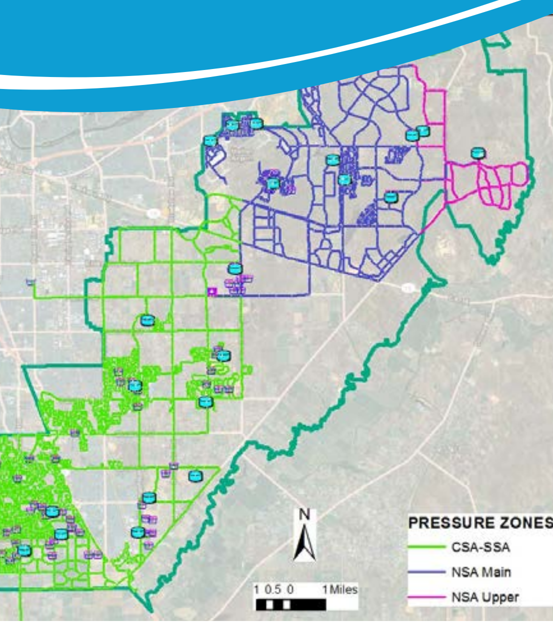
Brown AND Caldwell

Prepared for
Sacramento County Water Agency

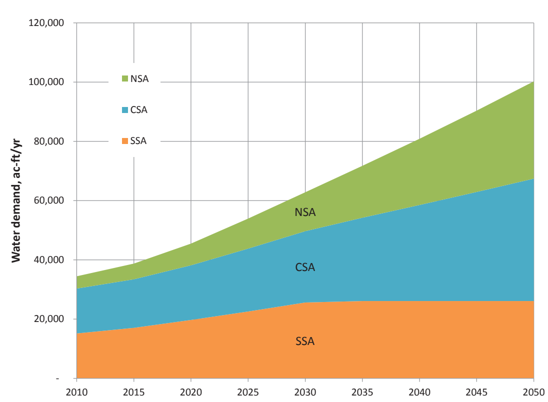
Zone 40
Water System Infrastructure Plan Update

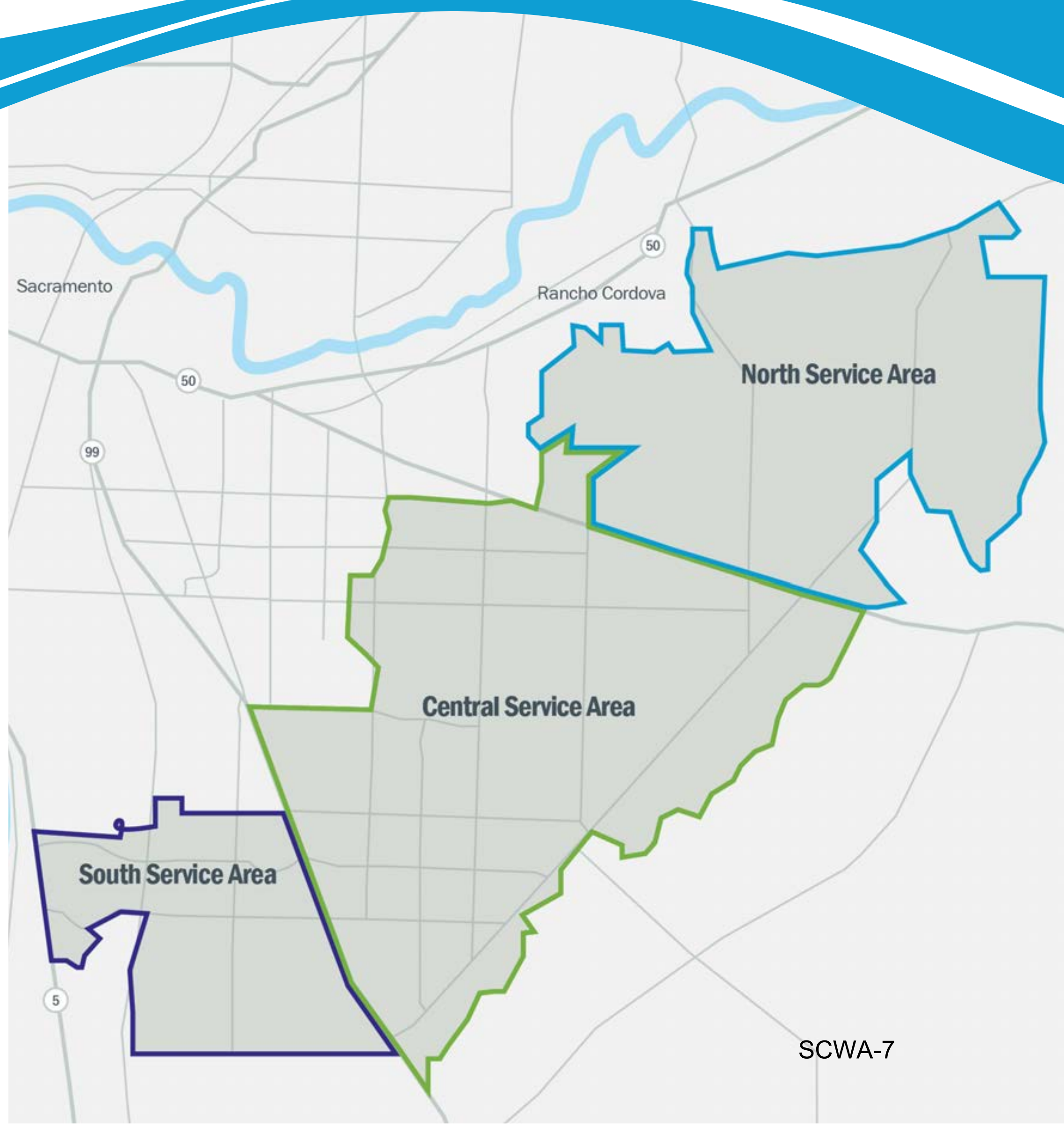
SACRAMENTO COUNTY WATER AGENCY

February 2016



Pressure Zone Separation in the Buildout Zone 40 Water Distribution System





SCWA-7

Zone 40 Water System Infrastructure Plan Update

Prepared for
Sacramento County Water Agency
Sacramento, CA
February 10, 2016

10540 White Rock Road, Suite 180
Rancho Cordova, California 95670

T: 916.444.0123
F: 916.635.8805

February 10, 2016

Robert Gardner
Sacramento County Water Agency
827 7th Street, Room 301
Sacramento, CA 95814 143542

Subject: Zone 40 Water System Infrastructure Plan Update

Dear Mr. Gardner:

Brown and Caldwell is pleased to submit the subject Plan. Please do not hesitate to contact me if you have any questions or comments.

Very truly yours,

Brown and Caldwell

Paul Selsky, PE
Project Manager

PS:ds

Zone 40 Water System Infrastructure Plan Update

Prepared for
Sacramento County Water Agency, Sacramento, CA
February 10, 2016

143542

Project Participants

Sacramento County Water Agency

Darrell Eck, Senior Civil Engineer

Robert Gardner, Associate Civil Engineer

Ping Chen, Associate Civil Engineer

Bob Steeg, GIS

Daniel Barry, Senior Civil Engineer

Carlos Smith, Associate Civil Engineer

John Kern, Associate Civil Engineer

Brown and Caldwell

Paul Selsky, Project Manager

Melanie Holton, Project Engineer

Jeff Lawrence, Reviewer

Dawn Schock, Document Preparation

May Huang, Engineer

Elizabeth Velasco, Engineer

Table of Contents

List of Figures

List of Tables

List of Abbreviations

AACE	Association for the Advancement Cost Engineering International
ac-ft/yr	acre-feet per year
Agency Act	Sacrament County Water Agency Act
ASR	aquifer storage and recovery
bgs	below ground surface
BMO	basin management objectives
Cal Am	California American Water Company
CIP	Capital Improvement Plan
City	City of Sacramento
CSA	Central Service Area
CMID	Construction Management and Inspection Division
CSCGMP	Central Sacramento County Groundwater Management Plan
CVP	Central Valley Project
DPR	direct potable reuse
DU	dwelling units
EBMUD	East Bay Municipal Utility District
FRWA	Freeport Regional Water Authority
GET	groundwater extraction and treatment
GPCD	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
GIS	geographic information system
GSWC	Golden State Water Company
GWTP	groundwater treatment plant
HGL	hydraulic grade line
in	inch
IPR	indirect potable reuse
JPA	joint powers authority
lf	linear feet
MDD	maximum day demand
MFR	Multi-family residential
MG	million gallons
mgd	million gallons per day
M&I	municipal and industrial
NSA	North Service Area
OHWD	Omochumne-Hartnell Water District
PL	Public Law
POU	Place of Use
PSA	purveyor specific agreement
Reclamation	U.S. Bureau of Reclamation
SACOG	Sacramento Area Council of Governments
SB	Senate Bill
SCGA	Sacramento Central Groundwater Activity
SCWA	Sacramento County Water Agency
SFR	Single family residential
SRCSD	Sacramento Regional County Sanitation District
SSA	South Service Area
SMUD	Sacramento Municipal Utility District
SWRCB	State Water Resources Control Board
SWTP	Surface Water Treatment Plant
TDS	total dissolved solids
UWDF	unit water demand factors
UWMP	urban water management plan
WFA	Water Forum Agreement
WRPP	Water Recycling Pilot Program
WSIP	Water System Infrastructure Plan
WSMP	Water Supply Master Plan
WTP	Water Treatment Plant

Section 1

Introduction

This document presents the Update to the Zone 40 Water System Infrastructure Plan (WSIP) for the Sacramento County Water Agency (SCWA). This section describes SCWA and Zone 40, the purpose of this Update, linkage to the 2006 WSIP (SCWA, 2006), the Zone 40 service area, and the report organization.

1.1 SCWA and Zone 40

SCWA was formed in 1952 by a special legislative act of the State of California called the Sacramento County Water Agency Act (Agency Act). SCWA is governed by a Board of Directors. Under the Agency Act, the Board may contract with the federal government and the State of California with respect to the purchase, sale, and acquisition of water. SCWA may also construct and operate any required capital facilities.

Zone 40 was created by SCWA Resolution No. 663 in May 1985, which described the boundaries of the zone and the types of projects to be undertaken. Zone 40 is a benefit zone created for the acquisition, construction, maintenance, and operation of facilities for the production, conservation, transmittal, distribution, and sale of ground or surface water or both for the present and future beneficial use of lands or inhabitants within the zone. Ordinance No. 18, adopted in 1986, empowered SCWA to establish fees, charges, credits, and regulations for the supply of water and required the development of a water supply master plan. The boundaries and scope of Zone 40's activities were expanded in April 1999 by Resolution WA-2331 to include the use of recycled water in conjunction with surface and groundwater.

SCWA provides retail water supply within Zone 40 to portions of unincorporated Sacramento County, the City of Rancho Cordova, and the City of Elk Grove. SCWA also provides wholesale water supply to a portion of the service area of Elk Grove Water District. SCWA will also provide wholesale water supply to California American Water Company's (Cal Am) service area in Rio del Oro. Elk Grove Water District operates a retail water system serving customers within a portion of the City of Elk Grove and is a department of the Florin Resource Conservation District.

1.2 Purpose

The purpose of this WSIP Update is to identify and size the water system facilities needed to supply Zone 40 through buildout. The timing of when the facilities are needed is determined and the associated capital costs are developed. This documents updates information contained in the WSIP that was completed in April 2006.

The 2006 WSIP was developed to be a high resolution staff level planning and implementation document that included description of Zone 40 project issues, water system design, water system modeling evaluation, operating guidelines, and cost evaluation. The 2006 WSIP details the water supply infrastructure needs for buildout of Zone 40, and includes the assumption that the proposed West Jackson, Jackson Township, and NewBridge projects are included.

The timing of this update is triggered by changes in the Zone 40 water supply portfolio, adoption of the Sacramento County General Plan, and completion of the Freeport Regional Water Project. Updating the WSIP in a timely manner allows for the proper planning of the necessary infrastructure.

The 2005 Water Supply Master Plan (WSMP) was developed prior to the 2006 WSIP and it presented recommendations to meet future water demands in Zone 40 through the year 2030 (identified as the 2030 Study Area) with a regional conjunctive use program balancing the use of groundwater, surface water, and recycled water supplies. The Freeport Regional Water Project alternative was selected as the preferred alternative. Subsequently, SCWA developed the 2006 Central Sacramento County Groundwater Management Plan, the 2010 Urban Water Management Plan (UWMP), and the 2011 Water Supply Master Plan Amendment for the Cordova Hills Project (SCWA, December 2011). The 2011 Cordova Hills Amendment addressed the proposed development by that name.

Water Supply Master Plan (WSMP) Amendments have been concurrently developed to address the sufficiency of water supply for the West Jackson, Jackson Township, and NewBridge projects. This WSIP Update includes most of the text of the WSMP Amendments plus additional technical information and detail that is intended to be used by SCWA staff and design engineers to further plan, develop, design, and construct the identified water system facilities. This WSIP develops the future water demands of Zone 40 assuming that the proposed West Jackson, Jackson Township, and NewBridge projects are approved and proceed.

1.3 Linkage to 2006 Zone 40 Water System Infrastructure Plan

This WSIP Update contains updates and additions to substantial portions of the 2006 WSIP. There are also some items from the 2006 WSIP that are not used for this Update.

Items from the 2006 WSIP that are updated for this document consist of the following:

1. Descriptions of all existing Zone 40 water facilities and infrastructure consisting of sizes, capacities, and locations.
2. Buildout land use area by category revised to reflect the changed study area and most recent land use planning information.
3. Unit water demand factors revised to incorporate recent changes in water use characteristics and the gallons per capita per day target requirement.
4. Projected water demands through buildout updated to include the revised study area, buildout land areas, and demand factors.
5. The growth rate projection revised based on information provided by SCWA staff.
6. Descriptions of water supply sources updated to reflect most recent information.
7. The availability of water supplies in average and dry years revised to reflect the latest estimates of supply availability.
8. Groundwater supply description revised to incorporate most recent Basin Management Report (SCGA, 2010).
9. Projection of annual use of surface water and groundwater for Zone 40 during dry and wet/average years updated based on the revised demands, availability of water supplies, and capacities and timing of future water supply facilities.
10. Water system hydraulic model updated and used to evaluate the future water system under wet and dry year supply conditions.
11. Future water supply and pipeline facilities needed through buildout updated.
12. The capital improvement program (CIP) updated to reflect the current needs.
13. Water sufficiency analysis updated for the entire Zone 40 to reflect the revised study area, water supply availability, and demands.
14. Future storage and pump station facilities through buildout identified and documented, and the timing of the need for the facilities.
15. Locations of future pipelines and their timing defined.
16. Cost estimates developed for all facilities planned through buildout.

New items that are presented in this Update that were not included in the 2006 WSIP and the 2011 Cordova Hills Amendment consist of the following:

1. Historical population, number of connections, and water production by type of supply presented for 2001 to 2013.
2. Current groundwater pumping to meet agricultural demands estimated.
3. Buildout population, connections, and dwelling units developed for each Zone 40 service area.
4. Water demand factors expressed as demand per dwelling unit and per type of customer.
5. Demand and supply comparison in five year increments for Zone 40.
6. Projected maximum day and annual use of surface water and groundwater by service area during dry and wet/average years projected through buildout.

The hydrologic year differences and maintenance and operations cost evaluation sections of the 2006 WSIP are not included in this Update.

1.4 Service Area Description

The Zone 40 boundary and service areas as well are shown on Figure 1-1. The study area for this analysis is the Zone 40 area including Elk Grove wholesale area and the future Cal Am area in Rio del Oro, except for the following areas.

- Portion of Elk Grove Water District that is not served by SCWA wholesale water supply.
- Omochumne-Hartnell Water District (OHWD).
- Areas within Zone 40 for which land use categories have not been assigned.
- Cal-Am service area in the CSA.

The study area is further described and illustrated in Section 3.2.

The Zone 40 has three service areas as follows:

- North Service Area (NSA)
- Central Service Area (CSA)
- South Service Area (SSA)

1.4.1 North Service Area

The NSA is located south of the American River and includes part of the City of Rancho Cordova. The NSA is currently supplied exclusively by groundwater. A surface water supply will be provided to the NSA in the near future that will initiate the conjunctive use program in that area. The NSA is the least developed of the three service areas, with currently less than 10 percent of the projected build out population. This service area includes the old Mather and Sunrise Corridor systems, as well as the newer Sunridge system. SCWA assumed ownership of the Mather System shortly after the County of Sacramento took over the old Mather Air Force Base after it was shut down by the US Air Force in the mid-1990s. In the case of the Sunrise Corridor System, SCWA was asked to take ownership and provide water service after the system was constructed through an assessment district in the late 1980’s. The majority of the land within the NSA boundary is rural and undeveloped.

1.4.2 Central Service Area

The CSA is located to the south of the NSA and is supplied by surface water from the Vineyard Surface Water Treatment Plant (SWTP) and groundwater. The CSA is partially developed with approximately 27 percent of the projected build out population. SCWA provides wholesale water to Elk Grove Water District within the CSA. This service area includes the old Grantline-99 system, as well as the newer Vineyard, Vineyard

Springs, and North Vineyard Station areas. The CSA is predominately residential with a small amount of commercial and institutional customers and a large rural component to the east.

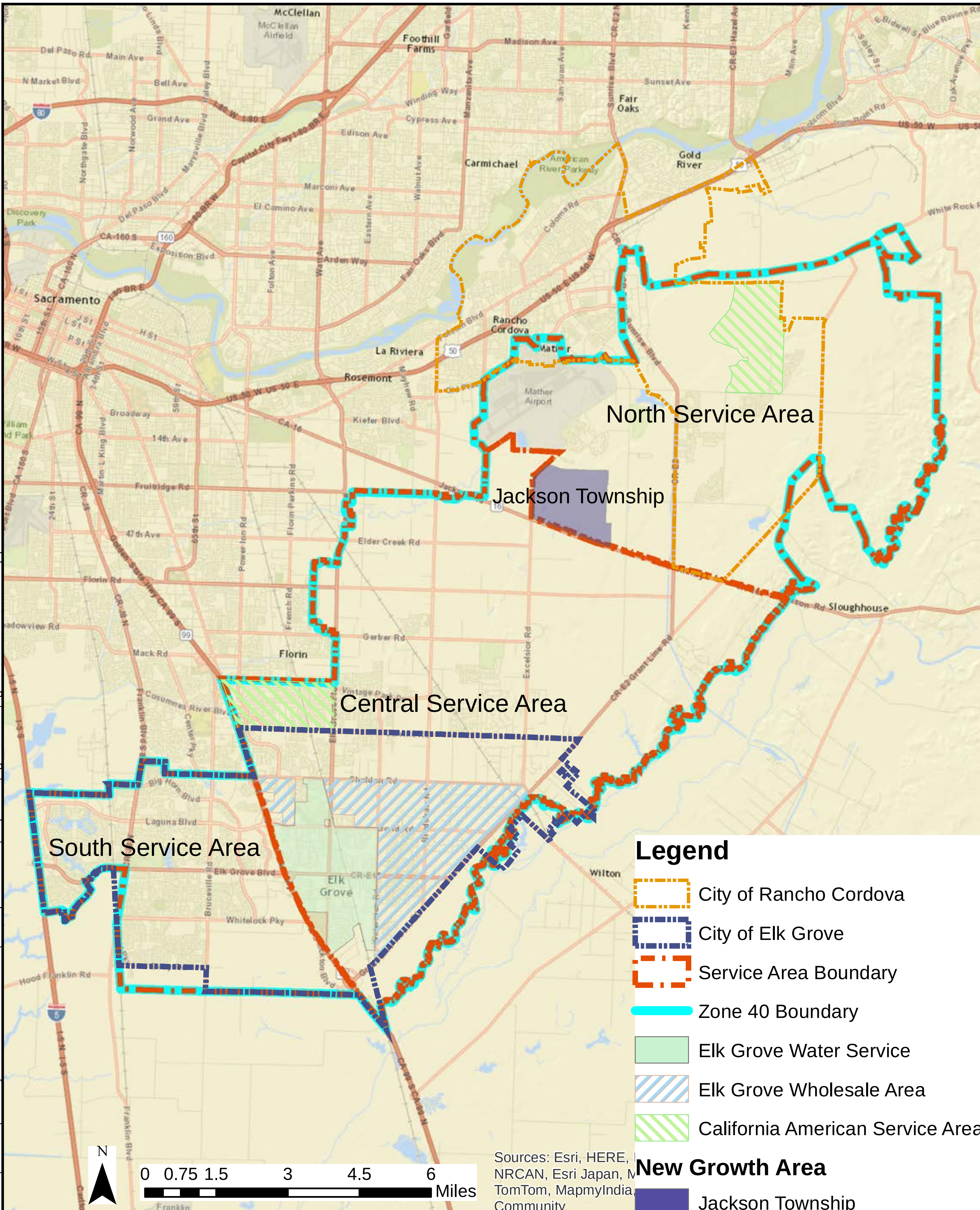
1.4.3 South Service Area

The SSA is located south of the CSA and to the west of Highway 99. The SSA is the most developed of the three service areas, with currently 60 percent of the projected build out population. The SSA is supplied by a mix of surface water, groundwater, and recycled water. This service area currently supplies the Laguna, East Franklin, and Laguna Ridge areas. The SSA is predominantly residential with some commercial and institutional customers as well.

1.5 Report Organization

The WSIP Update contains an additional five sections. Section 2 presents a description of the existing water system and its facilities. Section 3 describes the demographic and land use characteristics and the demands for the overall study area. Section 4 describes the water supplies, and Section 5 compares the water demands to water supplies that include consideration of supply facility capacities. Section 6 develops the required water facilities with their costs needed through buildout to supply the study area. Appendices are provided that includes backup and support information.

As stated earlier, this WSIP Update includes the entire text of the WSMP Amendments plus additional technical information and detail. The additional technical information and detail provided in this WSIP Update that supplements the WSMP Amendments are provided in the last subsections of Sections 3, 4, 5, and 6, and in the appendices.



