PSOMAS

City of Brawley Water Master Plan Volume 1

Prepared for

City of Brawley
Public Works Department

Prepared

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Balancing the Natural and Built Environment

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Executive Summary

Introduction

The City of Brawley owns and operates its water system, which generally includes distribution pipelines, reservoirs, pump stations, and a treatment plant. This Water Master Plan analyzes and evaluates these facilities and their ability to meet current and projected demands. It also addresses supply and regulatory requirements to assure continued reliable potable water service. This Plan is an update to the previous Water Master Plan and Capital Improvement Program that was prepared in 1999.

Scope of Work

The Water Master Plan scope of work includes the following tasks:

1. Water System Design Criteria
2. Water Demand Projections
3. Water System Computer Modeling
4. Raw Water Capacity Analysis
5. Water Treatment Plant Capacity
6. Capital Improvement Project Recommendations

Master Plan Development

Portions of this Master Plan have been based on fundamental assumptions established throughout the project. The City and Psomas discussed these assumptions and agreed that they resulted in a reasonable approach to developing the Master Plan. One of these assumptions is to use the Year 2030 as the future buildout planning year.

To help quantify the Master Plan objectives, a minimum acceptable level of service was established to help identify deficiencies in existing facilities, as well as to help determine the need for, and size of, proposed improvements. The established criteria meet Federal, State, and local regulations governing water quality for potable use, including AWWA M31, AWWA M32, NFPA, CDPH, and IID.

Existing Water System Facilities

Currently, the City of Brawley (City) manages an existing water system that includes two (2) raw water storage reservoirs, a water treatment plant (WTP), two (2) clearwell storage tanks, a distribution water pump station located at the WTP, one treated water storage tank with booster pump station, and approximately 100 miles of 2-inch to 36-inch water pipeline. The City consists of one pressure zone and serves approximately 5,900 potable water service connections.

The City purchases Colorado River water from the Imperial Irrigation District (IID) via the All American Canal system and, ultimately, is supplied to the Water Treatment Plant via the 19 MGD capacity Mansfield Canal. Raw water is treated at the City's 15 MGD capacity Water Treatment Plant, which can be modified or expanded to accommodate future growth. The WTP's power supply is backed up with a 1,000 kW diesel generator that has adequate capacity and fuel to run the entire plant for 60 days.

The City currently has 36 MG of raw water storage and 6 MG of treated water storage located at the Water Treatment Plant. In addition, they have a 3 MG treated water storage tank located near the Airport. Currently, treated water is pumped to the City's single pressure zone via five (5) 4,000 gpm pumps located at the WTP. In addition, there is a 1,600 gpm booster pump station that supplies water from the Airport tank. All residential customers now have water meters along with many of the business/commercial customers.

Water Demands and Planning Data

Water demands represent water that leaves the distribution system through metered or unmetered connections, or at pipe joints (leaks) or breaks. Water demands occur throughout the distribution system and typically vary based on the number and type of consumer in each location. To analyze demands for this Master Plan, the historical water usage was reviewed, along with the metered services, large users, unaccounted for water users (non-metered lots, parks, etc.), and land use. For this report, an average water consumption of 7.53 MGD was used, representing the 2009 and 2010 demands.

Land use designations were used to calibrate existing demands and project future demands for 2020 and 2030. The current General Plan was used to estimate land use areas, populations, and dwelling units within the current City limits and the existing sphere of influence.

This analysis was complicated by the fact that the current recession has resulted in a number of approved, partially constructed, and partially occupied subdivisions that needed to be considered in the existing analysis. For this Plan, it was assumed that only occupied homes/businesses would be included and that the remaining units would be occupied by the 2020 scenario. Projected populations were 24,953 existing, 42,748 year 2020; and 60,524 year 2030. Existing water demand factors were developed for the various land uses including low density residential, medium density residential, commercial, public facilities, industrial and light industrial/business park. Water demand factors were then developed for each land use to get the total to reach the current average water demand of 7.53 MGD.

Peaking factors were estimated to establish maximum day demands and peak hour demands. These factors are 1.5 and 2.2 times the average daily flow respectively. Fire flow factors were developed for each land use based on accepted fire flows and residual pressures.

In addition, the City has been in discussions with the City of Imperial regarding the planned Rancho Los Lagos development located south of the City's sphere of influence. For the purposes of this Plan, it was shown as a single demand on the 2030 scenario.

Water Distribution System Analysis

The model development and analysis for this 2012 Master Plan was completed primarily within the computer modeling software "InfoWater", with the final model deliverables being exported to EPANet files for the City's use. For this Master Plan, the City elected to leverage GIS by utilizing a hydraulic model that incorporates GIS features into the hydraulic model analyses. The roughness coefficients from the 1999 hydraulic model were used as a baseline value for the new hydraulic model.

The original models were updated to reflect additional developments and facilities constructed since 1999. Pipes and junctions were verified as to their attributes (elevations, sizes, and materials), and system operations were based on maintaining a 50 to 60 psi at the Malan pressure sensor location. Static water demands were distributed to pipe junctions (nodes) based on the number of nodes in a specific land use area. Demands were allocated accordingly to each node and total flows verified against the 2009 and 2010 average water demands.

In master planning, the computer model assists in measuring system performance, analyzing operational improvements, and developing a systematic method of determining the size and timing required for new facilities. The calibrated model can be used to analyze existing water systems, future water systems, or even specific improvements to the existing water system.

The hydraulic computer model was used to simulate the existing and future water distribution system in an effort to identify deficiencies that might occur under selected conditions. The following table identifies the model simulations that were conducted for this project.

Model Simulations

Simulation	Existing	2020	2030 w/o Los Lagos	2030 with Los Lagos	Duration	Demands
Average Day	X	X	X		Steady State	ADD
Maximum Day plus Fire	X	X	X	X	Steady State	MDD
Peak Hour	X	X	X	X	Steady State	PHD
EPS Waterage	X				24 Hours	ADD
EPS - Typical	X				24 Hours	MDD

For the existing system, based on these runs, there were three (3) areas identified as not meeting the design criteria:

- North Highway 111 is served by a small diameter pipeline and has pressures between 25 to 37 psi, which is less than the required 40 psi.
- The Cattle Call area, which is lower in elevation, has pressures in excess of 60 to 70 psi.
- The single pipeline serving the National Beef Plant has velocities in excess of 7 ft/sec.

In addition, there were 20 locations chosen for a fire flow analysis. Of these 20, seven (7) failed to meet the design criteria:

- The Brawly M.O.B Hospital had an available fire flow of 2,693 gpm (6,000 gpm required.
- The Pioneer Hospital had an available fire flow of 2,974 gpm (6,000 gpm required).
- The Phil Swing Elementary School had an available fire flow of 1,956 gpm (3,000 gpm required).
- The Poe Colonia development had an available fire flow of 1,341 gpm (1,500 gpm required). The pipeline serving this development also had a velocity exceeding 10 fps.
- The Hovley Drive and Park View Drive area had an available fire flow of 467 gpm (1,500 gpm required).
- Highway 111 and Shank Road had an available fire flow of 190 gpm (3,000 gpm required).
- SDSU had an available fire flow of 2,486 gpm (3,000 gpm required).

The future modeling scenarios showed many of the same deficiencies as the existing models for pressures, velocities and fire flows. This indicates that these deficiencies should be resolved during the first phases of improvements. The models also sized new pipelines for the developing areas which may either be constructed directly by the developers or by the City (with possible reimbursement).

Water distribution systems often rely on stored water to help equalize fluctuations between supply and demand, supply sufficient water for firefighting, and meet demands during an emergency or unplanned outage of a major supply source. Adequate storage requirements include the sum of operational, fire, and emergency storage volumes.

Based on discussions with IID, the storage required needs to offset the loss of production from the IID connections for six (6) average day demands. The City currently has 36 MG of storage in open at-grade reservoirs at the Water Treatment Plant.

The following table summarizes the required raw water storage for the existing and future conditions:

Additional Raw Water Storage Needed

Condition	ADD (MGD)	6 days of ADD (MG)	Existing Raw Water Storage (MG)	Additional Needed Raw Water Storage (MG)
Existing	7.5	45	36	9
2020	10.6	64	36	28
2030 w/o Rancho Los Lagos	14.3	86	36	50
2030 with Rancho Los Lagos	17.6	106	36	70

Treated water storage within the City's system also has to meet similar criteria for operational fluctuations, fires, and emergencies. The City currently has 9 MG of available treated water storage.

Based on these criteria, the City needs to add treated water storage as shown in the following table:

Additional Treated Water Storage Needed

Condition	Total Required Storage (MG)	Existing Storage (MG)	Additional Needed Storage (MG)
Existing	16	9.0	7.0
2020	22	9.0	13.0
2030 w/o Rancho Los Lagos	29	9.0	20.0
2030 with Rancho Los Lagos	36	9.0	27.0

The existing Water Treatment Plant (and distribution pump station) has a 15 MGD capacity, which is barely adequate to supply the 2030 buildout scenario without the Los Lagos development average day demand of 14.3 MGD. Typically, when WTP flows average over 12 MGD (80%), the City should begin planning for expansion of the treatment plant to increase capacity. This planning should occur sometime prior to 2020. However, with the Los Lagos development, the ADD is 17.6 MGD, which exceeds the plant capacity by 2.6 MGD. When and if the Rancho Los Lagos development proceeds, the City will need to further analyze and start planning for expansion of the existing WTP, which would also include expansion of the distribution pump station.

Capital Improvement Program

A Capital Improvement Program (CIP) will address needed water system capacity and operational improvements. These improvements will increase available fire flows, increase system reliability, and assure future water needs are met. There are four (4) priority projects that will correct the pressure and fire flow deficiencies:

- Highway 111 and Shank Road: Replace the 7,630 feet of 6” pipe with a 12” pipe. Cost = $1,960,000.
- M.O.B and Hospital: Replace 3,610 feet of 6”, 8”, and 10” pipe with a 12” pipe. Cost = $930,000.
- Hovley and Park View Drive: Replace 1,960 feet of 6” pipe with an 8” pipe. Cost = $460,000.
- Phil Swing Elementary School: Replace 350 feet of 6” pipe with an 8” pipe. Cost = $80,000.

Pipes that are 4 inches and less in diameter should be programmed to be replaced with 8” minimum. There are 2,820 feet of these pipes, cost = $650,000.

The existing cast iron pipes are very old and should all be replaced. Priorities should be given to areas that have a high break rate. There are a total of 126,700 feet of CIP in the system. Costs to replace them are $29,560,000.

Lastly, there is an existing need to provide additional raw water and treated water storage. The 9 MG raw water storage pond can be constructed at the WTP for a cost of $5,120,000. The additional 7 MG of treated water storage can be met by the 3 MG La Paloma tank/pump station (when it is constructed) and by a new 4 MG northern area storage tank and pump station costing $9,100,000. This can be constructed as a CIP project or funded by developers.

In the future, the City will be faced with an additional raw water storage shortfall of 41 MG. This construction cost of $23,320,000 can be part of a new CIP program funded by either developer fees or City obtained monies. There are four (4) additional treated water storage tanks/pump stations and 156,300 feet of transmission pipe which will most likely be constructed by developers as the work progresses. Total cost, $62,000,000.

1.0 Introduction

The City of Brawley owns and operates its water system, which generally includes distribution pipelines, reservoirs, pump stations, and a treatment plant. This Water Master Plan analyzes and evaluates these facilities and their ability to meet current and projected demands. It also addresses supply and regulatory requirements to assure continued reliable potable water service. This Plan is an update to the previous Water Master Plan and Capital Improvement Program that was prepared in 1999.

1.1 Background

The City of Brawley is located centrally in the broad desert expanse of Imperial County, California. It is approximately 13 miles north of El Centro and 15 miles southeast of the Salton Sea. See **Figure 1-1** for the Vicinity Map. The City was founded in 1902 and became incorporated in 1908. In the early 1900s the population was small, consisting mainly of railroad workers. Since then the population has grown to almost 25,000 persons and now includes year-round agriculture along with the cattle and feed industries as its biggest economic trades. Brawley has grown steadily over the years and because of the City's careful and continued planning efforts, is able to ensure water resources are available for future growth and development.

1.2 Scope of Work

The Water Master Plan scope of work includes the following tasks:

1. Water System Design Criteria
   a. Develop minimum and maximum pressure criteria for static, fire flow and peak flow conditions.
   b. Develop flow rates including average daily demand (ADD), maximum daily demand (MDD), and peak hour demand (PHD), including fire flows for existing, Year 2020, and Year 2030.
   c. Develop criteria for pipeline maximum velocities, Hazen-Williams roughness "C" factors and minimum pipe sizes. The "C" factors will be adjusted to reflect replacement of old existing cast iron pipe.
   d. Develop storage requirements based on operational, fire flow, and emergency storage requirements.
   e. Determine minimum required fire flow rates per land use and durations and pressures required per the latest version of the California Fire Code and City Fire Department.
   f. Develop current and future water quality criteria.

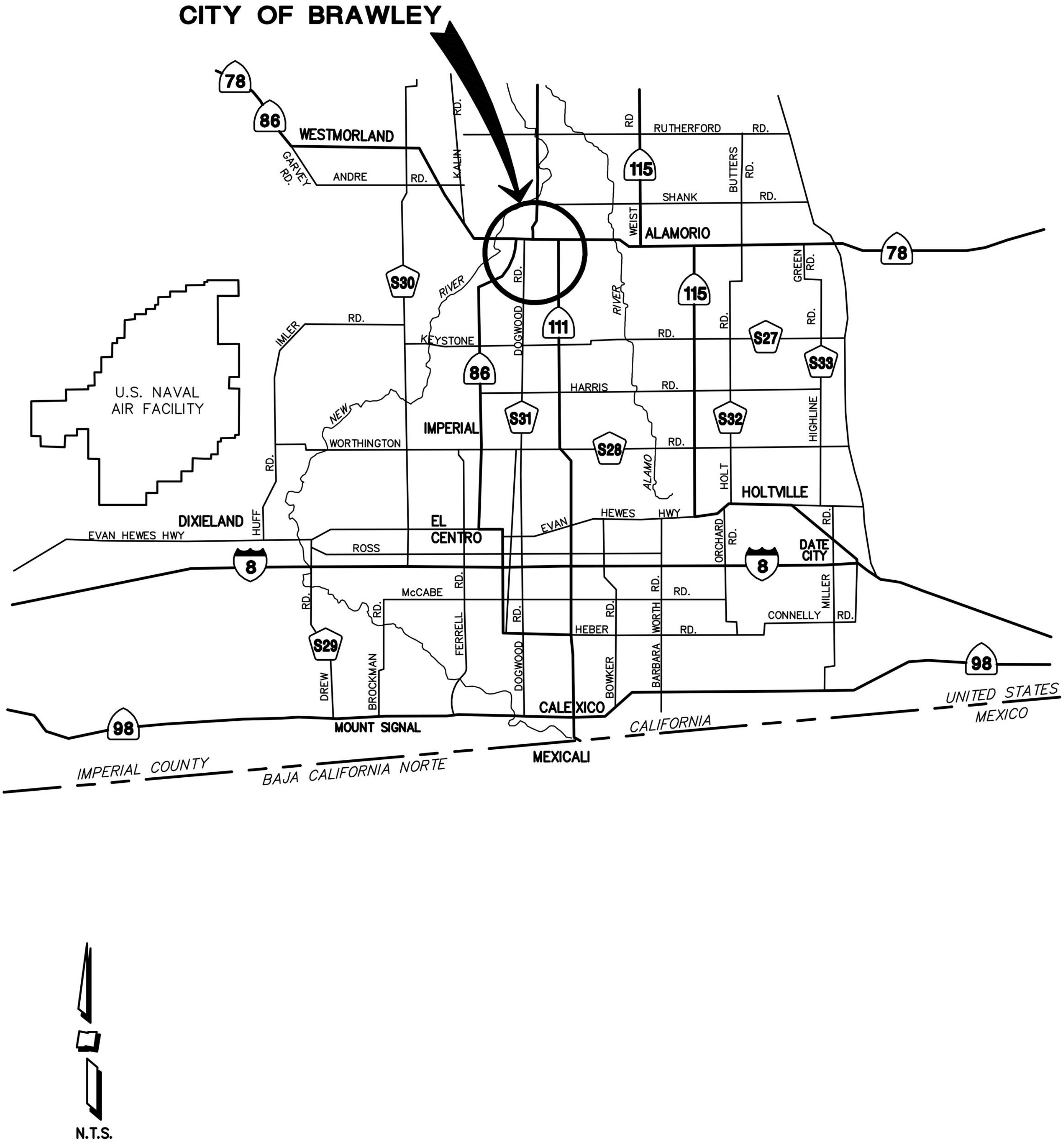

Figure 1-1
Vicinity Map
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2. Water Demand Projections
    a. Develop water usage for each land use category. The rates will be calibrated to reflect flows observed at the Water Treatment Plant.
    b. Develop future water demand projections based on current and proposed land use and population projections.
3. Water System Computer Modeling
    a. Develop base system, including pipes, tanks, pump stations, and fire hydrants.
    b. Provide an existing system model based on current conditions.
    c. Calibrate the existing system model with the results of fire flow tests and historical data from the Water Treatment Plant.
    d. Model the system to determine the required upgrades to the existing system to meet established design criteria.
    e. Model the system using Year 2020 and Year 2030 growth projections and determine the required improvements for the future system to meet established design criteria.
    f. Perform a storage analysis.
    g. Perform an extended time period analysis to model water quality, including estimating age of water and disinfection residuals.
4. Raw Water Capacity Analysis
    a. Analyze the adequacy of the existing and future raw water supply and storage.
    b. Coordinate with Imperial Irrigation District (IID) and review their Urban Water Management Plan.
    c. Investigate raw water delivery capacities to assure the supply canals have adequate capacity to serve the City.
    d. Evaluate availability and/or need for a redundant raw water source.
5. Water Treatment Plant Capacity
    a. Evaluate the adequacy of the Water Treatment Plant to serve the existing and future water needs of the City.
    b. Develop a schedule of required upgrades to meet state health requirements for reliable capacity and water quality.
6. Capital Improvement Project Recommendations
    a. Evaluate the results of the hydraulic analyses and identify system deficiencies.
    b. Develop a capital improvement program (CIP) for short term and long term capital improvements required to meet established design criteria.
    c. Prepare a written report of the CIP recommendations, including:
        i. Priority projects
        ii. Water storage requirements
        iii. Water booster station requirements
        iv. Recommended future system upgrades
        v. Water treatment plant capacity expansions
        vi. Operational improvements

vii. Telemetry and Supervisory Control and Data Acquisition (SCADA) improvements
viii. Raw water supply redundancy
ix. Water conservation recommendations
x. Cost opinions
xi. Possible funding sources

1.3 Acknowledgements

Project staff would like to acknowledge the following City of Brawley staff members who provided valuable information and assistance, contributing greatly to the successful completion of this project:

- Yazmin Arellano, Public Works Director
- Gordon Gaste, City Planner
- Steven Sullivan, Project Manager
- Guillermo Sillas, Associate Civil Engineer
- Alan Chan, Engineering Technician
- Ruben Mireles, Superintendent of Operations
- Fernando Soto, Water Treatment Facility Supervisor
- David Arvizu, Distribution/Pretreatment Supervisor
- Tony Verdugo, Streets and Utilities Supervisor
- Andrew Escobar, Chief Wastewater Plant Operator

1.4 Water Master Plan Objectives

This Water Master Plan has been prepared to provide a reference document for the existing water system operations and maintenance and a framework for future water system planning. The Plan objectives include the following:

1. Develop a comprehensive computer model calibrated to the existing system conditions.
2. Develop performance criteria for both existing and proposed water facilities.
3. Use the computer model to conduct hydraulic analyses of the existing water system and identify current deficiencies in the existing water system.
4. Identify and evaluate system improvements that will alleviate existing system deficiencies.
5. Incorporate projected water demands into the model and identify future system improvements that will be needed to meet the future demands.

6. Perform hydraulic analyses of the water system using the computer model to evaluate operations of the current and future water systems.
7. Review and summarize water quality and proposed regulations that may have an impact on local water supplies.
8. Develop a capital improvement program and capital costs for water system improvements and expansion.
9. Develop a phased project list to prioritize future water system improvement projects.
10. Review alternative financing programs for possible funding sources to pay for the recommended improvements.

1.5 Master Plan Development

Portions of this Master Plan have been based on fundamental assumptions that were established throughout the project. The City and Psomas discussed these assumptions and agreed that they resulted in a reasonable approach to developing the Master Plan. One of these assumptions is to use the Year 2030 as the future buildout planning year.

To help quantify the Plan objectives outlined above, a minimum acceptable level of service also needed to be established to help identify deficiencies in existing facilities, as well as to help determine the need for, and size of, proposed improvements. The criteria listed below were established to quantify the minimum service requirements for the water system and to serve as the minimum acceptable conditions under which the water system would be considered adequate. The criteria were intended to be used to analyze existing facilities and design proposed improvements. Where applicable, the source of these criteria is provided in parentheses.

1. The water provided to the City's consumers shall meet all federal, state, and local regulations governing water quality for potable use.
2. The water system shall be capable of providing the minimum fire flow, as determined in this Master Plan, with a minimum residual pressure of 20 psi (American Water Works Association (AWWA) M31, Manual of Water Supply Practices, Distribution System Requirements for Fire Protection, Chapter 2, Section: Rates of Water Use; Fire Marshal, National Fire Protection Association (NFPA)).
3. The water system shall be capable of providing at least 40 psi (California Department of Public Health (CDPH)) for the following demand periods: average day, maximum day, and peak hour. The water system shall be capable of providing a static pressure of at least 60 psi (the City is currently regulating the pressures at the treatment plant below 60 psi). Since there is only one pressure zone in the City, the 60 psi pressure would be considered the maximum pressure the system will see. Accordingly, pressure regulators and high pressure pipes are not required.

4. The maximum velocity in any proposed pipeline should be in accordance with the following guidelines (Standard Practice) (**Table 1-1**):

Table 1-1
Pipeline Velocities

	Desired Range	Questionable Range	Deficient Range
Average Day Analysis	0 to 5 fps	5 to 7 fps	Over 7 fps
Maximum Day and Peak Hour Analysis	0 to 7 fps	7 to 10 fps	Over 10 fps
Fire Flow Analysis	0 to 15 fps	--	Over 15 fps

Pipes with velocities in the Questionable Range should be reviewed on an individual basis. Those with velocities in the Deficient Range should be considered for replacement or paralleling.

5. The water system should have at least two independent supply sources (AWWA). Where two sources of supply are not practical, the zone should have sufficient storage to meet all emergency criteria with the supply out of service. Based on discussions with IID, the storage required needs to offset the loss of production from the IID connections for six (6) average day demands. (This is the period of time IID has indicated may be required for taking the canal out of service.)

6. Where water is pumped from an imported supply source, the booster pumping station shall have a backup pump online and be equal in size to the largest pump in the station. The station shall also have a backup (or secondary) power source. A portable generator can be considered acceptable as a backup power source for the booster station.

7. The water system shall have adequate potable water storage (AWWA M32, Manual of Water Supply Practices, Computer Modeling of Water Distribution Systems, Chapter 5, Section: System Design Criteria). This storage shall include operational, fire flow, and emergency storage. Operational storage shall be at least 30 percent of the maximum day demands (MDD). Storage for fire flows shall be at least the largest volume determined for any fire flow. Emergency storage shall be the volume required to offset the loss of electricity City-wide or Treatment Plant operation for 24 hours of maximum day demands.

   The sum of the operational storage, fire flow, and emergency storage volumes shall be the minimum required storage for the water system.

8. To meet pressure and velocity objectives, the following criteria are recommended for new pipelines. The minimum diameter for new pipelines shall be 8 inches, except in short cul-de-sac streets, where 6-inch pipe may be used beyond the last fire hydrant. In commercial and business areas, the minimum diameter for new pipelines shall be 12 inches. These diameters shall not preclude the use of larger diameters when needed to meet the minimum fire flows or other criteria. In some cases, smaller diameter pipelines (such as 6-inch or 8-inch) may be proposed to facilitate connection with nearby pipelines and avoid large headlosses from irregular connectivity.
9. Pipelines shall be looped to prevent one pipeline outage from disrupting service to a large area. An exception may be granted by the City's Engineer in special situations (AWWA M31, Manual of Water Supply Practices, Distribution System Requirements for Fire Protection).
10. Fire flows should be able to be met with one major water component out of service (American Water Works Association (AWWA) M31, Manual of Water Supply Practices, Distribution System Requirements for Fire Protection, Chapter 4).
11. Operational improvements are difficult to quantify. Nevertheless, proposed operational improvements that increase system reliability, efficiency, or reduce the cost to deliver water, should be examined. Where a benefit is found, the proposed improvement should be recommended.

