

Other Major Capital Improvement Projects

In addition to water distribution pipeline improvements, other significant capital improvement projects as part of the City's overall water system are recommended. These items include water supply wells, water storage, and water meter and lateral replacements.

Review City's water service lateral and meter replacement program to ensure regular maintenance and replacing of aging meters and laterals is being performed. This dovetails into overall recommendations that the City have sufficient resources to replace older water mains throughout the City, particularly the old asbestos cement water and cast iron water mains. This will be discussed further in Chapter 9.

Water Supply

In Chapter 5, it was recommended at the City provide at least one new domestic water well (Well #8) in the future. The additional well is needed to ensure water supply reliability for future demands, when the largest well may go out of service. A budget of \$2.5 million to cover hard and soft costs should be budgeted. It is envisioned this new well should come on in line within the next several years (Priority 1 Project), in conjunction with the Pinnacles Development. The well is recommended to be located at or near existing Wells 1 and 6 (at 14th Street between Cherry and Walnut Avenues). **Information on the existing water transmission main from this existing well site to the existing distribution system (in the vicinity of the Oak Tank and Booster Station) was not available, however the City should evaluate if all three wells (Wells 1, 6 and 8) can operate/pump simultaneously through the transmission main (especially under the scenario where Well 7 is out of service for any reason) without inducing excessive headloss (pressure loss) and thus reduced well pumping capacity.**

Water Booster Stations

At this time, specific capital improvement projects are not identified for the booster stations. However, it is recommended that the City work with their prior consultant to refine pump station settings and operations and address the recommendations made in the February 2016 technical memorandum by MKN & Associates. Once minor adjustments are made to the booster station controls, the City should be able to resume automated operation of the Oak and Corporation Booster Stations.

Water Meters and Water Services

The February 2016 technical memorandum referenced above, also identified the need to address leaky water services and meters in need of replacement. It is difficult to quantify a CIP for these items;

however, the City should maintain an annual budget to address these items as they arise. The City should inventory the meters by age, and water services by age and material. A more defined program for replacement can then be developed from this information. Furthermore, replacement of water meters and services should be considered when opportunities arise, such as when water mains are also being replaced.

Water Storage Tanks

It is recommended that one 1.5 MG water storage tank be constructed at the Corporation Yard, or in the south area of the City in conjunction with the Pinnacles Development, within the next 5 years (priority 1 CIP). This in part will depend on the timing of the Pinnacles Development. The new tank is envisioned to be a welded steel tank similar to the existing Corporation Yard tank. This tank has been budgeted at approximately \$1/gallon, or \$2.1 Million with hard and soft costs. The tank would be equipped with an altitude valve or other means of ensuring the tank does not overflow, particularly if the tank is located in the south area of the City where elevations are lowest.

In addition, the City should budget for anticipated coating of their existing water storage tanks. In particular, the Oak Tank should be slated for re-coating and re-lining in future years. The schedule and need for this work should be identified by a tank inspection by a qualified tank coating specialist. The tank interior would typically be inspected by a dive inspection. The cost for such study would be in the range of \$5,000. Tank re-coating and re-lining costs can vary considerably, depending on the extent to which existing coatings must be removed/sandblasted, and the degree of spot repairs for pitted and corroded areas on the tank. Assuming that the Oak Tank will require exterior and interior re-coating, using a budget number of \$6/SF, the construction cost for tank coating and lining would be approximately \$200,000. A total budget of \$280,000 should be set aside for coating the Oak Tank in future years. The timing of this project is not known at this time, but would likely fall within the Priority 2 time frame (within the next 10 years). The Corporation Tank should also be budgeted for this same amount, around the Year 2025 time frame (end of 10-Year CIP period, or possibly later).

Other water tank recommendations include:

- Oak and Corporation Yard Water Storage Tanks. Several minor projects should be considered by the City at both tanks:
 - Safety Tie-Off Provisions. Both tanks should improve upon safety tie-off provisions at the top of the tanks.
 - Tank Mixers. The City should budget for replacement of existing mechanical tank mixers in future years.
 - Flexible Seismic Joints. The City should consider if installation of flexible pipe joints (EBAA Iron double ball flex joints or equal) can be accommodated to better safeguard against pipe-to-tank damage during an earthquake. For the Oak Tank, this should be considered with other seismic improvement considerations below.
- Oak Tank Only:
 - Consider seismic retrofit of the tank, including a new concrete ring foundation with bolt-down provisions to better secure the tank in the event of an earthquake.