DATE	PROJECT	SITE	
8/4/15	148130	**Water System Infrastructure Plan Update**	**Figure 1-1**
Brown AND Caldwell; Department of Water Resources, Sacramento County Water Agency		TITLE **Zone 40 Service Area** SCWA-7	

P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 1 files\Figure 1-1 Jackson Township.pdf

Section 2

Existing Water System Description

This section describes SCWA's existing Zone 40 water system. It contains a description of the water supply facilities including surface water facilities, groundwater wells, storage tanks, pressure zones, and the piping system. Recycled water facilities are also described.

2.1 Surface Water Facilities

SCWA surface water supplies for Zone 40 are diverted from the Sacramento River at Freeport and through the City of Sacramento's (City) Sacramento River SWTP.

Surface water diverted from the Sacramento River at the Freeport diversion structure is conveyed through the Freeport Regional Water Authority (FRWA) pipeline, treated at the Vineyard SWTP, and then delivered to the Zone 40 service area. FRWA was created as a joint powers authority (JPA) between SCWA and East Bay Municipal Utility District (EBMUD) in 2002, to increase surface water supply to the southern part of Sacramento County to reduce the county's dependence on groundwater through the implementation of a conjunctive use program and to provide a dry year surface water supply for EBMUD.

In 2011, FRWA completed the Sacramento River diversion at Freeport and a conveyance pipeline. The 84-inch-diameter pipeline starts at the Freeport intake, crosses Interstate 5 and Highway 99 to the east, and then parallels Gerber Road to a bifurcation at Vineyard Road. A SCWA owned 60-inch (in) diameter pipeline then conveys water north from this point to the Vineyard SWTP, which is located in the CSA. An EBMUD owned 66-in diameter pipeline continues further east to the Folsom South Canal.

The current capacity of the Vineyard SWTP is 50 million gallons per day (mgd) with an ultimate capacity of 100 mgd. Treatment facilities include coagulation, flocculation, sedimentation, filtration, and chlorine disinfection. The plant is also provided with solids-handling facilities. Other facilities include a clear well / chlorine contact tank, an electrical building, and treated water pump station.

The Vineyard SWTP currently provides treated surface water primarily to customers in the CSA with a smaller amount of supply to customers in the SSA. Three pipelines cross Highway 99 and hydraulically connect the CSA and the SSA at Sheldon Road, Bond Road, and Grant Line Road. The Sheldon Road pipeline was constructed in 2010.

Surface water is also provided to the SSA through the Franklin Intertie. The City diverts and treats a portion of SCWA's surface water at their Sacramento River SWTP, and then wheels that water through their distribution system to the Franklin intertie to Zone 40. The Franklin Intertie has a capacity of 11.1 mgd. Water from the intertie flows into the SSA though two routes. A dedicated transmission main connects to SCWA's Dwight Road facility where the supply is pumped into the SSA. Water from the intertie is also supplied to the SSA through an in-line booster pump that connects directly to the SSA distribution system.

Table 2-1 summarizes the surface water facilities' capacities.

Table 2-1. Zone 40 Surface Water Facilities			
Facility	Treated water capacity, mgd	Storage tank volume, MG	Pump station capacity, mgd
Vineyard SWTP	50/100 ultimate	20	75 mgd
Franklin Intertie [(a)]	11.1	--	1.6[a]

(a) *This is the in-line booster pump near the intertie. Franklin Intertie supply is pumped to the SSA through both the Dwight Road GWTP booster pump station facility and the in-line booster pump.*

2.2 Groundwater Facilities

Groundwater is supplied to Zone 40 from wells that that are connected to groundwater treatment plants (GWTPs) and from wells that pump directly into the distribution system (direct feed).

Each GWTP facility consists of wells that are manifolded into a treatment plant, a ground level storage tank, and a pump station. Most GWTPs are supplied by more than one well. The existing GWTPs use oxidation and filtration with a manganese zeolite (greensand) filter media for iron and manganese treatment. Treated water from the GWTPs flows into the ground level storage tanks and is subsequently pumped into the distribution system. The pump stations are typically sized larger than the GWTP capacities so that peak hour supply can be pumped to the distribution system from the storage tanks. In the case of the Dwight Road GWTP in the SSA, the pump station is sized larger than the GWTP to also pump the Franklin Intertie supply into the SSA. Storage tanks that are not located at a GWTP facility are described in Section 2.3.3.

The direct feed wells pump directly into the distribution system and do not require treatment. Direct feed wells are located in some areas of the CSA and SSA. SCWA also has some wells that were drilled and planned to be equipped in the future. Because these wells are not currently equipped to provide a groundwater supply to the system, they are not included in this section.

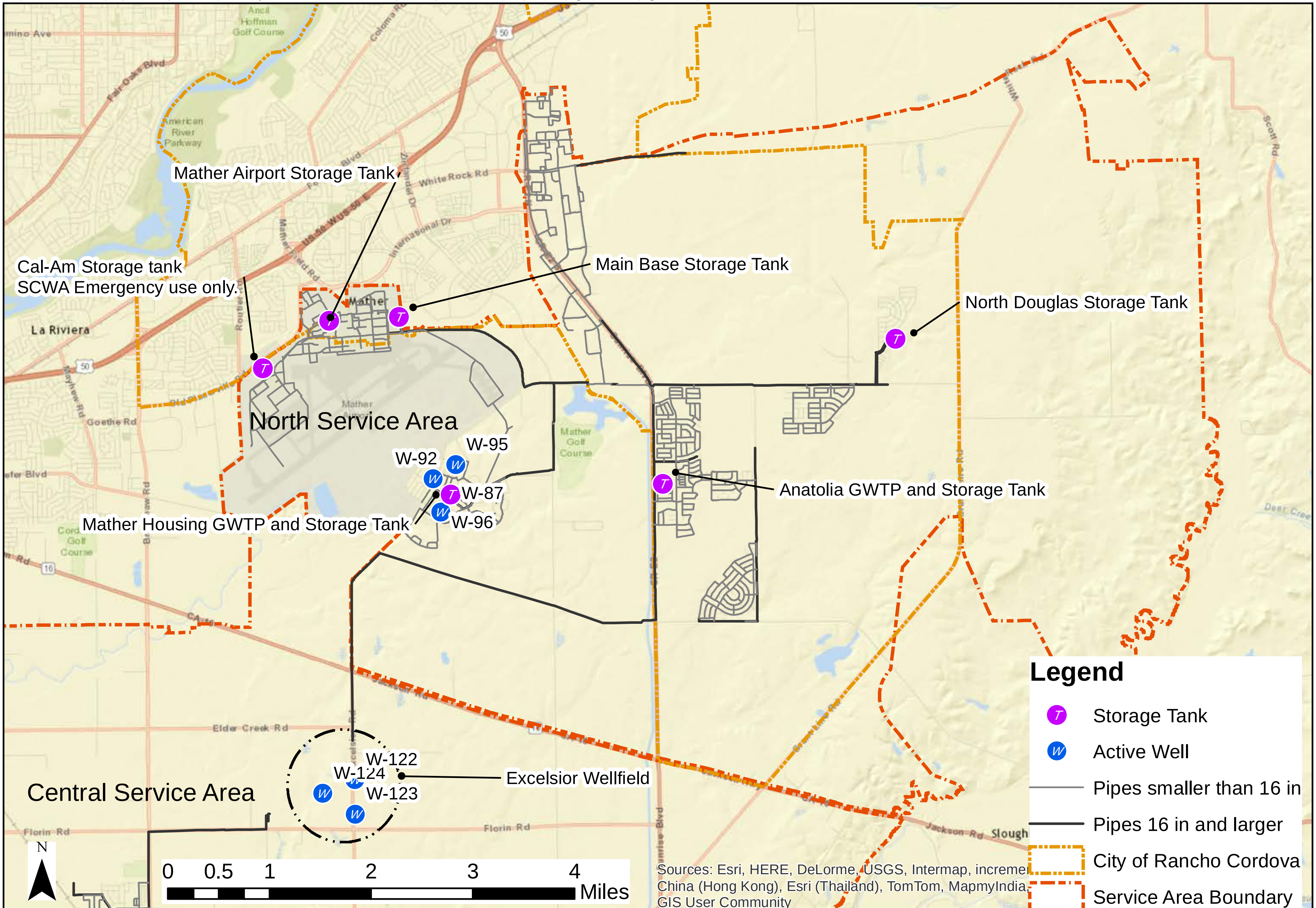
The wells used to feed the Anatolia GWTP are located in the CSA near the Vineyard SWTP, while the GWTP is located in the NSA and the treated water is supplied to the NSA. The wells that supply the GWTPs, storage tanks at the GWTPs, and pump stations in the NSA are listed in Table 2-2. There are no direct feed wells in the NSA. The locations of these facilities are shown on Figure 2-1.

Table 2-2. NSA Groundwater Facilities					
Facility	GWTP capacity, mgd	Well capacity		Storage tank volume, MG	Pump station capacity, gpm
		Wells to GWTP, gpm	Direct feed wells, gpm		
Mather Housing GWTP					
W-096 McRoberts Well	--	750			
W-095 Pittsfield Well	--	1,600			
W-087 Plant Well	--	1,200			
W-092 Veterans Park Well	--	1,200			
Subtotal	6.0	4,750		0.5	3,600 (5.2 mgd) [a]
WT-08 Anatolia GWTP					
W-122 Excelsior Well #1		1,800			
W-123 Excelsior Well #2		1,800			
W-124 Excelsior Well #3		1,800			
Subtotal	6.5	5,400		4.0	7,800 (11.2 mgd)
Total	12.5	10,150	--	4.5	11,400 (16.4 mgd)

[a] *The pump station pumps a portion of the supply from the tank. The remaining supply is fed by gravity to Mather Housing.*

The CSA is supplied water from the Vineyard SWTP and five groundwater treatment plants. There are also three direct feed wells that supply the CSA. The GWTPs, wells that supply the GWTPs, direct feed wells, storage tanks at the GWTPs, and pump stations in the CSA are listed in Table 2-3. The locations of these facilities are shown on Figure 2-2.

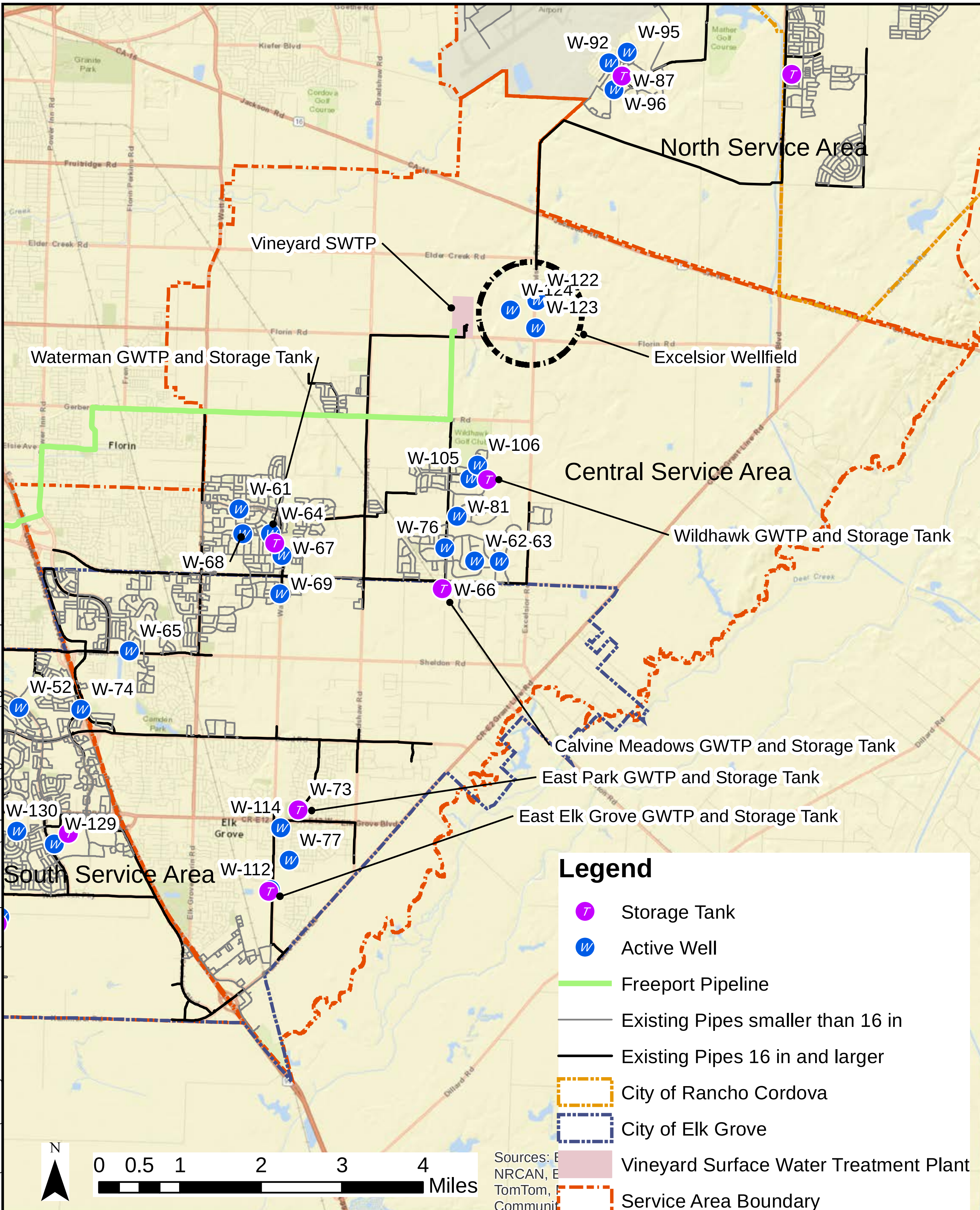
P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 2 files\Figure 2-1.pdf



Brown AND Caldwell DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY	PROJECT 143542	SITE **Water System Infrastructure Plan Update**
	DATE 11/7/14	TITLE **Existing Supply Facilities - NSA**

SCWA-7

Figure 2-1



DATE	PROJECT	SITE	
11/12/14	143542	**Water System Infrastructure Plan Update**	**Figure 2-2**
Brown AND Caldwell; DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY		TITLE **Existing Supply Facilities - CSA**	

SCWA-7

P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 2 files\Figure 2-2 Vert.pdf

Table 2-3. CSA Groundwater Facilities					
Facility	GWTP capacity, mgd	Well capacity		Storage tank volume, MG	Pump station capacity, gpm
		Wells to GWTP, gpm	Direct feed wells, gpm		
WF-01 Calvine Meadows GWTP					
W-066 Calvine Meadows Well		1,700			
W-076 Legends Well		1,750			
Subtotal	5.0	3,450		0.35	6,100 (8.8 mgd)
WT-05 East Elk Grove GWTP					
W-112 East Elk Grove On Site Well		1,500			
W-077 Waterman Ranch Well		1,500			
W-114 Windsor Downs Well		1,500			
Subtotal	6.5	4,500		3.5	9,000 (13.0 mgd)
WF-03 East Park GWTP					
W-073 East Park Well		1,915			
Subtotal	2.9	1,915		0.5	2,400 (3.5 mgd)
WT-02 Waterman GWTP					
W-061 Caymus Well		1,600			
W-069 Perry Ranch Well		1,500			
W-068 Tillotson Well		1,500			
W-067 Waterman Road Well		1,500			
W-064 Westray Well		1,500			
Subtotal	8.6	7,600		7.0	18,000 (25.9 mgd)
WT-03 Wildhawk GWTP					
W-105 Azinger Well		1,800			
W-106 Rodriguez Well		1,800			
W-081 Saddle Creek Well		1,500			
Subtotal	7.5	5,100		3.0	13,200 (19.0 mgd)
Direct feed wells					
W-062 Andalusian Well			1,100		
W-063 Equine Well			1,000		
W-065 Sheldon North Well			608		
Total	30.5		2,700	14.4	48,700 (70.1 mgd)

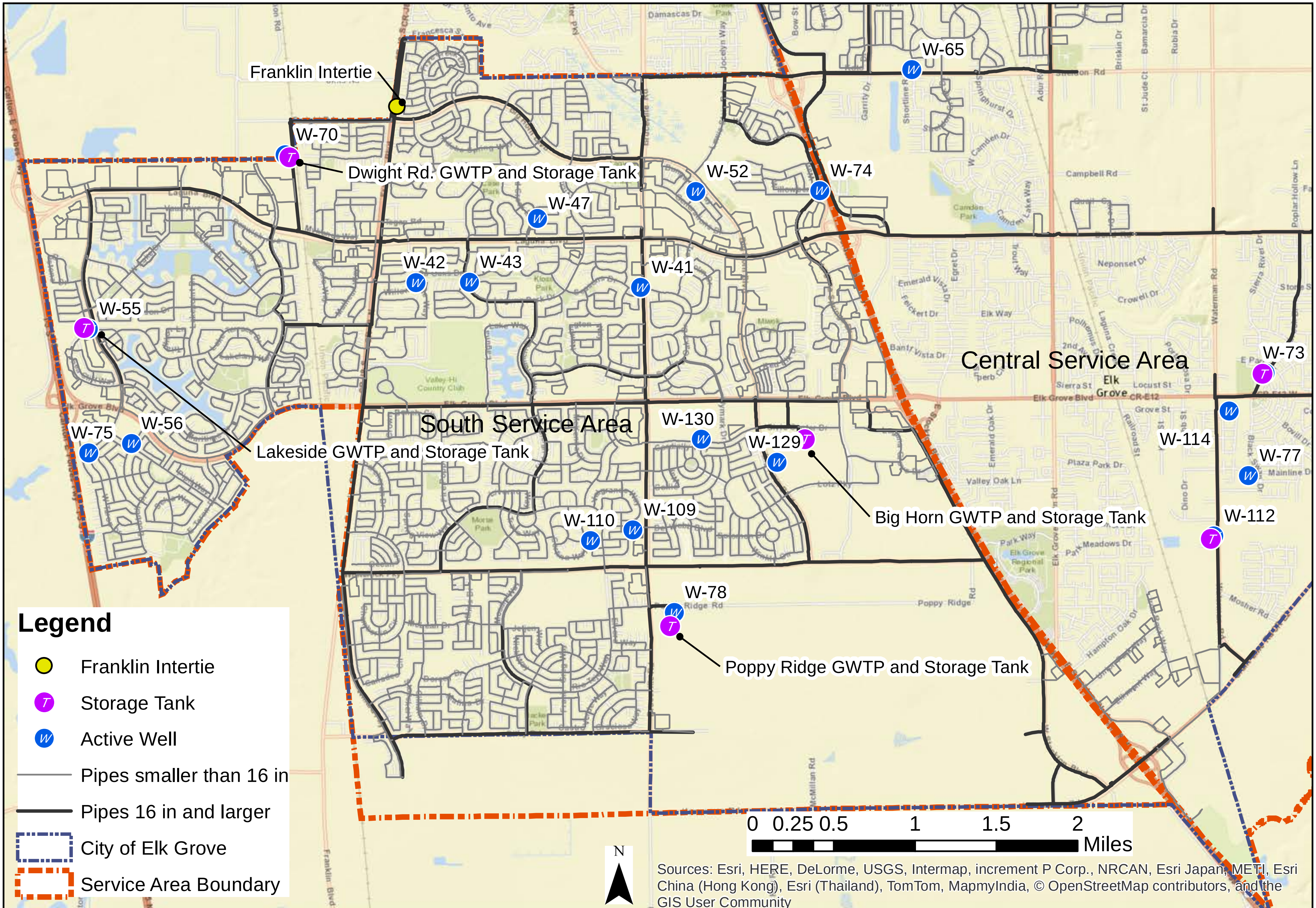
The SSA is supplied water from four GWTPs and from the Franklin Intertie. There are also six direct feed wells that supply the SSA. The SSA also receives some supply from the CSA. The GWTPs, wells that supply the GWTPs, direct feed wells, storage tanks at the GWTPs, and pump stations in the SSA are listed in Table 2-4. The locations of these facilities are shown on Figure 2-3.

Table 2-4. SSA Groundwater Facilities

Facility	GWTP capacity, mgd	Well capacity		Storage tank volume, MG	Pump station capacity, gpm
		Wells to GWTP, gpm	Direct feed wells, gpm		
Big Horn GWTP					
W-130 Big Horn Blvd #5 Well Civic Center Dr		1,500			
W-129 Big Horn offsite Well #4 Big Horn Blvd.		1,500			
Subtotal	4.5	3,000		2.0	6,000 (8.6 mgd)
Dwight Road GWTP					
W-070 Dwight Road Raw Water Well		1,500			
Subtotal	2.1	1,500		7.0	18,000 (25.9 mgd)(a)
Lakeside GWTP					
W-055 Lakeside Well		1,700			
W-056 Riparian Well		1,500			
W-075 West Taron Well		1,600			
Subtotal	6.5	4,800		0.5	5,000 (7.2 mgd)
Poppy Ridge GWTP					
W-110 Ferragamo Well		1,500			
W-078 Poppy Ridge On-Site Well		1,500			
W-109 Terrazo Well		1,500			
Subtotal	6.5	4,500		3.5	7,200 (10.4 mgd)
Direct feed wells					
W-042 Banyon Well			760		
W-052 Big Horn North Well			940		
W-043 Duck Slough Well			1,000		
W-047 Feather Creek Well			800		
W-041 Seasons Well			650		
W-74 Stockton (Park Meadows)			500		
Total	21.6	--	4,650	13.0	36,200 (52.1 mgd)

(a) *Dwight Road GWTP pump station capacity is sized to also pump the supply from the Franklin intertie into the SSA distribution system.*

P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 2 files\Figure 2-3 update.pdf



Brown AND Caldwell

DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY

PROJECT 148130	SITE Water System Infrastructure Plan Update	Figure 2-3
DATE 7/30/15	TITLE Existing Supply Facilities - SSA	SCWA-7

2.3 Water Distribution Facilities

Existing water distribution facilities within Zone 40 include storage tanks and pipelines. The system is also comprised of several pressure zones.

2.3.1 Pressure Zones

Zone 40 consists of two pressures zones, as described below. Figure 2-4 provides a hydraulic schematic of the Zone 40 system that illustrates the pressure zones and ground elevations of key water distribution and supply facilities. Table 2-5 summarizes the ground elevation and maximum day pressure range by pressure zone from SCWA's hydraulic model.