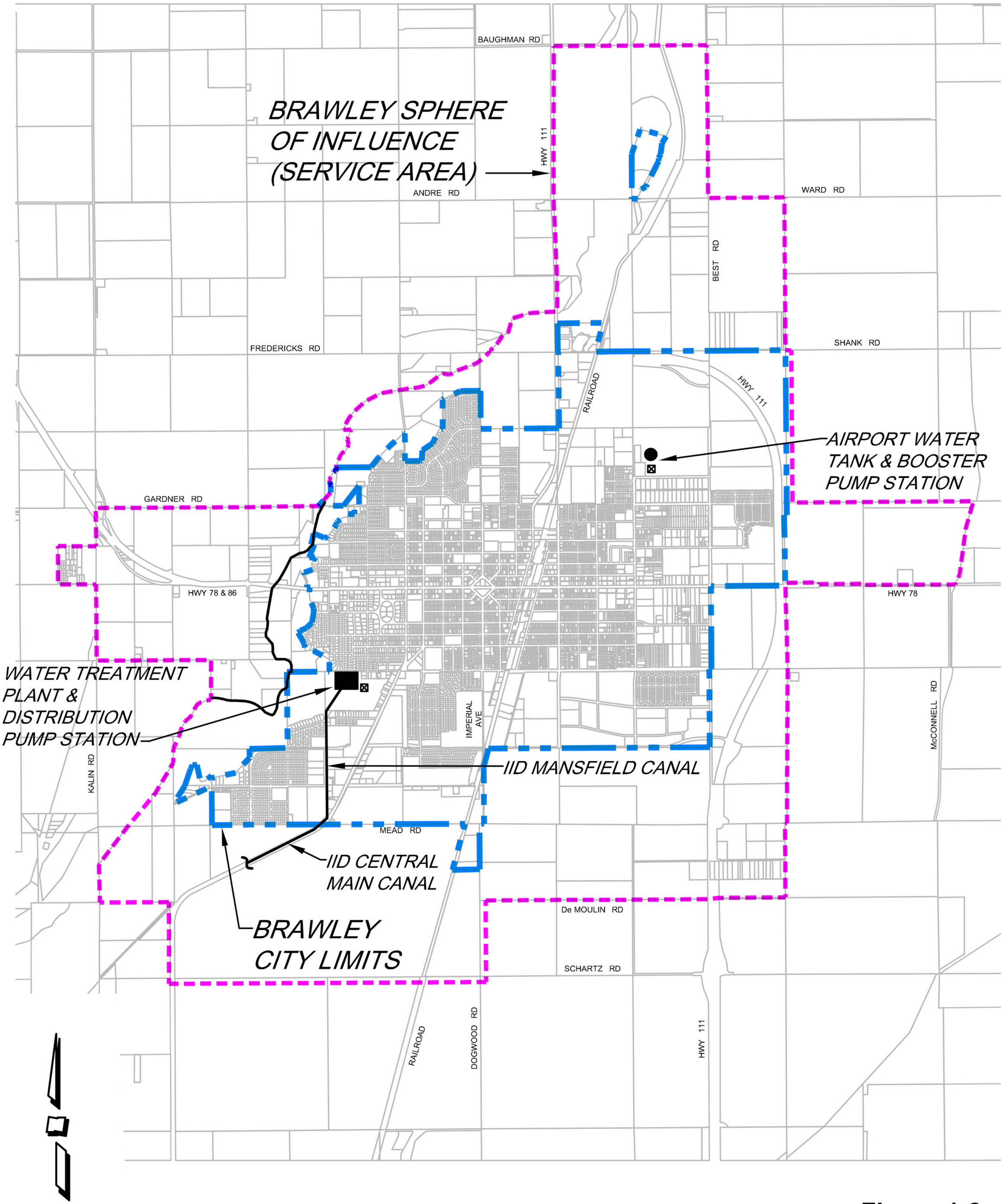
1.6 Study Area

The City of Brawley water service sphere of influence covers approximately 17 square miles, as shown in **Figure 1-2**. This area includes both the incorporated City of Brawley as well as unincorporated areas outside the current City limits.

1.7 Abbreviations

The following is a list of abbreviations used in this report:

AC	Asbestos Cement
ACP	Asbestos Cement Pipe
ADD	Average Day Demand
ac-ft	Acre-foot (one acre-foot of water is equal to 325,829 gallons)
ac-ft/yr	Acre-foot/year
AWWA	American Water Works Association
BPS	Booster Pumping Station
ccf	One hundred cubic feet



SCALE: 1"=4500'

Figure 1-2
City Limits & Sphere of Influence

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CDPH	California Department of Public Health
cfs	Cubic feet per second
CIP	Cast Iron Pipe
DI	Ductile Iron
DIP	Ductile Iron Pipe
Dia	Diameter
EPS	Extended Period Simulation (special type of hydraulic model simulation)
FCV	Flow Control Valve
fps	Feet per second
ft	Foot or feet
ft-MSL	Feet above Mean Sea Level
gpcd	Gallons per capita-day
gpd	Gallons per day
gpd/ac	Gallons per day per acre (volume of water used per acre of land)
gpm	Gallons per minute
HGL	Hydraulic Grade Line
Hp	Horsepower
HWL	High Water Level
IID	Imperial Irrigation District
in	Inch or inches
kWh	Kilowatt-hour
MDD	Maximum Day Demand
MG	Million Gallons
MGD	Million Gallons per Day
PHD	Peak Hour Demand
PRS	Pressure-regulating Station
PRV	Pressure-Reducing Valve
psi	Pounds per square inch (measure of pressure)
PSV	Pressure-sustaining Valve
PVC	Polyvinyl Chloride
SWP	California State Water Project
TDH	Total Dynamic Head

UFC	Uniform Fire Code
UPC	Uniform Plumbing Code
USGS	United States Geologic Survey
WTP	Water Treatment Plant

1.8 Unit Conversions

This section provides a list of conversion factors that are commonly used to convert values from one unit to another.

1.8.1 Volume

- Convert MG to ac-ft: Multiply by 3.0691.
- Convert ac-ft to MG: Multiply by 0.32583.

1.8.2 Flow Rate

- Convert ac-ft/yr to cfs: Multiply by 0.001381.
- Convert ac-ft/yr to gpd: Multiply by 892.7.
- Convert ac-ft/yr to gpm: Multiply by 0.621.
- Convert ac-ft/yr to MGD: Multiply by 0.000893.
- Convert cfs to ac-ft/yr: Multiply by 724.
- Convert cfs to gpd: Multiply by 646,300.
- Convert cfs to gpm: Multiply by 448.8.
- Convert cfs to MGD: Multiply by 0.646.
- Convert gpd to ac-ft/yr: Multiply by 0.00112.
- Convert gpd to cfs: Multiply by 0.000001547.
- Convert gpd to gpm: Multiply by 0.0006944.
- Convert gpd to MGD: Multiply by 0.000001 (or divide by one million).
- Convert gpm to ac-ft/yr: Multiply by 1.61.
- Convert gpm to cfs: Multiply by 0.002228.
- Convert gpm to gpd: Multiply by 1,440.

- Convert gpm to MGD: Multiply by 0.00144.
- Convert MGD to ac-ft/yr: Multiply by 1,120.
- Convert MGD to cfs: Multiply by 1.547.
- Convert MGD to gpd: Multiply by 1,000,000.
- Convert MGD to gpm: Multiply by 694.4.

2.0 Existing Water System Facilities

2.1 General

Currently, the City of Brawley (City) manages an existing water system that includes two raw water storage reservoirs, a water treatment plant (WTP), two (2) clearwell storage tanks and a distribution water pump station located at the WTP, one treated water storage tank with booster pump station, and approximately 100 miles of 2-inch to 36-inch diameter water pipelines. The City consists of one pressure zone and, per the 2010 Urban Water Management Plan (UWMP), serves approximately 5,900 potable water service connections. See **Figures 1-2** and **2-1**. (Figure 2-1 is included in a pocket at back of report.)

2.2 Supply Sources

2.2.1 Import Water

2.2.1.1 Imperial Irrigation District

The City purchases water from the Imperial Irrigation District (IID), which obtains its water from the Colorado River. Water is diverted from the River at the Imperial Dam near Yuma, Arizona, and is then transported via the IID-owned and operated 80-mile long All-American Canal which supplies the Imperial Valley. From the All American Canal, water flows through various IID canals, including the Central Main and Mansfield Canals which deliver the raw water directly to the City of Brawley Water Treatment Plant. The Mansfield Canal has a capacity of 19 MGD.

Untreated water used for agricultural purposes is delivered directly to the customers via the canals. Water used for domestic purposes is stored in raw water reservoirs and then filtered and disinfected at the Water Treatment Plant before being pumped into the City's potable water distribution system.

According to the UWMP, IID has assured the City that all of its required water supply demands will be delivered, even under shortage, drought conditions, and/or a worst case water supply scenario. IID has senior water rights to the Colorado River flows, and it is unlikely that the urban water supply of IID, which comprise less than three percent of its annual water deliveries, will ever be affected. Thus, the City expects no supply shortage at any point in the future. In the event of a water shortage due to a catastrophic interruption, the City will follow the contingency plan, as defined in the Urban Water Management Plan.

2.3 *Water Treatment Plant*

2.3.1 Description and Capacity

Currently, the City owns and operates a 15 MGD WTP located in the southwest portion of the City at 760 Willard Avenue. See **Figure 2-2**. This plant began operation in April 1999 and replaced the City's older plant that was located approximately one half mile north of the current location. The current plant was constructed to provide increased levels of filtration and disinfection to meet then current raw water treatment requirements and to alleviate capacity problems occurring at the older Water Treatment Plant. The WTP capacity of 15 MGD is capable of being expanded to 30 MGD to accommodate future growth. In general, the plant includes raw water storage and pumping, chemical injection, primary sedimentation, flocculation, filtration, and treated water storage and distribution pumping. The WTP also has emergency power supplied by a 1,000 kW diesel generator that has adequate capacity and fuel to run the entire plant for 60 days at current average day flow rates.

2.4 Storage Facilities

2.4.1 Raw Water Storage

The City currently has two raw water reservoirs with a total capacity of 36 MG. These reservoirs are located at the WTP and are at-grade open reservoirs which receive IID raw water.

2.4.2 Treated Water Storage

The City also has nine (9) MG of treated water storage. (See **Table 2-1** for a summary of the tanks.) Six (6) MG of this storage is located at the WTP within two (2) above grade steel tank clearwells. Each tank has 3 MG of capacity and an operational depth of 24'.

A second storage facility, the Airport (Jones) Tank, is located in the northeast portion of the City. The maximum water depth of the tank is 29.3 ft. An altitude valve on the inlet of the Airport Tank closes and opens based on the water level in the tank.

The City also has an abandoned elevated steel water storage tank located at Cesar Chavez Street and H Street. This tank was utilized until the early 2000's at which time it was taken out of service due to concerns with leaking and its structural stability. Although over the years the City has considered rehabilitating the tank and bringing it back in service, required upgrades to the tank have made it cost prohibitive.

Figure 2-2
Water Treatment Plant
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Table 2-1
Treated Water Storage Reservoirs

Description	Location	Year Installed	Material	Base Elevation (ft)	Diameter (ft)	Overflow Depth (ft)	Overflow HWL (ft-MSL)	Capacity (MG)
Hinojosa Tank	H Street	Abandoned	Steel	--	--	--	--	0.25
WTP Tanks	Willard/Cattle Call	1998	Steel	-121.2	125	24	-97.2	6.00
Airport Tank	Eastern/River	1992	Steel	-127	30	30	-97	3.00

2.5 Pump Stations

The City currently operates two potable water pump stations: one located at the WTP and the other adjacent to the Airport Tank in the northeastern portion of the City.

2.5.1 WTP (Distribution) Pump Station Capacity and Operation

The booster pump station at the WTP consists of the five (5) 4,000 gpm pumps. Four (4) of the pumps are variable frequency drive (VFD) pumps and one (1) is a constant speed pump. The pumps and their design points are summarized in **Table 2-2**. They are designed to provide enough water to hold a constant system pressure, set at generally around 55 to 60 psi. Typically, the selected VFD pumps will run in tandem and ramp up and down to meet pressures. As system demands increase and the pressures drop, then the constant speed pump turns on with the operating VFD pumps ramping down to 50%. While working in conjunction with the constant speed pump, the VFD-controlled pumps will then increase speed to meet the demands and hold the discharge pressure. The VFD pumps can be run by the emergency diesel generator located at the WTP.

2.5.2 Airport Booster Pump Station Capacity and Operation

The Airport Booster Pump Station includes three 1,600 gpm constant speed pumps. Up to two pumps operate, with the third pump used as a backup. The Airport Pump Station pumps from the Airport Tank during peak demand periods to maintain pressures within the system. These pumps are operated manually and, typically, used minimally. A 300kW diesel generator is located at the pump station that is capable of providing emergency power for up to five (5) days of average day flow.

Table 2-2
Potable Water Pump Stations

Facility Name	Pump Number	Pump Type	Total Dynamic Head (ft)	Nameplate Horsepower (Hp)	Capacity (gpm)
WTP Pump Station					
FWP-421	1	VFD-Electric	156	140	4,000
FWP-422	2	VFD-Electric	156	140	4,000
FWP-423	3	VFD-Electric	156	140	4,000
FWP-424	4	VFD-Electric	156	140	4,000
FWP-425	5	Electric	156	140	4,000
Total Reliable Capacity[1]					**16,000**
Airport Pump Station					
PMP-B-1	1	Electric	140	75	1,600
PMP-B-2	2	Electric	140	75	1,600
PMP-B-3 (Airport PS)	3	Electric	140	75	1,600
Total Reliable Capacity					**3,200**

[1] Reliable capacity is capacity with largest pump out of service.

2.6 Transmission and Distribution Pipelines

The City is responsible for operating and maintaining approximately 100 miles of pipelines ranging in size from 2 to 36 inches in diameter. The majority of the City's transmission and distribution mains generally consist of 6-inch to 12-inch diameter pipelines. Pipelines 12 inches in diameter and larger are considered transmission mains, while all smaller pipes are considered distribution mains.

Table 2-3 provides a summary of existing water system pipe lengths by diameter.

Table 2-3
Summary of Water Pipe Length by Diameter

Pipe Diameter (in)	Length (ft)	Percent of Total Length (%)
2	419	0.08
3	698	0.13
4	22,513	4.26
6	152,746	28.9
8	184,665	34.9
10	14,918	2.82
12	98,230	18.6
14	8,174	1.55
16	19,640	3.71
18	7,679	1.45
20	348	0.07
24	16,830	3.18
36	2,049	0.39
Total Pipe Length	**528,909**	

Table 2-4 provides a summary of pipe lengths by material and roughness coefficient (c factor) used in the hydraulic model. Most of the oldest pipe in the City's system is cast iron (CI) and represents approximately one-quarter of the total pipe length. The oldest pipe is located primarily in the downtown core and central area of the distribution system. Asbestos cement (AC) pipe accounts for a little over a quarter of all water pipelines, while the smallest amount of pipe is ductile iron (DI), which represents less than 1%. Polyvinyl Chloride (PVC) pipe is the largest quantity of pipe material installed and accounts for over 45% of the City system. PVC is typically the newest pipe that has been installed.

Table 2-4
Length of Pipelines by Material Type

Pipe Material	Length (mi)	Percent of Total Length (%)	C-Factor
Cast Iron	26.0	26	80 (less than 16”) 100 (16” and larger)
Ductile Iron	0.6	1	120
Asbestos Cement	28.0	28	120
Polyvinyl Chloride	45.0	45	130
Total Pipe Length	**99.6**		

2.7 Water System Conditions

2.7.1 Water Main Breaks

The City has experienced water main breaks in the past, a large portion of which have occurred within the cast iron pipe sections. It has been noted by City staff that the cast iron pipe that has been removed tends to have scale build-up on the insides, which decreases pipe capacity. It is likely that the alkaline soil has also contributed to the deterioration of the cast iron pipe. See Appendix A for the City’s pipe break records.

2.7.2 System Pressures and Fire Hydrant Flow Data

The City has four pressure monitoring stations located as follows:

1. Water Treatment Plant
2. East Malan Street and Old Highway 111
3. Airport/Jones Water Tank
4. River Drive and 3rd Street

Hydrant flow data was provided by the City for five (5) locations. (See Appendix B.) The data was per the Insurance Services Office (ISO). This data was used to help calibrate the water model. **Table 2-5** summarizes the five (5) hydrant locations tested.

Table 2-5
Fire Hydrant Test Data

Test	Type	Location	Available Flow at 20psi
1	Comm	Shank Road and Route 111	500 gpm
2	Res	Pedrino Court and Poe Colonia Lane	2,500 gpm
3	Comm	W. Route 86 and Las Flores Drive	1,100 gpm
4	Comm	Route 78 and Best Road	3,400 gpm
5	Res	Legion Road and Los Olivos Drive	1,900 gpm

3.0 Water Demands and Planning Data

Water demands represent water that leaves the distribution system through metered or unmetered connections, or at pipe joints (leaks) or breaks. Water demands occur throughout the distribution system and typically vary based on the number and type of consumer at each location. Water demands also vary throughout the day, resulting in a diurnal demand pattern that typically includes one peak in the morning and a second in the evening. In addition, demands vary seasonally, with the peak demands usually occurring during summer months.

To analyze the City's water system, a method of allocating the demands within the distribution system is essential. One commonly used method of distributing water demands is to group water users based on their land use (or zoning). Land use can be a very good measure of water use. In addition, land-use information is readily available and can be applied to existing areas, as well as future development projects. In this method, the water demands are typically calculated using the acreage of a specified area and a water demand factor, which represents a measure of water use per acre based on the land-use type or density of the area. The resulting calculated demands represent the estimated average day demand (ADD). Water system demands for other demand periods, such as maximum day and peak hour, are then developed by applying a peaking factor to the ADD.

3.1 Historical Water Consumption

Table 3-1 summarizes the water use within the City's sphere of influence for the years 2003 to 2010. (Water use is based on City-provided flow data from the WTP.)

Table 3-1
Average Water Consumption

	Average Water Consumption	
Year	**(MGD)**	**(ac-ft/yr)**
2003	7.87	8,818
2004	8.14	9,122
2005	7.83	8,766
2006	8.41	9,425
2007	8.52	9,544
2008	8.53	9,548
2009	7.87	8,815
2010	7.19	8,052
Average	**8.05**	**9,011**

As shown by the table, water consumption through the years has varied both up and down. This is likely a result of new development and expansion, combined with the fact that the City started installing water meters in 2003. Since 2003, the City has installed meters on all single family homes, most multi-residential lots, and on larger commercial/industrial services. In most cases, however, the commercial services are not currently metered; nor are City schools. Typically, water usage decreases with water meter installation, but in the City's case this was likely offset by increased development. In addition to water conservation efforts and City expansion, other influences, such as the impacts to the housing market and the economic recession that began in late 2008, could have brought the total water consumption down.

For this Master Plan, the average water consumption from the years 2009 and 2010 will be used for establishing water demand factors for the existing system. These years were selected as they are the most recent and include the most metered flow data. **Table 3-2** summarizes the City's water use for these two years and shows that the average water use within the City's sphere of influence is about 7.53 MGD.

Table 3-2
2009 to 2010 Average Water Consumption

Year	Average Water Consumption (MGD)	Average Annual Water Consumption (ac-ft/yr)
2009	7.87	8,814
2010	7.19	8,053
Average	**7.53**	**8,434**

3.1.1 Unaccounted-for-Water

Water taken out of the distribution system at metered connections is relatively simple to measure; however, not all water that leaves the system does so at metered connections. Water that exits the distribution system and cannot be measured or accounted for is known as "unaccounted-for-water" or non-revenue water. Unaccounted-for-water is the difference between metered water production and metered water consumption, and represents "lost" water. Unaccounted-for-water occurs for a number of reasons:

- Unmetered services (Currently in the City of Brawley this is mostly commercial and schools).
- Water lost from system leaking (i.e., from pipes, valves, pumps, etc.).
- The City Fire Department performs hydrant testing to monitor the level of fire protection available throughout the City and the City Water Department performs hydrant flushing to eliminate settled sediment and ensure better water quality. Neither is metered. However, the quantity of water used is estimated and taken into consideration when calculating unaccounted-for-water.
- Water used by the Fire Department to fight fires is also not metered.

- Customer meter inaccuracies. Meters have an inherent accuracy for a specified flow range. However, flow above or below this range is usually registered at a lower rate. Meters become less accurate with time due to wear.

It is important for water models to include unaccounted-for-water in the system demands so that the total water demand will balance with the total water supply. Once the City reaches a point to where all of the system's connections are metered, then an analysis could be made to determine how the City has improved or how the City can decrease the amount of unaccounted-for-water. This may be done in advance and/or at the time of analysis by the replacement of leaking pipelines, improved meters, or refinement of accounting disparities. Based on AWWA, an acceptable range of unaccounted-for-water is somewhere between 5 to 10 percent. The California Urban Water Conservation Council recommends a complete distribution system audit if unaccounted-for-water exceeds 10%. Once the City is able to do so, it is recommended that the values be observed on a yearly basis to monitor the losses.

3.1.2 Existing Water Demands

As described in Section 3.1, the City's annual average water production is about 8,434 ac-ft/yr (7.53 MGD) for the years of 2009 and 2010. This is the value this report will use as the City's total existing average day demand.

3.2 Existing and Projected Population

Based on the Southern California Association of Governments (SCAG) 2011 Local Profile for the City of Brawley, the City's population was 24,953 people in 2010. (See **Table 3-3**.) Based on discussions with the City Planning Department, future year 2030 population projections should be taken from the City's General Plan, which projects that the City will be built out at that time and will have a population of 60,542. As the General Plan does not have projections for the year 2020, a constant rate of increase between 2010 and 2030 was assumed. Based on this, the year 2020 population projection is 42,748. The number of people per dwelling unit (population density) was 3.27 in 2010. The population density is projected to drop slightly, to 3.24 in 2030, a 1.0 percent change.

Table 3-3
Historical and Projected Population and Housing

	2010(1)	2020(2)	2030(3)
Population	24,953	42,748	60,542
Total Dwelling Units	7,623	13,059	18,686
Population/DU	3.27	3.27	3.24

(1) Per 2010 Census data for the City of Brawley (for planning purposes it is assumed this includes sphere of influence)

(2) Assuming population will reach the General Plan 2030 projections at a constant rate (includes sphere of influence)

(3) Per the General Plan 2030 (includes sphere of influence)

3.3 Land Use and Development

In the coming years, the City of Brawley anticipates new development and continued redevelopment within its sphere of influence. This expansion is expected to increase water demands. To prepare for this growth, the City will require accurate water demand projections.

Actual water demands vary from user to user, depending on many factors, but land use is one of the primary determining factors for estimating water demands. Using land use to estimate water demands is common in master planning because the information is readily available, relatively accurate, and can be used for existing areas as well as future developments.

Information on land use, including new development and redevelopment zones within the City's sphere of influence, was obtained from the City of Brawley Planning Department. **Figure 3-1** shows the City's buildout condition (Year 2030) Official Land Use Map. This map includes all the area within the City sphere of influence, both the incorporated and the unincorporated areas.

The City's land use map was developed from the City's geographic information system (GIS) database. The database includes all the individual parcels within the City's sphere of influence. It also contains specific information for each parcel, such as parcel acreage and land use designation. Parcels vary in size and range from less than one acre to several hundred acres. Based on discussions with the City's Planning Department, this map represents future land use for the Year 2030. The land use designation categories were used to distribute water demands and to establish fire flow demands.