- Modify the overflow pipe screen to allow better flow out of the overflow pipe. This is a minor maintenance item that can be addressed by City staff.
- Corporation Tank Only:
 - Repair/replace the L-Brackets to the tank vent, and address corrosion at this area. Wallace Group did not inspect/review the top of the tank during the site visit; however, this recommendation is based on feedback from staff. Repair of the corrosion may not be able to wait for the next tank coating cycle. This should be confirmed by the City.

Water System Operation and Maintenance

In order to maintain the City's water system assets, the City establishes an annual O&M budget that must cover many aspects of water system on-going O&M. There are many things that the City should do to properly maintain the water system components. The recommended budget for O&M varies widely with the type of facilities, number and size of facilities, age and condition of existing facilities. The City should start by assessing their current O&M budget and verify if it is adequate or not for continued and on-going O&M. The City has two water booster stations, two water storage tanks, three water wells, and miles of water pipe, water valves, water services and meters. The City should review O&M manuals for all mechanical equipment such as water booster pumps and associated equipment, including electrical, standby generators, pressure relief and check valves, and all related system components. This will include keeping careful track of lubrication schedules and other service requirements, and keeping common replacement parts on hand. The City's budget should be based on prior historical experience coupled with anticipating on-going needs for their inventory of assets. This should include a program for valve exercising, line flushing where required, bacteriological and water quality sampling, and other items. The budget for O&M is beyond the scope of this master plan and capital improvement program, but the City should assess their current O&M budget for the water fund and continue to assess on-going water system O&M needs. Maintaining and keeping accurate records of costs and labor requirements year after year will assist the City in keeping annual O&M budgets sufficient for changing needs from year to year.

Table 9-3. First Priority Master Plan Improvement Projects

Project #	Title	Description	Quantity	Length (ft)	Existing Diameter (in)	New Diameter (in)	Street	Location	Construction Cost (\$)	LS	Total Project Cost (\$)
1-1	Maple and Palm Avenue	Replace 3" and 4" cast iron with 8" PVC	1	5,240	3 & 4	8	Maple Avenue/Palm Avenue	Between 5th Street and 11th Street	660,000	LS	1,000,000
1-2	Elm Avenue	Replace 6" and 8" Asbestos Cement with 12" PVC	1	880	6 & 8	16	Elm Avenue/Elm Circle	Elm Avenue from 4th Street to Elm Circle and Elm Circle	180,000	LS	260,000
1-3	7th Street	Replace 4" Asbestos Cement and PVC with 8" PVC and add hydrant at the north end of the Street	1	800	4	8	7th Street/Acacia Court	7th Street North of Apple Avenue and Acacia Court	110,000	LS	160,000
1-4	Larson Lane	Replace 4" Asbestos Cement with 8" PVC, add mid-block hydrant, and connect to 12" line in Apple Avenue	1	980	4	8	Larson Lane	Larson Lane from Apple Avenue to end.	130,000	LS	190,000
1-5	Water Storage Tank & Booster Station	New 1.5 MG welded steel water storage tank and booster station (See Note A)	1	-	-	-	-	Pinnacles Development	2,000,000	LS	2,800,000
1-6	Water Supply Well	New municipal water supply well, 1,500 gpm capacity (See Note A)	1	-	-	-	-	14th Street/Cherry Avenue	1,750,000	LS	2,450,000
1-7	Tank Safety Tie-Offs	Tank Safety Tie-Offs, Oak and Corporation Yard Water Tanks	1	-	-	-	-	Oak and Corporation Yard Water Tanks	5,000	LS	7,000
Total First Priority Project Costs									\$		6,867,000