- NSA Main Zone – The NSA Main Zone is the largest pressure zone within the NSA. The NSA Upper Zone will be added in the future.
- CSA/SSA Zone - The CSA and SSA form one pressure zone that is hydraulically connected by three pipelines that cross Highway 99.

Table 2-5. Pressure Zones

Pressure zone	Ground elevation range, ft	Maximum day pressure, psi
NSA Main Zone	74 to 215	40 to 85
CSA/SSA Zone	10 to 96	50 to 75

2.3.2 Pipelines

Table 2-6 summarizes the existing transmission and distribution pipeline length by pipe diameter in each of the service areas. SCWA defines transmission pipe to be those 16 inches in diameter and greater. This includes SCWA pipelines within the Elk Grove wholesale area and raw water pipelines that connect the groundwater wells to the GWTPs.

Table 2-6. Distribution Pipeline Length by Diameter by Service Area

Diameter, in	Pipe length, linear feet			
	NSA	CSA	SSA	Total
Distribution				
<8-in	54,200	200	10,600	65,000
8 to 10-in	264,300	421,700	1,080,200	1,766,200
12 to 14-in	128,800	175,700	344,100	648,500
Transmission				
16 to 24-in	52,300	167,600	231,800	451,600
30 to 36-in	47,100	34,300	16,200	97,500
> 36-in	11,800	24,800	1,300	37,800
Total	558,300	824,000	1,684,000	3,066,200

2.3.3 Storage Facilities

Zone 40 has fourteen active storage tanks. Eleven of the storage tanks are located at GWTPs and described in Section 2.2. The three storage tanks that are independent storage facilities that are not part of a GWTP facility are listed in Table 2-7. These tanks are used to meet the peak hour increment of demand that is greater than the maximum day demand as well as emergency and fire flow demands. Cal Am has a 3 mg storage tank in the NSA that is available to SCWA for emergency purposes.

Table 2-7. Stand-alone Storage Facilities

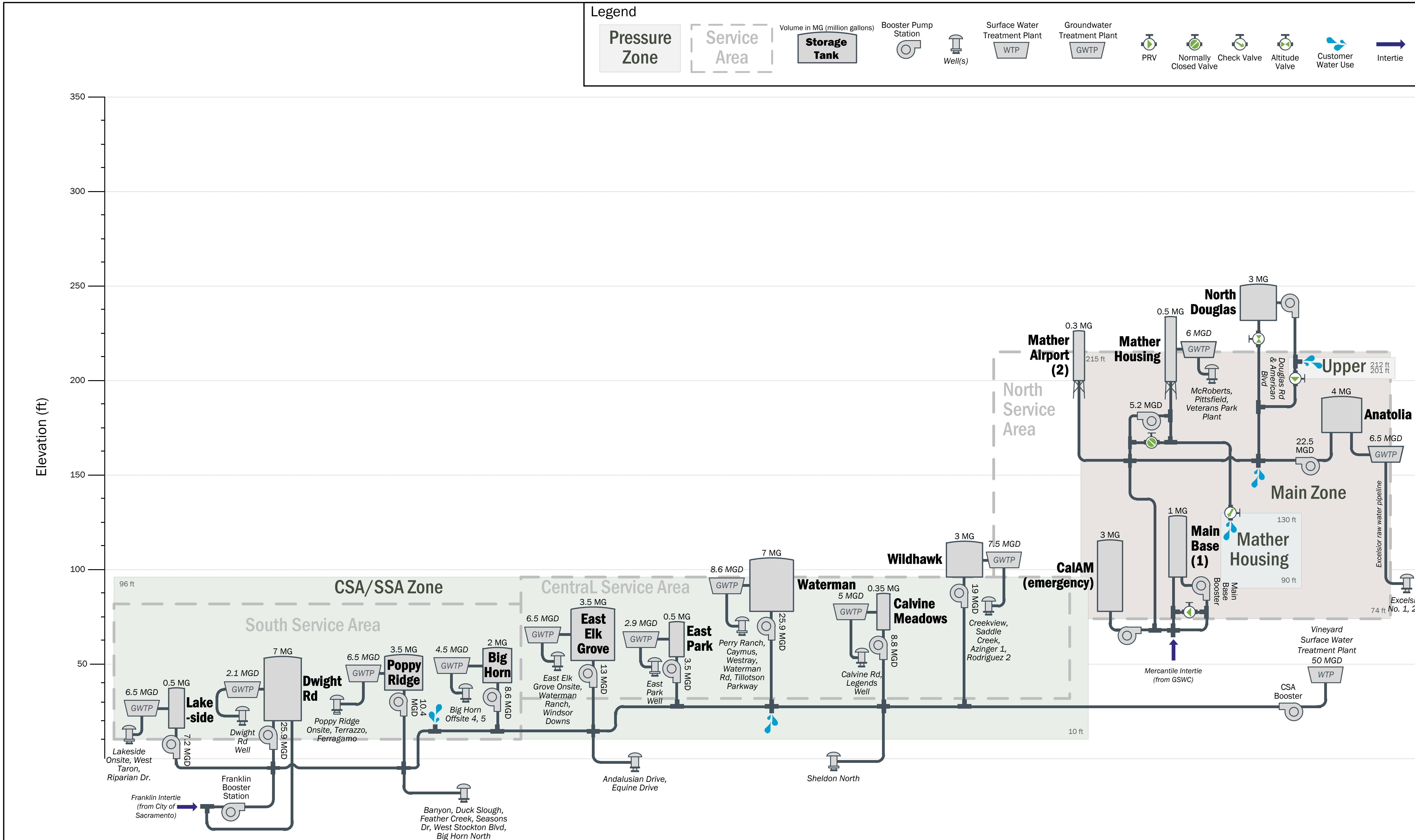
Name	Volume, MG	Pump station capacity, gpm	Pressure zone
Mather 1 storage (Main Base)	1.0	3,600 (5.2 mgd)	NSA Main Zone
Mather 2 storage (Mather Airport)	0.3	Elevated tank	NSA Main Zone
North Douglas	3.0	13,500 (19.4 mgd)	NSA Upper Zone
Total	4.3		

2.4 Recycled Water Facilities

Beginning in 2003, the Sacramento Regional County Sanitation District (SRCSD) started wholesaling recycled water to SCWA for the Phase I SRCSD/SCWA Water Recycling Pilot Program (WRPP). The Phase 1 recycled water service area consists of the Laguna West, Lakeside, and Laguna Stonelake communities that are located in the western third of the Laguna planning subarea in the SSA. In these areas SCWA retails the recycled water to large commercial irrigation customers, industrial customers, right-of-way landscaping, schools, and parks.

Some of the Phase 2 recycled water conveyance facilities have been constructed in the East Franklin Specific Plan planning subarea in the SSA. The portions of the system that are operational are using potable water as a supply source. Phase 2 is planned to also include the Laguna Ridge planning subarea.

SRCSD is responsible for the collection, treatment, and disposal of wastewater throughout most of the urbanized areas of Sacramento County. SRCSD operates a 5 mgd tertiary treatment facility at their regional wastewater treatment plant that includes a pump station. Recycled water is conveyed from the treatment facility via a single 24-inch transmission main than then drops to a 20-inch pipeline to the Phase 1 service area. The recycled water is then conveyed through a branched network of recycled water distribution pipelines ranging from 8-inch to 14-inch diameter in size.



Brown AND Caldwell

Sacramento County Water Zone 40

Figure 2-4. Existing System Hydraulic Schematic

SCWA-7

Section 3

Water Demands

This section describes the historical and buildout land use, demographics, demand factors, and demand projections for the Zone 40 study area as defined in Section 1.2.

3.1 Description of Methodology

Water demands are estimated based on the water demand estimate analysis progression shown on Figure 3-1. The approach has two components, which are the demographics and the water demands.

The first part of the process is focused on land use and demographics. Demographics consist of population, connections, and dwelling units (DUs). The 2010 developed land use acreage by type of use is used to establish demographic factors such as connections and dwelling units per acre. The buildout developed land use acreage is then used to estimate buildout demographics. Buildout is considered to be reached when the available land is fully developed up to the maximum allowed for each land use category.

The number of dwelling units at buildout is estimated based on the maximum number of DUs allowed per acre in each of the general plan residential land use categories multiplied by the number of acres. The projected number of DUs at buildout is used to estimate the number of buildout residential connections and population. The buildout population for Zone 40 is estimated using a population per DU factor from the 2010 population and DU census data. Following the completion of SCWA's 2010 UWMP, the 2010 census data became available. An analysis of the 2010 population served by Zone 40 based on the 2010 census was performed (Brown and Caldwell, 2012). The number of residential connections at buildout is based on the maximum DUs /acre allowed for residential land uses and assumed DUs per connection factors.

For non-residential land uses, the number of connections at buildout is more speculative because of the uncertainty of the mix of types and land area sizes of industries, businesses, parks, and other public facilities. For public land uses the size of parks and public facilities will influence the number of connections in that category. The number of connections at buildout is estimated assuming that the number of connections per acre would be 20 percent higher than the 2010 value. The projected annual connection growth for each service area is estimated.

The second part of the process consists of developing water demand factors based on the historical water use compared to the amount of developed areas, population, and DUs. These historical demand factors are used to develop the demand factors projected for buildout. The buildout demand factors are then used together with the buildout land use and demographics to estimate the buildout water use. The increase in demand to buildout for each service area is based on the projected increase in connections for each service area.

The information presented in Section 3 typically includes all of SCWA's retail service area, the Elk Grove wholesale area, and the future Cal Am wholesale area in Rio del Oro. In the instances where the information excludes the Elk Grove wholesale area, it is so noted.

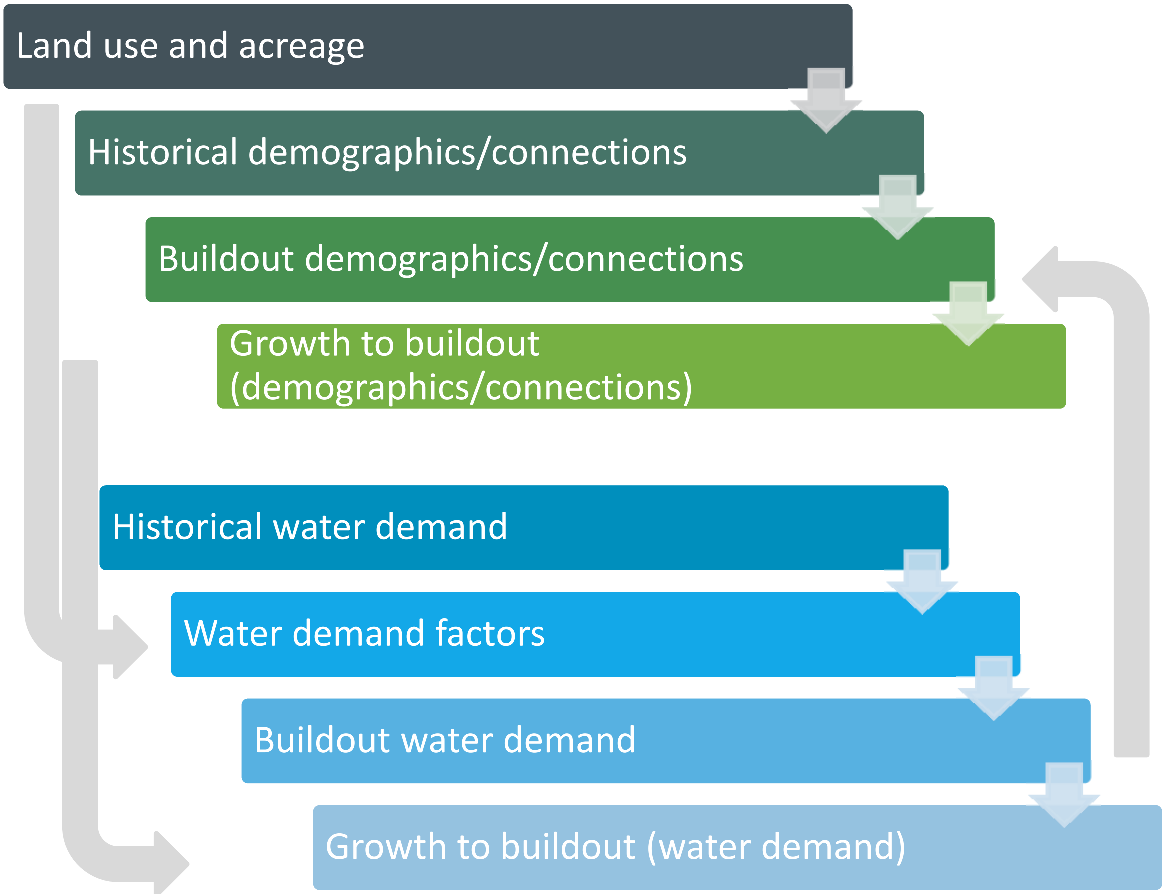


Figure 3-1. Water Demand Estimate Analysis Progression

3.2 Land Use

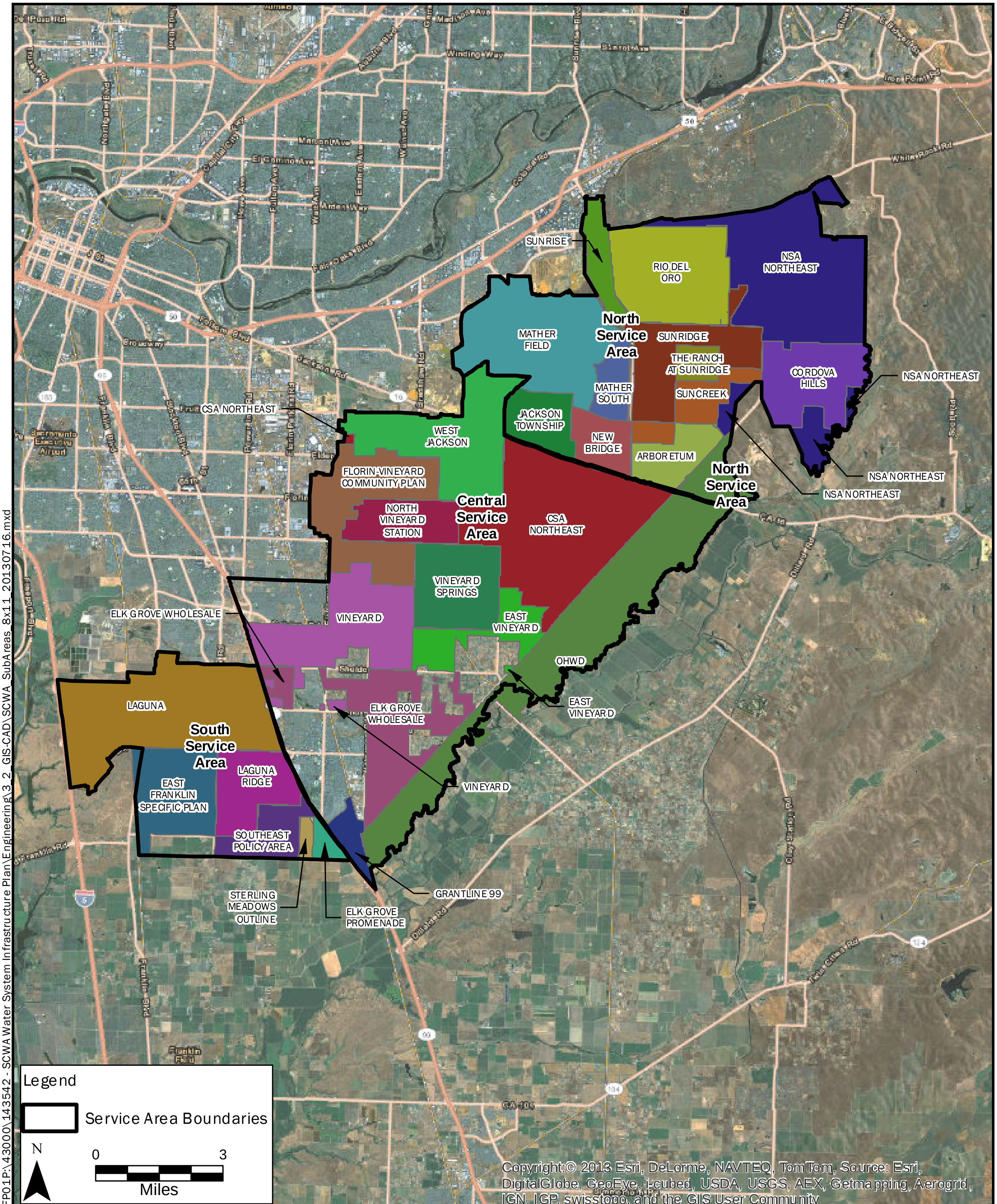
This section describes the planning subareas and land use categories.

3.2.1 Planning Subareas

The study area is divided into planning subareas. The boundaries of the subareas correlate to current city boundaries, unincorporated areas, communities, and planned development defined by future development plans. The subareas are grouped into the three Zone 40 service areas: NSA, CSA, and SSA. The location of these subareas is illustrated on Figure 3-2.

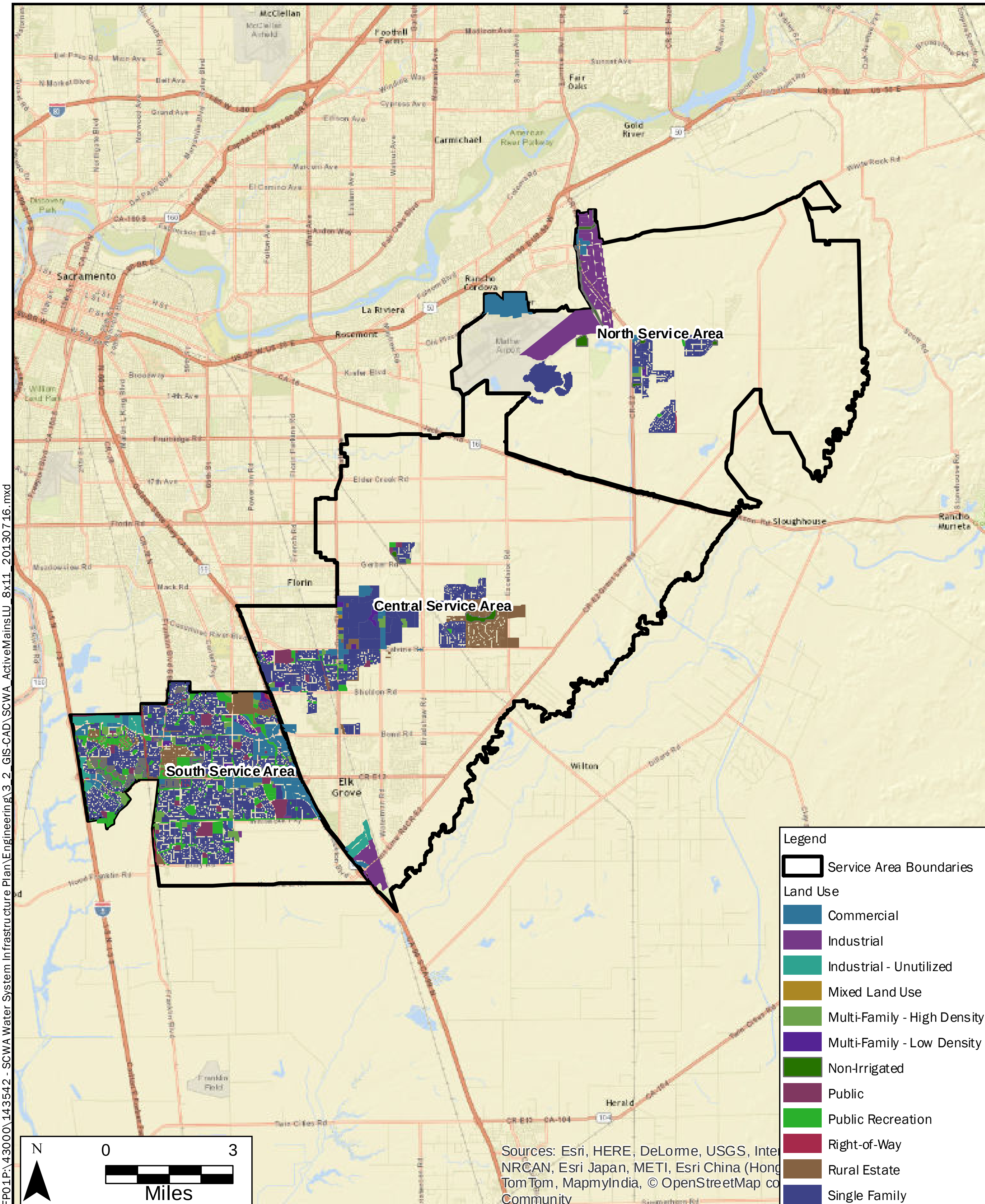
3.2.2 Current and Buildout Land Use

The area of land that was served by SCWA in 2010 is illustrated on Figure 3-3. The shaded areas on Figure 3-3 represent the area of land developed in 2010 and served retail water by SCWA. Figure 3-3 does not include the portion of Elk Grove Water District that is served by SCWA wholesale water supply. The 2010 developed acreage is based on the location of SCWA's existing retail water distribution piping system.



Document Path: BCSACFP01P:\43000\143542 - SCWA Water System Infrastructure Plan\Engineering\3_2_GIS-CAD\SCWA_SubAreas_8x11_20130716.mxd

DATE	PROJECT	SITE	
11/6/14	143542	**Water System Infrastructure Plan Update**	**Figure 3-2**
Brown and Caldwell / Department of Water Resources Sacramento County Water Agency		TITLE **Water Planning Subareas**	SCWA-7



DATE	PROJECT	SITE
11/6/14	143542	**Water System Infrastructure Plan Update**

Brown AND Caldwell

DEPARTMENT OF WATER RESOURCES
SACRAMENTO COUNTY
WATER AGENCY

TITLE

Developed Area Currently Served by SCWA

SCWA-7

Figure 3-3

Document Path: BCSACFP01P:\43000\143542 - SCWA Water System Infrastructure Plan\Engineering\3_2_GIS-CAD\SCWA_ActiveMainsLU_8x11_201307 16.mxd

GIS maps of the land uses defined by the most recent and use planning information for Sacramento County, the City of Elk Grove, and the City of Rancho Cordova, as well as maps of proposed developments were used to quantify the area of each land use category within each subarea. The land use categories presented in the General Plans have been collapsed into a reduced set for the purposes of this analysis. Buildout is considered to be reached when the available land is fully developed up to the maximum allowed for each land use category.