3.3.1 Land Use Designations

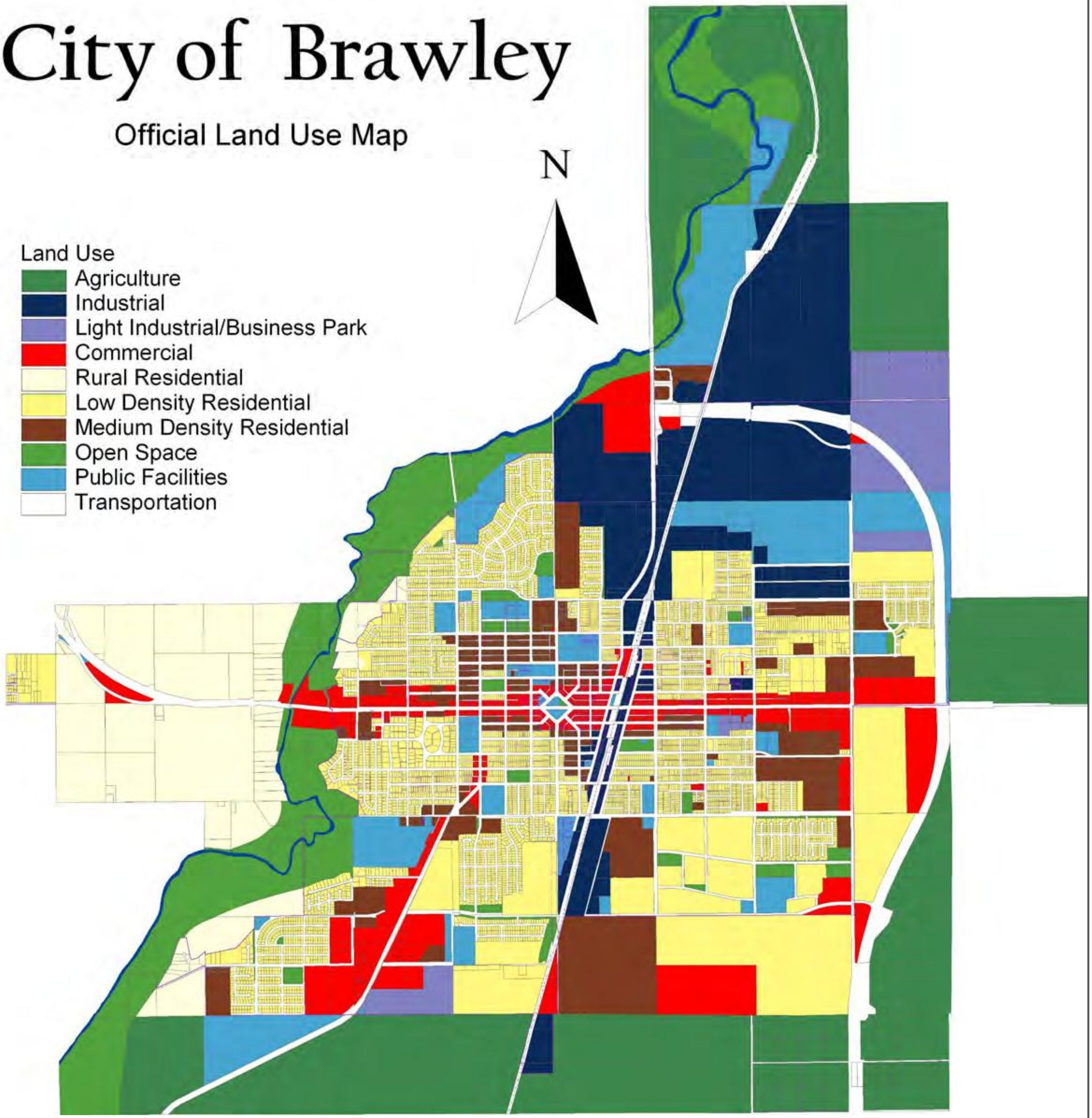
For this Master Plan analysis, land uses are divided into four broad categories or designations: residential, commercial, public facilities, and industrial.

Residential land uses are subdivided into categories that generally reflect the density of existing residential development. These subcategories include single family and multiple family. Single family residential development is characterized by those residential neighborhoods or subdivisions with detached housing intended for use by a single family. The majority of the land within the City designated as residential falls into this category. Apartments and condominium developments are included in the multiple family residential categories.

The commercial land use designation refers to a wide range of retailing, administrative, and service-related activities.

The public facilities land use designation includes a wide range of public facilities, such as government offices, fire and police stations, religious facilities, hospitals, parks, schools, and medical offices.

Industrial land uses are divided into light industrial/business and industrial. The light industrial designation allows for a range of non-manufacturing uses, such as warehousing and distribution facilities, while industrial refers to such industrial activities as manufacturing and assembly.



Map per City of Brawley Planning Dept.
Updated April 2011

Figure 3-1
Land Use Map
City of Brawley Integrated Master Plan
September 2012

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3.3.2 Existing Land Use Areas

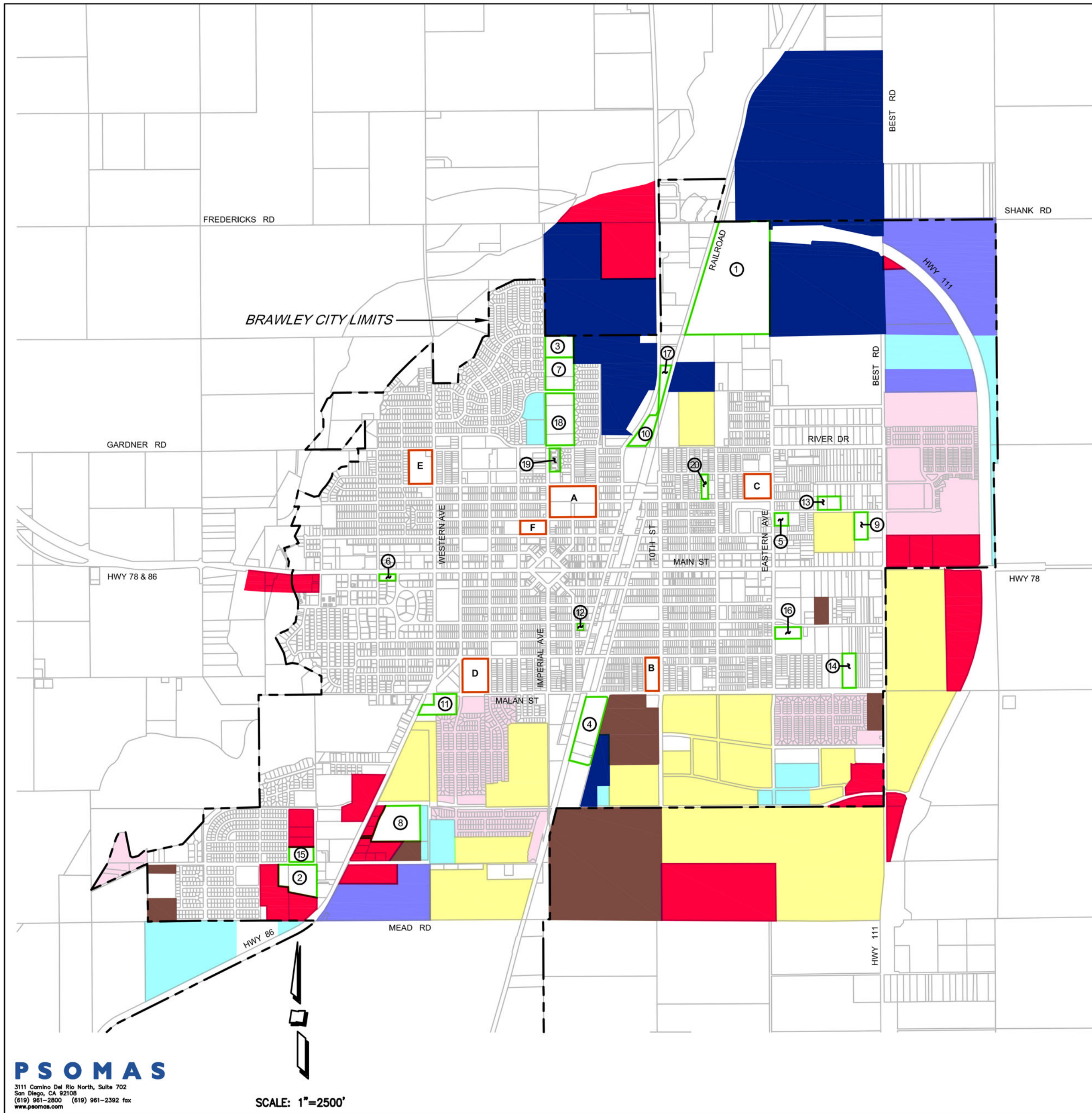
Based on the City's GIS database and the City Land Use Map, there are 5,431 acres of land within the City's sphere of influence that were considered in this Master Plan for the purposes of estimating water demands. This acreage represents both developed and undeveloped land. It does not include rural residential, open space, transportation, and agricultural land, as water demands for these land use areas were considered negligible. (Agricultural land obtains water directly from IID canals.)

To determine the existing developed versus undeveloped areas, an analysis was performed which determined locations of vacant lots as well as those areas where new developments had started, but were abandoned due to the economy. (Brawley has a number of developments in the south and east sides of town that have homes built but are not occupied.) **Figure 3-2** shows the areas that were deemed vacant or 'not developed' by land use category.

Existing land use in the City's sphere of influence is tabulated in **Table 3-4**. (Land uses presented in this Water Master Plan are solely for the purposes of estimating water demands.) About 46% of the area within the City's sphere of influence remains as vacant land (2,516 acres).

Table 3-4
Existing Land Use

General Plan Land Use Category	Sphere of Influence Total Area (Ac)	Existing Developed Area (Ac)	Vacant Area (Ac)	% Vacant by Land Use	% of Total Vacant Land
Residential					
Low Density (3 to 7 DU/Ac)	1,977	1,127	850	43%	33%
Medium Density (15 DU/Ac)	621	364	257	41%	10%
Residential Subtotal	**2,598**	**1,491**	**1,107**	**43%**	**44%**
Commercial	**704**	**349**	**355**	**50%**	**14%**
Public Facilities	**747**	**551**	**196**	**26%**	**8%**
Industrial					
Industrial	1,073	437	636	59%	25%
Light Industrial/Business	309	87	222	72%	9%
Industrial Subtotal	**1,382**	**524**	**858**	**62%**	**34%**
TOTAL	**5,431**	**2,915**	**2,516**	**46%**	**100%**



BIG WATER USERS:

# ID	USER NAME	AREA * (ACRE)
1	NATIONAL BEEF PL	96
2	PIONEER HOSPITAL	14
3	I.V. HOUSING (1250 IMP)	8
4	CROWN COOLING	18
5	SALTON VILLAGE AP	2.2
6	TRAVEL INN	1.4
7	I.V. HOUSING (950 IMP)	13
8	WALMART STORES	19
9	BRAWLEY FAMILY APT	5
10	D' ARRIGO BROS	6
11	PRIEST DEVELOP CO	8
12	DS WATERS OF AM	0.5
13	AMCAL HOUSING INC	4
14	MALAN MOBILE HOME	6
15	BRAWLEY M.O.B. LLC	4.5
16	SPRING-ENCINO APT	4
17	GREEN VALLEY FMS	3.3
18	HOUSING ATH (820 IMP)	17
19	BRAWLEY PARK IMPER	3
20	SPRING-E APT(1165 B)	2

SCHOOLS:

# ID	SCHOOL NAME	AREA* (ACRE)
A	BRAWLEY HIGH SCH	18
B	MIGUEL HIDALGO EL	6
C	OAKLEY ELEM SCH	8
D	WITTER ELEM SCH	11
E	PHIL SWING ELEM S	10
F	BARBARA WORTH JH	5

* ACREAGE ESTIMATED BASED ON GENERAL PLAN LOT LINES AND ADDRESS METER DATA; NOT TAKEN FROM RECORD INFORMATION.

LEGEND:

SYMBOL	LAND USE / DESCRIPTION
(dark blue)	INDUSTRIAL (VACANT LAND)
(light purple)	LIGHT INDUSTRIAL (VACANT LAND)
(red)	COMMERCIAL (VACANT LAND)
(yellow)	LOW DENSITY RESIDENTIAL (VACANT LAND)
(brown)	MED DENSITY RESIDENTIAL (VACANT LAND)
(cyan)	PUBLIC FACILITIES (VACANT LAND)
(dashed line)	BRAWLEY CITY LIMITS
(green outline)	BIG WATER USER
(orange outline)	SCHOOL
(pink)	PARTIALLY DEVELOPED AREA

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Figure 3-2
Vacant Land / Big Water Users / School Map
City of Brawley Integrated Master Plan
September 2012

3.3.3 Future Land Use Areas

3.3.3.1 Projected 2030 Development

As shown in **Table 3-3,** the City has 2,516 acres of vacant land, of which 44 percent is zoned for future residential development. The other large future use is Industrial, with approximately one third of the area designated for this use. All of the vacant land is projected to be developed by the year 2030, which will increase demands on the City's water system.

Due to the downturn in the economy at the end of 2008, the City has a number of new developments where construction was halted before they were completed. These developments were largely residential and located on the south and east sides of town. See **Table 3-5** for a summary of these projects and **Figure 3-3** for their locations. Some of these projects, such as Luckey Ranch, have utilities and roads constructed as well as a few unoccupied homes. The figure also shows other planned developments that likely were intended to be constructed by now, but have been delayed and/or are being reevaluated. These projects have been incorporated into the future land use projections.

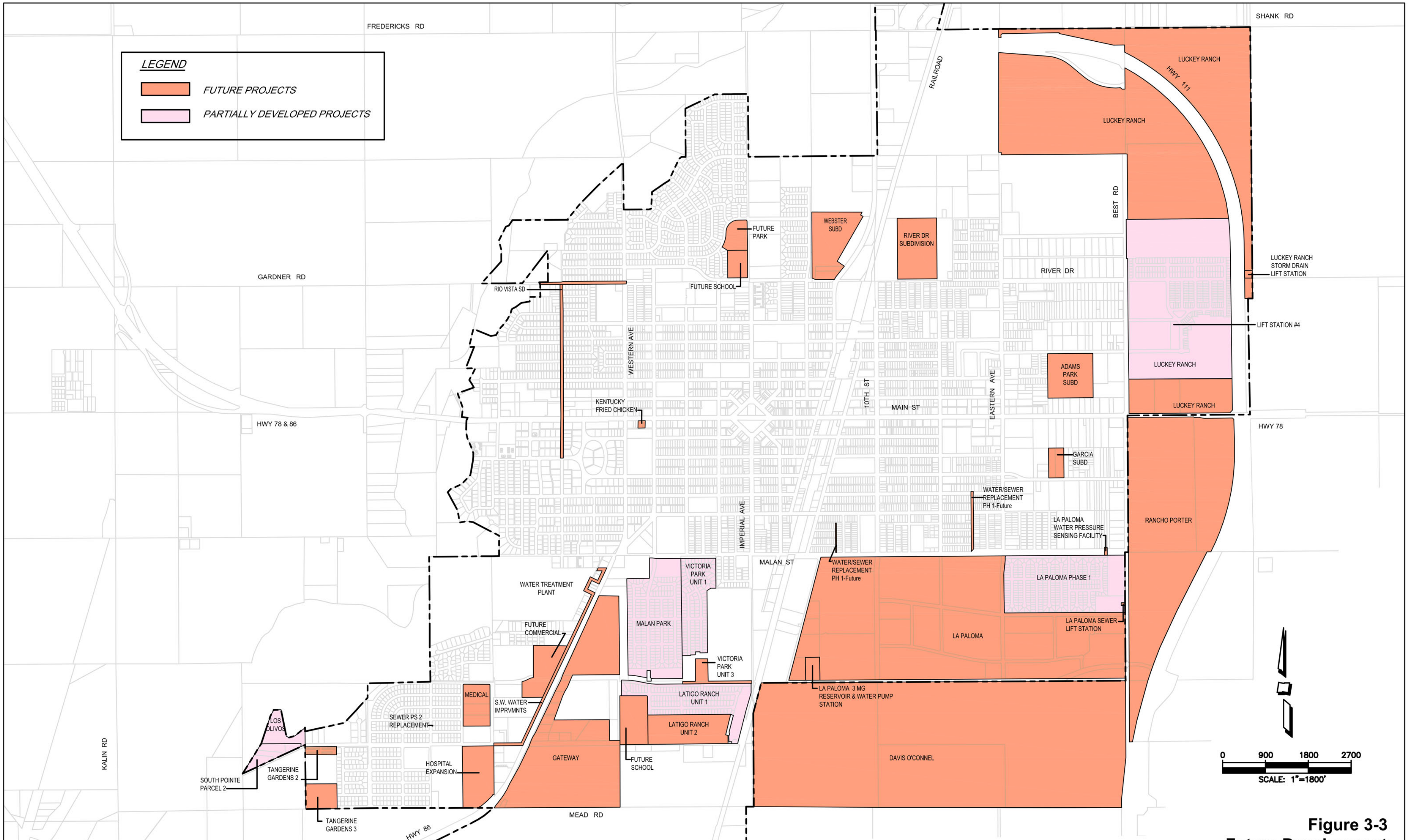

Figure 3-3
Future Development
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Table 3-5
Development Project Status

Development Name	Water System Status	Occupancy Status
Latigo Ranch Unit 1	All water facilities are installed.	Less than 20 homes occupied.
Latigo Ranch Unit 2	Not Built	N/A
Malan Park	Northern portion is built.	Northern portion is occupied.
Victoria Park Unit 1	All water facilities are installed.	About half the homes are occupied.
Victoria Park Unit 3	Not Built	N/A
La Paloma Phase 1	All water facilities are installed.	About 25 homes are occupied.
La Paloma Future Phases	Not Built. Design included 3MG Water Tank and Booster PS	N/A
Luckey Ranch	All water facilities are installed.	Not Occupied. About 20 homes are built but are vacant.
Los Olivos	All water facilities are installed.	Not Occupied.
South Point	All water facilities are installed.	Not Occupied.

The projected 2030 development areas are shown in **Table 3-6**. These areas are based on the projected 2030 buildout condition and, per the City's Planning Department, are not expected to change.

Table 3-6
Projected 2030 Land Use

General Plan Land Use Category	Projected 2030 (Sphere of Influence) Total Area (Ac)
Residential	
Low Density (3 to 7 DU/Ac)	1,977
Medium Density (15 DU/Ac)	621
Residential Subtotal	**2,598**
Commercial	**704**
Public Facilities	**747**
Industrial	
Industrial	1,073
Light Industrial/Business	309
Industrial Subtotal	**1,382**
TOTAL	**5,431**

3.3.3.2 Projected 2020 Development

In addition to the year 2030 buildout condition, this Master Plan is also evaluating the projected year 2020 development and corresponding water demands. The 2020 projected development areas are shown in **Table 3-7** and **Figure 3-4**. These areas were calculated based on the assumption that development will occur at a relatively constant rate between now and the projected 2030 buildout condition.

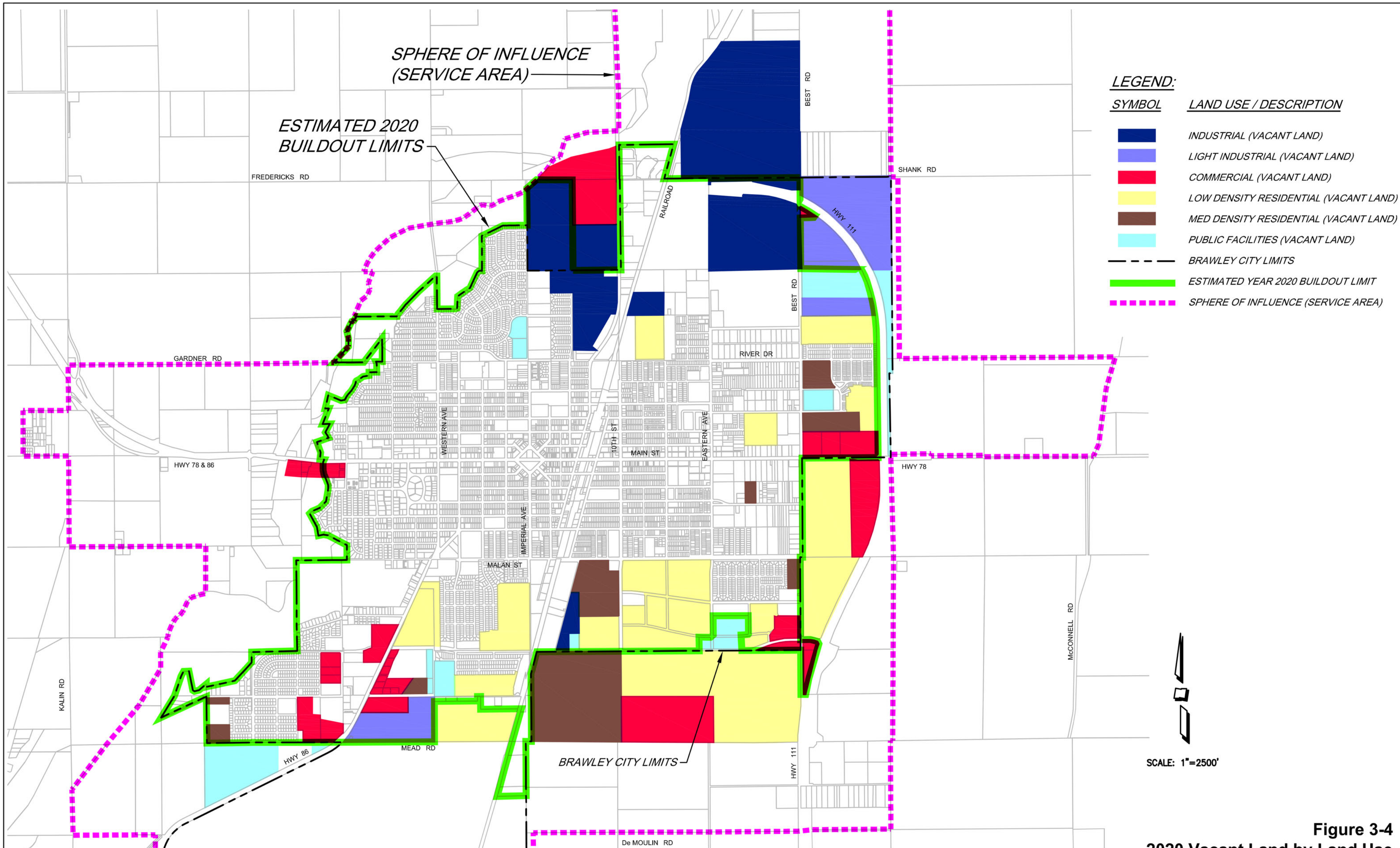

Figure 3-4
2020 Vacant Land by Land Use
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September 2012

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Table 3-7
Projected 2020 Land Use

General Plan Land Use Category	Sphere of Influence Total Area (Ac)	Projected 2020 Developed Area (Ac)	Vacant Area (Ac)	% Vacant by Land Use	% of Total Vacant Land
Residential					
Low Density (3 to 7 DU/Ac)	1,977	1,535	442	22%	32%
Medium Density (15 DU/Ac)	621	465	156	25%	11%
Residential Subtotal	**2,598**	**2,000**	**598**	**23%**	**43%**
Commercial	**704**	**508**	**196**	**28%**	**14%**
Public Facilities	**747**	**634**	**113**	**15%**	**8%**
Industrial					
Industrial	1,073	737	336	31%	24%
Light Industrial/Business	309	166	143	46%	11%
Industrial Subtotal	**1,382**	**903**	**479**	**35%**	**35%**
TOTAL	**5,431**	**4,045**	**1,386**	**26%**	**100%**

The projected 2020 developed area is 4,045 acres and the remaining vacant area is 1,386 acres. Of this vacant land, approximately 43% is zoned residential, 14% is commercial, 2 % is public, and 35% is industrial.

Although there are a multitude of possible scenarios for the proposed 2020 development condition, for simplicity, this Master Plan analysis focuses on the assumption that development will occur at a constant rate and consistently over land use types.

3.3.3.3 Future Rancho Las Lagos (Imperial) Development

The City has indicated that in the future the City may expand its water service area/sphere of influence to include a future planned development to the south in the County of Imperial. This future development is known as the Rancho Los Lagos Development, which has also sometimes been referred to as the Imperial Development. The proposed development is approximately 1,100 acres of mixed use, including residential, multifamily, commercial, and various public facilities. For this Master Plan, a separate scenario will be evaluated which includes the projected water demand from this proposed future development as well as the 2030 buildout condition. For more details on the Rancho Los Lagos development, refer to the Water Supply Assessment (WSA), dated July 15, 2008, in Appendix K of the Rancho Los Lagos development's draft EIR dated October 23, 2009.

3.3.4 Land Use Summary

Table 3-8 shows a summary of the existing and projected land use acreages for each of the planning years.

Table 3-8
Summary of Existing and Projected Land Use

General Plan Land Use Category	Existing (Ac)	2020 (Ac)	2030 (Ac)
Residential			
Low Density (3 to 7 DU/Ac)	1,127	1,535	1,977
Medium Density (15 DU/Ac)	364	465	621
Residential Subtotal	**1,491**	**2,000**	**2,598**
Commercial	**349**	**508**	**704**
Public Facilities	**551**	**634**	**747**
Industrial			
Industrial	437	737	1,073
Light Industrial/Business	87	166	309
Industrial Subtotal	**524**	**903**	**1,382**
Total Developed Area	**2,915**	**4,045**	**5,431**

3.4 Water Demand Calculations

The historical per capita consumption rate can be multiplied by population projections to estimate future water demands. However, land use-derived water demands provide a more accurate representation of the locations of increased water demands. Therefore, the water system demands within the City's sphere of influence were calculated using land use information.