Table 9-4. Second Priority Master Plan Improvement Projects

Project #	Title	Description	Quantity	Length (ft)	Existing Diameter (in)	New Diameter (in)	Street	Location	Construction Cost (\$)	LS	Total Project Cost (\$)
2-1	Elm Avenue	Replace 8" Asbestos Cement with 12" PVC	1	1,430	8	12	Elm Avenue/3rd Street	Elm Avenue from Elm Circle to 3rd Street and 3rd Street from Elm Avenue to Maple Avenue	290,000	LS	410,000
2-2	8th Street	Replace 6" Asbestos Cement with 8" PVC and add two hydrants (one at mid-block and one at end)	1	690	6	8	8th Street	8th Street North of Apple Avenue to end	100,000	LS	140,000
2-3	Tom Rogers Circle	Replace 6" Asbestos Cement with 8" PVC	1	490	6	8	Tom Rogers Circle	Tom Rogers Circle from Oak Avenue to end	70,000	LS	100,000
2-4	Renfro Place	Replace 6" Asbestos Cement with 8" PVC	1	500	6	8	Renfro Place	Renfro Place from Oak Avenue to end	70,000	LS	100,000
2-5	San Antonio Drive	Replace 6" Asbestos Cement with 8" PVC and add hydrant at the end of San Simeon Court	1	1,840	6	8	San Antonio Drive	All of San Antonio Drive and San Simeon Court	230,000	LS	330,000
2-6	El Camino Real	Replace 12" PVC with 16" DIP	1	1,410	12	16	El Camino Real	El Camino Real from Pine Avenue to Cypress Avenue	360,000	LS	510,000
2-7	Oak Tank Maintenance	Re-coating and re-lining of Oak Tank	1	-	-	-	Oak Avenue	Oak Avenue Tank	125,000	LS	180,000
2-8	Corporation Tank Maintenance	Re-coating and re-lining of Corporation Tank (see Note B)	1	-	-	-	Corporation Yard	Corporation Yard	200,000	LS	280,000
2-9	Tank Mixer Equipment Replacement	Replace Mixer Equipment at Oak and Corporation Yard Tanks	1	-	-	-	---	Oak and Corporation Yard Tanks	25,000	LS	40,000
2-10	Oak Tank Seismic Retrofit	Oak Tank Seismic Retrofit (See Note C)	1	-	-	-	---	Oak Tank	100,000	LS	140,000
Total Second Priority Project Costs									\$		2,230,000

Table 9-5. Third Priority Master Plan Improvement Projects

Project #	Title	Description	Quantity	Length (ft)	Existing Diameter (in)	New Diameter (in)	Street	Location	Construction Cost (\$)	LS	Total Project Cost (\$)
3-1	Throughout City	Replace 3" Cast Iron with 8" PVC	1	650	3	8	Throughout City	Throughout City	90,000	LS	130,000
3-2	Throughout City	Replace 4" Cast Iron with 8" PVC	1	4,030	4	8	Throughout City	Throughout City	510,000	LS	800,000
3-3	Throughout City	Replace 6" Cast Iron with 8" PVC	1	15,276	6	8	Throughout City	Throughout City	1,910,000	LS	2,700,000
3-4	Throughout City	Replace 8" Cast Iron with 8" PVC	1	4,919	8	8	Throughout City	Throughout City	620,000	LS	900,000
3-5	Throughout City	Replace 6" Asbestos Cement with 8" PVC	1	12,460	6	8	Throughout City	Throughout City	1,560,000	LS	2,200,000
3-6	Throughout City	Replace 8" Asbestos Cement with 8" PVC	1	8,905	8	8	Throughout City	Throughout City	1,120,000	LS	1,600,000
3-7	Throughout City	Replace 10" Asbestos Cement with 12" PVC	1	547	10	12	Throughout City	Throughout City	90,000	LS	130,000
3-8	Throughout City	Replace 12" Asbestos Cement with 12" PVC	1	8,795	12	12	Throughout City	Throughout City	1,320,000	LS	1,900,000
3-9	Throughout City	Replace 16" Asbestos Cement with 16" DIP	1	3,795	16	16	Throughout City	Throughout City	950,000	LS	1,400,000
3-10	Apple Avenue	Remove or Abandon 6" Asbestos Cement if pipe fails.	1	1,100	6	-	Apple Avenue	Apple Avenue from Larson Lane to 9th Street	25,000	LS	25,000
Total Third Priority Project Costs									\$		11,785,000