The buildout land use for the study area is illustrated on Figure 3-4, which also shows the land use for the OHWD subarea. The 2010 and buildout land use acreages by land use category are summarized in Table 3-1. The acreages presented in Table 3-1 are net acres for 2010 and gross acres for the study area at buildout.

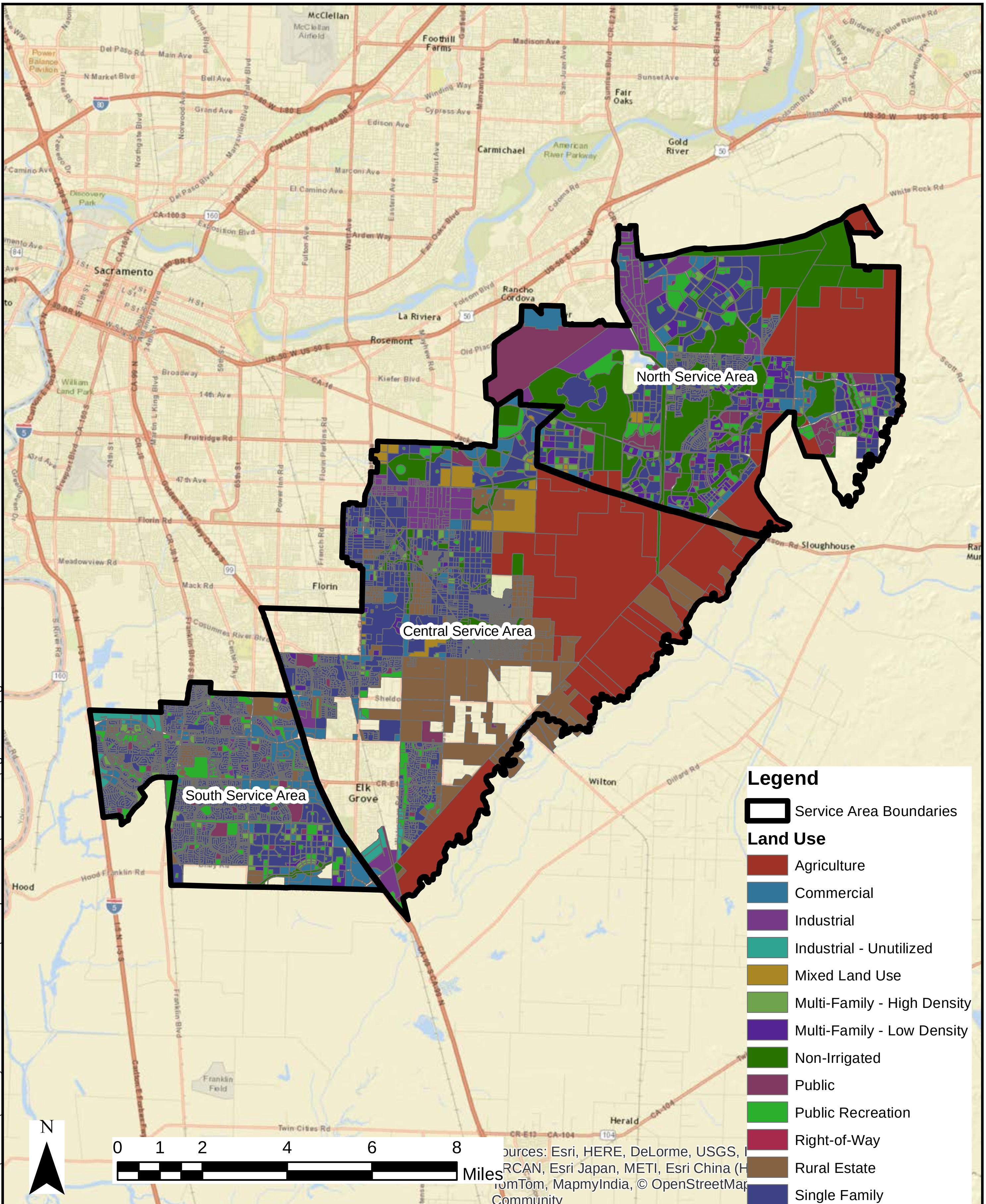
Gross acres are defined as the total land area for each land use category including streets and right of way areas. Net acres exclude the area occupied by streets and right of ways. It is assumed that streets and right of ways cover 20 percent of the gross area within the residential, commercial, and industrial land use categories. This accuracy of this assumption could be improved by quantifying the actual street and right of way areas in existing and proposed development. All other land use categories are assumed to not have streets and right of ways, so their net and gross acreages are the same.

The buildout gross acreage was estimated based on GIS data that included areas of both net and gross acreage. For those areas where the GIS data was net acreage, the quantity of net acres was converted to gross acres. The 2010 net acres was estimated using GIS data, but not converted to gross acres.

The developed area at buildout within Zone 40 will increase to three times the area that is currently developed. Figures 3-5, 3-6, and 3-7 illustrate the buildout gross acreage and percent of acreage by land use category in the NSA, CSA, and SSA, respectively. As shown in these figures, there are significant differences between the service areas in the proportion of land area for each land use category.

Table 3-1. 2010 and Buildout Area By Land Use		
Land use category	2010 developed area, net acres	Buildout area, gross acres
Rural estate	1,380	6,870
Single family	6,970	18,140
Multi-family - low density	220	3,750
Multi-family - high density	390	1,310
Commercial	1,520	4,330
Industrial	1,110	3,470
Industrial-unutilized	340	580
Public	920	2,120
Public recreation	1,270	4,820
Mixed land use	20	1,230
Right-of-way	70	580
Subtotal, municipal water supply land area	14,210	47,200
Self-supported/supplied by others	-	870
Non-irrigated	500	9,800
Agricultural	-	11,620
Total	14,710	69,490

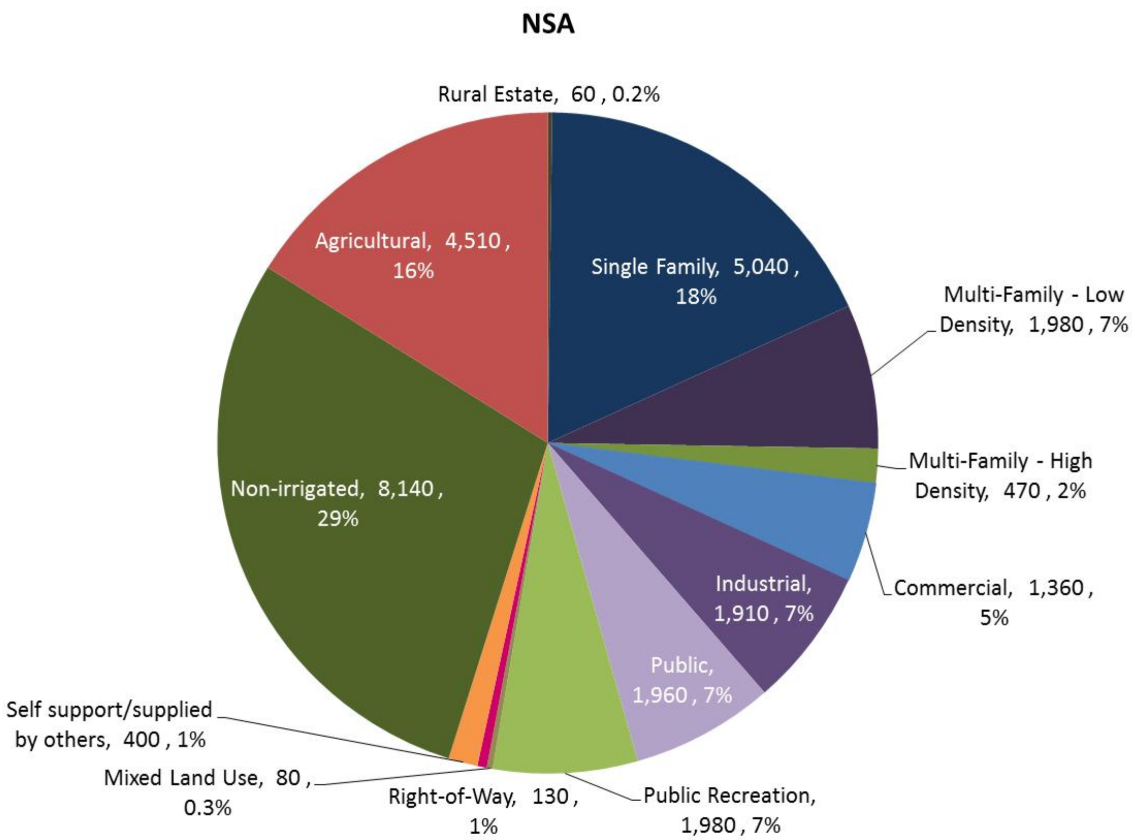
Note: Elk Grove wholesale area is not included in the 2010 developed area acreage and is included in the buildout acreage.



P:\Shared folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape Files\Figure 9 files\Figure 9-2.mxd

DATE	PROJECT	SITE	
07/30/15	148130	**Water System Infrastructure Plan Update**	**Figure 3-4**
Brown AND Caldwell; DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY		TITLE: **Buildout Land Use - Cumulative**	

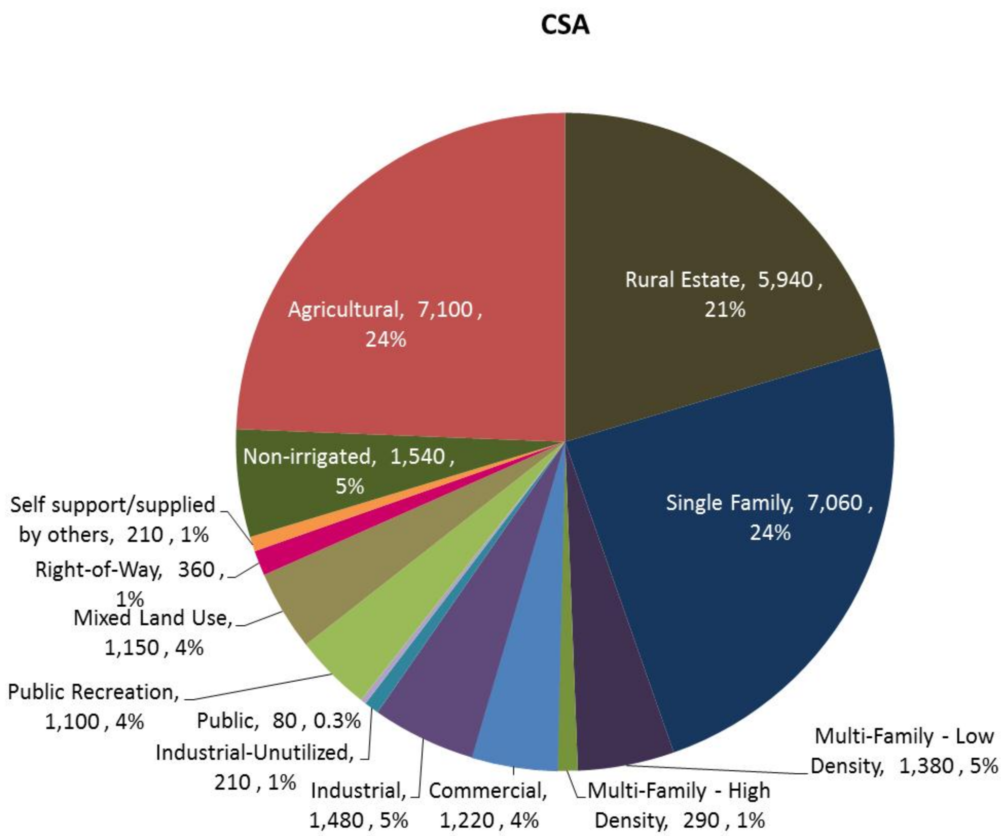
SCWA-7



Note: Pie slice values are acres. Percentage is percent of total NSA acreage.

NSA total gross acreage = 28,020 acres

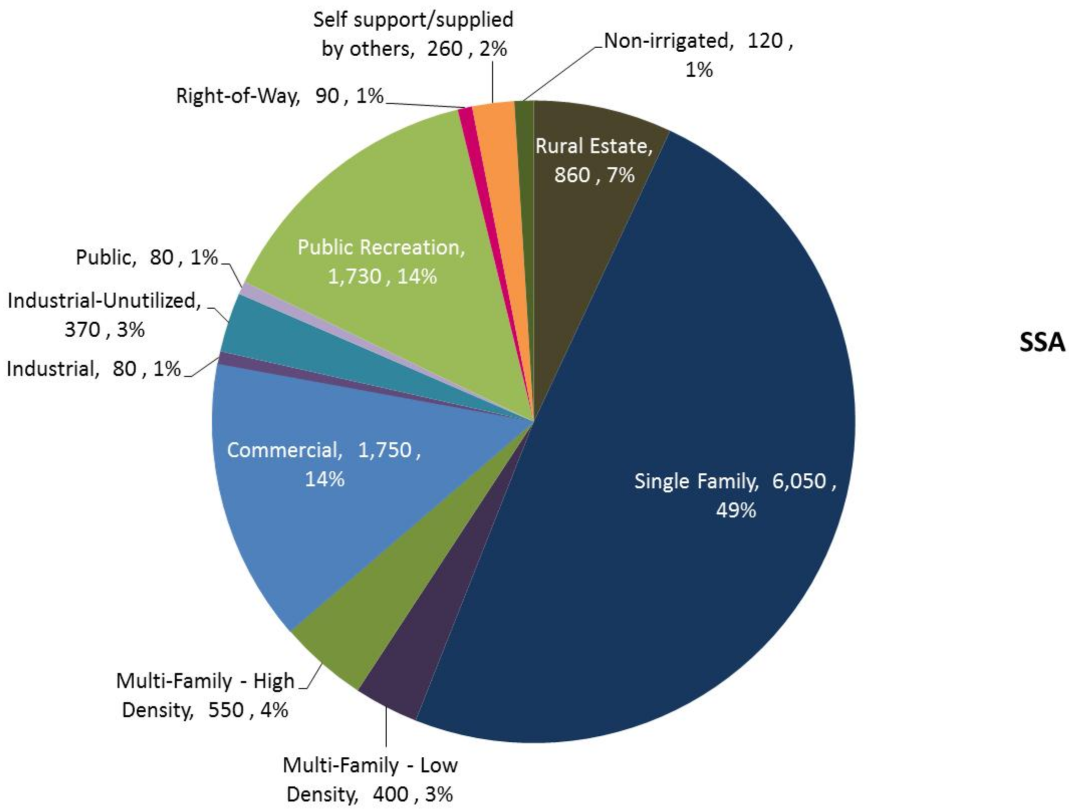
Figure 3-5. Buildout NSA Land Use by Category within the Study Area



Note: Pie slice values are acres. Percentage is percent of total CSA acreage.

CSA total gross acreage = 29,120 acres

Figure 3-6. Buildout CSA Land Use by Category within the Study Area



Note: Pie slice values are acres. Percentage is percent of total SSA acreage.

SSA total acreage = 12,340 acres

Figure 3-7. Buildout SSA Land Use by Category within the Study Area

3.2.3 Residential Land Use Density

The general plan residential land use categories each have a dwelling unit (DU) density range in terms of the minimum and maximum allowed number of DUs per acre. The buildout DUs and resulting residential water connections developed in this analysis are based on the maximum density allowed within each land use category (i.e. 7 DU/acre for the RD 5-7 land use category). The financial analysis that was conducted for Zone 40 focused on a ten year planning horizon before buildout occurs, so it is not impacted by the buildout dwelling unit density assumption. As described previously, each of the four residential land use categories defined for this analysis represent several general plan residential land use categories. The average and maximum dwelling unit densities established for each of the four residential land use categories were developed using the weighted average by buildout acreage of the several land use types represented in each category. Actual land use density at buildout may vary from what is assumed in this document.

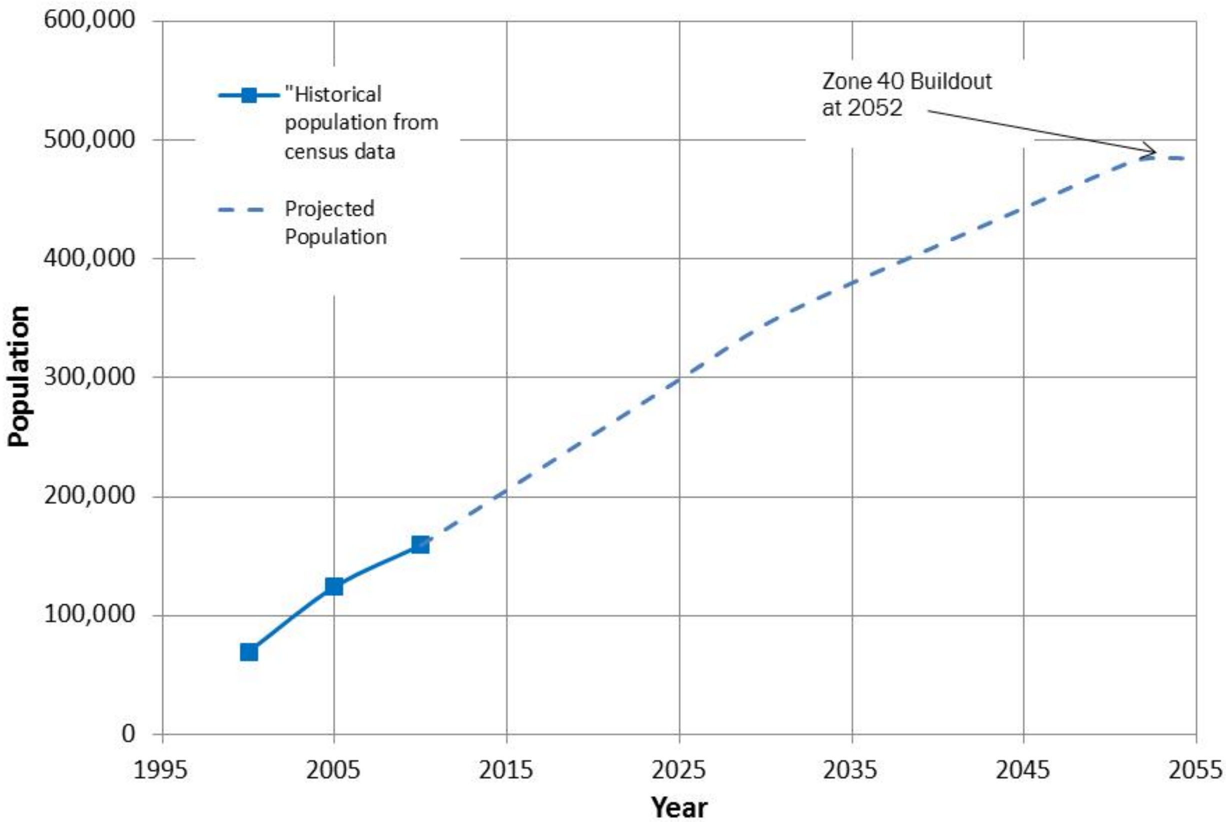
Another density variable is bonus density. In general, bonus density is an increased dwelling unit density above and beyond the maximum allowable residential density under the local zoning ordinance. Section 65915 of the Government Code requires that local government provide a developer with incentives or concessions for increasing the production of housing units and child care facilities when an applicant seeks a density bonus for a housing development or for the donation of land for housing within the county. In 2004, Senate Bill (SB) 1818 amended section 65915 of the Government Code, pertaining to the density bonus law. The purpose of SB 1818 is to encourage developers to build affordable housing by requiring local governments to provide meaningful incentives. The projected number of dwelling units has not been adjusted for the possibility of bonus density being provided.

3.3 Historical and Buildout Demographics

This section describes the historical DUs, population, number of connections, and the analysis to develop the projected demographics at buildout as well as the resulting projected growth rates of connections and population for Zone 40.

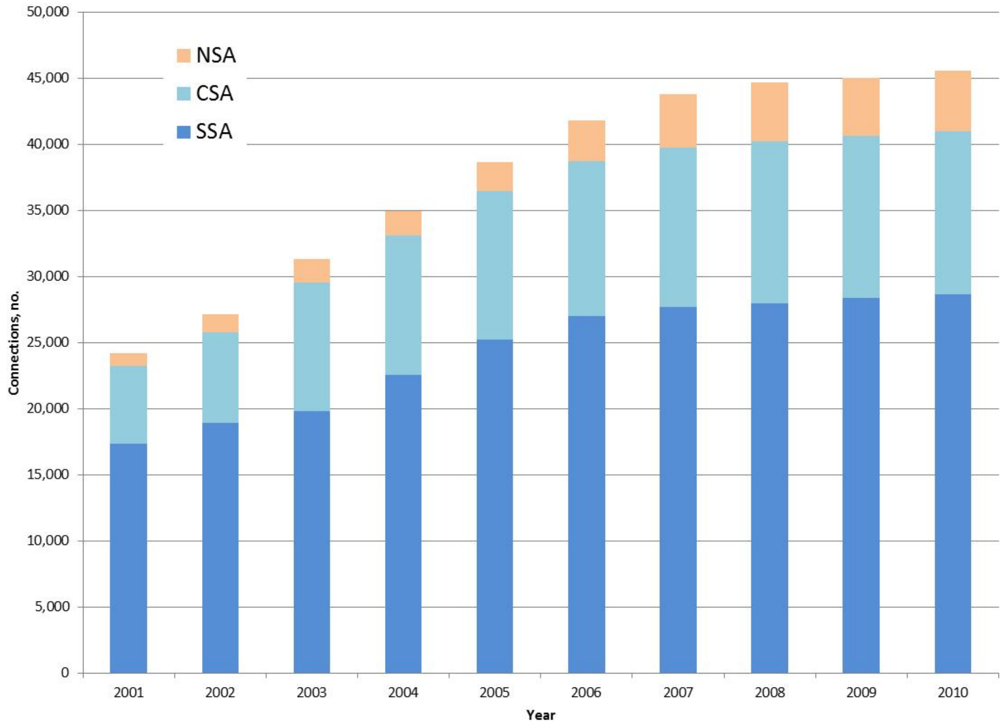
3.3.1 Historical Population and Connections

Following the completion of SCWA's 2010 UWMP, the 2010 census data became available. An analysis of the 2010 population served by Zone 40 based on the 2010 census was performed (Brown and Caldwell, 2012). The historical population in Zone 40 based on the 2000 and 2010 census is shown on Figure 3-8. The historical number of connections by service area within Zone 40 is shown on Figure 3-9.