The resulting water demands represent the water system demands for an average day of the year. Seasonal and daily variations in the water demands are accounted for by using various peaking factors times the ADD to simulate other demand periods. These multipliers, or peaking factors, were developed to calculate the maximum day and peak hour demands using ADD as a basis.

3.4.1 Water Demand and Factors

3.4.1.1 Existing System Water Demand and Factors

For the existing system, water demand factors were determined by evaluating a combination of historical data, metered data, and similar factors used for other similar cities. Water demand factors for residential areas, as well as the City's 20 largest users, were developed from City-provided meter data for the years 2009 and 2010.

For the low density and medium density residential demand factors, specific areas of the City were selected that had only that specific residential land use. The individual meter readings within that area were then tabulated and divided by the estimated acreage to generate an average usage per acre for each land use category. Using this methodology, the resulting water demand factors were estimated to be 2,514 gpd/acre for low density residential and 3,000 gpd/acre for medium density residential. Distributing the 2010 census population, as shown in Table 3-3, of 24,953, over an estimated total low density residential land usage of 1,127 acres and medium density residential land usage of 364 acres, equates to an average existing residential demand rate of 157 gpd per person.

In developing the demand factors, the 20 largest water users were identified, based on the metered data, and isolated out of the residential demand factor calculation described above. This was done so these large users would not skew the results and would provide a more realistic demand factor for the other existing land use areas. **Table 3-9** shows the 20 largest water users with their associated acreages and average water usage.

Table 3-9
Existing Largest Water User Demands

	Largest Water Users	Land Use	Area (ac)	Average Day Water Demand (MGD)
1	National Beef Plant	Industrial	96.0	1.620
2	Pioneer Hospital	Commercial	14.0	0.061
3	I.V. Housing Authority (1250 N. Imp.)	Medium Density Residential	8.0	0.056
4	Crown Cooling	Industrial	18.0	0.053
5	Salton Village Apartments	Medium Density Residential	2.2	0.038
6	Travel Inn	Commercial	1.4	0.028
7	I.V. Housing Authority (950 N. Imp.)	Medium Density Residential	13.0	0.027
8	Walmart Stores	Commercial	19.0	0.027
9	Brawley Family Apartments	Medium Density Residential	5.0	0.024
10	D'Arrigo Brothers	Industrial	6.0	0.019
11	Priest Development Corp.	Medium Density Residential	8.0	0.019
12	DS Water of America	Industrial	0.5	0.018
13	Amcal Housing, Inc. (1605,1623 C)	Medium Density Residential	4.0	0.018
14	Malan Mobile Home Park	Medium Density Residential	6.0	0.018
15	Brawley M.O.B, LLC (Hospital)	Commercial	4.5	0.016
16	Spring-Encino Apartments	Medium Density Residential	4.0	0.016
17	Green Valley Farms	Industrial	3.3	0.016
18	Housing Authority (820 N. Imp.)	Medium Density Residential	17.0	0.015
19	Brawley Park Imperial, LLC	Medium Density Residential	3.0	0.013
20	Spring-Encino Apartments (1165 B)	Medium Density Residential	2.0	0.012
	Totals		**235.0**	**2.115**

The schools are not metered. Therefore, current school populations were used to calculate their water demands, and their areas were isolated out of the demand factor by land use calculation as well. **Table 3-10** shows the schools with their associated acreages and average water usage.

Table 3-10
Existing School Water Demands

Schools (Public Facility Land Use)	Student Population	Area (ac)	Average Day Water Demand (MGD)
Brawley High School	1,750	18	0.035
Miguel Hidalgo Elementary	700	6	0.014
Oakley Elementary	750	8	0.015
Witter Elementary	720	11	0.014
Phil Swing Elementary	850	10	0.017
Barbara Worth Junior High	850	5	0.017
Totals		**58**	**0.112**

The metered data did not seem to provide enough consistency to be used in establishing accurate water demand factors for the commercial, public facility, industrial, and light industrial/business park land use areas. As a result, after isolating the 20 largest water users and isolating the school areas, the initial water demand factors for the subsequent land use areas were then adjusted so that the summation of all the water demands was close to the total existing demand of 7.53 MGD. These resulting demand factors are comparable to other demand factors used for similar cities in the desert when it is considered that the big users and schools are not included.

Open space, agriculture, rural residential, transportation, and vacant/undeveloped land-use areas were assigned a value of 0 gpd/ac, as these uses do not have any significant water demand. The adjusted water demand factors are shown in **Table 3-11**. The resulting average day demands, less the demands for the 20 largest users and the schools, were estimated to be 5.304 MGD.

Table 3-11
Existing Water Demand and Factors by Land Use

Land Use Type	Area (ac)	Water Demand Factor (gpd/ac)	Average Day Water Demand (MGD)
Low Density Residential	1,127	2,514	2.834
Medium Density Residential	292	3,000	0.876
Commercial	310	1,100	0.341
Public Facilities	493	1,100	0.542
Industrial	313	1,990	0.622
Light Industrial/Business Park	87	1,030	0.089
Totals	**2,622**	**--**	**5.304**

In summary, **Table 3-12** shows the total existing water demands within the City's sphere of influence, including the existing estimated water demands by land use, the existing largest water user demands, and the existing school water demands.

Table 3-12
Summary of Existing Water Demands

Existing Water Users	Area (ac)	Average Day Water Demand (MGD)
Existing Demands by Land Use	**2,622**	**5.304**
Existing Largest Users	**235**	**2.115**
Existing Schools	**58**	**0.112**
Totals	**2,915**	**7.531**

3.4.1.2 Future System Water Demands and Factors

As development and redevelopment continues, cities or agencies see a corresponding increase in population and, therefore, in water demands. Population projections for the City show an increase of about 143% percent from existing condition population of 24,953 to the 2030 buildout condition population of 60,542. The majority of the increased water demands are projected to come from new development as opposed to redevelopment.

As a result of the City's metering program, the residential demand factors have dropped over the years since the last master plan was prepared. As the City residential areas are all now metered, it is deemed reasonable that future residential demand factors will likely remain relatively unchanged. For this reason, the medium density residential demand factor used for the future conditions will remain at 3,000 gpd/ac. For the low density residential land use, a slightly higher and more conservative 2,600 gpd/ac is being used. However, for planning purposes, increasing the water demand factors for commercial, public facilities, industrial, and light industrial/business park land uses was deemed reasonable due to the numerous future development possibilities for each land use type and the other unknowns at this time.

Table 3-13 summarizes the water demand factors used for each planning year by land-use category.

Table 3-13
Estimated Water Demand Factors by Planning Year

Land-use Type	Water Demand Factor (gpd/ac)		
	2010	2020	2030
Low Density Residential	2,514	2,600	2,600
Medium Density Residential	3,000	3,000	3,000
Commercial	1,100	2,000	2,000
Public Facilities	1,100	2,000	2,000
Industrial	1,990	3,500	3,500
Light Industrial/Business Park	1,030	2,000	2,000

Future 2030 Water Demands and Factors

Table 3-14 shows the future water demands for the projected 2030 buildout condition by land use category. It is projected that an additional water demand of 6.7 MGD will be added to the system by the year 2030. This will increase the total system demand to 14.3 MGD, slightly less than double the existing demand of 7.5 MGD.

Table 3-14
Future 2030 Water Demands by Land Use

Land Use Type & Existing Users	Additional 2030 Developed Area (ac)	Water Demand Factor (gpd/ac)	Additional 2030 Average Day Water Demand (MGD)	Existing Average Day Water Demand (MGD)	Total 2030 Average Day Water Demand (MGD)
Low Density Residential	850	2,600	2.209	2.834	5.043
Medium Density Residential	257	3,000	0.770	0.876	1.646
Commercial	355	2,000	0.709	0.341	1.050
Public Facilities	196	2,000	0.392	0.542	0.934
Industrial	636	3,500	2.224	0.622	2.846
Light Industrial/Business Park	222	2,000	0.443	0.090	0.532
Existing Largest Users	--	--	--	2.115	2.115
Existing Schools	--	--	--	0.112	0.112
Totals	**2,516**	**--**	**6.747**	**7.531**	**14.278**

Future 2020 Water Demands and Factors

Table 3-15 shows the future water demands for the projected 2020 development by land use. As discussed previously, for the purposes of this Master Plan, it is projected that development will occur at a relatively constant rate between now and ultimate buildout in 2030. Therefore, the added 2020 water demands are approximately 3.1 MGD, which is slightly less than half of that projected for 2030. (It is not exactly half due to the need to arbitrarily estimate the 2020 development boundary and land use categories.)

Table 3-15
Future 2020 Water Demands by Land Use

Land Use Type & Existing Users	Additional 2020 Development Area (ac)	Water Demand Factor (gpd/ac)	Additional 2020 Average Day Water Demand (MGD)	Existing Average Day Water Demand (MGD)	Total 2020 Average Day Water Demand (MGD)
Low Density Residential	408	2,600	1.061	2.834	3.895
Medium Density Residential	101	3,000	0.303	0.876	1.179
Commercial	156	2,000	0.312	0.341	0.653
Public Facilities	83	2,000	0.166	0.542	0.708
Industrial	312	3,500	1.091	0.622	1.713
Light Industrial/Business Park	79	2,000	0.158	0.090	0.247
Existing Largest Users	--	--	--	2.115	2.115
Existing Schools	--	--	--	0.112	0.112
Totals	**1,139**	**--**	**3.090**	**7.531**	**10.621**

3.4.1.3 Rancho Los Lagos Future System Water Demands

As discussed previously, the City is considering supplying water service to the future Rancho Los Lagos development proposed south of the City's current sphere of influence. Based on data provided in the Rancho Los Lagos development draft EIR, the projected average water system demand is 3.32 MGD (2,300 gpm). Therefore, this demand added to the 2030 ADD of 14.28 MGD brings the future average day demand on the water system to 17.60 MGD.

3.4.2 Peaking Factors and Demands

Peaking factors were developed in order to determine the water demands for conditions other than an average day's water use. Peaking factors account for fluctuations in demands on a daily or hourly basis. For example, during hot summer days, water use is typically higher than on a cold and/or rainy winter day. Common peaking factors include factors for maximum day demands (MDD), peak hour demand (PHD), and minimum day demand (MinDD) periods. Peaking factors are determined using the water system demands for a selected period and dividing the quantity by the ADD. The MDD factor, for example, is determined by comparing the water demands for the day of the year with the highest daily water demand to the ADD.

Variations in water demand also occur during a 24-hour period. In residential areas, there are often two peak-use periods, in the morning and again in the late afternoon. Areas that have automatic sprinkler systems for irrigation may also see peak periods late at night through the early morning hours.

System-wide peaking factors can be difficult to determine. An hourly water use curve, known as the system diurnal curve, is often developed for water systems to help identify how demands change through the day. This curve can be used to develop hourly factors used by the computer model. The following is a discussion of the development of each of the peaking factors developed for this study.

3.4.2.1 Average Day Demand

The ADD is calculated by dividing the total annual water demand by the number of days in a year. The ADD was taken from the Years 2009 and 2010, using the metered data and WTP flows. For the City, the average annual water production for these two calendar years was used to establish the average day demand of 8,434 ac-ft/yr, resulting in an average daily production of 7.53 MGD (5,230 gpm).

3.4.2.2 Maximum Day Peaking Factor

The maximum day peaking factor represents the ratio of the largest daily demand observed in the year to the ADD for the same year. This factor can then be applied to the ADD of future planning years to project maximum day water demands. MDDs are commonly used to establish production and pumping capacity requirements system-wide.

Historical water production records for the Years 2009 and 2010 were used to establish the maximum day peaking factor. As City records provide information on total water production on a daily basis, MDDs can then be researched. **Table 3-16** summarizes the maximum day production and peaking factor for the given years. The maximum day peaking factor used for system modeling and future projections in this Master Plan is 1.5, which is an approximate average of the two years.

Table 3-16
Maximum Day Peaking Factors

Year	Maximum Day Date	Maximum Day Production (MGD)	Average Day Production (MGD)	Maximum Day Peaking Factor
2009	7/30/2009	11.49	7.87	1.46
2010	7/2/2010	11.19	7.19	1.56
		Maximum Day Peaking Factor		**1.5**

3.4.2.3 Peak Hour Peaking Factor

PHD represents the hour with the highest water system demand during the maximum day. Water systems often experience the highest demand on reservoirs and booster stations during peak hour. This period can also be the controlling demand period for pipeline sizing, although the maximum day plus fire flow demand is often more critical. Minimum water system criteria, such as the minimum allowable system pressure, are often evaluated using peak hour demands.

The peak hour peaking factor developed for the City's water system was based on peak hourly production data provided from the WTP for the Year 2010. Peak hour data from historical readings for the WTP indicate a peak hour flow of 16.9 MGD occurred on July 20, 2010. Based on this hourly demand, the peak hourly demand was determined to be 2.2 times the ADD.

3.4.2.4 Minimum Day Demand Factor

MinDDs in this Master Plan represent the lowest water system demand during the day. The minimum day demand factor developed for the City's water system was based on 2010 production data provided from the WTP. Based on this data, the minimum day demand was determined to be 0.2 times the ADD.

3.4.2.5 Existing System Peaking Factors and Demand Summary

The average water demand for the City's water system is currently 7.53 MGD. Using the maximum day peaking factor of 1.5, the MDD for the existing system is 11.3 MGD. For the PHD, a peaking factor of 2.2 times ADD results in peak hour flows of 16.56 MGD. **Table 3-17** summarizes the resulting peaking factors and existing system demands for average day, maximum day, peak hour, and minimum day demand.

Table 3-17
Existing System Peaking Factors and Demands

Simulation Period	Peaking Factor	Existing System Demand (MGD)	(gpm)
Average Day Demands	-	7.53	5,230
Maximum Day Demands	1.5	11.30	7,850
Peak Hour Demands	2.2	16.56	11,500
Minimum Day Demands	0.2	1.51	1,050

3.4.2.6 Future System Peaking Factors and Demand Summary

Table 3-18 summarizes the projected water system demands for average, maximum, peak hour, and minimum day demand periods, including with and without the Rancho Los Lagos water system demand.

Table 3-18
Future System Peaking Factors and Demands

Simulation Period	Peaking Factor	2020 System Demand (MGD)	2030 System Demand w/o Rancho Los Lagos (MGD)	2030 System Demand with Rancho Los Lagos (MGD) (1)
Average Day Demands	-	10.62	14.28	17.6
Maximum Day Demands	1.5	15.93	21.42	26.4
Peak Hour Demands	2.2	23.36	31.41	38.72
Minimum Day Demands	0.2	2.12	2.86	3.52

(1) For modeling and CIP purposes, Rancho Los Lagos is only being evaluated in the PHD and fire flow condition.

3.5 Fire Flow Requirements

In addition to providing adequate water supply and pressure to serve residential, commercial, public, and industrial water demands placed on the system, the water system must also deliver an adequate supply for firefighting. Since fires can occur at any time, the water system must be capable of providing the required flow with an adequate residual pressure. The water system should be capable of providing the fire flow during the day of the year with the highest water demands, MDD.

To determine the capability of the system to provide adequate fire flows, it was necessary to establish minimum fire flow demand requirements to be applied to various locations throughout the distribution system, as well as a minimum residual and system pressure. In master planning, the fire flow demands are usually based on the type of land use in the area of the fire flow.

The fire flow requirements are summarized in **Table 3-19**. The criteria listed were developed based on local codes, criteria used in other similar agencies, and previous discussions with City of Brawley Fire Department.

Table 3-19
Fire Flow Requirements

Land Use Category	Minimum Fire Flow Required (gpm)	Minimum Residual Pressure (psi)	Duration (hrs)
Low Density Residential	1500	20	2
Medium Density Residential	2500	20	2
Commercial/Public/Light Industrial and Business Park	3000	20	3
Industrial	5000	20	4
Beef Plant/Hospital	6000	20	4

4.0 Water Supply

Historical Potable Water Production

Potable water production is measured by the WTP metered flows. Historical potable water production for 8 years, 2003 through 2010, was shown previously in Table 3-1. The total supply is regulated only by the total amount of water that can be treated and pumped at the WTP.

As shown in Table 3-2 the City provides an average annual water supply of 8,434 ac-ft/yr, (7.53 MGD) to meet water system demands.

4.1 City Water Supplies

4.1.1 IID Current Agreement and Redundant Supply

The City of Brawley has a long standing agreement with IID to provide raw water to the City via the Colorado River and the All American Canal. From the All American Canal, water flows through various IID-owned and operated canals, including the Mansfield Canal, which delivers raw water directly to the City of Brawley Water Treatment Plant. The Mansfield Canal has a capacity of 19 MGD. The City does not have a redundant supply of raw water.

4.2 Future Water Supply Sources

Currently, there are no practical alternative water supplies for the City. The local groundwater is high in Total Dissolved Solids (TDS) and other agricultural pollutants. The New and Alamo Rivers also are high in TDS and pollutants. There are no other sources of new water available to the City in the foreseeable future. Accordingly, the City is entirely dependent on IID for their water supplies. However, since the municipal demands only account for around 3 percent of IID’s total demand, even major impacts to the Colorado River supplies would not have a significant impact on municipal supplies. The City’s 2010 Urban Water Management Plan describes IID’s significant water rights to the Colorado supply and states it is doubtful that any drought-related cutbacks would impact municipal supplies.

4.2.1 Water Conservation

The City has recently completed installing meters on all domestic services and many commercial and industrial users. This has resulted in apparent reduction in water usage, lowering the per capita demands. This could be due to an increased awareness by the users and the associated costs from excessive or wasteful usage. As shown in Section 3.4.1.1, the City’s current per capita usage is estimated to be 157 gpcd. This is a 40% per capita reduction from the 259 gpcd used in the 1999 Water Master Plan.

4.2.2 Water Shortage Response Plan

The City of Brawley as water purveyor must provide reliable potable water to the City at all times. They have developed a water shortage response plan designed to provide a minimum of 50% of normal supply during a severe or extended water shortage. **Table 4-1** summarizes the stages, triggering mechanisms and reduction goals.

Table 4-1
Water Shortage Stages and Reduction Goals

Percent Reduction of Supply	Stage I Up to 15%	Stage II 15 – 25%	Stage III 25 – 35%	Stage IV – 35 – 50%>
Condition				
Supply	Projected supply insufficient to provide 80% of normal demand	Projected supply insufficient to provide 75% of normal demand	Projected supply insufficient to provide 65% of normal demand	Projected supply insufficient to provide 50% of normal demand
Water Quality	Contamination of 10% of water supply	Contamination of 20% of water supply	Contamination of 30% of water supply	Contamination of 40% of water supply
Type of Rationing Program	Voluntary	Mandatory	Mandatory	Mandatory

4.3 Water Quality

4.3.1 Chlorine Residual Tests

Data from the City shows that over the last five (5) years the chlorine residual is typically between 1.13 MG/L to 1.19 MG/L, meeting current water standards. See Appendix C for the City's chlorine residual test data. The City has six (6) sampling stations and ten (10) sampling sites from either hydrants or spigots. The following lists their locations:

Sampling Stations

1. W. H Street Between Sycamore Drive and S. Rio Vista Avenue
2. Rio Vista Avenue and Cattle Call Drive
3. West G Street and S. Western Avenue
4. NW corner of S. 9th Street and Malan Street
5. SW corner of S. 9th Street and Malan Street
6. S. Cesar Chavez Street and K Street

Sampling Sites

1. Cattle Call Drive & Rio Vista Avenue Hydrant
2. South 9th Street & H Street Hydrant
3. North 5th Street & Magnolia Street Hydrant
4. 1656 River Drive Hydrant
5. Pioneers Memorial Hospital
6. Hidalgo School
7. Imperial Oasis, 590 West Main Street
8. Witter School
9. Brawley Auto Body, 1667 Main Street
10. Imperial Valley Apts., 694 N. 3rd Street
11. 3.0 MG tank, 1515 Jones Street
12. Police Department

5.0 Hydraulic Computer Model Development

5.1 Planning and Design Criteria Summary

Table 5-1 provides a summary of the planning and design criteria used for developing and analyzing the water system.

Table 5-1
Water Planning and Design Criteria Summary

	Evaluation Condition	Value	Unit
System Pressure			
Static	Static	60	psi
Peak Hour	PHD	40	psi
Max Day plus Fire	MDD	20	psi
Pipeline Velocity			
Average Day	Maximum Desired	5	fps
	Deficient	Over 7	fps
Peak Hour	Maximum Desired	7	fps
	Deficient	Over 10	fps
Max Day plus Fire	Maximum Desired	15	fps
	Deficient	Over 15	fps
Existing Water Demand Factors			
Low Density Residential		2,514	gpd/ac
Medium Density Residential		3,000	gpd/ac
Commercial/Public		1,100	gpd/ac
Light Industrial/Business Park		1,030	gpd/ac
Industrial		1,990	gpd/ac
Future Water Demand Factors			
Low Density Residential		2,600	gpd/ac
Medium Density Residential		3,000	gpd/ac
Commercial/Public		2,000	gpd/ac
Light Industrial/Business Park		2,000	gpd/ac
Industrial		3,500	gpd/ac
Peaking Factors			
Peak Hour	PHD	2.2	
Max Day	MDD	1.5	
Minimum Day	MinDD	0.2	

	Evaluation Condition	Value	Unit
Fire Flow Requirements			
Low Density Residential	MDD	1,500	gpm for 2 hours
Medium Density Residential	MDD	2,500	gpm for 2 hours
Commercial/Public	MDD	3,000	gpm for 3 hours
Light Industrial/Business Park	MDD	3,000	gpm for 3 hours
Industrial	MDD	5,000	gpm for 4hours
Beef Plant/Hospital	MDD	6,000	gpm for 4 hours
Treated Water Storage			
Operational	MDD	30%	Gallons
Fire Flow	Largest Fire	6,000	gpm for 4 hours
Emergency	MDD	100%	Gallons
Raw Water Storage			
Emergency	ADD	6 days	MG

5.2 Hydraulic Model

The model development and analysis for this 2012 Master Plan is being completed primarily within the computer modeling software "InfoWater", with the final model deliverables being exported to EPANet files for the City's use. To develop the current hydraulic model, initially the previous 1999 water model was imported into InfoWater and then edits were made to it to reflect changes that have occurred to the water system since 1999.

5.3 Previous Computer Model

The City's previous hydraulic model, completed by Weston and Pountney Associates in 1999, was developed and calibrated in a water modeling software called Cybernet. The vendor providing this software was Haestad Methods, Inc. The base platform of the City's previous hydraulic model was AutoCAD, with very little reference to GIS.

For this Master Plan, the City elected to leverage GIS by utilizing a hydraulic model that incorporates GIS features into the hydraulic model analyses. The roughness coefficients from the 1999 hydraulic model were used as a baseline value for the new hydraulic model. These values were adjusted based on current field testing and calibration efforts.

5.4 Hydraulic Model Software Program

Innovyze, Inc., has captured a large market share in Southern California and promotes the water modeling software brands H_2ONET®, H_2OMAP Water, and InfoWater. For the City's purposes in hydraulic modeling, Innovyze's InfoWater software was selected for evaluating the water distribution system.

5.5 Model Development

5.5.1 General

As a first step in updating the existing model, water facilities that were included in the 1999 water hydraulic model were imported into the new model. Once this was accomplished, the model was then edited to include any new facilities installed since 1999. Generally, this work included discussions with City staff to determine what projects had been constructed after 1999 and then reviewing as-built drawings to determine what and where facilities had been installed, replaced, or taken out of service. In some cases, the as-built data was available as AutoCAD files, but in many instances the development project data was provided as PDF files. Facilities added from a PDF should be considered an approximation of the field location. Ideally, all future facilities added will be from a source such as AutoCAD or GIS that is consistent with a coordinate system. If needed, adjustments were made to the location of the pipes and nodes in order to correspond better to a real-world coordinate system.