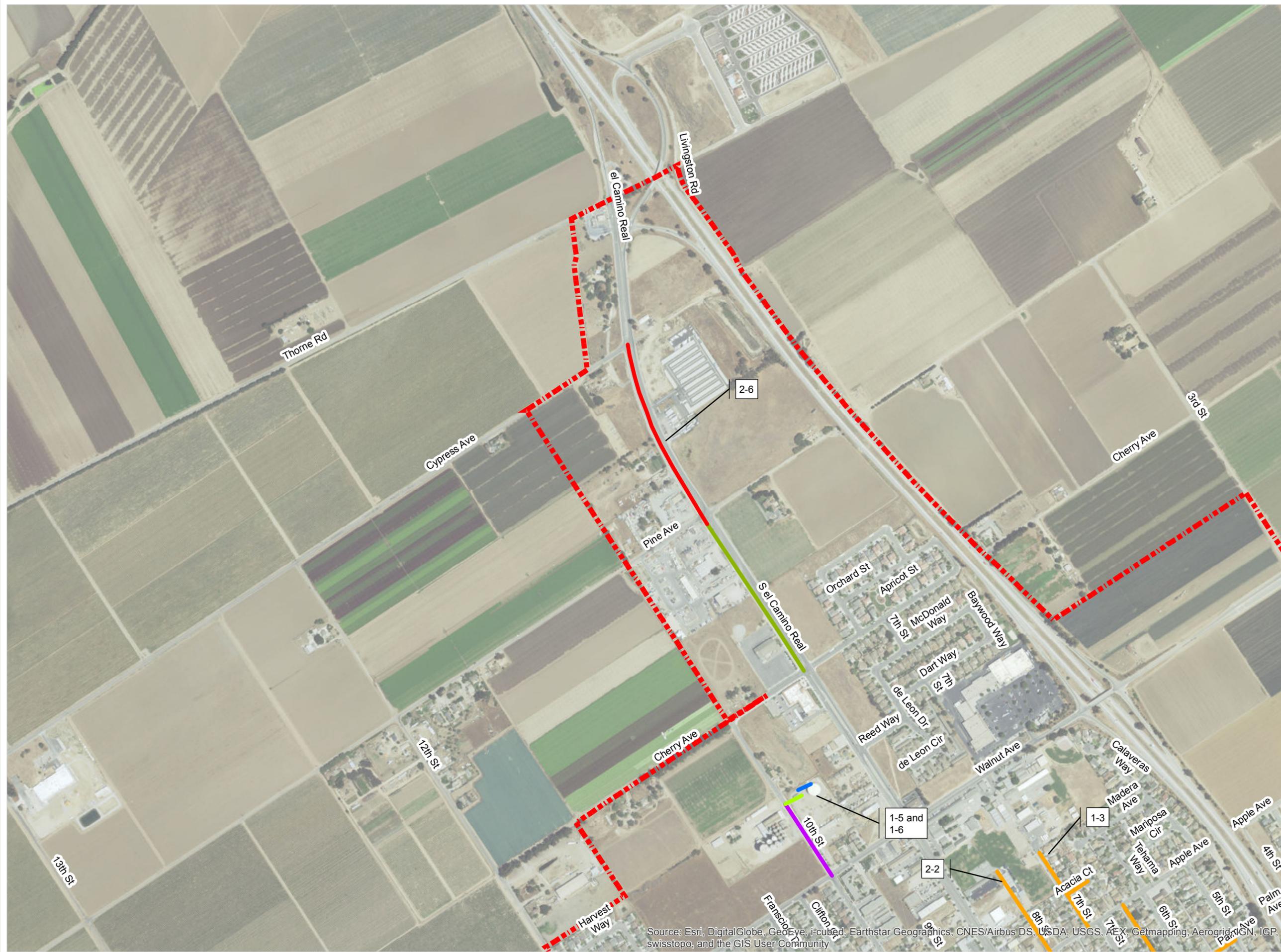
Table 9-6. Future Priority Master Plan Improvement Projects