Elk Grove wholesale population is included. 2010 Elk Grove wholesale population is estimated to equal 10,144 people in 2010.

Figure 3-8. Historical and Projected Population in Zone 40



Note: Connections in Elk Grove wholesale area are not included on this figure because of unavailable historical information for all of the years depicted.

Figure 3-9. Historical Connections by Service Area

3.3.2 Buildout Analysis of Dwelling Units, Population, and Connections

This section describes the analysis performed to estimate the number of DUs, population, and connections based on the estimate of the buildout area by land use type presented in Section 3.2. The estimate of the buildout water demand is described in Section 3.6.

The number of DUs at buildout is estimated based on the maximum number of DUs allowed per acre in each of the general plan residential land use categories multiplied by the number of acres. The projected number of DUs at buildout is used to estimate the buildout residential connections and population. The buildout population for Zone 40 is estimated using a population per DU factor from the 2010 population and DU census data. The number of residential connections at buildout is based on the maximum DU/acre allowed for residential land uses and assumed DU per connection factors.

For non-residential land uses, the number of connections at buildout is more speculative because of the uncertainty of the mix of types and land area sizes of industries, businesses, parks, and other public facilities. For public land uses the size of parks and public facilities will influence the number of connections in that category. The number of connections at buildout is estimated assuming that the number of connections per acre would be 20 percent higher than the 2010 value.

The projected DUs, population, and connections at buildout by land use category are shown in Table 3-2. Population per DU and per connection, DUs per connection, and connections per acre by land use category are also shown in this table. The number of people per connection projected at buildout is approximately 4.6 people/connection. This is higher than the 2010 value of 3.3 people/connection because of the proportionally large increase in multi-family land use area compared to single family land use area from 2010 to buildout. A larger proportion of the residential dwelling units and connections will be multifamily at buildout compared to 2010, which will result in a higher number of people per connection.

Table 3-2. Buildout Dwelling Units, Population, and Connections by Land Use Category

Land use category	Dwelling units	Population	Connections	Population/ dwelling unit	Population/ connection	Dwelling units/ connection	Connections/ acre
Rural estate	3,300	11,000	3,300	3.3	3.3	1 .0	0.5
Single family	87,100	287,500	87,100	3.3	3.3	1 .0	4.8
Multi-family - low density	41,800	115,000	4,200	2.8	27.4	10.0	1.1
Multi-family - high density	27,700	70,700	1,800	2.6	39.3	15.0	1.4
Commercial			1,900				0.4
Industrial			1,400				0.4
Industrial-unutilized							-
Public			200				0.1
Public recreation			4,100				0.9
Mixed land use			500				0.4
Right-of-way			700				1.2
Self-supported/ supplied by others			-				
Non-irrigated			-				
Agricultural			-				
Total	159,900	484,200	105,200	3.0	4.6	1.5	1.5

The 2010 and projected buildout DUs, population, and connections by service area are shown in Table 3-3. The projected buildout number of DUs and population for the NSA, CSA, and SSA are very similar; however the number of connections in the NSA are significantly less than the CSA and SSA. This is because the there is a greater number of multi-family DUs in the NSA than the CSA and SSA. Since there are several multi-family dwelling units per connection, a lower number of connections is needed in the NSA to serve the similar number of dwelling units.

Table 3-3. 2010 and Buildout Dwelling Units, Population, and Connections by Service Area						
Service area	2010			Buildout		
	Dwelling units	Population	Connections	Dwelling units	Population	Connections
NSA	4,000	11,700	4,600	54,300	159,600	28,800
CSA	17,400	56,600	15,600	54,300	166,200	38,300
SSA	30,600	91,300	28,900	51,300	158,400	38,100
Total	52,000	159,600	49,100	159,900	484,200	105,200

Note: 2010 dwelling units, population, and connections in Elk Grove wholesale area are estimated and included in the CSA values. Elk Grove wholesale area service connections in 2010 are estimated to be 3,200 connections and the DUs are estimated to be 3,500 based on a 1.1 DU per connection factor. The population is estimated to equal 10,144 people.

3.3.3 Connection Growth Projection

The future growth rate of Zone 40 is expressed as the growth in the number of water system connections. The growth in water system connections is projected based on an evaluation of the range of historical growth trends that have occurred in each service area. Because of the uncertainty in the future rate of growth, three growth rates were developed and expressed as low, medium, and high. The medium growth rate is used for the projections in this document. The low and high connection growth rates are approximately the same as the lowest (1,300 connections per year) and highest (3,600 connections per year) historical 5-year moving average growth rate for the 9 year period from 2001 to 2010. The medium growth rate begins at 1,000 new connections per year increasing to 1,500 new connections per year in 2020 and thereafter until buildout. The number of new connections estimated to occur each year for each service area is presented in Table 3-8. The connection growth rate from 2015 to 2024 was provided by SCWA staff. Any change in the growth of new connections to the water system will change the water demand projection and the timing of the need for future water facilities.

The projected connection growth in 5-year increments, number of connections at buildout, and the buildout year for each service area are summarized in Table 3-9. The projected number of connections through 2050 for each of the growth scenarios is illustrated on Figure 3-11.

Table 3-8. Projected Annual Connection Growth (new connections) [a]				
Year	NSA (buildout 2052)	CSA (buildout 2051)	SSA (buildout 2031)	Total
2015	300	300	400	1,000
2016	300	300	500	1,100
2017	300	300	500	1,100
2018	350	350	500	1,200
2019	400	400	500	1,300
2020	500	500	500	1,500
2021	500	500	500	1,500
2022	500	500	500	1,500
2023	500	500	500	1,500
2024	500	500	500	1,500
2025	500	500	500	1,500
2030	500	500	500	1,500
2031	600	600	299	1,499
2035	750	750	-	1,500
2040	750	750	-	1,500
2045	750	750	-	1,500
2050	750	750	-	1,500
2051	750	15	-	765
2052	659	-	-	659

Note: Annual growth is shown from 2015 to 2025. Years after 2025 are shown in 5-year intervals and for years when buildout within a service area occurs. Annual growth for years not shown between 5-year intervals is constant.

[a] New connections include the Elk Grove wholesale subarea, Cal Am portion of Rio Del Oro subarea, and recycled water connections.

Table 3-9. Projected Connections in 5-Year Increments										
Service area	2010	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
NSA	4,600	5,600	7,500	10,000	12,500	16,100	19,800	23,600	27,300	28,800
CSA	15,600	16,600	18,400	20,900	23,400	27,000	30,800	34,500	38,300	38,300
SSA	28,900	30,300	32,800	35,300	37,800	38,100	38,100	38,100	38,100	38,100
Total Zone 40	49,100	52,600	58,800	66,300	73,800	81,300	88,800	96,300	103,800	105,200

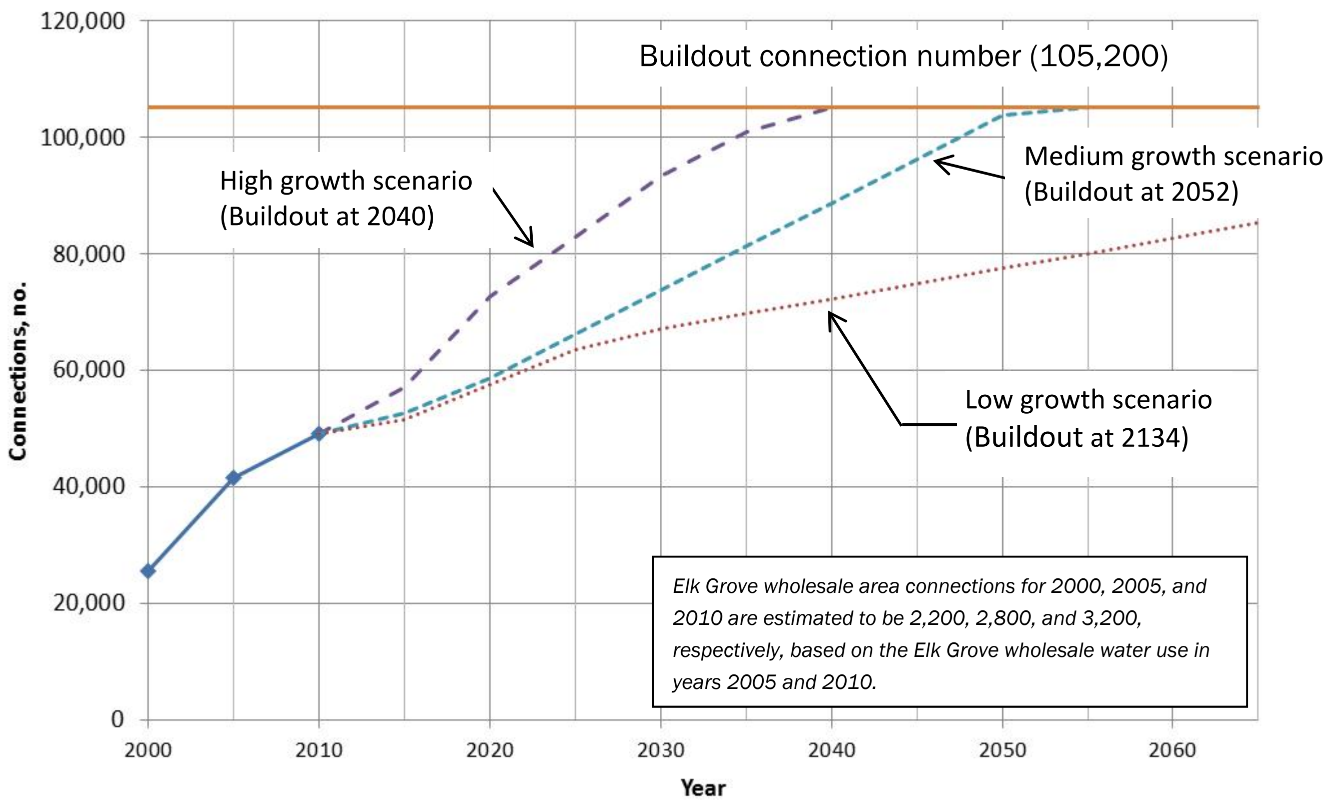


Figure 3-11. Historical and Projected Zone 40 Connections at High, Medium, and Low Growth Rates

3.4 Historical Water Production

Historical potable and recycled water production in Zone 40 from 2001 to 2013 by service area is shown in Table 3-10 and illustrated on Figure 3-12. The production quantities presented in Table 3-10 for the CSA and SSA differ from the water demands in these two service areas since some of the water produced in the CSA is utilized in the SSA. A portion of the SSA's water demand has been supplied by water from the CSA that has increased with the start-up of the Vineyard SWTP in 2011. Water flows from the CSA to the SSA through three connections across Highway 99 as described in Section 2.1.

Table 3-10. Zone 40 Historical Water Production, ac-ft/yr													
Area	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
NSA	2,666	2,550	2,505	2,314	3,066	3,951	4,270	4,619	4,295	4,150	4,353	5,020	4,804
CSA	5,342	6,072	6,578	8,891	9,260	9,817	10,287	11,038	11,941	13,616	12,682	17,592	19,751
CSA (wholesale to Elk Grove) [(a)]	900	1,707	1,973	2,638	3,018	3,304	3,420	3,219	2,870	3,487	3,487	3,487	3,487
SSA [(b)]	13,386	14,071	13,558	15,346	17,980	17,104	18,453	18,875	16,610	12,411	12,974	9,185	7,338
SSA (recycled water)	-	-	609	786	695	596	837	915	866	794	829	870	922
Total	22,294	24,399	25,223	29,975	34,019	34,773	37,267	38,666	36,583	34,458	34,325	36,154	36,302

[(a)] *Historical production for Elk Grove wholesale from 2001 through 2010 provided by SCWA staff. Elk Grove wholesale production for 2011 through 2013 is estimated and assumed to equal 2010 production.*

[(b)] *These values represent the water production in the SSA.*

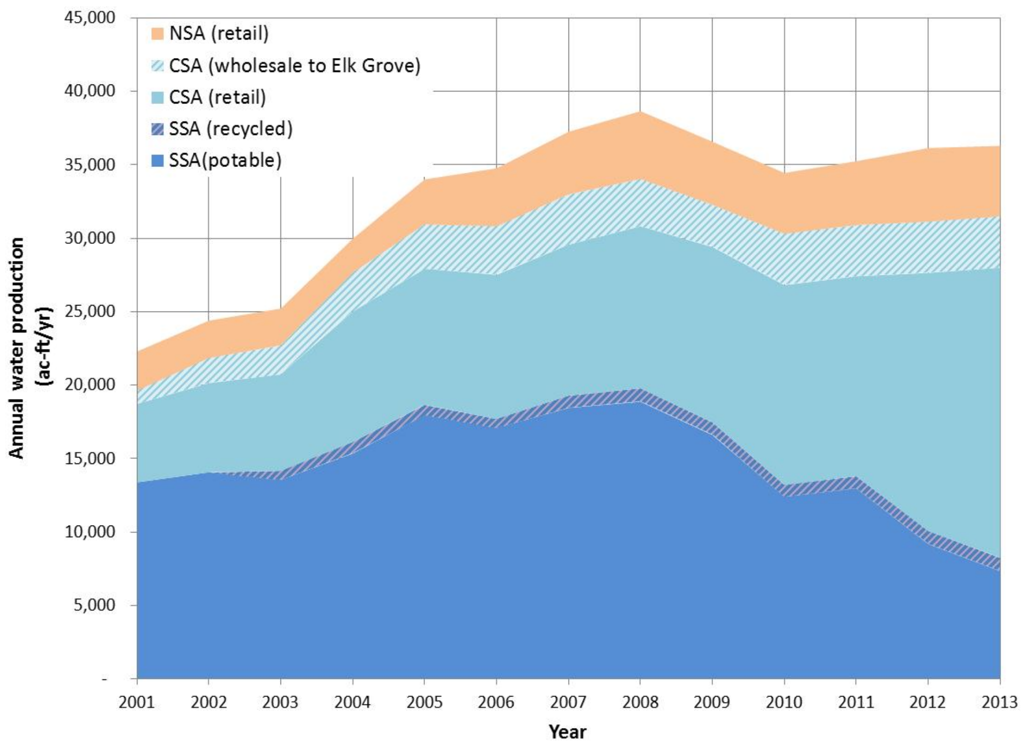


Figure 3-12. Historical Annual Water Production by Service Area

3.5 Unit Water Demand Factors

Buildout unit water demand factors (UWDFs) are developed using a water demand per land area approach expressed as ac-ft/yr per acre. The buildout water demands are estimated by combining the buildout land use acreage for each type of land use with the applicable buildout UWDFs. This land area based approach for developing the buildout water demands is the same methodology used in the current WSMP and the subsequent Cordova Hills amendment. Since water use characteristics have changed over the last few years, this study includes an update of the UWDFs. The buildout UWDFs are updated based on consideration of several sources of information.

- 2005 WSMP UWDFs: The UWDFs in the 2005 WSMP, which are assumed to be gross factors (applied to gross acreage) (SCWA, 2005).
- Cordova Hills WSMP Amendment: The UWDFs for buildout in the 2005 WSMP were verified with limited meter data (SCWA, 2011).
- SCWA analysis of residential water use: SCWA conducted an analysis of metered residential connections in Zone 40 and developed UWDFs for rural residential, single family, multi-family low density, and multi-family high density land uses for the years 2005 through 2012 (SCWA, 2013). The analysis showed a reduction in the UWDFs since the previous work was completed. This analysis is presented in Appendix A.
- Analysis of SCWA 2010 Water Use Factors: UWDFs representing 2010 were developed for this study using 2010 estimated developed acreage in Zone 40 and SCWA water use data by customer category.
- 2010 UWDFs of other water agencies: The water demands per acre for other local water agencies were analyzed to use as a point of comparison.
- Gallons per capita per day (GPCD): In July 2011, SCWA adopted the 2010 UWMP, which included an analysis and selection of the SBx7-7 GPCD goal for all of SCWA's service areas. To meet SCWA's GPCD goal for all of its service areas, the Zone 40 GPCD target for 2020 is 196 GPCD. The Zone 40 per capita demand was less than the target in 2010. The UWDFs are selected to result in an overall per capita demand that does not exceed the 2020 target.

It's recognized that unit water use on a per capita basis has been trending downward for several years. The analysis of 2005 to 2012 residential water use by SCWA showed marked reductions in the water use per acre, which was also evident in the analysis of 2010 demand conducted for this study. Therefore it can be concluded that the UWDFs for buildout should be lower than those previously established.

As an initial step the UWDFs from the SCWA analysis were selected for the residential factors. The equivalent water use factors expressed as demand per dwelling unit and per connection were developed and compared to the analysis of 2010 water use factors and similar water use factors for other local water agencies that consist of the City, Sacramento Suburban Water District, and the City of Roseville. The analysis of SCWA's 2010 water use provided multifamily and nonresidential UWDFs that appear to be unrealistically low. It is suspected that the acreages quantified in that analysis include areas not served by the water system. This is an area to further investigate in the future.

As a result of the comparison, the buildout residential UWDFs are defined to be the same as the UWDFs in the SCWA analysis for the rural residential, single family, and multi-family low density categories. The UWDF for multi-family high density is assumed to be 5 percent less at buildout than the value determined in the SCWA analysis. The updated buildout nonresidential UWDFs are established to be 30 percent higher than indicated in the analysis of 2010 factors and 20 percent less than the previous 2005 and 2011 demand factor estimates.

No specific adjustments to the residential demand factors have been made for the bonus density issue discussed previously in this section. Since the residential UWDFs are the same as the 2005 to 2012 UWDFs from the SCWA analysis, the UWDFs may incorporate some bonus density to the extent that bonus density has been awarded in the past.

To compare the UWDFs with the target GPCD, the UWDFs were converted to the equivalent GPCD. As shown in Table 3-13, the actual 2010 and projected buildout GPCD meet the target GPCD.

The defined buildout UWDFs are less than the factors established in the previous WSMP amendment and close to or exactly the same as the actual unit water use factors experienced from 2005 to 2012. The assumed buildout factors result in an overall buildout per capita demand that is slightly less than the GPCD target and slightly greater than the 2010 GPCD value. Water use declined in 2014 as a result of the Governor's drought declaration. It is assumed that the 2014 water use is temporary and will increase back to the levels of the 2005 to 2012 period. It is quite possible that unit water demands could decline in the future due to the passive savings that result from low flow plumbing fixtures achieving a higher level of saturation in Zone 40. However, the amount of decline of these updated water demand factors compared to the previous WSMP Amendment makes it prudent at this time to not assume that even greater reductions that result in a per capita demand significantly below the GPCD target will be achieved and can be counted on. The subject of additional water conservation effects on unit water use should be revisited by SCWA routinely with updates of the buildout UWDFs.

The UWDFs for the non-residential water use categories have some uncertainty due to the unknown water use characteristics of future non-residential development as well as lack of minimal data for current non-residential UWDFs. There can be a wide range in water use by different types of non-residential development. It is recommended that as non-residential development occurs in the future, the water use of that new development be monitored and tracked along with the specific type of development and the amount of acreage occupied.

The gross unit water demand factors are listed in Table 3-11. These UWDFs should be applied to gross acreage that has not been adjusted to remove streets or right-of-way. Water system loss is not included in the UWDFs.

Table 3-11. Buildout Unit Water Demand Factors

Land use	Gross unit water demand factors [a], ac-ft/acre/yr
Rural estate	1.37
Single family	2.13
Multi-family - low density	2.44
Multi-family - high density	3.33
Commercial	2.02
Industrial	2.02
Public	0.81
Public recreation	2.80
Mixed land Use	2.15
Right-of-way	0.18
Self-supported/supplied by others	
Non-irrigated	--
Industrial-unutilized	--
Agricultural	--

(a) *Water loss is not included in the unit water demand factors.*

3.6 Buildout Water Demands

Based on the buildout UWDFs and the buildout acres by land use category, this section presents the buildout water demands for Zone 40. Recycled water demand that is limited to the SSA is included in the overall Zone 40 water demand projections.

3.6.1 Zone 40 Buildout Water Demands

Based on the buildout land area in Table 3-1 and the unit water demand factors in Table 3-11, the buildout water demand by land use category is shown in Table 3-12.

Water loss includes water loss due to leaks, breaks, storage overflows, water use for firefighting, line flushing, and other authorized, but unbilled uses. Since SCWA is not completely metered, data are unavailable for determining the current percent of water loss. Water loss is assumed to 7.5 percent of water sales.

Table 3-12. Buildout Water Demand by Land Use Category

Land use category	Water demand, ac-ft/yr
Rural estate	9,400
Single family	38,600
Multi-family - low density	9,200
Multi-family - high density	4,400
Commercial	8,700
Industrial	7,000
Public	1,700
Public recreation	13,500
Mixed land use	2,600
Right-of-way	100
Subtotal (land use with water demand)	95,300
Water system losses (7.5% of water sales)	7,100
Self-supplied/supported by others	0
Industrial-unutilized	0
Non-irrigated	0
Agricultural	0
Total production	102,400

Table 3-13 compares historical and projected water use metrics including demand per capita, per dwelling unit, per connection, and per acre for Zone 40. The demand per acre is expressed for developed acres, which are the land use categories that would receive municipal water supply. Below are some observations regarding some of the factors with the larger change ratios between 2010 and buildout.

- Non-residential water use/DU factor almost doubles from 2010 to buildout. This reflects the large increase in the amount of non-residential land area and resulting water use compared to the projected increase in residential land area.
- Non-residential use/non-residential connection factor increases by 20 percent from 2010 to buildout. This reflects the change in the mix of non-residential land use categories. One example is the proportionally large increase in public land use acreage at buildout. The public recreation land use category has connections that serve larger parcels and have a higher UWDF compared to the other non-residential land use categories.