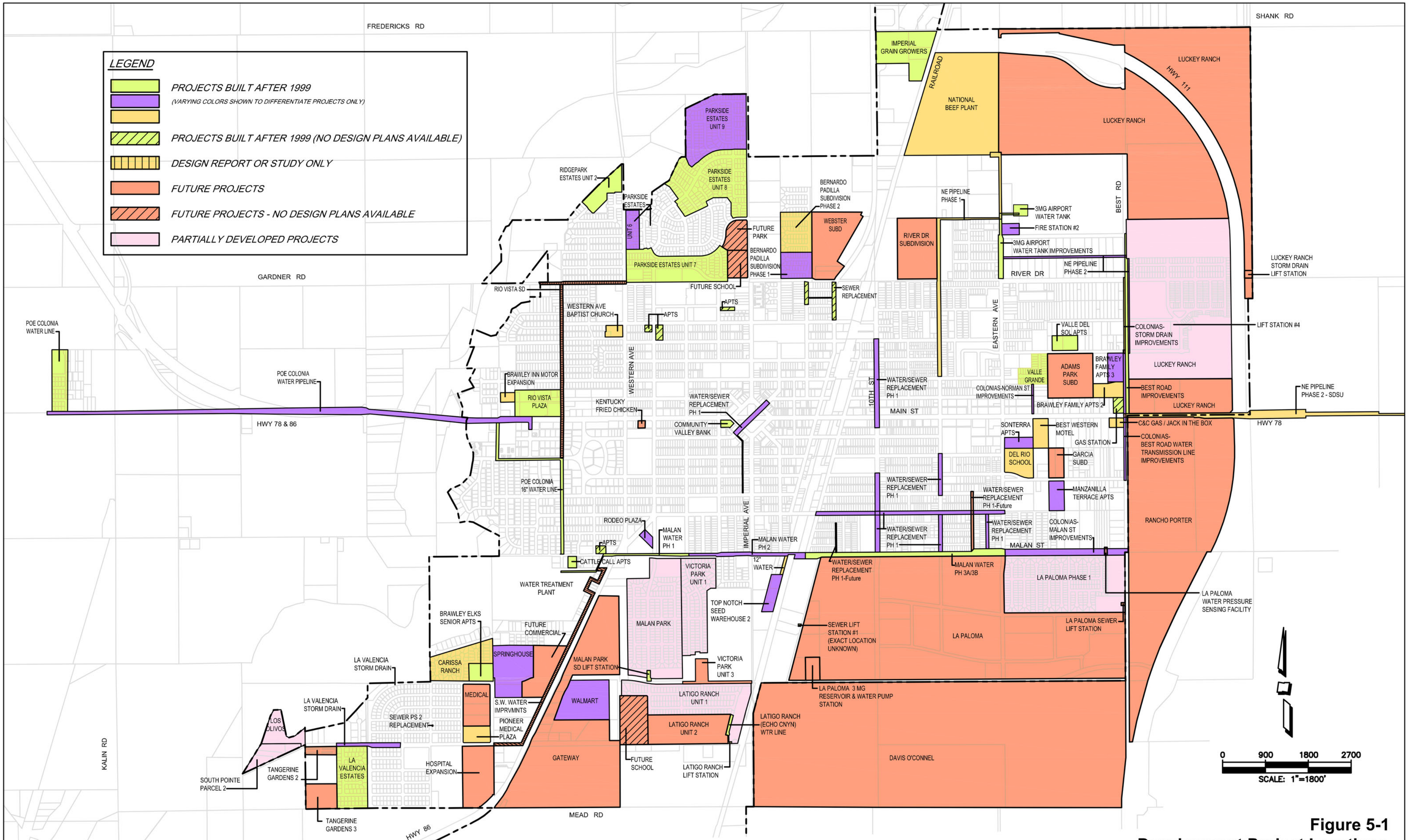
An exhibit with all of the developments/facilities added to the model is included as **Figure 5-1.** See **Figure 2-1** (included in pocket at the back of the report) for the overall existing water infrastructure map.

5.5.2 Reservoirs

For modeling purposes, the two treated water clearwells located at the WTP were modeled as a single open reservoir with an overflow HGL of -97.2 ft. The ground surface elevation at the plant is -121.2 ft.

A second storage facility, the Airport (Jones) Tank is located in the northeast portion of the City. The Airport Pump Station pumps from the Airport Tank during peak demand periods to maintain pressures within the system. The ground elevation at the Airport Tank and Pump Station location is -127 ft. The maximum tank level is 29.3 ft., resulting in an overflow elevation of -97.7 ft.

An altitude valve on the inlet of the Airport Tank closes and opens based on the water level in the tank. The City operates this tank and pump station manually, so for modeling purposes, controls were assumed for these facilities. An operating range of ten (10) feet was assumed for the tank, so that the altitude valve opens when the Airport Tank drains ten (10) feet and closes when the tank is full.



PSOMAS
3111 Camino Del Rio North, Suite 702
San Diego, CA 92108
(619) 961-2800 (619) 961-2392 fax
www.psomas.com

Figure 5-1
Development Project Locations
City of Brawley Integrated Master Plan
September 2012

5.5.3 Pump Stations

The pumps at the Water Treatment Plant (WTP) and Airport Pump Station were entered in the model with multi-point curves taken from the original pump design data. The same curve was used for the five (5) WTP pumps and a different curve for each of the three (3) Airport pumps. There are four (4) variable frequency drive (VFD) pumps at the WTP and one (1) constant speed pump. The pumps and their design points are summarized in **Table 5-2**. **Figures 5-2** and **5-3** show the curves used in the model for the WTP pumps and the Airport Pump Station pumps.

Table 5-2
Summary of Pump Data

Pump ID	Variable or Constant Speed	Total Design Head (ft)	Design Flow (gpm)
FWP-421 (WTP)	Variable	155	4,000
FWP-422 (WTP)	Variable	155	4,000
FWP-423 (WTP)	Variable	155	4,000
FWP-424 (WTP)	Variable	155	4,000
FWP-425 (WTP)	Constant	155	4,000
PMP-B-1 (Airport PS)	Constant	140	1,600
PMP-B-2 (Airport PS)	Constant	140	1,600
PMP-B-3 (Airport PS)	Constant	140	1,600

Figure 5-2
WTP Pump Station Curve

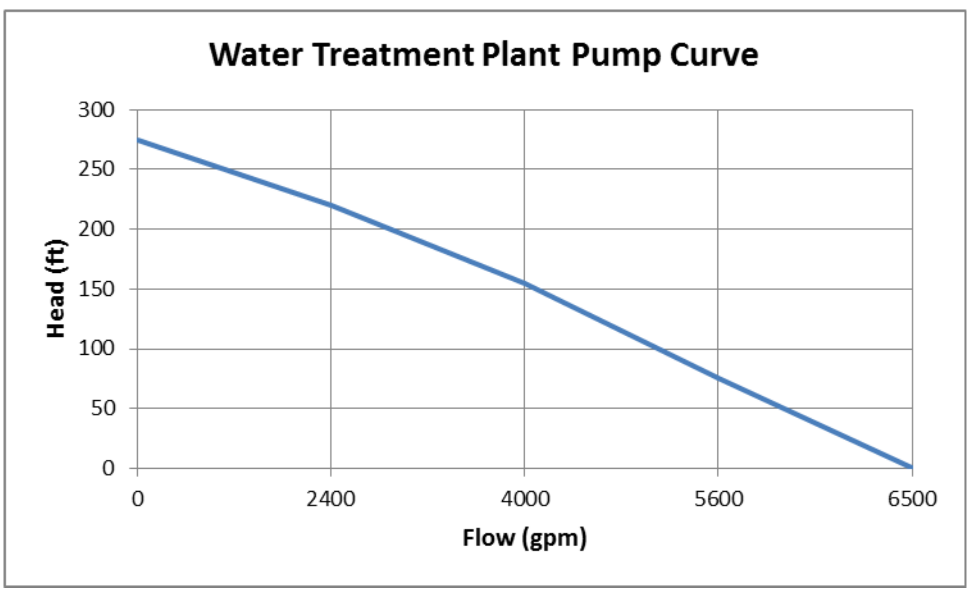
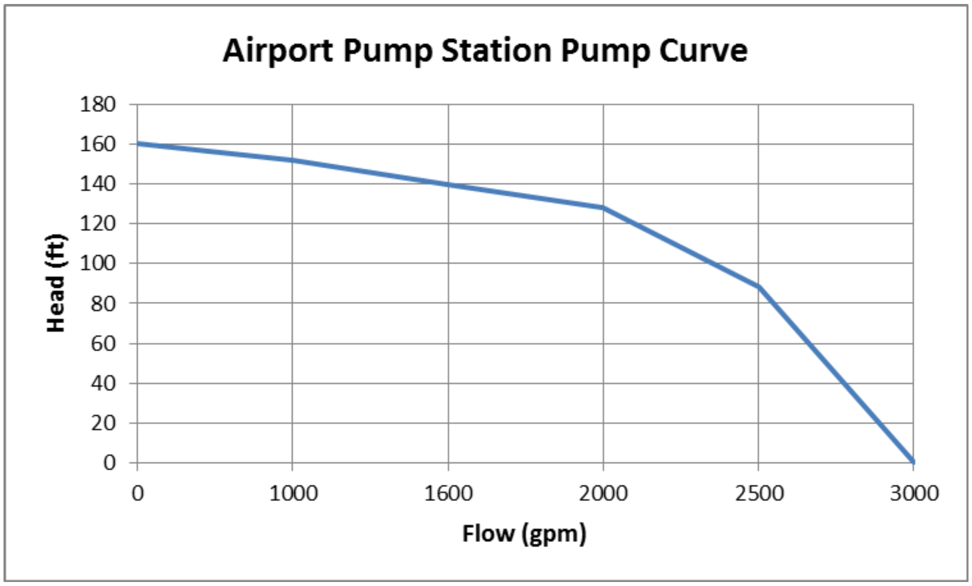


Figure 5-3
Airport Pump Station Curve



5.5.4 Pipes and Junctions

Figure 2-1, located in a pocket at the back of this report, shows the existing water system facilities, including pipe diameter. Model junctions (nodes) are shown wherever two or more pipes come together. Appurtenances, such as hydrants and valves, were not added to the model, although this may be something that the City will want to do in the future, depending on different types of hydraulic analyses they would like to perform and how the model may be used in the future.

The converted water model did not have a coordinate system or spatial projection associated with it. GIS processing and manual adjustments were made to the point features (model nodes) in order to bring them closer in alignment with other layers in the City's geodatabase, as well as attain closer association with real-world coordinates. This was necessary for the purposes of assigning elevations, water demand allocation, and improved consistency with other data sources.

It is important to note that, while the hydraulic model junctions are more closely associated with a spatial projection and real-world coordinate system, there are still some minor differences between the field locations of facilities and the model representation of those same facilities. In the future, the City may want to further update the model facilities to reflect actual field locations of all facilities, by survey methods.

The source for the elevation data used in the model is the USGS National Elevation Dataset (NED). The vertical datum is the North American Vertical Datum of 1988. The horizontal coordinate system is State Plan 1983, California Zone 5. Elevations within the City's sphere of influence are below sea level and, therefore, negative elevations, ranging from -150 to -100 ft. The model has been updated with these elevations. Elevations at the WTP storage and pump stations are based on information provided by City staff.

Elevations at the Airport Tank and Pump Station are based on the USGS elevation data. It should be noted, however, that many elevations on various City construction plans show positive elevations, indicating that 500 to 1,000 feet has been added to the actual elevation to make the number positive and easier to understand. Unfortunately, there has been no standard bench mark conversion adopted within the City and as a result, without additional surveys, ground elevations cannot be verified. For this report, many ground elevations were extrapolated from other data and should be considered approximations.

5.5.5 Operational Data

The operational data included in the model are the controls for the pumps and the Airport Tank altitude valve (modeled as a throttle control valve). The five (5) pumps at the Water Treatment Plant all operate based on pressure in the system. In the field, pressures between 55 and 60 psi at two (2) pressure sensing stations (Malan Street/Old Hwy 111 and River Drive/Pater Street) are used to control when the booster pumps at the WTP turn on and off, as well as when the speed changes for the two variable speed pumps. For modeling purposes a pressure range between 50 and 60 psi at the Malan Street location is used to control the operation of the pumps (i.e., pumps turn on when pressure drops below 50 psi and turn off above 60 psi).

The pumps at the Airport Pump Station are operated manually in the field, although used minimally. For modeling purposes, a single pump was operated for those scenarios where the Airport Tank and Pump Station were active.

5.5.6 Water Demands and Allocation

Water use factors, expressed as average rate in gpd/acre, were developed for each land use type. The water use factors were used for developing and allocating the average day water demands to the water distribution system model. As described in Chapter 3, in general, the water use factors were developed based on historical meter data by customer class. Water demands for large users and schools were developed and allocated separately.

In developing the model, the demands for large users and schools were first applied to the nearest model junction based on the service address. A GIS process was then utilized to develop water demands for each parcel by multiplying the parcel acreage by the associated water use factor according to the land use of each parcel.

The centroid of each parcel was associated with the nearest model junction. The demand per parcel was then assigned to the associated model junctions for the system-wide model demand allocation. A similar process was completed for the existing land use scenario and for 2020 and 2030 scenarios assigning demands to vacant parcels slated for development in the future. The water demands assigned to the model were verified against historical total production from the treatment plant for 2009 and 2010.

Due to their insignificant water demand, parcels with a land use of natural open space, agriculture, transportation, or rural residential were excluded from the parcels for which water demands were calculated. The parcels associated with existing large users and schools were also excluded from demand calculations by parcel area, since those customers had point demands assigned based on historical meter data for each of those customers, with the exception of schools which were projected.

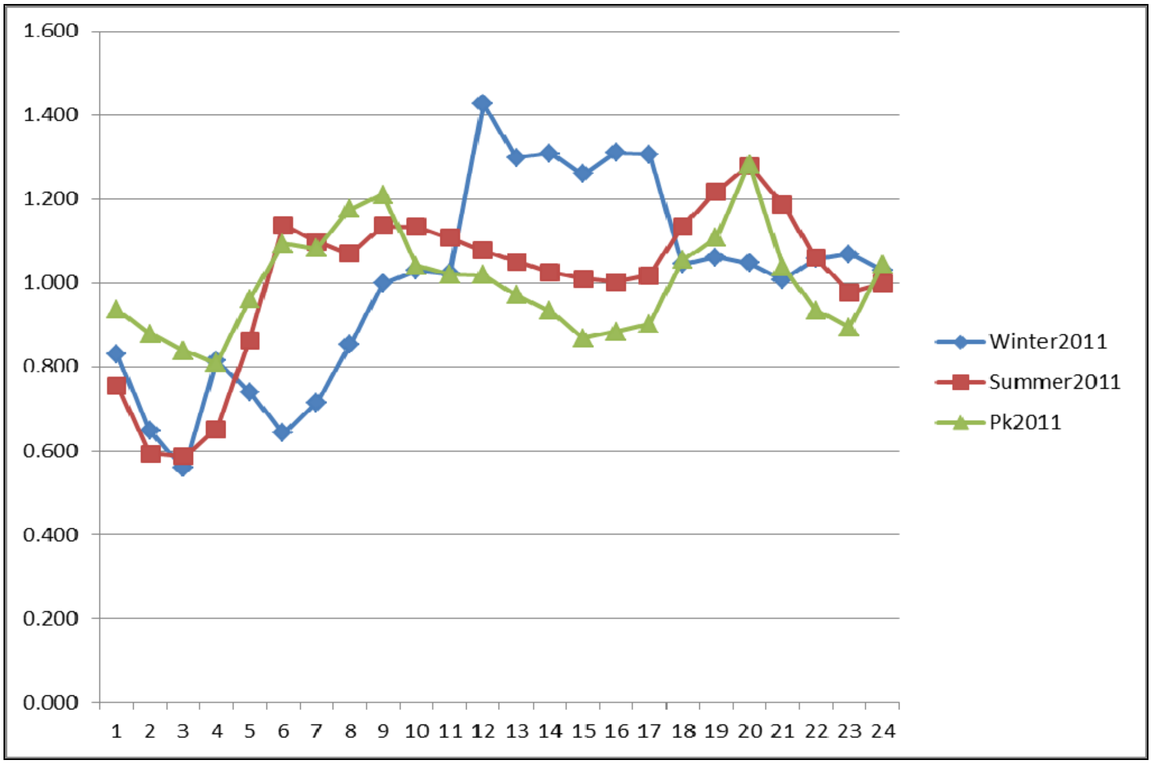
5.5.7 Diurnal Curve Development

Hourly flows from the WTP finished water storage for a 24-hour period were used to develop diurnal curves for the City's sphere of influence. Two diurnal curves were developed and loaded to the model: one for maximum day demand conditions and one for average day demand conditions. The diurnal curve developed for the City is shown in **Figure 5-4** and shows a typical pattern of higher usage in early to mid-morning and again in late afternoon to evening.

It is important to note that this hourly data shows the pattern for flows for the finished water storage, but does not provide a clear indication of water demands by different customer classes within the system. In order to develop more accurate diurnal curves that accurately reflect customer usage throughout the system, it would be necessary to have hourly data for all of the facilities within the system in order to determine the total mass balance.

It can sometimes be preferable to develop different diurnal curves for different types of land use, since water use patterns can have a noticeable variation, especially when comparing commercial and industrial customers with residential customers, for example. It is necessary for there to be sufficient data to develop land use specific diurnal curves, which is not the case for Brawley at this time. The City's system-wide water use is considered uniform enough for a single demand pattern to be used. **Figure 5-4** shows the diurnal curves developed from the WTP data and used for the EPS demand data sets and scenarios in the model.

Figure 5-4
Diurnal Curves



5.5.8 Scenario Development

The water distribution model was developed with multiple scenarios and datasets. Unique scenarios were created for the specific analyses completed for the Master Plan that include existing and future facilities, various demand conditions, and operational conditions. The future scenarios and associated datasets are for the year 2020 and year 2030 planned level of development. The year 2030 service area is a buildout condition that includes the City's entire planned service area, the demands associated with this buildout condition, and a proposed backbone piping layout. The year 2020 scenario is a reduced service area and demands compared to the year 2030 scenario.

The year 2030 conditions also had unique scenarios with and without the Rancho Los Lagos Development (Imperial Development), south of the City's planned service area. It is unknown at this time whether the City will provide water service to this customer and, therefore, the system analyses evaluated both conditions.

In addition to the scenario development based on existing and future development conditions, unique scenarios were created for the peak hour demand conditions, maximum day demands, fire flow, and water age with average day demands. The peak hour and fire flow analyses were modeled as a steady state simulation and the water age analysis was evaluated as a 28-day extended period simulation (EPS). The water age analysis was evaluated for existing average day demand conditions only, while peak hour and fire flow analyses were run for existing and future development conditions. An EPS maximum day demand scenario was run for existing system conditions to evaluate operational conditions over a 72-hour time period.

Table 5-3 provides a summary of the model scenarios and description of each. There were several other scenarios that were developed and used within InfoWater for the purposes of the Master Plan, but only those scenarios exported to EPANet are summarized in the table below. There are several unique data sets created in InfoWater for demands, controls, patterns, and pipes, but since EPANet does not use this type of database structure, a summary of those unique data sets are not included herein.

Table 5-3
Summary of Hydraulic Model Scenarios

Model Scenario	Description
Existing System	
EX_ADD_WATERAGE	Water age scenario with existing average day demand
EX_MDD_EPS	Extended period simulation with existing maximum day demand
EX_MDD_FF	Steady state fire flow analysis with existing maximum day demand
EX_PHD_SS	Steady state existing peak hour demand
Future System	
FUT_2020_MDD_FF	Year 2020 steady state fire flow scenario with maximum day demands
FUT_2020_PHD	Year 2020 steady state peak hour demand
FUT_2030_FF_IMPDEV	Year 2030 steady state fire flow with maximum day demand and the Imperial Development (Los Lagos)
FUT_2030_FF_NOIMPDEV	Year 2030 steady state fire flow with maximum day demand and no Imperial Development (Los Lagos)
FUT_2030_PHD_IMPDEV	Year 2030 steady state peak hour demand with the Imperial Development (Los Lagos)
FUT_2030_PHD_NOIMPDEV	Year 2030 steady state peak hour demand with no Imperial Development (Los Lagos)

5.6 Model Validation

Only limited water system data was available for the City’s water system facilities (primarily at the WTP); therefore, a detailed model calibration was not possible.

However, model validation was completed utilizing pressure readings at the two pressure sensing stations within the distribution system, as well as an operational knowledge of how the pumps and storage tank typically operate. Some historical fire flow test data was also available, although it was unknown what was occurring at all facilities within the system while the tests were conducted, nor the time of day when the tests were completed, so it was used only as a general guideline.

Model validation of the water hydraulic model was completed for both the steady state and extended period simulation scenarios with existing demand conditions. The hydraulic model results were compared to historical field conditions to ensure the model is representing the actual system with a reliable degree of accuracy.

The following subsections describe the steady state and extended period simulation model validation. It is typically preferable to use the hydraulic grade line (HGL) for model calibration and validation, so both pressure and HGL of model and field results were compared.

5.6.1 Steady State Validation

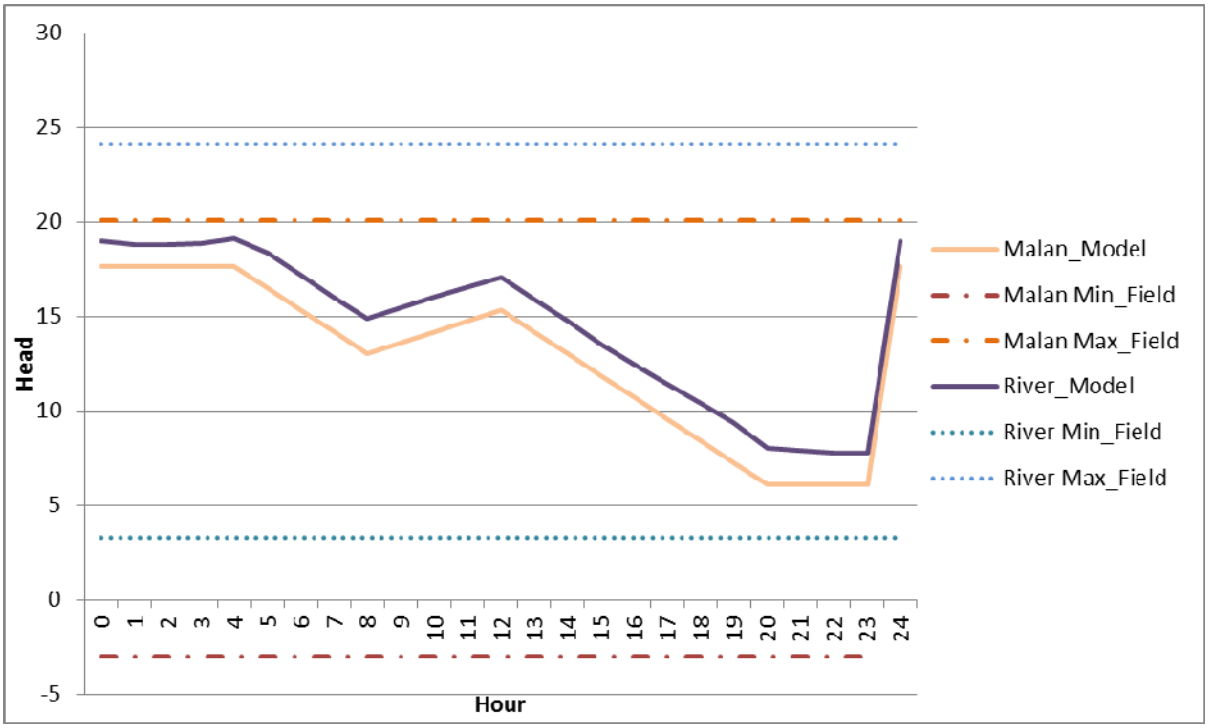
The City conducted hydrant fire flow tests on June 16, 2011, at five (5) locations. The hydrant tests were used for steady state calibration of the water hydraulic model. There are also two pressure sensing stations within the system (Malan Street/Old Hwy 111 and River Drive/Pater Street) that were used to compare field results to the model results. At both locations, the model results were within 2 psi of the field results and both model and field results operate within a 55 to 60 psi range.

5.6.2 Extended Period Simulation Validation

The City has some SCADA data (recorded data) available for the finished water tank levels and pump flows which were used as a guideline for pump and tank operation. There were no operational controls available for either pump station within the system, so several assumptions were made based on known operating conditions and the response of the system under various modeled scenarios.

Since hourly pressure readings were not available at the two pressure sensing stations on Malan Street and River Drive, the minimum and maximum HGL over time was used to compare to the model HGL at these two locations. **Figure 5-5** shows the model results for the HGL at the two pressure sensing stations for a 24-hour simulation, with the minimum and maximum HGL at both pressure sensing stations from the field data. The model is operating within the range of HGLs recorded in the field at both locations. The pressures at these two locations are between 50 and 60 psi for the EPS model simulations, which is consistent with field results.

Figure 5-5
Comparison of Model and Field HGL at the Pressure Sensing Stations



6.0 Water Distribution System Analysis

In master planning, the computer model assists in measuring system performance, analyzing operational improvements, and developing a systematic method of determining the size and timing required for new facilities. The calibrated model can be used to analyze existing water systems, future water systems, or even specific improvements to the existing water system. By analyzing numerous scenarios relatively quickly and easily, the model provides answers to many "what if" questions. The computer program analyzes all of the information in the system data file and generates results in terms of pressures, flow rates, and operating status. The key to the use of the computer model is correctly interpreting these results and understanding how the water distribution system is affected.