Project #	Title	Description	Quantity	Length (ft)	Existing Diameter (in)	New Diameter (in)	Street	Location	Construction Cost (\$)		Total Project Cost (\$)
F-1	Elm Avenue	Replace 10" Asbestos Cement with 12" PVC. Triggered by development of parcels zoned for industrial facilities.	1	550	10	16	Elm Avenue	Elm Avenue from 5th Street to 4th Street	110,000	LS	160,000
F-2a	Oak Avenue	Replace 8" and 12" PVC and 6" Cast Iron with 16" DIP. Triggered by development of parcels zoned for industrial facilities.	1	2,640	6/8/2012	16	Oak Avenue/3rd Street	Oak Avenue from 3rd Street to 2nd Street	660,000	LS	1,000,000
F-2b	3rd Street	Replace 8" and 12" PVC and 6" Cast Iron with 12" PVC and 16" DIP. Triggered by development of parcels zoned for industrial facilities.	1	670	8	12	Oak Avenue/3rd Street	3rd Street from Maple Avenue to Oak Avenue	140,000	LS	200,000
F-3	El Camino Real Industrial	Replace 12" PVC with 16" DIP. Triggered by development of parcels zoned for industrial facilities	1	1,250	12	16	El Camino Real	El Camino Real from Cherry Avenue to Pine Avenue	320,000		450,000
F-4	El Camino Real	Replace 6" Asbestos Cement with 8" PVC. Triggered by development of parcels zoned for low density residential	1	220	6	8	El Camino Real	El Camino Real from Tyler Street to south end of system	30,000		50,000
F-5	Corporation Yard 1.5 MG Water Tank	Corporation Yard 1.5 MG Water Tank	1	LS	---	---	Corporation Yard	1.5 MG Water Tank	1,500,000		2,100,000
Total Future Project Costs										\$	3,760,000

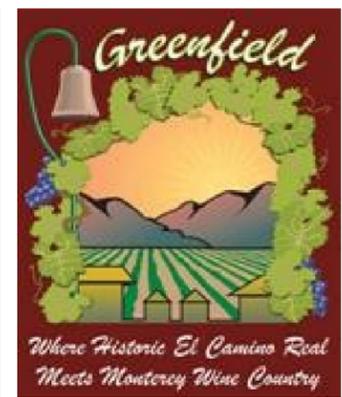
NOTES:

- A. This Project may be part of the Pinnacles Development Conditions of Approval. If Pinnacles Booster Station is not constructed with next few years, the City should consider expanding pumping capacity at Corporation and/or Oak Booster Stations (with population at 18,000 and greater)
- B. If center vent corrosion is not repaired at the time tank exterior is to be coated, L-Bracket/vent repair should be done in conjunction with tank coating.
- C. Include consideration of flexible pipe joint installation at both tank sites.

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LEGEND

City Boundary

PIPE DIAMETER (INCHES)

- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 24

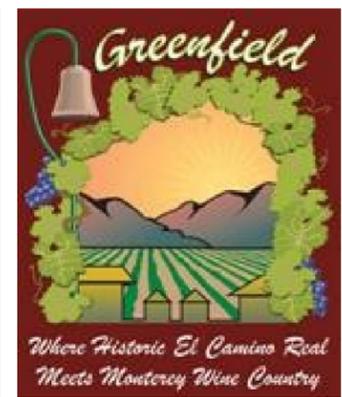
Figure 9-1

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PROPOSED MASTER PLAN WATER SYSTEM IMPROVEMENT PROJECTS



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LEGEND

City Boundary

PIPE DIAMETER (INCHES)

	6
	8
	10
	12
	14
	16
	18
	24

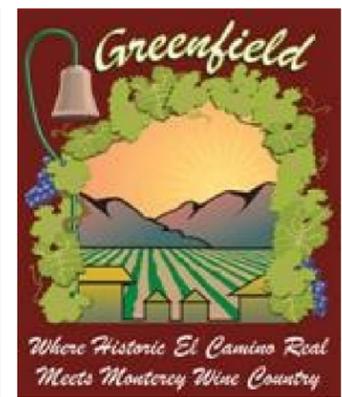
Figure 9-2

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PROPOSED MASTER PLAN WATER SYSTEM IMPROVEMENT PROJECTS



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 MECHANICAL ENGINEERING
 PLANNING
 PUBLIC WORKS ADMINISTRATION
 SURVEYING/GIS SOLUTIONS
 WATER RESOURCES
 WALLACE SWANSON INTERNATIONAL
 612 CLARION COURT
 SAN LUIS OBISPO, CA 93401
 805 544-4011 www.wallacegroup.us

LEGEND

City Boundary

PIPE DIAMETER (INCHES)

- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 24

Figure 9-4

THIS MAP IS INTENDED FOR THE EXPRESSED USE OF THE CITY OF GREENFIELD AND DOES NOT CONSTITUTE A LEGAL DOCUMENT. WALLACE GROUP DID NOT PERFORM SURVEY SERVICES FOR THIS MAP. DATA COMPILED FROM MULTIPLE SOURCES.

PROPOSED MASTER PLAN WATER SYSTEM IMPROVEMENT PROJECTS