Table 3-13. Zone 40 Comparison of 2010 to Buildout Water Use Metrics

	2010	Buildout	Change ratio
Gallons per capita per day [a]	186	189	1.02
Total use/total DU, gpd/DU	570	572	1.00
SFR use/ SFR DU, gpd/DU	490	474	0.97
MFR use/MFR DU, gpd/DU	119	174	1.46
Non-res use/DU, gpd/DU	102	188	1.84
Total use/total con, gpd/connection	606	870	1.43
SFR use/SFR con, gpd/connection	490	474	0.97
MFR use/MFR con, gpd/connection	2,734	2,003	0.73
Non-res use/non res con, gpd/connection	2,856	3,457	1.21
Total demand per developed acre, ac-ft/ac	2.10	2.20	1.05
Potable demand per developed acre (recycled water removed), ac-ft/ac	2.05	2.13	1.04

SFR=single family residential

MFR=multi-family residential

Note: Water loss of 7.5% of water sales is included in this table.

[a] *Includes recycled water. The Zone 40 2020 target is 196 GPCD. This target value does not include recycled water. GPCD for purposes of reporting to the California Department of Water Resources does not include recycled water.*

3.7 Water Demand Growth Projection

Water demand growth projections are determined based on the projected connection growth described previously. The projected water demands by service area are shown in Table 3-14 and illustrated on Figure 3-13.

Table 3-14. Projected Water Demand in 5-Year Increments, ac-ft/yr										
Service area	2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
NSA	4,200	5,300	7,300	10,100	13,100	17,500	22,400	27,500	32,800	34,900
CSA	15,200	16,400	18,400	21,200	24,100	28,100	32,400	36,800	41,300	41,400
SSA	15,200	17,100	19,700	22,600	25,600	26,100	26,100	26,100	26,100	26,100
Total study area	34,500	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,400

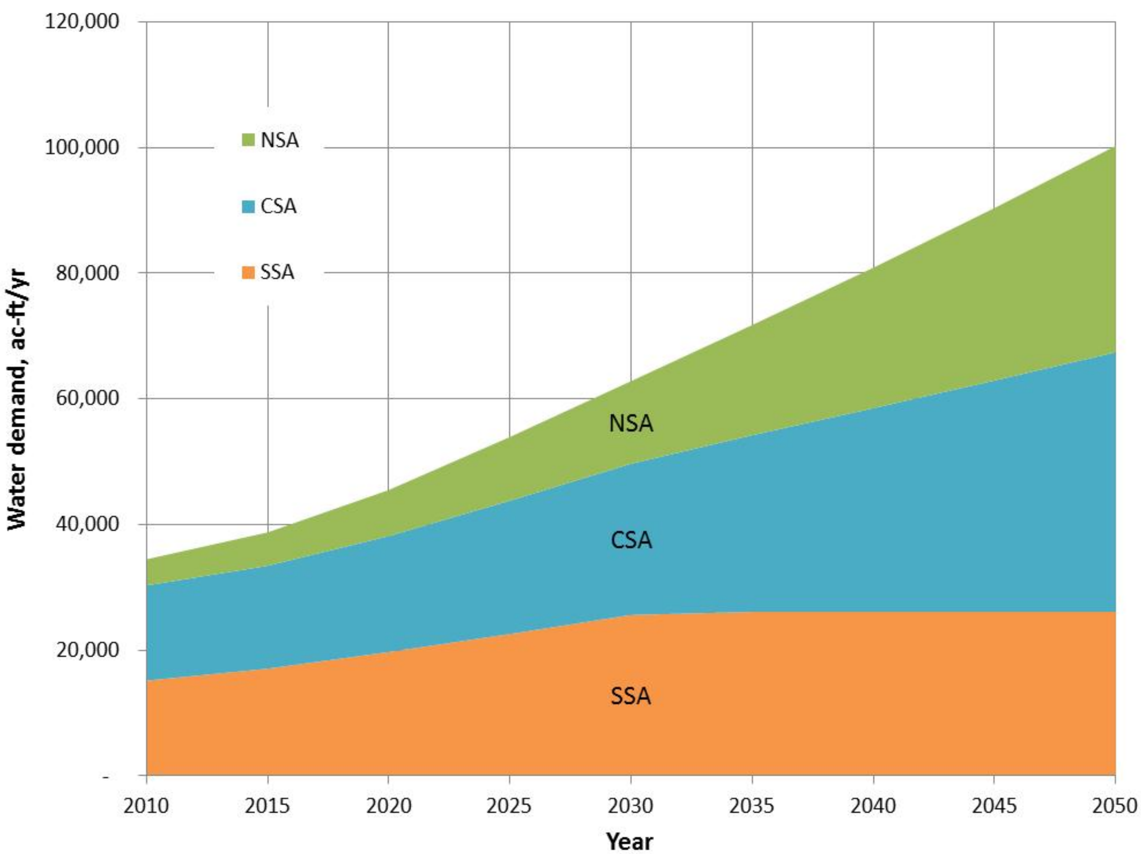


Figure 3-13. Water Demand Projection

3.8 Recycled Water Demands

As presented earlier in Table 3-10, recycled water use is currently approximately 900 ac-ft/yr. Recycled water use is projected to increase to a total of 3,300 ac-ft/yr when the planned Phase 2 recycled water system for the East Franklin and Laguna Ridge areas is completed.

The potential for additional recycled water use in areas in close proximity to the existing and planned Phase 1 and 2 areas are estimated to be approximately 500 ac-ft/yr based on serving public and public recreation land use categories in the adjacent Southeast Policy Area and Sterling Meadows subareas. This analysis of additional potential recycled water demand is not a recommendation to supply recycled water to these areas.

3.9 Additional Land Use Information

This section presents additional land use information to supplement the information provided in the previous sections.

3.9.1 Land Use Categories and Data Sources

The land use categories in this analysis are the same land use categories used by SCWA in the 2006 WSIP. Because the land use category names are sometimes different in the County planning documents such as the County General Plan and development planning tables, figures, and GIS data from other agencies and developers listed in Table 3-1, each land use category is cross referenced to the 2006 WSIP land use categories, which are used for this analysis. The non-irrigated land use category is land that is not irrigated for agriculture and not developed requiring a municipal water supply. The cross reference of land use categories is provided in Appendix C. Also included in Appendix C is a list of the subareas within each of the three service areas and the date on which and the agency from whom the SCWA staff received land use information for each of the subareas.

3.9.2 Gross Acreage Conversion

The compiled GIS landuse data for this analysis is a hybrid of net and gross acreage. The GIS landuse data in most of the already developed areas of Zone 40 is net acreage because it excludes streets. Land use acreage for the 2010 developed areas do not include land area that is occupied by streets. As a result, the estimate of 2010 acreage is net acreage. The landuse GIS acreage for proposed development areas and other areas not yet developed is considered gross acreage and includes land area that will be occupied by streets. It is assumed that 20 percent of a gross area for residential and commercial land uses will be occupied by streets. An estimate of the percent land area of each subarea that is covered by net GIS acreage is used to estimate a net to gross factor for each subarea. Table 3-15 presents the estimate net and gross coverage percentages and the resulting net and gross increase factors that are applied to the residential, commercial, and industrial land uses in each subarea. Appendix D contains a summary of the GIS and estimated gross acreage by land use category for each subarea.

- For a subarea that is 100 percent net acreage the total net to gross increase factor is 1.25, increasing the water consuming acreage in that subarea.
- For a subarea that is 100 percent gross acreage the total net to gross increase factor is 1, and the water consuming acreage in that subarea remains the same.
- For a subarea with some net acreage and some gross acreage, the net to gross increase factor is between 1 and 1.25.

Table 3-15. Net to Gross Acreage Conversion Factors						
Subarea	Estimate net and gross coverage		Net to gross factor	Net and Gross Increase Factors		
	% Net	% Gross		Net increase factor (% net x 1.25 (net to gross factor)	Gross increase factor (% gross x 1)	Total net to gross increase factor
NSA						
Arboretum	0%	100%	1.25	-	1.00	1.00
Cordova Hills	0%	100%	1.25	-	1.00	1.00
Jackson Township	0%	100%	1.25	-	1.00	1.00
Mather Field	0%	100%	1.25	-	1.00	1.00
Mather South	0%	100%	1.25	-	1.00	1.00
NewBridge	0%	100%	1.25	-	1.00	1.00
NSA Northeast	0%	100%	1.25	-	1.00	1.00
Rio Del Oro	0%	100%	1.25	-	1.00	1.00
Suncreek	0%	100%	1.25	-	1.00	1.00
Sunridge	80%	20%	1.25	1.00	0.20	1.20
Sunrise	100%	0%	1.25	1.25	-	1.25
The Ranch at Sunridge	0%	100%	1.25	-	1.00	1.00
CSA						
CSA Northeast	0%	100%	1.25	-	1.00	1.00
East Vineyard	0%	100%	1.25	-	1.00	1.00
EG Wholesale	70%	30%	1.25	0.88	0.30	1.18
Florin Vineyard Gap	0%	100%	1.25	-	1.00	1.00
Grantline 99	0%	100%	1.25	-	1.00	1.00
North Vineyard Station	10%	90%	1.25	0.13	0.90	1.03
Vineyard	75%	25%	1.25	0.94	0.25	1.19
Vineyard Springs	75%	25%	1.25	0.94	0.25	1.19
West Jackson	0%	100%	1.25	-	1.00	1.00
SSA						
East Franklin	95%	5%	1.25	1.19	0.05	1.24
Elk Grove Promenade	0%	100%	1.25	-	1.00	1.00
Laguna	100%	0%	1.25	1.25	-	1.25
Laguna Ridge	35%	65%	1.25	0.44	0.65	1.09
Southeast Policy Area	0%	100%	1.25	-	1.00	1.00
Sterling Meadows	0%	100%	1.25	-	1.00	1.00

3.9.3 GIS Data Differences and Inconsistencies

Ultimately, the GIS based land acreages by category are used to estimate future water demand. Public recreation is a land use category that is represented inconsistently in the various GIS data sources. In some areas open space land used for storm drainage is categorized as public recreation. All land acreage categorized as public recreation is assigned a water demand factor, discussed later in this section. As a result, future public recreation water demands may be overestimated if non-irrigated lands are included in this category and if the public recreation unit water demand factor is not reduced appropriately to account for the non-irrigated land in this category. It is recommended that a GIS cleanup exercise be conducted in the future to delineate non-irrigated public recreation land such as storm drainage areas, from irrigated public recreation land such as irrigated parks.

There are also other inconsistences in the GIS data such as how streets are categorized in the GIS data. In some instances streets are categorized as right-of-way (ROW). In other locations streets are categorized as vacant or have no land use category assigned at all. Figure 3-14 contains an example clip of the GIS data in the SSA identifying a public recreation land area that is actually storm drainage. On Figure 3-14, the top picture is an aerial photo of the sample area. In the bottom picture, the GIS data layers are turned on in the same sample areas. In the bottom picture the brighter green is categorized as public recreation. The red streets in the development are categorized as ROW. The green streets in the development to the left are categorized as vacant. The streets with no coloring at the top of the clip and in the neighborhood to the right are not categorized as anything at all.

A full analysis of the extent of these inconsistencies was not conducted; however, as shown on Figure 3-15, the potential issue of overestimating the irrigated public recreation land seems to be more prominent in the SSA as shown by the bright blue areas that represent the land areas categorized as public recreation.

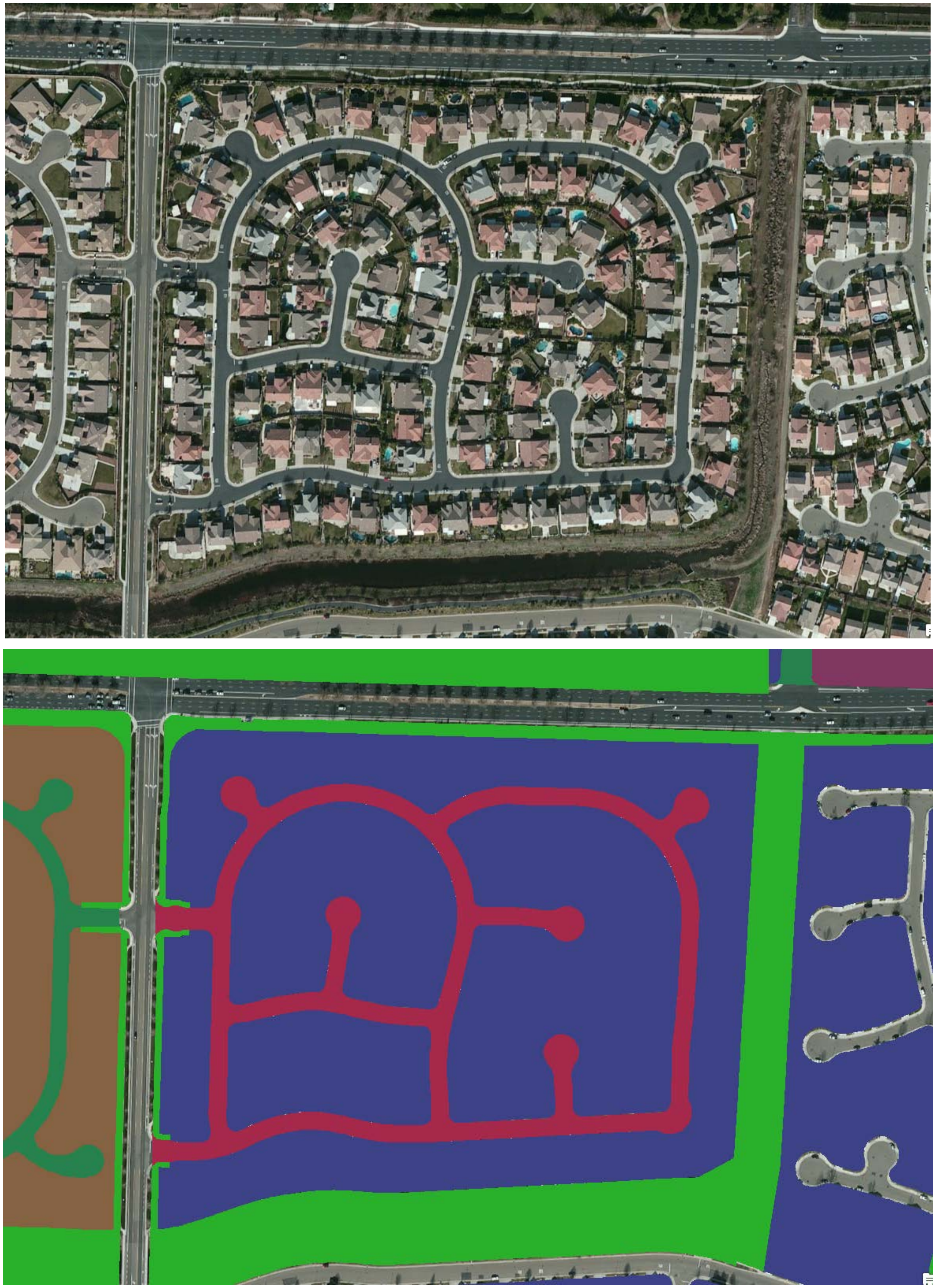


Figure 3-14. Example of Zone 40 GIS Data Differences and Inconsistencies

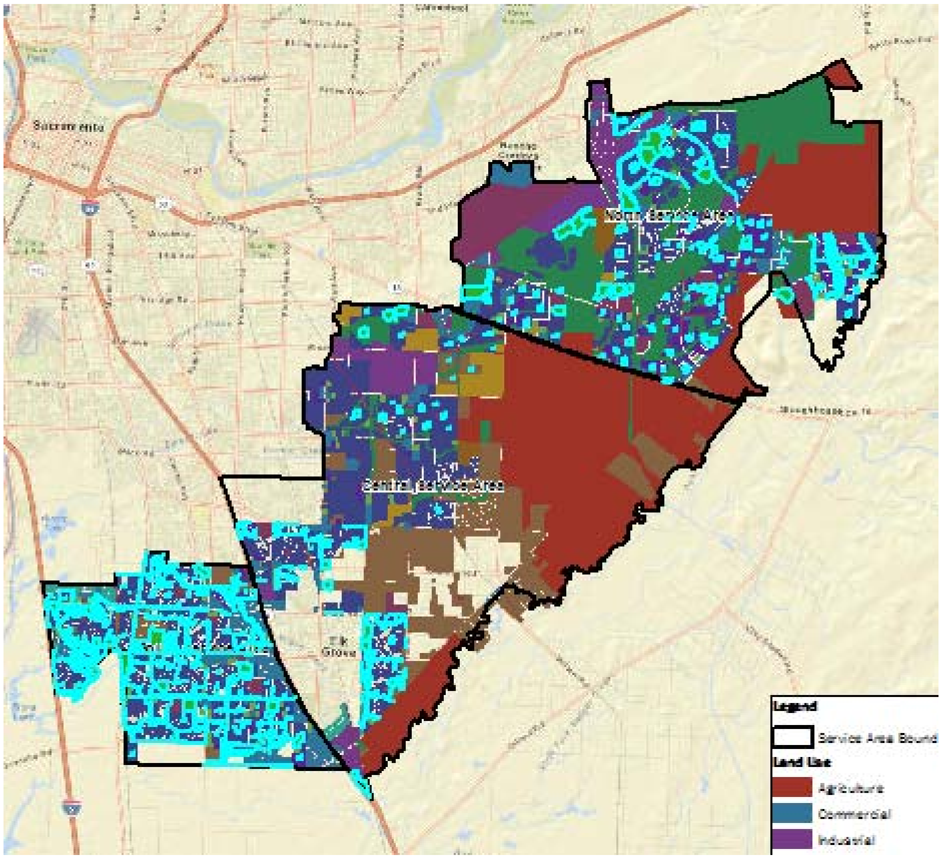


Figure 3-15. Public Recreation Acreage at Buildout (in bright blue highlight)

3.10 Additional Historical Connection and Population Analysis

This section presents additional historical connection and population analysis and information to supplement the information provided in the previous sections.

3.10.1 Comparison of Historical Population and Connections

A comparison of the population per connection factors for each service area indicates differences in each of the Zone 40 service areas as shown in Table 3-16. The estimate of population per connection varies dependening upon the source of the population data such as the US Census or the Sacramento Area of Governments (SACOG). An analysis of the 2010 population by service area based on the 2010 US Census that was previously prepared is provided in Appendix E and illustrated on Figure 3-16.

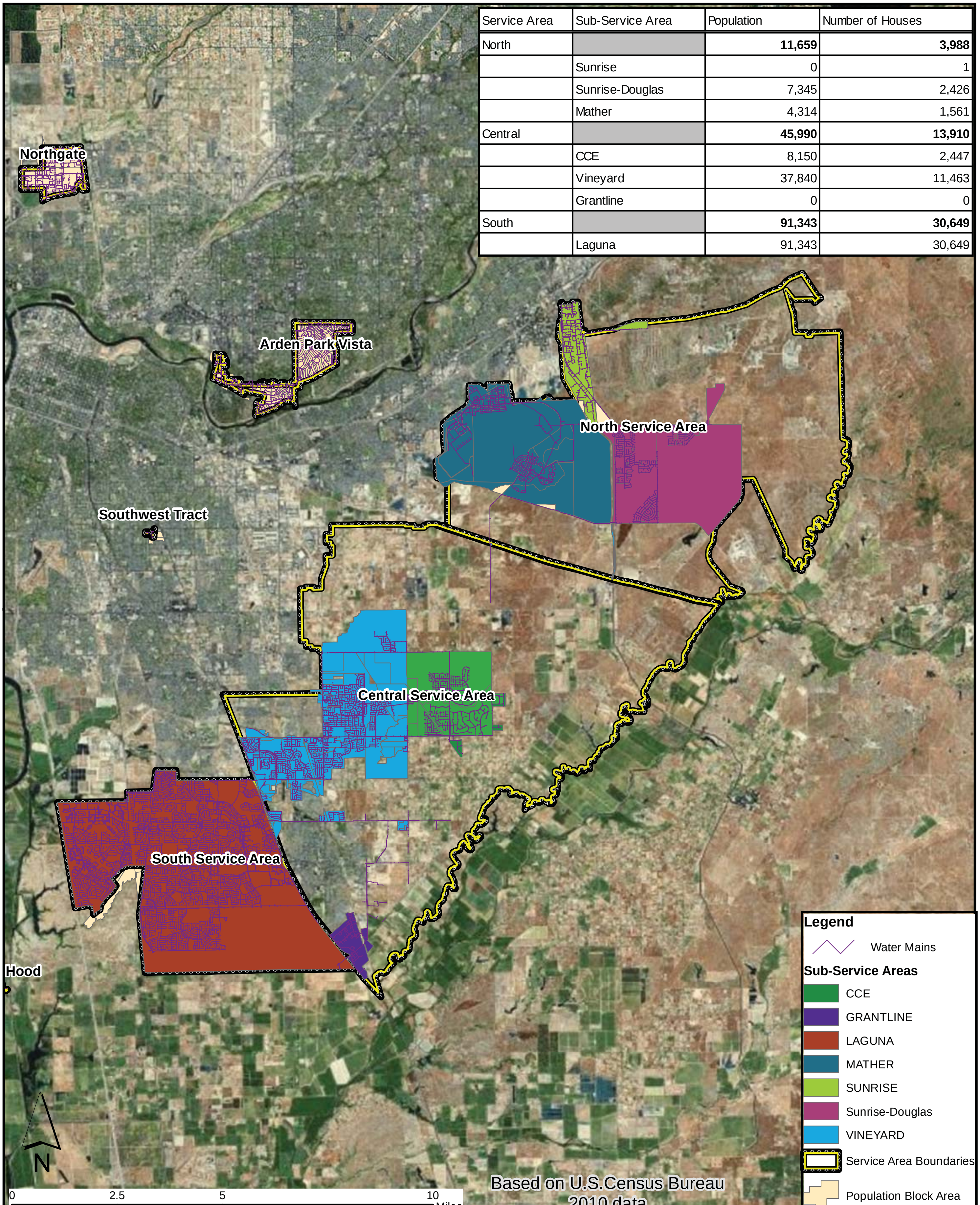
Table 3-16. Comparison of Historical Demographics and Connections	2000	2005	2010
NSA			
Connections, SCWA records	950	2,236	4,596
Population, 2010 census			11,659
Population, 2010 UWMP estimate [a]	1,239	3,106	6,888
Population, SACOG estimate		5,749	
Employment, SACOG		13,892	
Population/connection, 2010 census			2.54
Population/connection, UWMP estimate [b]	1.30	1.39	1.50
Population/connection, SACOG estimate		2.57	
CSA			
Connections, SCWA records	5,652	11,233	12,331
Population, 2010 census			45,990
Population, 2010 UWMP estimate [a]	22,745	53,536	60,786
Population, SACOG estimate		31,743	
Employment, SACOG		3,115	
Population/connection, 2010 census			3.73
Population/connection, UWMP estimate	4.02	4.77	4.93
Population/connection, SACOG estimate		2.83	
SSA			
Connections, SCWA records	16,629	25,219	28,674
Population, 2010 census			91,343
Population, 2010 UWMP estimate [a]	45,691	67,573	77,019
Population, SACOG		59,958	
Employment, SACOG estimate		10,474	
Population/connection, 2010 census			3.19
Population/connection, UWMP estimate	2.75	2.68	2.69
Population/connection, SACOG estimate		2.38	
Zone 40			
Connections, SCWA records	23,231	38,688	45,601
Population, 2010 census			148,992
Population, 2010 UWMP estimate [a]	69,675	124,216	144,693
Population, SACOG estimate		97,450	
Employment, SACOG		27,482	
Population/connection, 2010 census			3.27
Population/connection, UWMP estimate	3.00	3.21	3.17
Population/connection, SACOG estimate		2.52	

[a] *UWMP 2010 population estimates are based on correlating year 2000 census data with the 2010 connection number.*

[b] *Population per connection UWMP estimate is based the 2010 UWMP population estimate divided by the Zone 40 connection data presented in the 2010 UWMP.*

Zone 40 connections and population data are based on retail water customers only and do not include EGWS wholesale connections and population. Some slight discrepancies in this table with the total 2010 Zone 40 population and connections presented elsewhere in this report are due to that the 2010 Elk Grove wholesale population and connections are estimated using different assumptions.