6.1 Model Simulations

The hydraulic computer model was used to simulate the existing and future water distribution system in an effort to identify deficiencies that might occur under selected conditions. Table 6-1 identifies the model simulations that were conducted for this project and lists the demand set that was used for each scenario, as well as the operational control set.

Table 6-1
Model Simulations

Simulation	Existing	2020	2030 w/o Los Lagos	2030 with Los Lagos	Duration	Demands
Average Day	X	X	X		Steady State	ADD
Maximum Day plus Fire	X	X	X	X	Steady State	MDD
Peak Hour	X	X	X	X	Steady State	PHD
EPS Water Age	X				24 Hours	ADD
EPS - Typical	X				24 Hours	MDD

6.2 Modeling Results

The existing system analyses included peak hour and fire flow evaluations under steady state conditions, which is an instantaneous 'snap-shot' of what is occurring in the system. Extended period simulations (EPS) were used to evaluate conditions over a period of time. EPS analyses were conducted for existing maximum day demand (MDD) conditions and for existing water age at average day demand conditions.

Future system analyses evaluated development conditions for year 2020 and year 2030. Year 2030 development is considered a buildout condition with most of the growth occurring east and south of the existing development. The year 2020 development uses a percentage of the area of the undeveloped parcels to estimate an intermediate growth level.

Analyses for the future system development included peak hour and fire flow steady state evaluations. A separate analysis evaluated a year 2030 condition with the Imperial Development included to the south. Initial piping sizes for the future pipe grid were primarily 8 inches.

Model results were compared to the desired service criteria in order to evaluate system deficiencies. Pipe velocities between 7 and 10 ft/sec are considered questionable and pipes with velocities greater than 10 ft/sec are considered critical. The minimum service pressure criterion is 40 psi. (See Appendix G for the Existing and Future Model Data.)

6.2.1 Existing System Analysis

6.2.1.1 Peak Hour Analysis

Service pressures and velocities were evaluated with the peak hour demand (PHD) condition to ensure that the distribution system is able to meet the service criteria under this condition. Total peak hour demand is 11,500 gpm. Pressure is maintained between 40 and 60 psi throughout most of the distribution system. **Figure 6-1** shows the system-wide pressures during the existing peak hour demand condition. The following are the areas that did not meet the recommended criteria:

- The area at the far north end of Hwy 111 has the lowest pressures, between 25 to 37 psi, which do not meet the required service criteria. The pipe supplying the customers at this location is 6-inch diameter, with a total length of 7,630 ft (1.45 mi). Because it was necessary to make several assumptions in the development and allocation of the demands to the model, it is possible that customer demands at this location are higher in the model than what typically occurs in the field. However, the 6-inch pipe also provides limited capacity for meeting fire flow demands, as discussed later in this section, and needs to be upsized to provide adequate supply to the north end of Hwy 111.
- The Cattle Call area, in the southwest part of the system, has the highest pressures of between 62 and 72 psi. The pipes supplying this area have a diameter of primarily 4 inches.
- There is only one pipe, serving the National Beef Plant, which has a velocity above the maximum criteria of 7 ft/sec (7.5 ft/sec) under existing peak hour conditions.

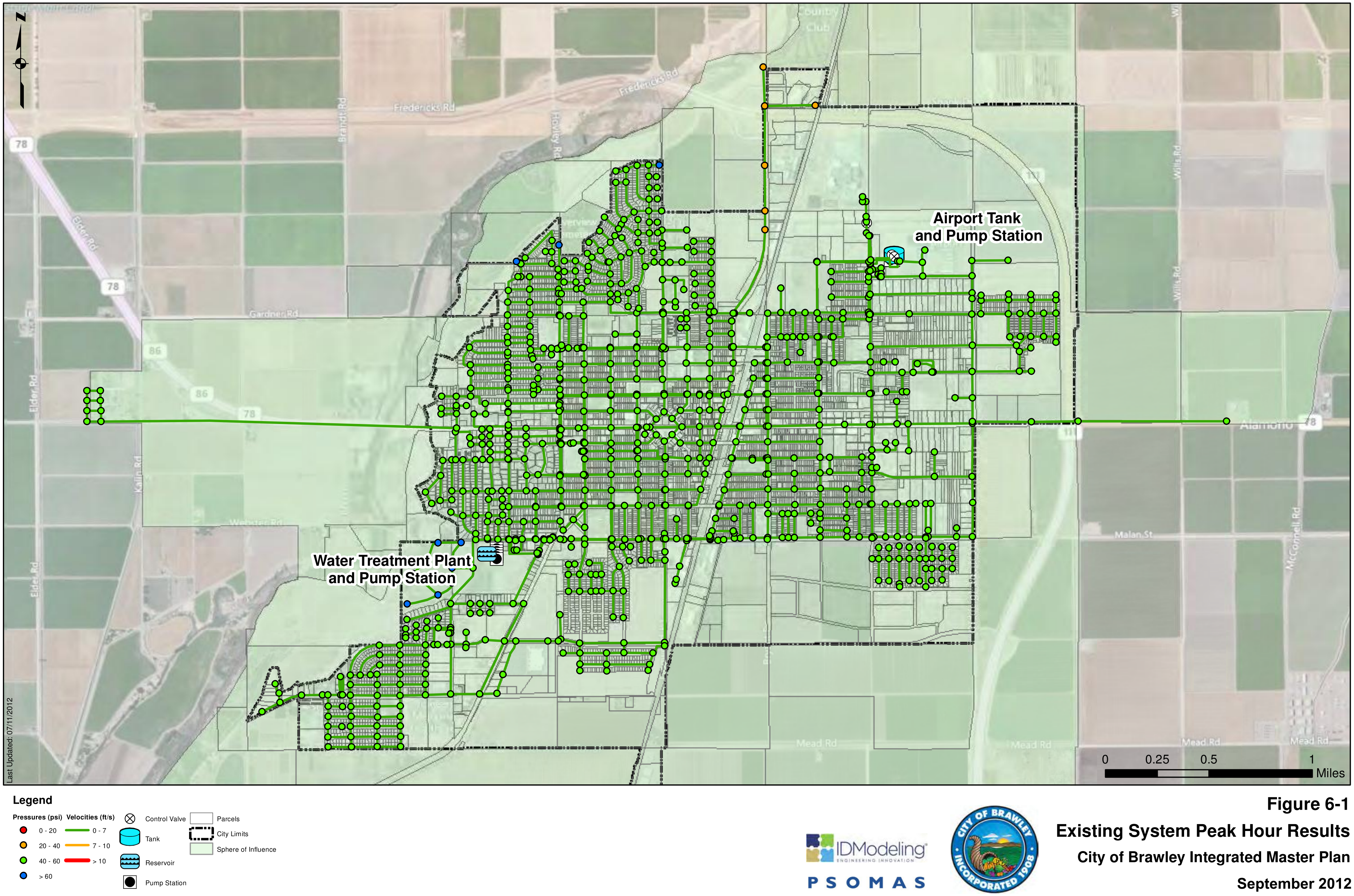


Figure 6-1

Existing System Peak Hour Results

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The peak hour demands were evaluated with and without the Airport Tank and Pump Station in operation, since the City operates the Airport Pump Station manually and utilizes it minimally. There was minimal difference between the two operating conditions.

6.2.1.2 Fire Flow Analysis

There were 20 locations selected within the City's water service area to analyze available fire flow demands. The locations were selected in order to provide a thorough distribution across the water system, a mix of land use types, and some of the most critical locations, such as hospitals and schools. The fire flow analysis locations are shown in **Figure 6-2**. The fire flow locations, model node ID, required fire flow and available fire flows are summarized in **Table 6-2**.

All fire flow analyses were evaluated under steady state MDD conditions. Initial conditions assumed that one of the Airport pumps was on in conjunction with three of the pumps at the Water Treatment Plant (two VFD pumps and one constant speed pump).

There are seven (7) locations where the calculated available fire flow was less than the required fire flow. These seven locations are described below and illustrated with red dots in **Figure 6-2.**

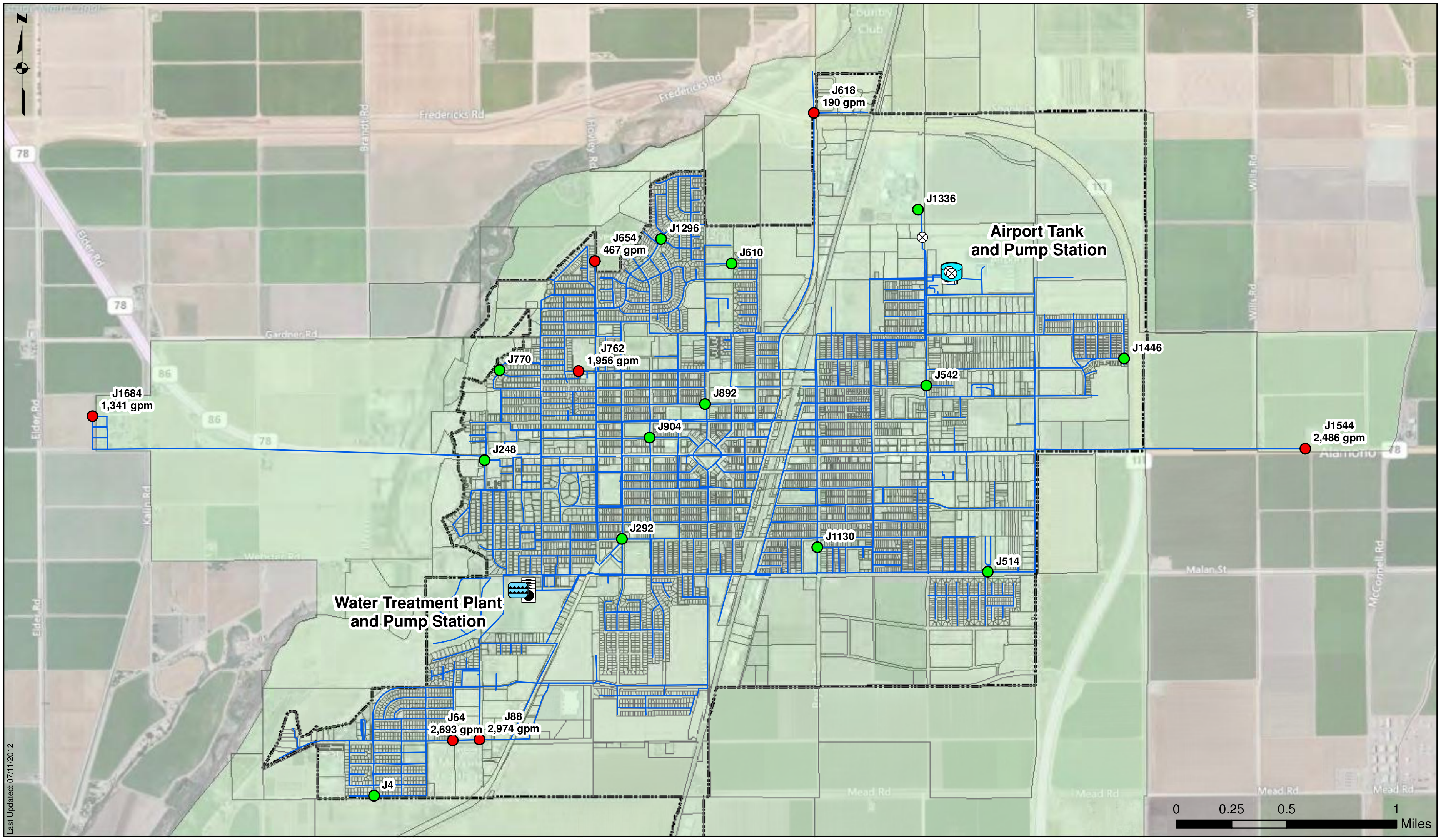
- The Brawley M.O.B. Hospital (junction J64), located at Evelyn Avenue and West Legion Road, has a required fire flow demand of 6,000 gpm and the available fire flow is 2,693 gpm. As there is not a continuous larger diameter distribution main directly from the WTP, the capacity to supply this large fire flow demand is limited.

- The Pioneer Hospital (junction J88), located at Willard Avenue & West Legion Road, has a required fire flow demand of 6,000 gpm and available fire flow of 2,974 gpm. There is not a continuous larger diameter distribution main directly from the WTP, which limits the capacity to supply this large fire flow demand.

- Phil Swing Elementary School (junction J762) on West A Street has a required fire flow of 3,000 gpm. The available flow is 1,956 gpm. The piping serving this area is 6-inch diameter, limiting the fire flow demand that can be supplied to this location.

- West Cady Road in the Poe Colonia development (junction J1684) is at the far western end of the City's distribution system and cannot meet the required residential fire flow of 1,500 gpm. The available fire flow is 1,341 gpm. The pipe serving the Poe Colonia development is a 16-inch main. However, all of the piping within the development is 6-inch diameter, limiting the available fire flow. Under fire flow conditions, velocity in the 6-inch pipe supplying the hydrant exceeds 10 fps.

- Hovley Drive and Park View Drive (junction J654) primarily serves a residential neighborhood and has a required fire flow of 1,500 gpm. The available fire flow is 467 gpm. There is only a 6-inch main along Hovley Drive north of Park View Drive, which limits the amount of demand that can be supplied to this area.
- Hwy 111 and Shank Road (junction J618) serves several industrial and public customers at the north end of the system, with a required fire flow of 3,000 gpm. The pipe along US Hwy 111 is a 6-inch and, therefore, provides very limited supply during fire flow demands as well as under PHD. The available fire flow for existing system conditions is 190 gpm.
- San Diego State University (J1544) at US Hwy 78, west of McConnell Road, has a required fire flow of 3,000 gpm. The available fire flow is 2,486 gpm. The single 12-inch main serving this customer is sufficient to meet the peak hour demands, but the headloss is significant enough in this long distribution main such that full fire flow cannot be supplied.



Legend

Existing Fire Flow Availibility

- Deficient
- Borderline
- Adequate

- Control Valve
- Tank
- Reservoir
- Pump Station
- Existing Pipes
- Parcels
- City Limits
- Sphere of Influence

Figure 6-2

Existing System Fire Flow Results

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Table 6-2
Existing System Required and Available Fire Flow

Nearest Cross Streets	Junction ID	Land Use	Required Fire Flow (gpm)	Available Fire Flow [(1)] (gpm)
Avenida del Valle & Calle Estrella	J4	Low Density Residential	1,500	2,042
Evelyn Ave. & W. Legion Rd. (Brawley M.O.B. Hospital)	J64	Hospital	6,000	***2,693***
Willard Ave. & W. Legion Rd. (Pioneer Hospital)	J88	Hospital	6,000	***2,974***
S. 10th St. & Leonard St. (Miguel Hidalgo Elementary)	J1130	Public	3,000	15,364
S 1st St. & East K St. (Witter Elementary)	J292	Public	3,000	4,436
N. 2nd St. & East E. St.	J904	Commercial	3,000	4,127
N. Imperial Ave. & East C St. (High School & Junior High School)	J892	Public	3,000	7,425
N. El Cerrito Dr. & West A St. (Phil Swing Elementary)	J762	Public	3,000	***1,956***
W. Magnolia St. & West A St.	J770	Low Density Residential	1,500	2,191
W. Cady Rd. (Poe Colonia)	J1684	Low Density Residential	1,500	***1,341***
Hovley Dr. & Park View Dr.	J654	Low Density Residential	1,500	***467***
Jones St. & Mesquite Ave.	J1296	Low Density Residential	1,500	6,159
Hwy 111 & Shank Rd.	J618	Industrial	5,000	***190***
Best Rd. (Luckey Ranch)	J1446	Low Density Residential	1,500	7,330
N. Eastern Ave. & East B St. (Oakley Elementary)	J542	Public	3,000	7,650
Malan St. (Malan Mobile Home Park)	J514	Low Density Residential	1,500	4,239
W. Main St. & S. Las Flores Dr.	J248	Commercial	3,000	4,644
US Hwy 78, west of McConnell Rd. (San Diego State University)	J1544	Public	3,000	***2,486***
Slider Rd., north of airport (National Beef Plant)	J1336	Heavy Industrial	6,000	8,132
I.V. Housing Authority	J610	Medium Density Residential	3,000	3,185

[(1)] Locations with deficient fire flow have the available fire flow in bold italics and are shown on Figure 6-2 as red dots. Locations that were adequate are listed in regular font and shown on Figure 6-2 as green dots.

6.2.1.3 Maximum Day Extended Period Simulation

The City's system was evaluated under MDD conditions with an extended period simulation of three (3) days. The extended period simulation used a 24-hour diurnal pattern that repeats each 24-hour period. Two operational conditions were evaluated for the MDD EPS condition. The first assumed the Airport Pump Station operational and the Airport Tank was filling and emptying (active), and a second operational condition assumed the Airport Pump Station was off and the Tank was not filling or emptying (inactive).

The total existing system MDD is approximately 7,850 gpm. During the operational scenario with the Airport Tank active, the tank is refilling and two VFD pumps are on at the WTP. One pump is on at the Airport Pump Station. The pumps at the WTP are controlled by the pressure at the Malan Street/Old Hwy 111 pressure sensing station. The operational scenario with the Airport Tank and Pump Station inactive has two (2) VFD pumps at the WTP operating.

Pipe velocities for both scenarios are within the desired criteria range of less than 7 fps. System pressures are above the minimum service pressure of 40 psi under both operational scenarios, with the exception of the area at the north end of Hwy 111 served by a 6-inch main and discussed previously for the peak hour and fire flow analyses.

Graphs of the pump flows and the pressure at the two pressure sensing stations, for both operational conditions, are included in Appendix D. A graph of the HGL of the two storage facilities when the Airport Tank is active is included as well. The WTP reservoir has the same fixed HGL when the Airport Tank is inactive and, therefore, is not graphed in that scenario.

6.2.1.4 Water Age Analysis Results

Water age analyses were run for the City's existing system. Two water analyses were run under average day demand (ADD) conditions for a period of 28 days. The 28-day period of time is used in order to allow the system to reach equilibrium.

The water age analyses were run both with and without the Airport Tank and Pump Station active in order to evaluate the impact of that tank on the water age within the distribution system. There is no significant difference in pressure throughout the system between the two scenarios. However, certain areas of the system are noticeably impacted by the Airport Tank being active, resulting in higher water ages. These are described in greater detail later in this section. The two (2) VFD pumps at the WTP were active and the remaining pumps off for both operational scenarios.

Actual operations of the Airport Tank and Pump Station may vary from what was modeled. Different tank mixing and water age may result from different operational conditions.

Airport Tank and Pump Station Active

Figure 6-3 shows the average water age throughout the existing distribution system with the Airport Tank and Pump Station active. Most of the locations shown in red in the figure with water ages greater than five (5) days are on dead-end pipes and locations with no demands in the model. A graph of the Airport Tank water age and tank level is included in Appendix-E. The majority of the system has a water age of a day or less. A few areas have water ages between one and three days and include: near the Airport Tank and Pump Station; in the far southwest portion of the system; the La Paloma development in the southeast; and the Poe Colonia development to the east.

There are a few areas within the City's distribution system that experience water ages greater than three days with the Airport Tank and Pump Station active. These include:

- San Diego State University (junction J1544) is located at the far eastern end of the system. It is located at the end of a 12-inch pipe, which experiences very low velocities (less than 1 fps). The average water age through the 12-inch main is approximately 3.5 days and at the customer location is over 5 days.
- Luckey Ranch, in the northeastern part of the system, has water age of a day or less throughout much of the development, except at several dead-end lines and at the northern end of the system. At the north end of that development east of Best Road and along Best Road north of River Drive, the average water age reaches eight (8) days by the end of the 28-day run. The spikes of older water correspond to the Airport Tank draining and sending plugs of higher aged water into the system.
- The National Beef Plant is located north of the Airport Tank and Pump Station and is directly impacted by the water age of the Airport Tank with the pump station on and the tank filling. The water age at this customer location has water age up to eight (8) days by the end of the 28-day run, which corresponds to water age in the Airport Tank. Plans for future development in this area would continue the distribution main and pipe looping north of this location, which will improve water age.

Airport Tank and Pump Station Inactive

The water age results with the Airport Tank and Pump Station inactive are similar to the results with these facilities active. Water age in the majority of the system is one day or less. Water age of greater than five (5) days occurs at dead-end pipes and locations with no demands, particularly on the outlying extents of the system. Water age for San Diego University remains higher than three (3) days.

The other locations with water age between one (1) to three (3) days that were already discussed remain the same. The water age at the National Beef Plant, north of the Airport Tank, is less than a day old with the tank inactive.

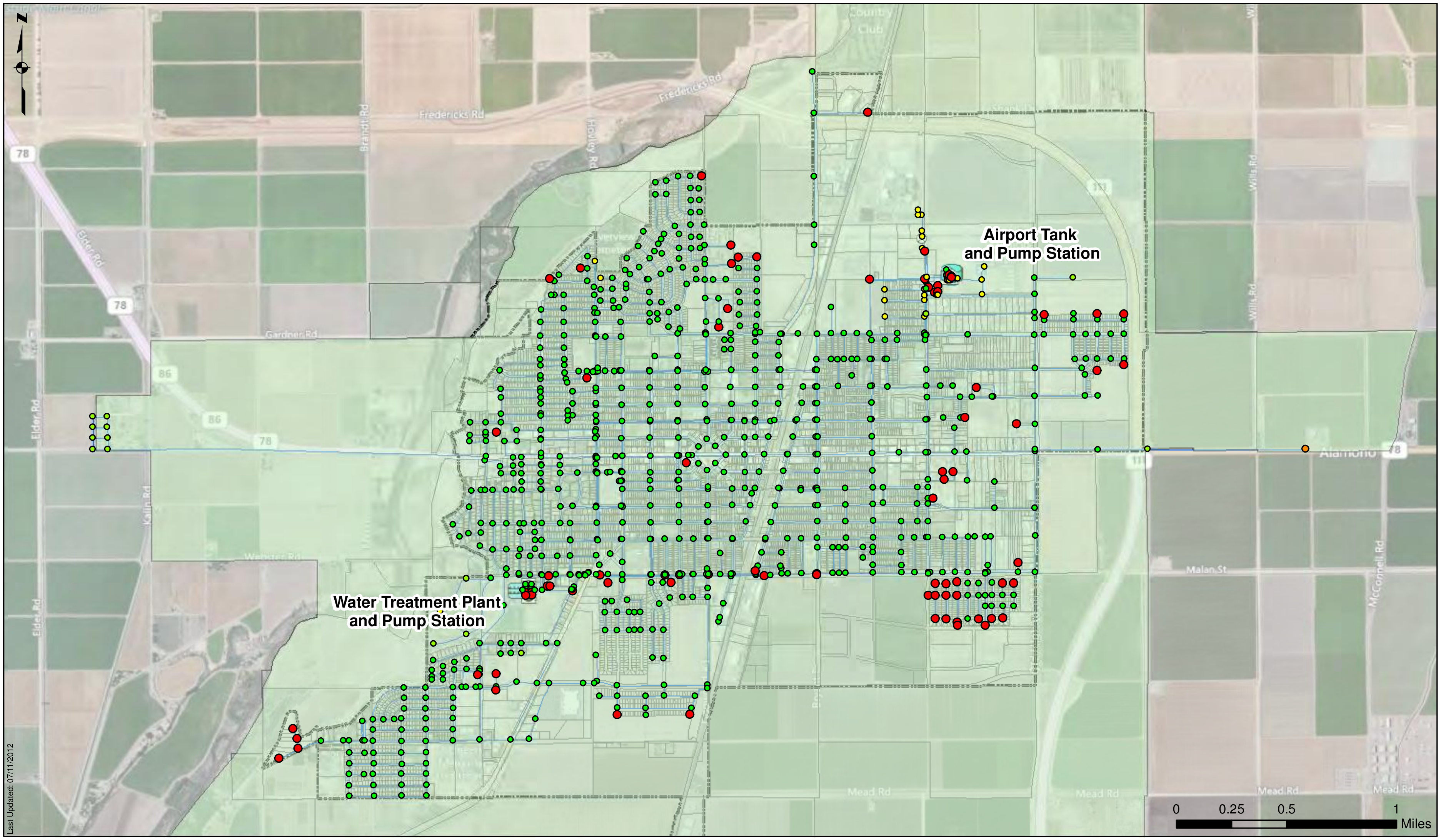

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Figure 6-3

Existing System Water Age Results

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6.2.2 Future System Analysis

Future water system analyses were conducted under year 2030 (assumed buildout condition) and year 2020 demand conditions. The year 2030 system and demands assumed that all undeveloped parcels within the City Sphere of Influence would be served. Most of the development is located to the east and south. The same water duty factors were used for both year 2020 and year 2030 water demands as summarized in Chapter 3. Since the location and timing of new development is not well known at this time, the year 2020 includes a somewhat smaller area than the year 2030 service area boundary.