Service Area	Sub-Service Area	Population	Number of Houses
North		**11,659**	**3,988**
	Sunrise	0	1
	Sunrise-Douglas	7,345	2,426
	Mather	4,314	1,561
Central		**45,990**	**13,910**
	CCE	8,150	2,447
	Vineyard	37,840	11,463
	Grantline	0	0
South		**91,343**	**30,649**
	Laguna	91,343	30,649



BROWN AND CALDWELL

PROJECT 140620

SITE Sacramento County, Sacramento, CA

Date: 2/14/2012

TITLE 2010 Census Analysis

SCWA-7

Figure 3-16

Path: BCSAC01K:\40000\140620 - SCWA 2010 UWMP\GIS\MapDocs\Working\WaterService_SubAreas_V2.mxd

3.10.2 Historical Connection Growth Analysis

An analysis of the historical connection growth rates for SCWA and Zone 40 service areas was performed to determine the appropriate estimate of projected connection growth in Zone 40. Table 3-17 presents the historical connection growth analysis for two data periods: 2001 to 2010 and for 1995 to 2010. Figure 3-17 illustrates the new connections per year for SCWA and Figure 3-18 illustrates the new connection per year for each service area of Zone 40. Detailed annual tables of this growth projection analysis are provided in Appendix F.

Table 3-17. Historical Connection Growth Analysis, connections/yr

	Data period	Lowest 5-yr average	9-yr average	9-yr median	Highest 5-yr moving average
NSA	Based on 9 year period, 2001-2010	424	401	372	544
CSA		220	716	471	1,163
SSA		691	1,261	899	1,938
Zone 40		1,335	2,378	1,742	3,645
Zone 40	Based on 16 year period, 1995-2010	1,430	2,154	1,954	3,588

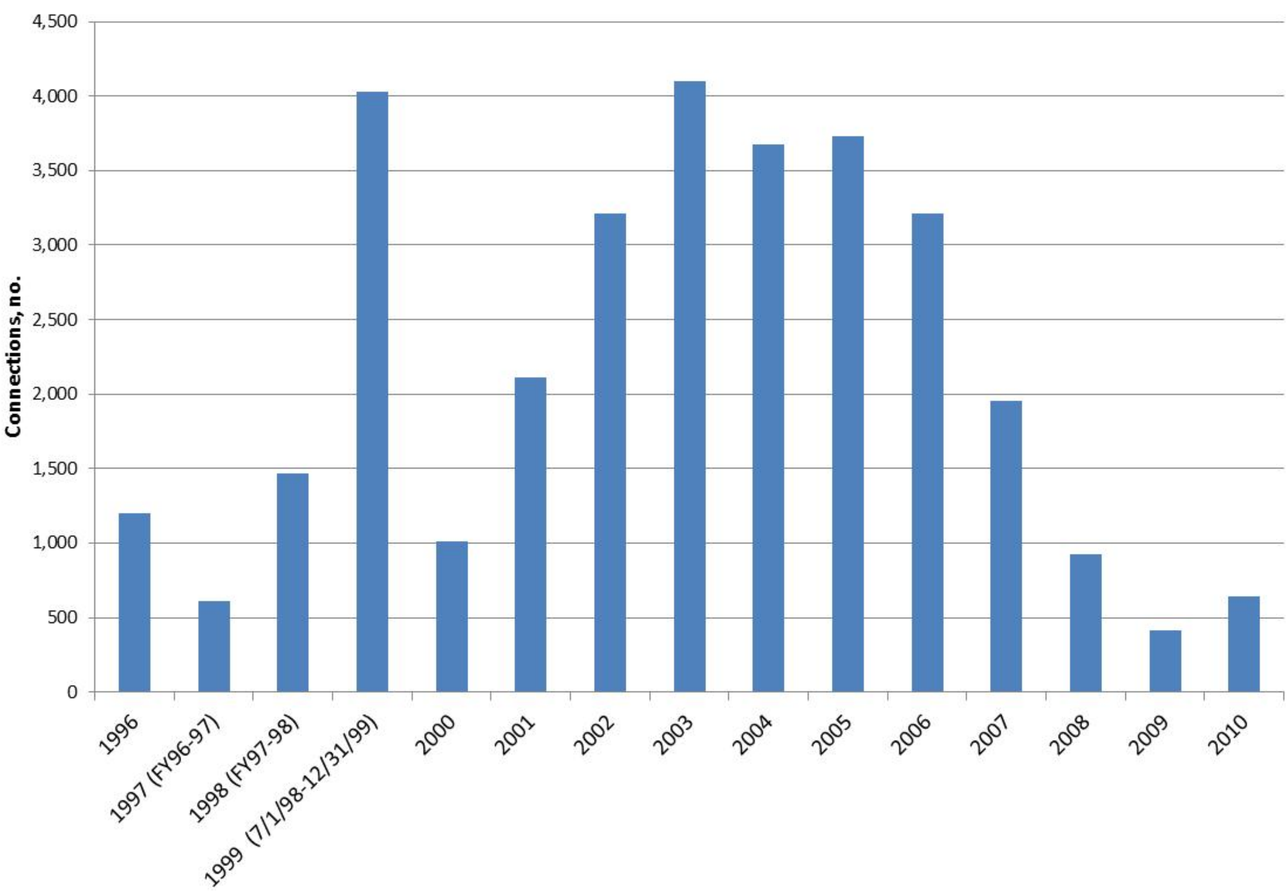


Figure 3-17. SCWA Historical Connection Growth Rate – New Connections per Year

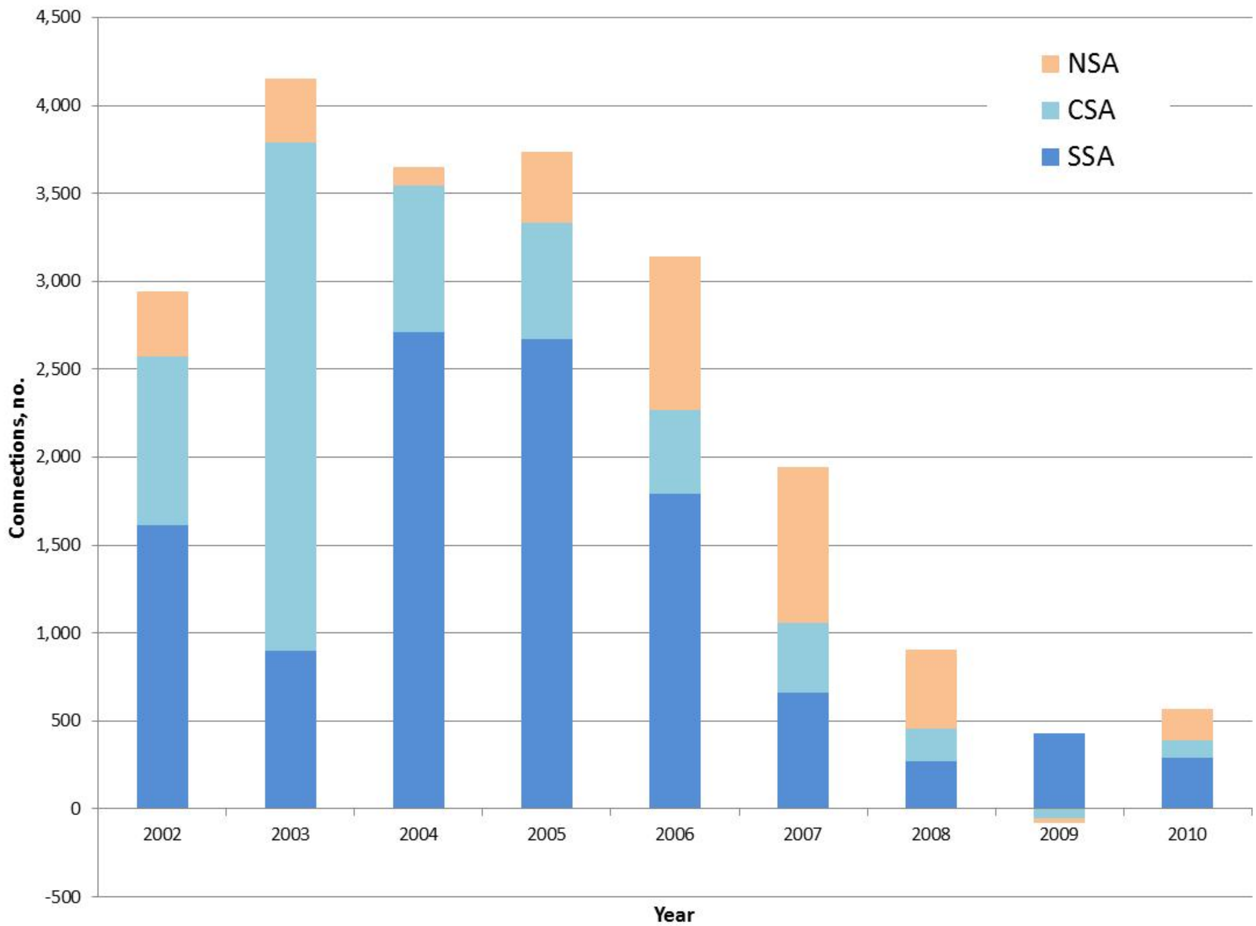


Figure 3-18. Historical Connection Growth Rate – New Connections per Year by Service Area

3.11 Additional Buildout Population, Dwelling Unit, and Connections Analysis

This section presents additional buildout population, dwelling unit, and connections information to supplement the information provided in the previous sections.

3.11.1 Buildout Demographics Based on Average vs. Maximum Density

As stated previously the buildout dwelling units and resulting population and water connections in this analysis are based on the maximum density allowed within each land use category. For informational purposes, a comparison of the buildout dwelling units, population, and connections estimated based on the average density and maximum density for each of the residential land use categories is provided in Table 3-18 and on Figure 3-19. Only the residential land use categories have density ranges and as a result, there is one density value for each of the non-residential land use categories. The average land use density is based on the weighted average of the average density for each of the land use types within each category. The maximum land use density is based on the weighted average of the maximum of the each of the land use types within each category. Overall, the average to maximum density increase is 10 percent.

Table 3-18. Buildout Demographics at Average vs. Maximum Land Use Density									
	DUs			Population			Connections		
Land use	Average density	Maximum density	Percent difference	Average density	Maximum density	Percent difference	Average density	Maximum density	Percent difference
Rural Estate	3,272	3,338	2%	10,799	11,016	2%	3,272	3,338	2%
Single Family	80,579	87,115	8%	265,912	287,481	8%	80,579	87,115	8%
Multi-Family - Low Density	36,369	41,815	15%	100,015	114,992	15%	3,637	4,182	15%
Multi-Family - High Density	25,180	27,706	10%	64,209	70,650	10%	1,679	1,847	10%
Commercial							1,854	1,854	0%
Industrial							1,403	1,403	0%
Industrial-Unutilized									
Public							241	241	0%
Public Recreation							4,053	4,053	0%
Mixed Land Use							491	491	0%
Right-of-Way							665	665	0%
Vacant									
Agricultural									
Total	145,401	159,975	10%	440,935	484,139	10%	97,874	105,189	7%

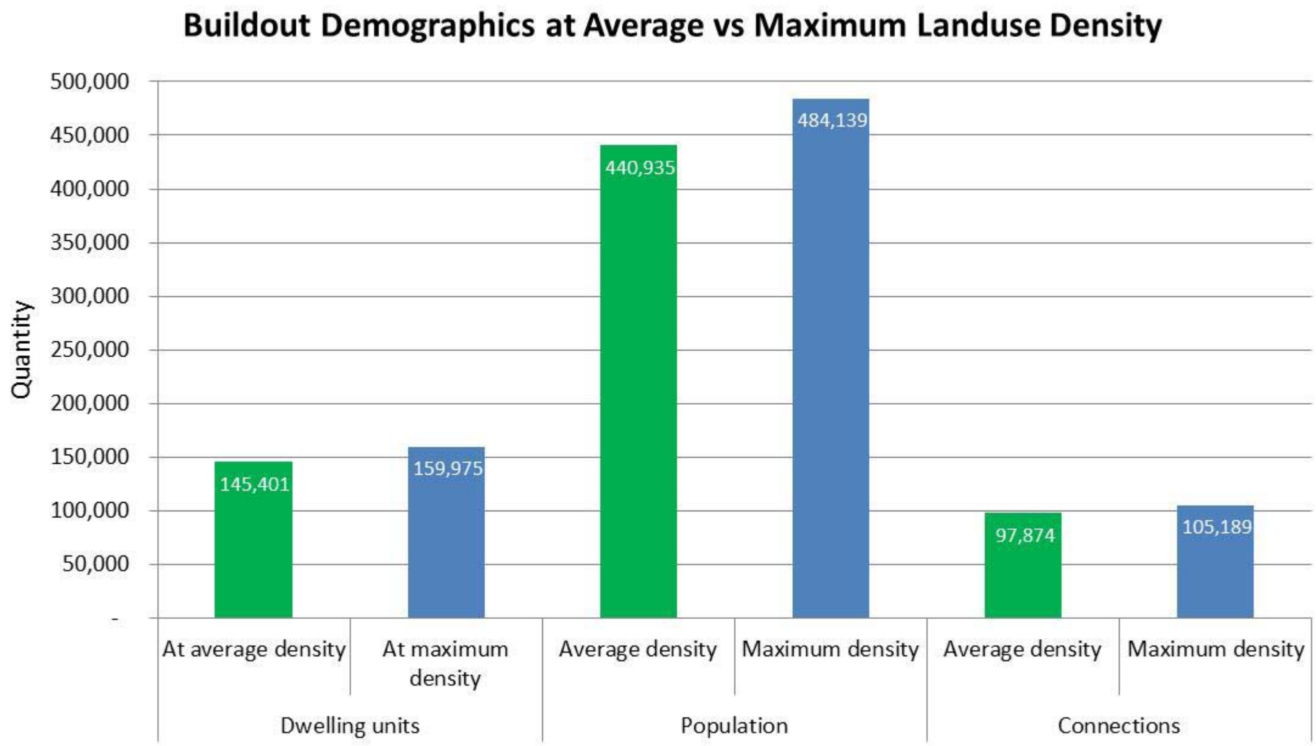


Figure 3-19. Buildout Demographics at Average vs. Maximum Landuse Density

3.12 Additional Analysis of Projected Water Demand Characteristics

The resulting buildout demand by customer category as a result of the updated unit water demand factors is compared to the demand by customer category in previous years for SCWA as well as the demand by customer category for other agencies in the Sacramento region. The resulting water demand characteristics are also analyzed by service area.

3.12.1 Analysis of Water Use by Customer Category

Although Zone 40 was not completely metered in 2005 and 2010, estimates of the use by customer category are based on water use by the metered customers, number of customers by customer category, and total water production. The water use by customer category for 2005 and 2010 as well as at buildout for this analysis and from the 2006 WSIP is shown on Figure 3-20. Note that SCWA's customer categories are not the same as the land use categories in all cases. The legend in this figure lists the SCWA customer category followed by the land use category matching the customer category in parenthesis. As shown on Figure 3-20, the majority of the water use in Zone 40 is for residential purposes currently and approximately 60 percent is for residential purposes in the future.

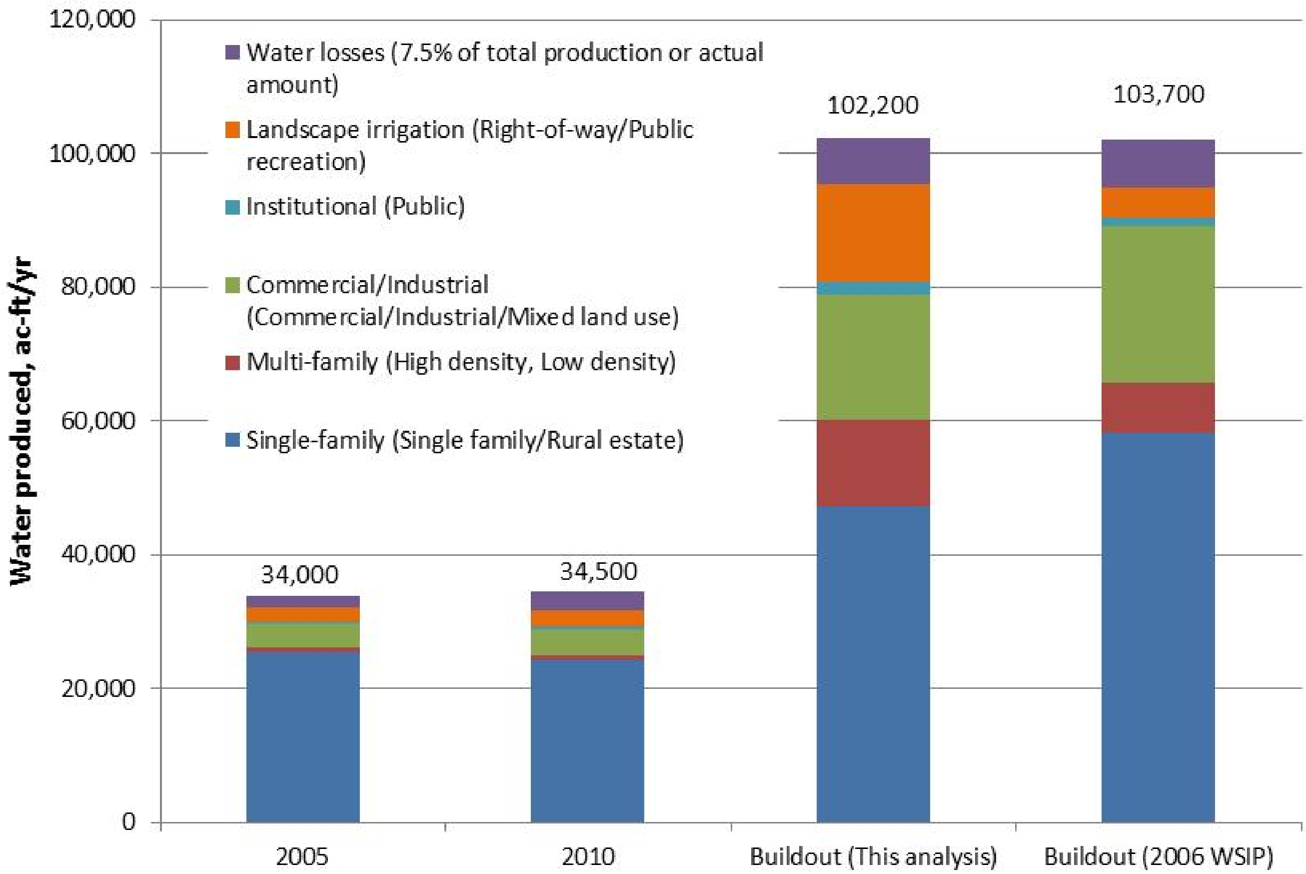


Figure 3-20. Water Use by Customer Category

Note: Legend lists the SCWA customer category followed by the related land use category in parenthesis.

3.12.2 Comparison of Zone 40 Water Use Factors and Other Water Agencies

2010 data from the City of Sacramento, Sacramento Suburban Water District, and City of Roseville is compared to Zone 40 2010 and buildout demand factors in Table 3-19 and illustrated on Figure 3-21.