The distribution of the existing demands was not changed for the year 2020 and 2030 conditions. The same process used to distribute the existing water demands to the hydraulic model, was used for the future water demands. Model scenarios for 2030 were developed for an alternative where the City would serve the Rancho Los Lagos (Imperial development) and another alternative in which it would not be served by the City system.

Peak hour and fire flow analyses were evaluated for the future scenarios and are summarized below. The year 2030 scenario was used to identify capital improvement projects. The year 2020 scenario, along with the existing system analyses, provided information used in the prioritization of projects that will ultimately be needed to serve future development.

6.2.2.1 Future 2030 System Analysis

Year 2030 development and demand conditions were analyzed with and without the planned Rancho Los Lagos (Imperial Development), which will be located south of the City's existing service area. The peak hour analysis without Rancho Los Lagos development identified seven (7) pipes with velocities between 7 and 10 ft/sec. The pipe information, velocity, and location are summarized in Appendix F. All pressures are greater than 40 psi at peak hour demand conditions without the Rancho Los Lagos development. See **Figure 6-4.**

There are eight (8) pipes for the 2030 peak hour analysis with the Rancho Los Lagos development that have velocities between 7 and 10 ft/sec. See **Figure 6-5**. One of these pipes was identified with the existing system analysis and provides service to the National Beef Plant. Two (2) pipes are at the outlet of the Jones Pump Station, and the remainder of pipes with velocities between 7 and 10 ft/sec are along Malan Street. Additionally, there is a 12-inch pipe serving the La Paloma development from Malan Street that has velocity greater than 10 ft/sec. The pipes with velocities greater than 7 ft/sec are summarized in Appendix F.

There are six (6) junctions that have pressures less than 40 psi. These are all located at the southern portion of where the Rancho Los Lagos demands are assigned.

The fire flow analysis evaluated the same fire flow locations used for the existing system analysis, as well as four (4) additional locations with the expanded future service area. The fire flow analysis results with and without the Rancho Los Lagos (Imperial

Development) are very similar and identified seven (7) locations where the available fire flow is less than the required fire flow. These locations are the same as those identified for the existing system and for the year 2020 demand conditions. The required and available fire flow at all of the fire flow analysis locations is presented in **Table 6-3.**

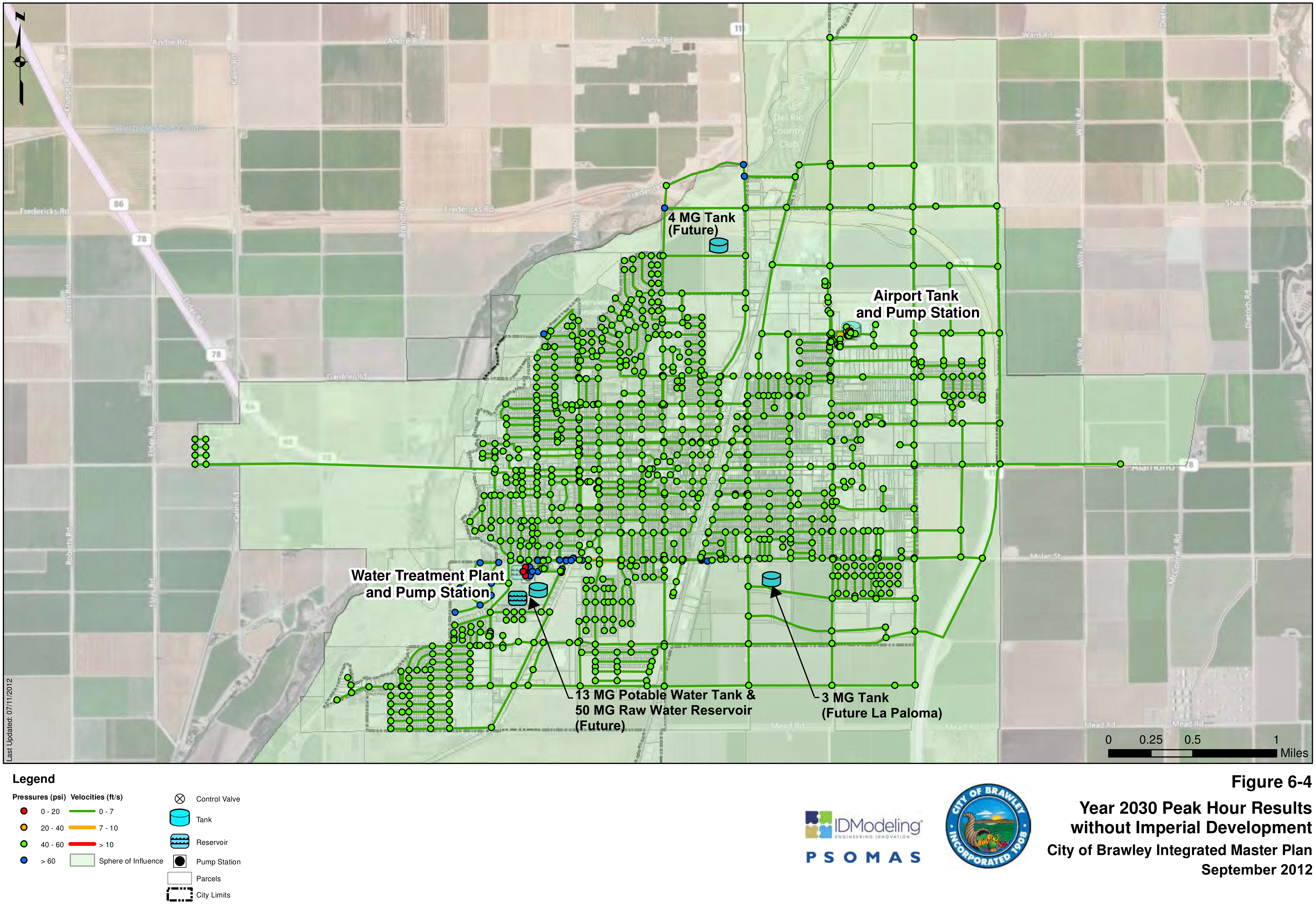

Figure 6-4

Year 2030 Peak Hour Results without Imperial Development

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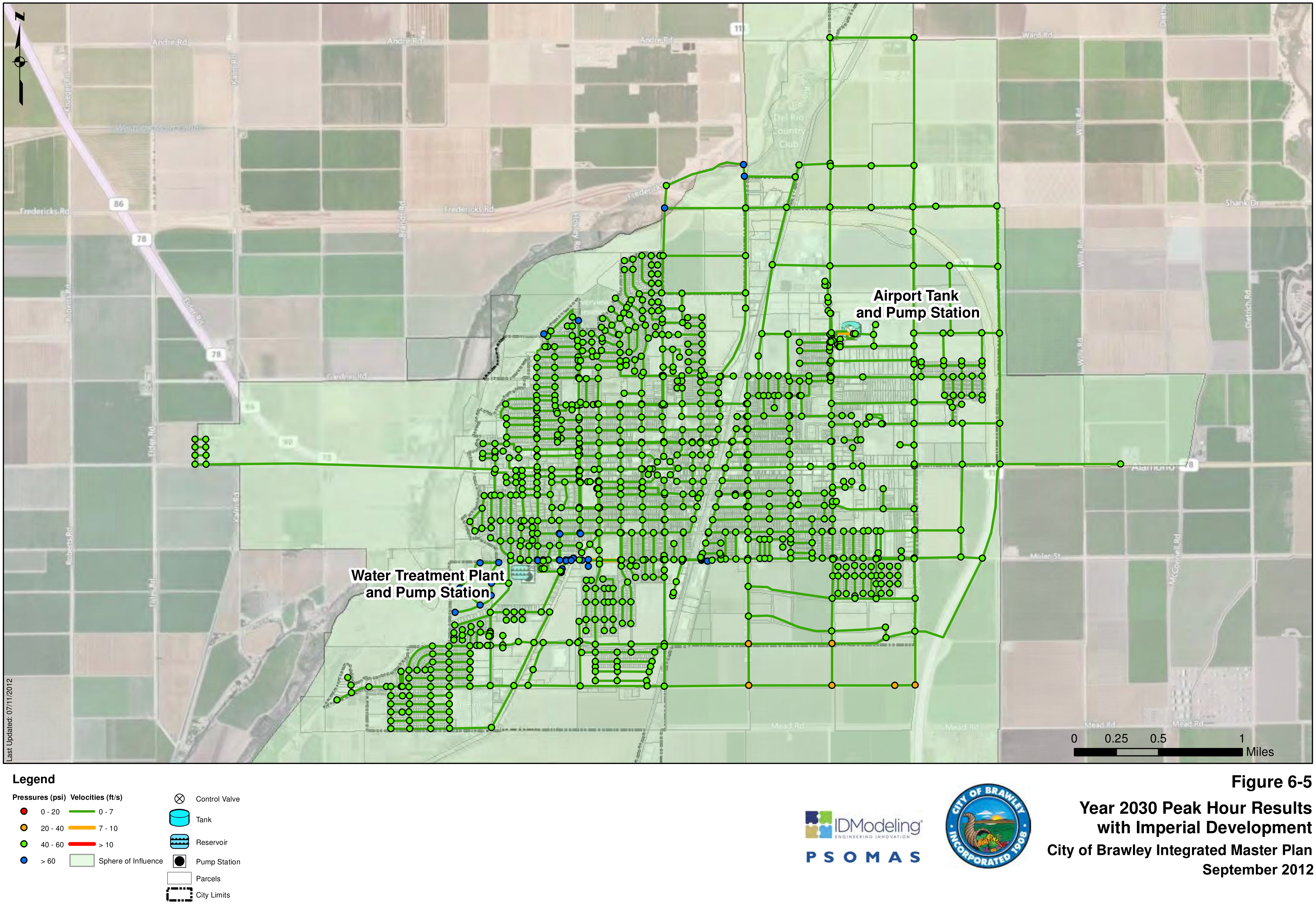

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Figure 6-5

Year 2030 Peak Hour Results with Imperial Development

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Table 6-3
Future System Required and Available Fire Flow

Nearest Cross Streets	Junction ID	Land Use	Required Fire Flow (gpm)	Available Fire Flow (gpm)		
				Year 2020	Year 2030 without Los Lagos	Year 2030 with Los Lagos
Avenida del Valle & Calle Estrella	J4	Low Density Residential	1,500	2,602	2,692	2,639
Evelyn Ave. & W. Legion Rd. (Brawley M.O.B. Hospital)	J64	Hospital	6,000	***3,759***	***4,238***	***4,121***
Willard Ave. & W. Legion Rd. (Pioneer Hospital)	J88	Hospital	6,000	***4,278***	***5,088***	***4,898***
S. 10th St. & Leonard St. (Miguel Hidalgo Elementary)	J1130	Public	3,000	14,573	13,477	11,809
S. 1st St. & East K St. (Witter Elementary)	J292	Public	3,000	4,451	6,180	6,257
N. 2nd St. & East E St.	J904	Commercial	3,000	4,081	6,627	6,745
N. Imperial Ave. & East C St. (High School & Junior High School)	J892	Public	3,000	7,175	8,331	8,486
N. El Cerrito Dr. & West A St. (Phil Swing Elementary)	J762	Public	3,000	***1,921***	***2,588***	***2,633***
W. Magnolia St. & West A St.	J770	Low Density Residential	1,500	2,159	2,375	2,415
W. Cady Rd. (Poe Colonia)	J1684	Low Density Residential	1,500	***1,356***	***1,417***	***1,433***
Hovley Dr. & Park View Dr.	J654	Low Density Residential	1,500	***460***	***747***	***755***
Jones St. & Mesquite Ave.	J1296	Low Density Residential	1,500	7,220	7,616	7,771
Hwy 111 & Shank Rd.	J618	Industrial	5,000	***3,359***	***3,283***	***3,319***
Best Rd. (Luckey Ranch)	J1446	Low Density Residential	1,500	8,563	8,909	8,598
N. Eastern Ave. & East B St. (Oakley Elementary)	J542	Public	3,000	7,174	8,439	8,381
Malan St. (Malan Mobile Home Park)	J514	Low Density Residential	1,500	10,676	9,879	8,158
W. Main St. & S. Las Flores Dr.	J248	Commercial	3,000	4,969	7,063	7,115
US Hwy 78, west of McConnell Rd. (San Diego State University)	J1544	Public	3,000	***2,916***	***2,929***	***2,917***
Slider Rd., north of airport (National Beef Plant)	J1336	Heavy Industrial	6,000	9,112	10,028	10,114
I.V. Housing Authority	J610	Medium Density Residential	3,000	4,793	4,978	5,065
Best Rd., north of Shank Rd. (Future)	J1982	Industrial / Public	3,000	5,569	5,115	5,151

Nearest Cross Streets	Junction ID	Land Use	Required Fire Flow (gpm)	Available Fire Flow (gpm)		
				Year 2020	Year 2030 without Los Lagos	Year 2030 with Los Lagos
Avenida Ct., east of Avenida de Colimbo (Future)	J1386	Low Density Residential	1,500	4,882	4,805	4,627
Harvey Rd., north of Mead Rd. (Future)	J1226	Low Density Residential	1,500	3,441	3,285	2,701
Malan St. & Hwy 111 (Future)	J1244	Low Density Residential	1,500	4,224	4,163	4,043

6.2.2.2 Future 2020 System Analysis

The year 2020 peak hour results were very similar to the existing peak hour analysis results. The pressure across the system is above 40 psi. The area at the north end of Hwy 111 that was identified with low pressures for existing system conditions had sufficient pressure under peak hour demands with additional pipe looping. However, the available fire flow demand cannot be met with the existing 6-inch serving that location.

All pipes have velocities less than 10 ft/sec. There is 12-inch main supplying the National Beef Plant with velocities between 7 and 10 ft/sec. This pipe was identified as having a velocity greater than the maximum velocity criteria with the existing peak hour analysis and is a reduction from the 18-inch segment of pipe between Duarte Avenue and the customer service location.

There are seven (7) locations identified as unable to meet the required fire flow with the maximum day demands. All of these locations were identified in the existing system fire flow analysis as having less than the required fire flow. The required fire flow and available fire flow for the 2020 development scenario is also shown in **Table 6-3**.

6.2.2.3 Future Pipe Summary

Once the City is fully built out in 2030, the City will have approximately 129 miles of 6” to 36” diameter water mains, of which almost 50% will be 8” diameter pipe. Table 6-4 summarizes the pipe lengths for the various pipe sizes.

Table 6-4
Summary of Pipe Length by Diameter

Pipe Diameter (in)	Existing Pipes Length (ft)	Existing Pipes Percent of Total Length (%)	Future Pipes Length (ft)	Future Pipes Percent of Total Length (%)
2	419	0.08	0	NA
3	698	0.13	0	NA
4	22,513	4.26	0	NA
6	152,746	28.9	152,692	22.5
8	184,665	34.9	328,948	48.4
10	14,918	2.82	14,918	2.20
12	98,230	18.6	122,271	18.0
14	8,174	1.55	8,174	1.20
16	19,640	3.71	19,640	2.89
18	7,679	1.45	11,008	1.62
20	348	0.07	348	0.05
24	16,830	3.18	19,393	2.85
36	2,049	0.39	2,049	0.30
Total Pipe Length	**528,909**		**679,441**	
	100 miles		**129 miles**	

7.0 Other Water Facility Analyses

7.1 Water Storage Analysis

Water distribution systems often rely on stored water to help equalize fluctuations between supply and demand, supply sufficient water for firefighting, and meet demands during an emergency or unplanned outage of a major supply source. Adequate storage requirements include the sum of operational, fire, and emergency storage volumes. The following discusses the ability of the City storage facilities to meet the water system storage requirements.

7.1.1 Raw Water Storage

Based on discussions with IID, the storage required needs to offset the loss of production from the IID connections for six (6) average day demands. (This is the time IID has indicated may be required for taking the canal out of service.) The City currently has 36 MG of storage in open at-grade reservoirs at the Water Treatment Plant.

Table 7-1 summarizes the required raw water storage for the existing and future conditions.

Table 7-1
Additional Raw Water Storage Needed

Condition	ADD (MGD)	6 days of ADD (MG)	Existing Raw Water Storage (MG)	Additional Needed Raw Water Storage (MG)
Existing	7.5	45	36	9
2020	10.6	64	36	28
2030 w/o Rancho Los Lagos	14.3	86	36	50
2030 with Rancho Los Lagos	17.6	106	36	70

7.1.2 Treated Water Storage

Treated water storage within the City system for existing and future conditions should meet the following criteria:

- Operational storage shall be at least 30 percent of the maximum day demands (MDD).
- Fire flow storage shall be the largest fire in gpm times its duration: 6,000 gpm x 4 hours
- Emergency storage shall be 100 percent of the maximum day demand (MDD).

Based on these criteria the City needs the treated storage as shown in **Table 7-2**.

Table 7-2
Treated Water Storage

Condition	MDD (MGD)	Operational Storage, 30% of MDD (MG)	Fire Flow Storage, 6,000 gpm x 4 hours (MG)	Emergency Storage, 100% of MDD (MG)	Total Required Storage (MG)
Existing	11.30	3.39	1.44	11.30	16.1
2020	15.93	4.78	1.44	15.93	22.2
2030 w/o Rancho Los Lagos	21.42	6.43	1.44	21.42	29.3
2030 with Rancho Los Lagos	26.4	7.92	1.44	26.4	35.8

Table 7-3 summarizes the required treated water storage for the existing and future conditions. The City currently has 9 MG of treated water storage. 6 MG of this storage is located at the WTP and 3 MG is located at the Airport (Jones) Tank. The City needs an additional 7 MG of storage to meet the existing condition storage criteria. A 3 MG above-grade storage tank was designed and approved for construction in the La Paloma development. This tank has not yet been constructed due to the halting of the development construction. Once this tank is constructed, the City's existing need will decrease to 4 MG.

Table 7-3
Additional Treated Water Storage Needed

Condition	Total Required Storage (MG)	Existing Storage (MG)	Additional Needed Storage (MG)
Existing	16	9.0	7.0
2020	22	9.0	13.0
2030 w/o Rancho Los Lagos	29	9.0	20.0
2030 with Rancho Los Lagos	36	9.0	27.0

7.2 Water Treatment Plant and Distribution PS Capacity

The existing Water Treatment Plant (and distribution pump station) has a 15 MGD capacity, which is barely adequate to supply the 2030 buildout scenario without the Los Lagos Development average day demand of 14.3 MGD. Typically, when the WTP flows average over 12 MGD (80%), the City should begin planning for expansion of the treatment plant to allow separate lead time for design, permitting, construction, and start-up. This planning should occur sometime prior to 2020. However, with the Los Lagos development, the ADD is 17.6 MGD, which exceeds the plant capacity by 2.6 MGD. See **Table 7-4**. When and if the Rancho Los Lagos development proceeds, the City will need to further analyze and start planning for expansion of the existing WTP, which would also include expansion of the distribution pump station.

Table 7-4
Water Treatment Plant Capacity

	Capacity (MGD)	Existing ADD (MGD)	2020 ADD (MGD)	2030 ADD w/o Los Lagos (MGD)	2030 ADD with Los Lagos (MGD)
Water Treatment Plant	**15**	7.5	10.3	14.3	17.6

8.0 Recommended Capital Improvement Program

A Capital Improvement Program (CIP) will address needed water system capacity and operational improvements. These improvements will increase available fire flows, increase system reliability, and assure future water needs are met.

Cost estimates developed for this Master Plan are based on June 2012 dollars. Total project costs include estimates for construction, engineering and technical services, legal, administration, construction management, and contingency. Estimated construction costs are based on historical bids submitted by contractors for similar projects for the City and Psomas. The estimated cost of engineering and technical services was assumed to be 15 percent and legal and administration costs were assumed to be 10 percent of the construction cost. A contingency of 30 percent of the estimated construction cost was also included.

The estimates contained herein are planning level cost estimates based on current perceptions of conditions at the project locations. These estimates reflect Psomas' professional opinion of costs at this time and are subject to change as the project design matures. Psomas cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the estimated costs presented in this Master Plan.

The project costs for water pipelines were estimated using a unit cost per foot of pipe. This unit cost includes valves spaced at a minimum of 250 feet apart and fire hydrants spaced at 500 feet apart. This unit cost was assumed to include the materials and installation. The cost of acquisition of land or easements is not included in the pipeline cost estimates.

The unit construction costs used in this Master Plan are shown in **Table 8-1**. (The future unit pipeline costs (with the exception of replacement of existing facilities) are lower than existing as they do not include removal and replacement costs for items such as existing pipelines and pavement.)

Table 8-1
Unit Construction Costs – Water System Improvements

Pipelines (Diameter)	Existing Unit Cost ($/lineal ft)	Future Unit Cost ($/lineal ft)
6 inches	$134	$114
8 inches	$143	$122
12 inches	$158	$134
14 inches	$165	$140
16 inches	$200	$170
18 inches	$223	$190
24 inches	$300	$279
Storage Reservoirs Including Pump Station (Volume)	**Existing Unit Cost ($/gallon)**	**Future Unit Cost ($/gallon)**
3 MG	$1.4	$1.4
4 MG	$1.4	$1.4

8.1 Recommended Improvement Projects

Several water system improvements were identified based on the existing and future system analyses described previously. The highest priority projects are those that address deficiencies identified with the existing system analyses. All projects are sized to meet the ultimate demand and development conditions of year 2030.

8.1.1 Distribution Pipe Projects

Four areas in the City were identified as having insufficient capacity to supply the required fire flow. These were identified as deficient for both the existing and future system conditions and are being given the highest priority for replacement. A summary of the recommended improvements associated with these is summarized below and shown on **Figure 8-1**, (located in a pocket at the back of this report).

Project FF-1 HWY 111 and Shank Road

The existing peak hour analyses identified a single area with pressures less than 40 psi, at the north end of Hwy 111. The required fire flow of 5,000 gpm in this area also cannot be met under existing or future demand conditions. The 6-inch pipe (P714, P710, P708, P712, P2738, P2730) serving this area was modeled with an upsized 12-inch pipe under existing conditions. Although this single improvement increases pressures and provides added fire flow, it does not provide sufficient peak hour and fire flow capacity. Minimum pressures of 40 psi are obtained during peak hour demand conditions and the required fire flow of 5,000 gpm can be met with additional pipe looping of 8-inch and 12-inch pipe in the area for future development. It is recommended that the City collect meter data for the customers at this location prior to design and construction in order to verify required pipe sizes. (7,630 ft of 12-inch PVC)

Project FF-2 Brawley M.O.B. and Pioneer Hospitals

The Brawley M.O.B. and Pioneer Hospitals are located south of the WTP and were identified as having deficient fire flow for both existing and future conditions. Currently, there is not a direct connection from the WTP going south. Three (3) pipeline improvements were identified in order to provide the required fire flow of 6,000 gpm at each hospital. With the improvements below, the available fire flow at Pioneer Hospital is 7,052 gpm and the modeled fire flow at Brawley M.O.B. Hospital is 6,421 gpm at 20 psi residual pressure.

- East of the WTP, going south along S. Brawley Avenue: Replace the existing 6-inch (P2840, 1,430 ft) with 12-inch pipe and connect to the 36-inch from the WTP. Replace the existing 6-inch (P144, 280 ft) with 12-inch along Julia Drive going east to S. Brawley Avenue.
- W. Legion Road between Evelyn Avenue and Willard Avenue: Replace existing 10-inch (P132, 600 ft) with 12-inch.
- Evelyn Avenue between Panno Road and W. Legion Road: Replace existing 8-inch (P110, P112, P114, P70, P72; 1,300 ft) with 12-inch.

Project FF-3, Hovley Drive

The available fire flow at Hovley Drive and Park View Drive is less than the required fire flow of 1,500 gpm for existing and future demand conditions. A 6-inch PVC pipe serves this location. Upsizing this pipe (P862) to an 8-inch provides the sufficient capacity to meet the required fire flow (1,960 ft of 8-inch PVC).

Project FF-4, Phil Swing Elementary School

Phil Swing Elementary on W. A Street west of N. Western Avenue is served by a 6-inch pipe. East of N. Western Avenue there is a 12-inch main along W. A Street, and north along N. Western Avenue up to W. A Street there is a 14-inch pipe. Replacing the existing 6-inch (P992, P2478) pipe with 8-inch pipe along W. A Street interconnected to the 12-inch and 14-inch at N. Western Avenue provides the sufficient capacity for existing and future fire flow at Phil Swing Elementary School (350 ft of 8-inch PVC).

8.1.1.1 Cast Iron Pipe Replacement Project

In addition to improvements at specific locations, all cast iron pipe and pipe 4 inches in diameter and less is identified for replacement. It is assumed that all cast iron pipe will be replaced with minimum 8-inch diameter Polyvinyl Chloride pipe. The existing cast iron pipe represents the oldest pipe in the system and is located throughout much of the central part of the service area. Due to the age and the build-up in these pipes, they tend to result in hydraulic restrictions as well as a higher incidence of main breaks.

8.1.1.2 Small Diameter Pipe Replacement Projects

Due to the minimal flow capacity and the pipe age, all 4-inch and smaller pipe should be replaced with 8-inch pipe.

8.1.1.3 Other Pipeline Concerns

Fire flow in the Poe Colonia development was slightly less than required for existing and future demand conditions. The existing condition was about 150 gpm less than required and in the future 2030 condition, this improved to only 50 gpm less than required. The development is served by a 16-inch distribution main, but the pipe sizes within the development are 6-inch PVC. Upsizing these pipes to 8-inch provides sufficient capacity to meet the required fire flow. (747 ft of 8-inch PVC) As the fire flow is only slightly less than required, no improvement is recommended for this location at this time.

San Diego State University is served by a 12-inch distribution main of approximately 3,785 ft in length, which is insufficient to meet the required fire flow of 3,000 gpm. The existing condition was about 500 gpm less than required and in the future 2030 condition this improved to only 70 gpm less than required. Replacing this main with a 16-inch pipe provides sufficient capacity to meet the required fire flow. However, this would potentially introduce water quality issues, since the daily demands are sufficiently served by the 12-inch pipe and existing water age analyses show higher water ages along this distribution main. Because the condition will improve as future water mains are installed, and due to the fact that the SDSU buildings likely have sprinkler systems, no improvement is recommended for this location at this time.

In addition to the above locations with recommended improvements, there were a few locations with pipe velocities between 7 and 10 ft/sec. As these velocities are not excessive, there are no improvements recommended for these locations at this time. However, they should be monitored as new development continues, particularly at the southern end of the service area.

8.1.1.4 Future Development Pipelines

To accommodate future buildout of the City by the year 2030, approximately 30 miles of water pipelines will need to be installed. These pipelines range from 6” diameter to 24” diameter and will mostly be required in the south and east parts of the City where the majority of the future development will occur. See **Figure 8-1** for the future pipe locations.

8.2 Water Storage and Pump Stations Improvements

To meet existing and future demands, the City needs additional raw water and potable water storage. **Table 8-2** summarizes the City's needed storage improvements.

Table 8-2
Water Storage Improvements[1]

Condition	Additional Needed Raw Water Storage (MG)	Additional Needed Potable Water Storage (MG)
Existing	9	7.0
2020	28	13.0
2030 w/o Rancho Los Lagos	50	20.0
2030 with Rancho Los Lagos	70	27.0

[1] This does not include the La Paloma tank.

To meet raw water demands the City should construct new raw water ponds on the vacant land at the WTP.

8.3 Water Treatment Plant Expansion

Planning for the expansion of the WTP should begin at a time when the average flows approach 12 MGD (2020). Expansion could include engineered improvements to the clarifiers, filters or construction of additional clarifiers and filters to assure that the 2030 demands can be met. When and if the Rancho Los Lagos development proceeds, the City will definitely need to start planning for the expansion of the Water Treatment Plant. It is estimated that the Average Day Demand with the Rancho Los Lagos development will be approximately 17.6 MGD. This is 2.6 MGD more than the 15 MGD existing plant capacity. See **Table 8-3**.

Table 8-3
Water Treatment Plant Capacity

	Existing Capacity (MGD)	2030 ADD w/o Los Lagos (MGD)	2030 ADD with Los Lagos (MGD)	Additional WTP Capacity Needed w/ Los Lagos (MGD)
Water Treatment Plant	15	14.3	17.6	**2.6**

8.4 Water Quality

As noted in the hydraulic analyses, there are areas in the City that have a slightly increased water age. This occurs mostly on the outer edges of the City such as at the La Paloma development and at the SDSU campus. As the City develops and more water demand is placed on these outer areas, and as more looped water pipes are installed, water age will improve.

To improve water quality, the City should also consider implementing a plan to operate the existing Airport tank on a daily basis. This will particularly improve water quality in the eastern part of the City.

8.5 Summary of Recommended Water System Improvements

The existing and future recommended water system improvements and associated costs are presented in **Table 8-4**. The existing water pipe replacements total approximately 27 miles, which includes fire flow capacity improvements, cast iron pipe replacements, and small diameter pipe replacements. The existing system improvements also include 7.0 MG of tank and booster pump station capacity increases at various locations and 9 MG of additional raw water storage at the WTP. See Appendix H for the itemized costs.

The future water system improvements include approximately 30 miles of 6” to 24” diameter new pipelines, an additional 13.0 MG of tank and booster pump station capacity, and 41 MG of raw water storage. These future water systems include the existing system improvements described above.

Table 8-4
Summary of Water System Improvement Costs

	Improvement Type	Quantity	Units	Cost
	Existing Water System Improvements			
FF-1	Hwy 111 and Shank Road - Replace Existing 6" with 12"	7,630	Lineal Feet	$1,960,000
FF-2	M.O.B. and Pioneer Hospital - Replace 6", 8", 10" with 12"	3,610	Lineal Feet	$930,000
FF-3	Hovley Dr and Park View Dr – Replace 6" with 8"	1,960	Lineal Feet	$460,000
FF-4	N El Cerrito Dr and West A St (Phil Swing Elementary) - Replace 6" with 8"	350	Lineal Feet	$80,000
CIP	Cast Iron Pipe Replacements	126,700	Lineal Feet	$29,560,000
SPR	4" and Less Pipe Replacements (not including CI replacements)	2,820	Lineal Feet	$650,000
T-1	3 MG La Paloma Tank w/Booster Pump Station	3	Million Gallons	$6,820,000
T-2	4 MG Northern Tank w/Booster Pump Station	4	Million Gallons	$9,100,000
T-RW-3	9 MG Raw Water Pond	9	Million Gallons	$5,120,000
	Total Existing Water System Improvements			***$54,680,000***
	Future Water System Improvements[1]			
FD	Future Development Pipe Installation – 6" to 24"	156,300	Lineal Feet	$32,170,000
TF-1	3 MG Tank w/ Booster Pump Station	3	Million Gallons	$6,820,000
TF-2	3 MG Tank w/ Booster Pump Station	3	Million Gallons	$6,820,000
TF-3	3 MG Tank w/ Booster Pump Station	3	Million Gallons	$6,820,000
TF-4	4 MG Tank w/ Booster Pump Station	4	Million Gallons	$9,100,000
T-RW-5	41 MG Raw Water Pond	41	Million Gallons	$23,320,000
	Total Future Water System Improvements[1]			***$85,060,000***
	Total Existing and Future Water System Improvements			***$139,740,000***

[1] Without Los Lagos development

8.6 Capital Improvement Program Costs

Design and construction of the proposed existing water system capital improvements are to be phased over the next 20 years. The prioritized project phasing categories are as follows:

Priority 1: FF-1, 2, 3, and 4 - $3,430,000

Priority 2: CIP Replacement - $29,560,000

Priority 3: SPR Pipe Replacements - $650,000

Priority 4: Raw Water Storage - $5,120,000

Priority 5: Treated Water Storage (T-1 and T-2) - $15,920,000

Notes:

1) Fund CIP Replacements as funds are available. Prioritize in frequent break areas.
2) Fund FF and SPR projects through annual CIP program based on new billing rates and development impact fees for new connections
3) Fund Raw and Treated Water Storage through CIP funds and development impact fees and other funding sources.
4) All future storage and pipeline projects should be paid directly by developers. Reimbursement agreements could be written to share costs amongst developers.

9.0 Funding Mechanisms

This chapter describes financing alternatives for proposed water projects. Funding sources include Federal, State, and local financing programs. Revenue sources include ad valorem taxes, special districts, and developer-imposed impact fees. Funding sources are explored that are not dependent on user charge revenue. The sources of funds for new capital projects are described, but this chapter does not address the amount of funds the City could raise or the repayment impacts. Most of these sources of funding are summarized in **Table 9-1**.

Federal Programs

The Border Environment Cooperation Commission (BECC), in conjunction with North American Development Bank (NADB), is a source of funding that the City of Brawley has used in the past to fund water and wastewater projects. These two organizations were created in 1994 by the Governments of the United States and Mexico under a side-agreement to the North American Free Trade Agreement (NAFTA). The goal of BECC/NADB is to help improve the environmental conditions of the Mexico–United States border region in order to advance the well-being of residents in both nations. BECC focuses on the technical, environmental, and social aspects of project development, while NADB concentrates on project financing and oversight for project implementation.

State Programs

CDBG

Community Development Block Grants (CDBG) are administered by the State. The primary statutory objective of the CDBG program is to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities, principally for persons of low- and moderate-income. The State must ensure that at least 70 percent of its CDBG grant funds are used for activities that benefit low- and moderate-income persons over a one-, two-, or three-year time period selected by the State. This general objective is achieved by granting "maximum feasible priority" to activities which benefit low- and moderate-income families or aid in the prevention or elimination of slums or blight. Under unique circumstances, States may also use their funds to meet urgent community development needs. A need is considered urgent if it poses a serious and immediate threat to the health or welfare of the community and has arisen in the past 18 months.

Local governments have the responsibility to consider local needs, prepare grant applications for submission to the State, and carry out the funded community development activities. Local governments must comply with Federal and State requirements.

CDPH

The California Department of Public Health (CDPH) implements a number of programs that provide funding opportunities to public water systems. The following was taken from their website:

SDWSRF: The Safe Drinking Water State Revolving Fund (SDWSRF) provides funding to correct public water system deficiencies based upon a prioritized funding approach that addresses the systems' problems that pose public health risks, systems with needs for funding to comply with requirements of the Safe Drinking Water Act, and systems most in need on a per household affordability basis.

ARRA: Funding from the federal American Recovery and Reinvestment Act of 2009 (ARRA) provides the SDWSRF with ~$160 million. ARRA, which was signed into law in February 2009, provides funding for infrastructure development for California's drinking water systems.

Proposition 50: Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Water Code Section 79500, et seq.) was passed by California voters in the November 2002 general election. CDPH is responsible for portions of the Act that deal with water security, safe drinking water, and treatment technology. *NOTE: CDPH is no longer accepting pre-applications for Proposition 50 funding, but the Department of Water Resources has funding available for certain types of drinking water projects*.

Proposition 84: Proposition 84, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act of 2006 (Public Resources Code Section 75001, et seq.), was passed by California voters in the November 2006 general election. CDPH is responsible for portions of the Act that deal with safe drinking water supplies, including emergency and urgent funding, infrastructure improvements, and groundwater quality.

DWTRF: The Drinking Water Treatment and Research Fund addresses drinking water contamination by methyl tertiary butyl ether (MTBE) and other oxygenates.

It should be noted that some of the programs are currently on hold due to the severity of the current State budget crisis.

Local Financing Programs

General Obligation Bonds

General obligation bonds are debt instruments that are backed by the full faith and credit of the issuing municipality. They are generally repaid by ad valorem property taxes and are typically used to fund projects that serve the entire community and are for projects that do not provide direct sources of revenues such as user charges. They must be approved by two-thirds (2/3) of the jurisdiction's voters.

Districts

Most of the commonly used sources of debt for public facilities involve special districts. The interest rates on these sources of debt are not subsidized, as are some of the State and Federal loans, and will vary with market conditions and the time of the sale. For the last several years, these rates have been in the range of 5 to 6.5 percent. Several special districts are described below.

Assessment Districts

Assessment Districts formed under the conventional statutes (Improvement Act of 1911, Municipal Improvement Act of 1913, and Improvement Bond Act of 1915) provide some of the less costly development money available because of the real estate security. Assessment Districts do not require an election vote, but a mailed ballot vote. Votes are tabulated at a protest hearing and if more than 50 percent of the property owners vote against the formation of the district (weighted by assessment amount) the proceedings must be halted. Assessment Districts are initiated by petition of the property owners in the proposed district or by action of the City Council.

Mello-Roos Districts

The Mello-Roos Community Facilities Act authorizes cities, counties, and special districts to form "community facilities districts" to finance the construction, improvement or purchase of public facilities that benefit a clearly defined service area. Two or more government agencies may form a community facilities district through a joint financing agreement. All government agencies with jurisdiction in the proposed district boundary must agree to the formation of the district.

The community facilities district may issue bonds, if approved by two-thirds of the voters within the district. Bonds are repaid through special tax assessments. The assessment may not be strictly proportionate to property value. Unlike special assessment districts, the tax does not have to be based directly on benefit derived from the public facilities, although it may be so. Taxes have been based on acreage, street frontage, or square footage of buildings.

Infrastructure Financing Districts

Infrastructure financing districts are formed in proceedings similar to the formation of a Mello-Roos Community Facilities District and, once formed, can use the property tax increment resulting from new development within the district to finance capital facilities. The act to establish these districts became law in 1991. All projects must have community-wide significance, the district must have the consent of affected taxing entities, the district cannot overlap a redevelopment project area, and two-thirds vote is required to create the district. Utility facilities such as water, sewer, and storm drain improvements typically do not increase property tax revenues, so this may not be an appropriate vehicle for these improvements.

Developer Imposed Programs

Developer imposed programs can be used to fund improvements. One approach is for the developer to agree to build the improvements as part of the development. Another approach involves revenues from developer impact fees. This method typically involves pay-as-you-go where impact fees would be collected in a special fund until enough money had accumulated to begin construction. The size of the construction outlay may make pay-as-you-go a difficult approach or, at a minimum, require project phasing.

A third approach would be to issue a revenue bond to obtain upfront construction funding based on the pledge of future impact fees. However, this is unconventional and would require a large reserve fund and may also require a guarantor other than the City. Other options may prove to be more effective.

Revenue Sources

Ad Valorem Taxes

To issue general obligation bonds, a two-thirds majority vote to incur the debt and its repayment is required. This repayment is in the form of ad valorem taxes. The amount of general obligation bonds that can be issued is dependent on the other general obligations outstanding and the total assessed valuation of the City.

Assessment Districts (1911/1913 with 1915 Bond Act and Mello-Roos)

The formation of an assessment district creates its own direct revenue source. The project costs are spread to property owners based on an allocation of costs in proportion to the property's benefit or on a tax formula based on benefit. The costs and benefits received are used to create an equation that spreads cost equitably among the benefiting properties. This allocation becomes a lien on the property if the assessment is not paid.

Infrastructure Financing District

This district generates revenue on a tax increment basis. Tax increment revenues are calculated as follows: the property taxes collected from properties within the boundaries at the time the district is formed are the frozen base, and the additional amount collected above this amount is the tax increment. Revenue generation will depend on the amount of increased property values resulting from the planned improvements. Tax increment revenue also tends to lag a few years after the improvements are put in place.

Impact Fees

For new development, revenues can be generated by imposing impact fees. The magnitude of these fees is dependent on the costs attributed to new development and the City's philosophy on collecting these fees. The impact fee calculation will be regulated by Section 66000 of the California Government Code, which governs impact fees from not being more than the costs that can be attributed to each new user.

Table 9-1
Comparison of Financing Alternatives

Name	Type of Financing	Amount Available	Terms	Revenue Sources	Voter Approval Required?	Minimum time to Implement	Likelihood of Obtaining Financing	Other Comments
Pay-As-You-Go	Cash	Depends on Level of Charges	None	Impact Fees	No	-	This method will not generate sufficient funding for many improvements	
Revenue Bond	City Obligation	Depends on revenue stream	10-30 years	Impact Fees	No	6-12 months	Low, Unconventional	Needs Guarantor other than City
General Obligation Bond	City Obligation	Dependent on other GO bonds and total assessed valuation	20-30 years	ad valorem tax	Yes, 2/3	24 months	Low (voter approval)	
Infrastructure Financing District	District obligation	Depends on tax increment available	Unknown	Tax Increment	Yes, 2/3 within District	24 months	Low (voter approval), not yet used in California	Cannot overlap redevelopment area
Conventional Assessment District (1911, 1913 – 1915 IBA)	District obligation	Depends on level of assessment	10-30 years	Property Assessments	Property Owner Protest Vote/ Hearing	6 months	OK, should have diversity of ownership	
Mello-Roos Community Facilities District	District obligation	Depends on level of assessment	10-30 years	Property Assessments	Property Owner Election, 2/3 Vote	12 months	Depends on stability of revenue	Timing depends on election

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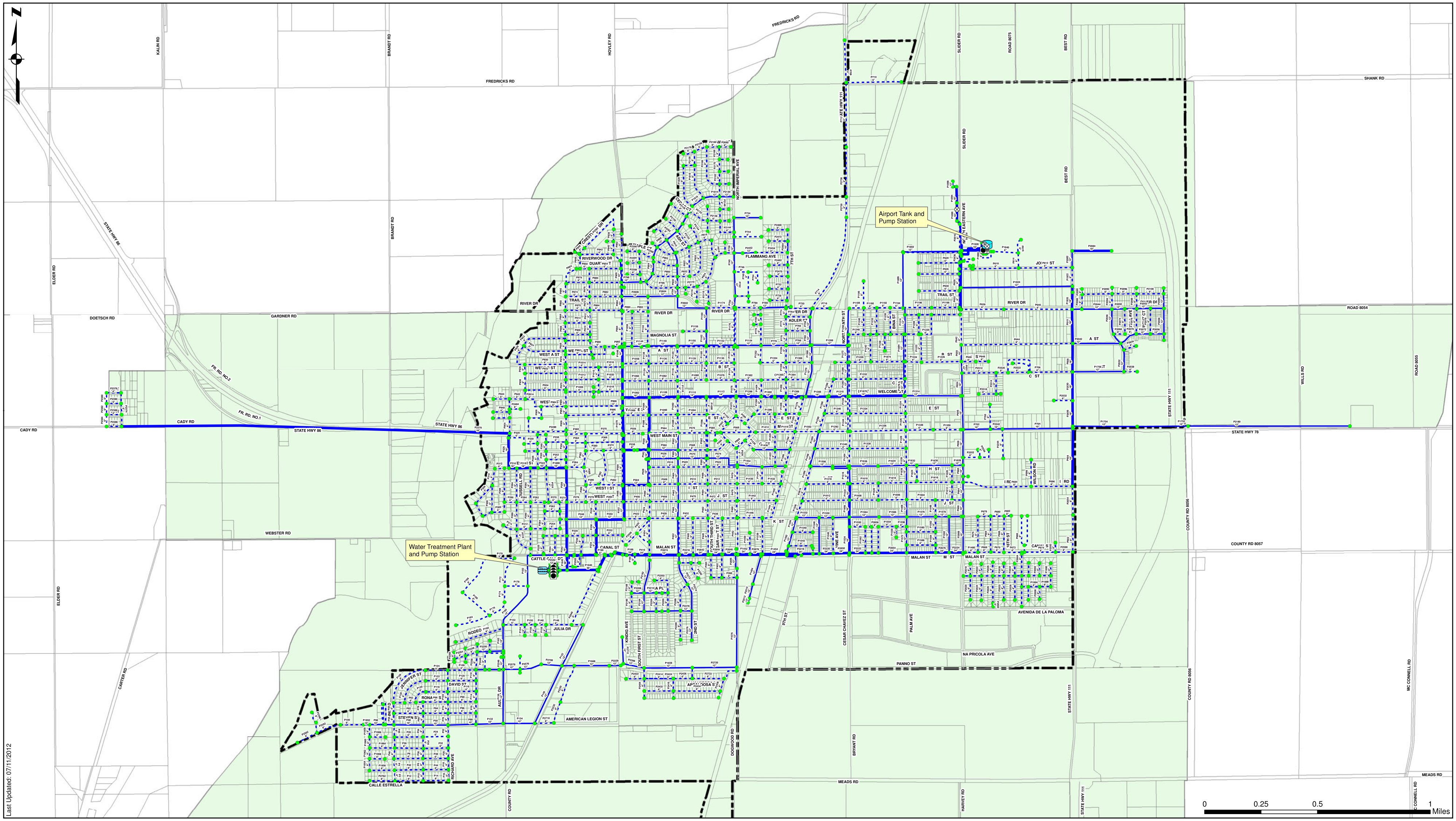

Legend

- Existing Junctions
- Control Valve
- Tank
- Reservoir
- Pump Station

Existing Pipes (Diameter)

- 8" and less
- 10" and 12"
- 14" and greater

- Parcels
- City Limits
- Sphere of Influence

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Figure 2-1

Existing Water Infrastructure

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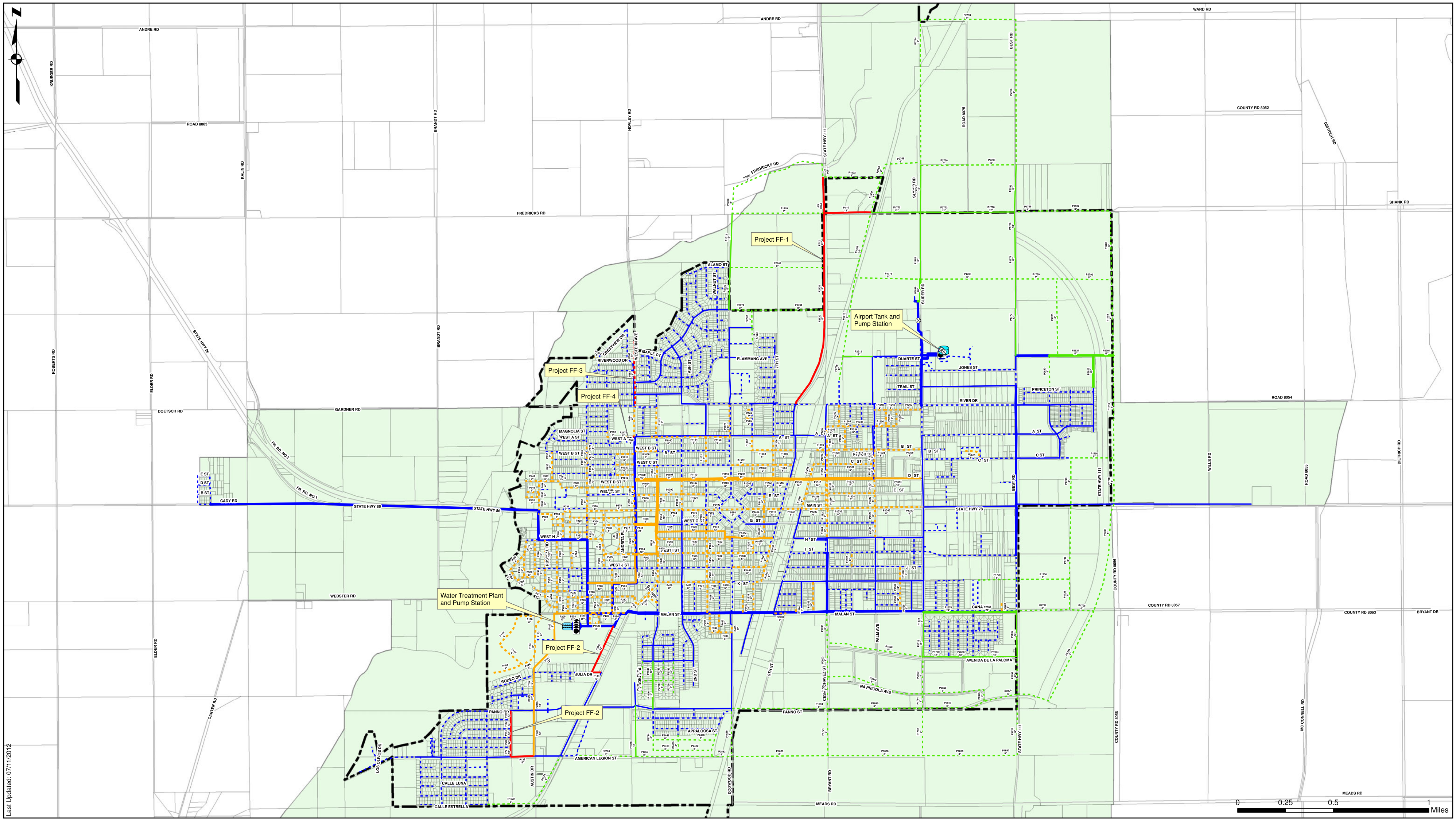

Legend

Control Valve	**Existing Pipes (Diameter)**	**Future Pipes (Diameter)**	**Capital Improvement Project Pipes (Diameter)**	**Cast Iron and 4" and less Replacement Pipes (Diameter)**	Parcels
Tank	8" and less	8" and less	8" and less	8" and less	City Limits
Reservoir	10" and 12"	10" and 12"	10" and 12"	10" and 12"	Sphere of Influence
Pump Station	14" and greater	14" and greater	14" and greater	14" and greater	

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Figure 8-1

Capital Improvement Projects and Future Water Infrastructure

City of Brawley Integrated Master Plan

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