Table 3-19. Comparison of Zone 40 2010 and Buildout Demand Factors with Nearby Water Agencies					
Category	City of Sacramento, 2010 [a]	Sacramento Suburban Water District, 2010 [b]	City of Roseville, 2010 [c]	Zone 40	
				2010	Buildout
Population	466,488	170,615	114,078	148,992	484,340
Connections					
SFR connections	113,375	37,366	34,801	43,659	91,730
MFR connections	19,143	3,830	1,650	212	4752
Non-res connections	10,456	2,987	3,001	1,729	8,707
Total connections	133,696	44,183	39,452	45,600	105,189
Water use					
SFR water use, ac-ft/yr	37,362	15,978	15,836	23,990	50,986
MFR water use, ac-ft/yr	21,672	10,330	2,196	650	13,883
Non-residential water use, ac-ft/yr	33,026	6,440	9,406	5,538	37,620
Total deliveries, ac-ft/yr	92,060	32,747	27,438	30,178	102,488
Dwelling units					
SFR dwelling units	119,000	45,142		43,659	91,730
MFR dwelling units	60,000	21,130		4,888	66,120
Per dwelling unit factors					
SFR water use/SF DU, ac-ft/yr/DU	0.31	0.35		0.49	0.52
MFR water use/MF DU, ac-ft/yr/DU	0.36	0.49		0.13	0.20
Per connection factors					
Pop/connection	3.49	3.86	2.89	3.27	4.60
Pop/residential connection	3.52	4.14	3.13	3.40	5.02
Total water use/connection, ac-ft/yr/con	0.69	0.74	0.70	0.66	0.97
SFR water use/SFR connection, ac-ft/yr/con	0.33	0.43	0.46	0.49	0.52
MFR water use/MFR connection, ac-ft/yr/con	1.13	2.70	1.33	2.76	2.72
Non-residential water use/Non-residential connection, ac-ft/yr/con	3.16	2.16	3.13	2.88	4.02
MFR DU/MFR connection	3.13	5.52		23.1	13.9
Per capita demand, GPCD	188	183	230	181	189

Zone 40 2010 population, connection, and water use data is for retail customers only and does not include recycled water and EGWS wholesale. Zone 40 buildout data includes recycled water use and Elk Grove wholesale area population, and connections. Some slight discrepancies in this table with the total 2010 Zone 40 population, connections, and demands presented elsewhere in this report are due to that the 2010 Elk Grove population and connections are estimated using different assumptions.

[a] *Source: City of Sacramento 2010 UWMP*

[b] *Source: Sacramento Suburban Water District 2010 UWMP*

[c] *Source: City of Roseville 2010 UWMP*

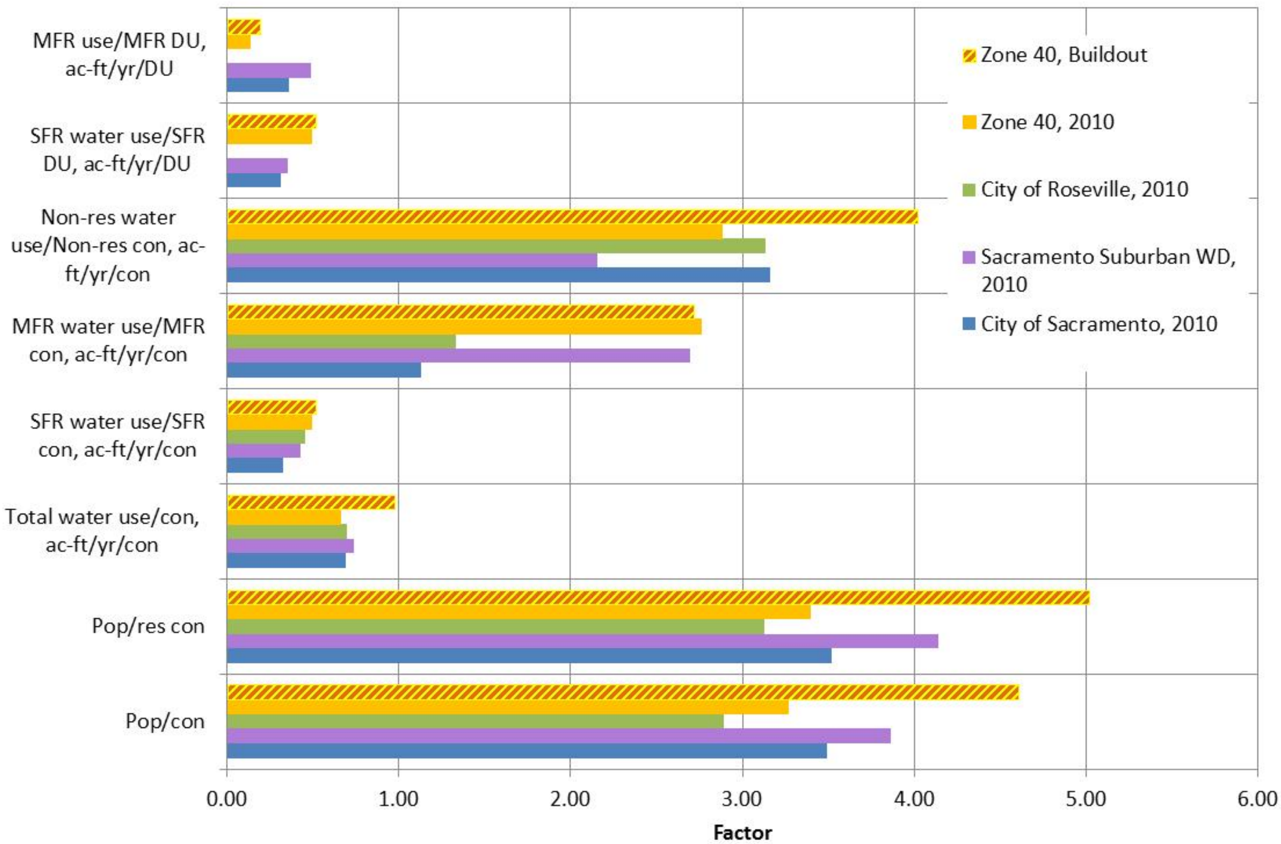


Figure 3-21. Comparison of Zone 40 2010 and Buildout Demand Factors with Nearby Water Agencies

3.12.3 Per Capita Demand Comparison

The overall SCWA water system per capita demand target is 223 GPCD. This is the target for all of the SCWA water systems consisting of Zone 40 and six other SCWA service areas. Because some of the SCWA water system service areas are at or near buildout or do not have population associated with the area, their individual per capita demands are higher than the SCWA system-wide target. As a result, the informal per capita demand water use target by 2020 for Zone 40 is 195 GPCD, which is lower than the overall SCWA water system target of 223 GPCD. Based on the buildout water demand and population in this report, 182 GPCD is the resulting buildout per capita demand for Zone 40 based on the projected buildout potable water use for Zone 40, excluding the estimated recycled water use, and the estimated Zone 40 buildout population, including the Elk Grove wholesale area.

A comparison of the 2010 per capita demand, the resulting per capita demand for the Zone 40 unit water demand factors recommended in this analysis, and those used for the 2006 WSIP is shown on Figure 3-22.

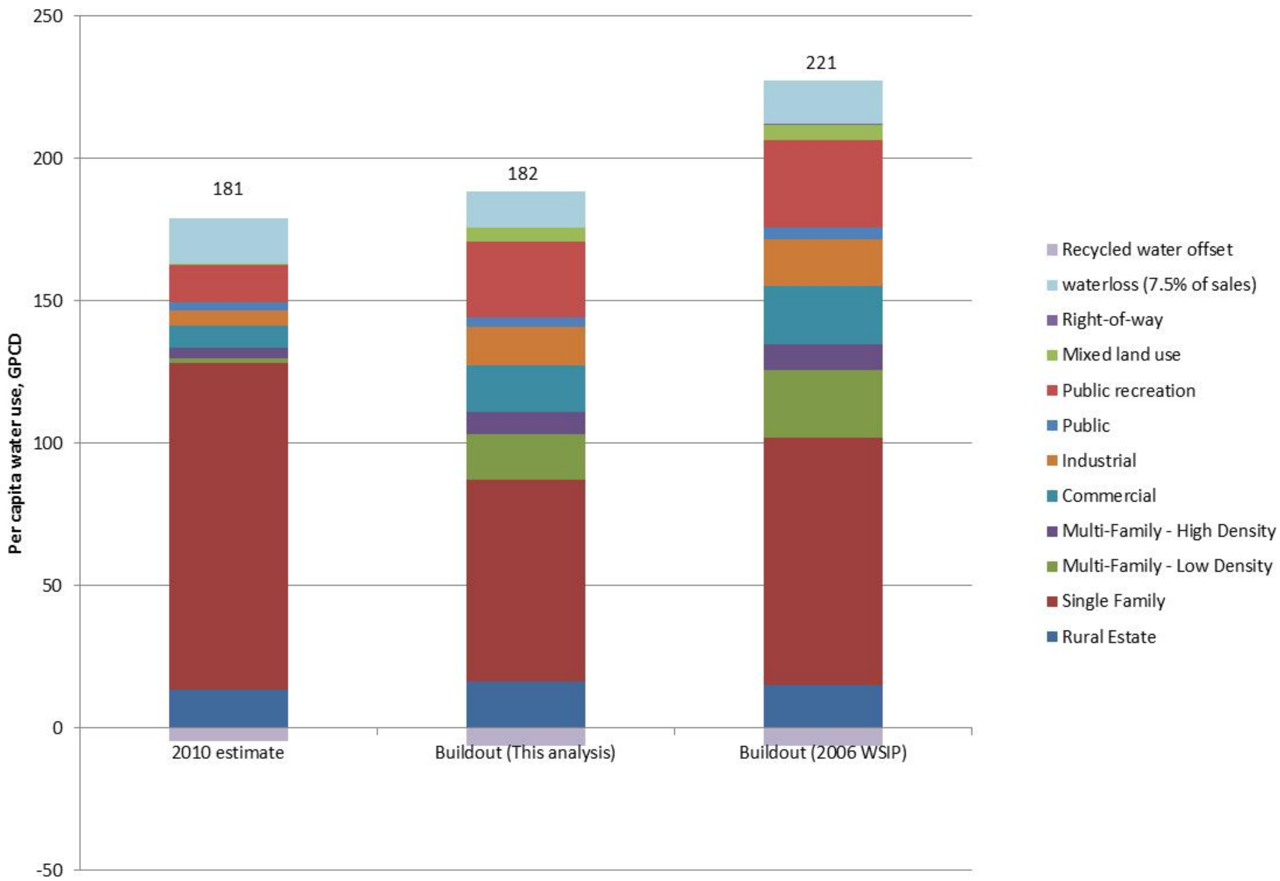


Figure 3-22. Comparison of 2010 and Buildout Per Capita Demand by Land Use Type

Note: The numerica value at the top of each column on this graph is the potable per capita demand with recycled water use applied as a potable supply offset.

3.13 Detailed Water Demands by Subarea

The water demand and acreage by land use type within each subarea is included in Appendix D. Table 3-20 presents a summary of the buildout demand by subarea.

Table 3-20. Buildout Demand by Subarea, ac-ft/yr	
NSA	
Arboretum	1,810
Cordova Hills	4,330
Jackson Township	2,120
Mather Field	4,840
Mather South	1,850
NewBridge	1,180

Table 3-20. Buildout Demand by Subarea, ac-ft/yr	
Rio Del Orod	6,950
Suncreek	2,250
Sunridge	4,330
Sunrise	2,040
The Ranch at Sunridge	760
NSA subtotal	32,460
NSA water loss	2,440
NSA total	34,900
CSA	
East Vineyard	1,950
Elk Grove Wholesale	6,730
Florin Vineyard Gap	6,540
Grantline 99	650
North Vineyard Station	3,060
Vineyard	8,890
Vineyard Springs	4,180
West Jackson	6,520
CSA subtotal	38,520
CSA water loss	2,890
CSA total	41,400
SSA	
East Franklin	5,410
Elk Grove Promenade	520
Laguna	11,930
Laguna Ridge	4,060
Southeast Policy Area	1,920
Sterling Meadows	450
SSA subtotal	24,290
SSA water loss	1,820
SSA total	26,100
Zone 40 total	102,400

Section 4

Water Supply

The sources of water for SCWA's Zone 40 consist of surface water, groundwater, and recycled water. The existing water supply sources are described and quantified in this section. The adequacy and reliability of each supply for normal and dry hydrological conditions are presented.

4.1 Water Forum Agreement

SCWA is a stakeholder in the Water Forum, a Sacramento regional water management initiative. The Water Forum Agreement (WFA) was the result of the efforts of a diverse group of community organizations formed in 1994 to formulate principles for a regional solution for protecting the lower American River and providing for future water supply. The WFA was designed to achieve the two coequal objectives of providing a reliable and safe water supply for the region's economic health and planned development to the year 2030 and preserving the fishery, wildlife, recreational, and aesthetic values of the lower American River.

The WFA includes purveyor specific agreements (PSA) that define the benefits each water purveyor will receive as a stakeholder and actions each water purveyor must take to receive these benefits. The PSA for SCWA discusses the planned surface water supplies as part of a conjunctive use program to meet SCWA's water needs for planned growth. The PSA says that SCWA will divert surface water at or near the mouth of the American River or from the Sacramento River. Pertinent elements of the PSA for SCWA are discussed in the surface water and groundwater supply descriptions in this section.

4.2 Surface Water

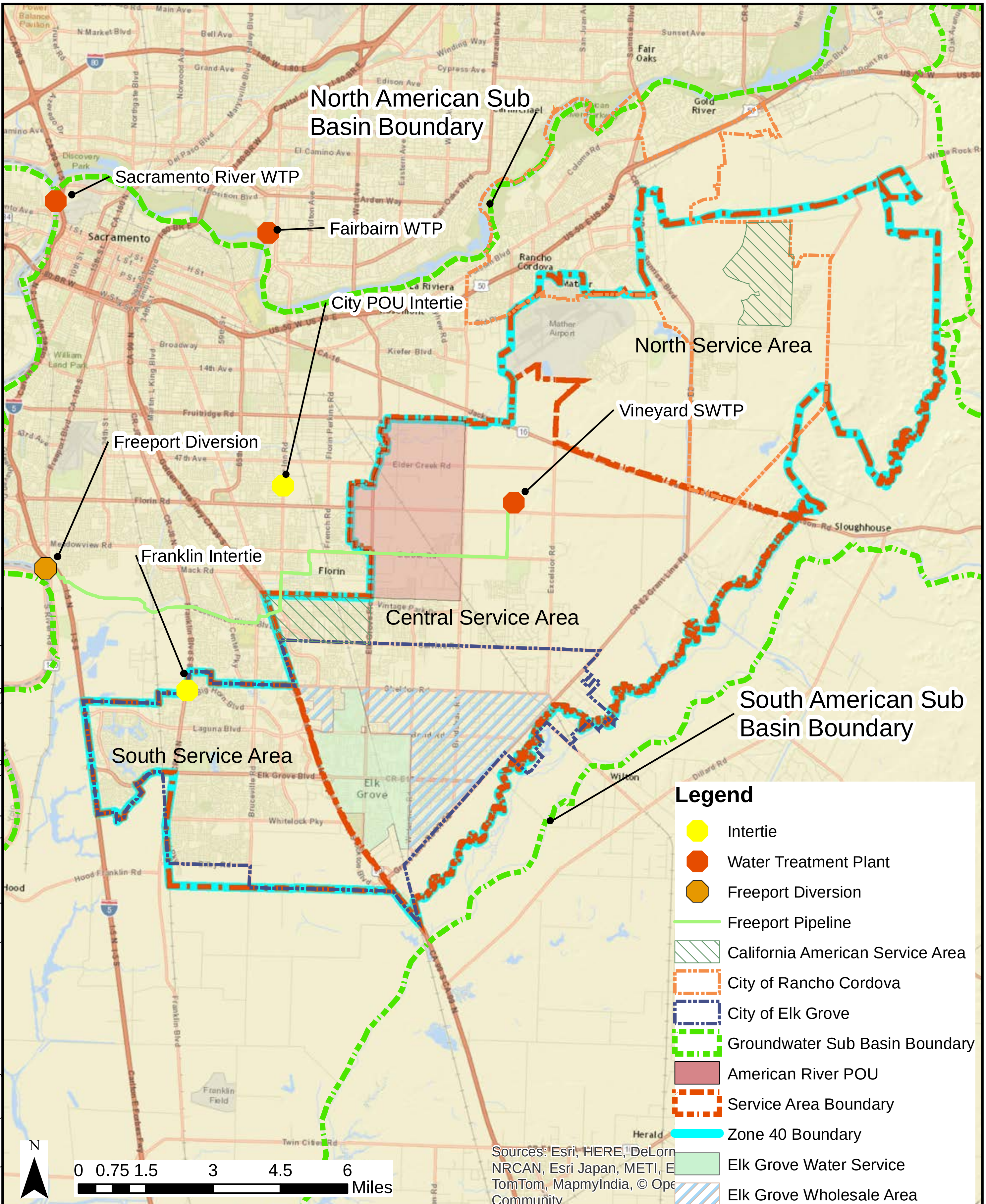
Zone 40 surface water supplies consist of Central Valley Project (CVP) water, appropriative water, American River Place of Use (POU) water, and other surface water sources. Figure 4-1 illustrates the location of the major surface water facilities.

The quantities of surface water available to SCWA in wet/average, drier, and driest years and the frequency of their occurrence are important aspects for the planning of a conjunctive use system. The availability of each surface water supply source in different water year types is described below.

4.2.1 Central Valley Project Water

The CVP water supply consists of the CVP contract held by SCWA and the two Sacramento Municipal Utilities District (SMUD) assignments that total 45,000 ac-ft/yr. Most of the CVP water is diverted at the Freeport diversion on the Sacramento River and treated at the Vineyard SWTP. Some of the CVP supplies are diverted from the Sacramento River and treated at the City's Sacramento River SWTP and delivered to SCWA at the Franklin Intertie.

SCWA entered into a contract in April 1999 with the U.S. Bureau of Reclamation (Reclamation) for 22,000 ac-ft/yr of CVP supplies pursuant to Public Law (PL) 101-514. This contract is often referred to as "Fazio Water" in recognition of the efforts by Congressman Vic Fazio to secure this contract. Of this 22,000 ac-ft/yr, 7,000 ac-ft/yr has been subcontracted to the City of Folsom for diversion from Folsom Lake, with 15,000 ac-ft/yr available for SCWA through the Freeport diversion or Franklin Intertie. This supply is currently (2015) diverted at the City's Sacramento River SWTP and delivered to SCWA at the Franklin Intertie.



P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 4 files\Figure 4-1.pdf

DATE	PROJECT	SITE	
1/20/15	143542	**Water System Infrastructure Plan Update**	**Figure 4-1**
Brown AND Caldwell DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY		TITLE **Zone 40 Water Supply**	

SCWA has entered into two three-party agreements with the City and SMUD for the assignment to SCWA for a total of 30,000 ac-ft/yr of water from SMUD's existing contract with Reclamation. These assignments are often referred to as "SMUD I" and "SMUD II". This supply is also available for SCWA through the Freeport diversion or Franklin Intertie.

SCWA's total CVP supply is subject to reductions in dry years. The water supply allocations are defined by Reclamation on a year to year basis and are expressed as a percentage of either the contract amount or amount of average use. For the 20 year period of 1995 to 2014, the lowest allocation was 50 percent in 2014.

The water supply allocations are based on a draft policy that defines water shortage terms and conditions. Reclamation initiated the development of a Municipal and Industrial (M&I) Water Shortage Policy in 1992, with several proposals prepared through 2001. The 2001 draft water shortage policy states that Reclamation would reduce M&I water to a contractor once irrigation water allocations are reduced below 75 percent of the contract amount. Reclamation has a provision in the draft policy for a minimum M&I shortage allocation of 75 percent that is applied to the last three years of historical use with certain adjustments, although the actual allocation in 2014 was 50 percent of historical use (US, 2001). In 2010, Reclamation convened several workshops that will lead to the development of an Environmental Impact Statement that could potentially modify the existing policy or develop a new policy (US, 2011).

Supply allocations of 100 percent in a wet and average year, 75 percent for a drier year, and 50 percent of the historical use in the driest year are assumed.

4.2.2 Appropriative Water

In February 2008, the State Water Resources Control Board (SWRCB) approved SCWA's appropriative right permit application to divert water from the American and Sacramento Rivers (Permit 21209). The amount of appropriated water available for use could range up to 71,000 ac-ft/yr in wet years, primarily during the winter months. This water would be diverted at the Freeport diversion on the Sacramento River. Since SCWA's demands are low in the winter months, SCWA would likely have to construct storage to utilize the full amount. It is possible that 35,000 ac-ft/yr of this supply could be utilized without the ability to store the water. No supply from this source is assumed for the drier and driest years.

4.2.3 City of Sacramento's American River Place of Use Water Supply

A portion of Zone 40 lies within the City's American River POU. The City has a pre-1914 water right to the American River with a POU boundary that extends beyond the City's boundary and includes a portion of Zone 40, as shown on Figure 4-1. The amount of water available to serve the POU area within Zone 40 is estimated to be 9,300 ac-ft/yr (SCWA, July 2011).

The Water Forum PSA for SCWA assumes that the City's American River water entitlements would be a source of supply for Zone 40. This is consistent with the City's PSA. The City is planning for the wholesale delivery of American River water within the POU including areas outside of the City limits. A connection would be constructed to supply the Florin Vineyard Community Plan area in the CSA, with the timing based on when the supply is actually needed.

The City's diversions from the American River at the Fairbairn Water Treatment Plant are reduced when American River flows are less than the Hodge Flow Criteria, which would likely result in no POU water being available for SCWA in these circumstances. The City may decide to divert water during these restricted times at their Sacramento River diversion, although additional infrastructure might need to be constructed by the City to be able to convey this water to SCWA. It might be possible for SCWA to divert the POU water at the Freeport diversion. Given the uncertainty of the availability of POU water during dry periods, a supply allocation of zero percent in the driest year and drier year, and 100 percent in the wet and average year is assumed.

4.2.4 Other Water Supplies

Other water supplies are water transfers that would be obtained from various water users that hold surface water rights on the Sacramento River and the American River upstream of SCWA's point of diversion. To obtain these supplies, SCWA would enter into purchase and transfer agreements with other entities that hold surface water rights. There are Sacramento River water supplies available for transfer in dry years, although the costs of these dry year supplies can exceed $500 per ac-ft.

The assumed quantity of other water supplies is 9,600 ac-ft/yr in dry years and no supplies transferred in wet years. The annual supply to demand comparison presented in Section 5.2 indicates that these other water supplies would not be needed at all if the CVP, POU, and groundwater supply amounts are not less than assumed. Therefore, the amount of other water supplies that would be needed would vary depending on the water supply situation.

SCWA has a Memorandum of Understanding dated April 2000 with GSWC to purchase up to 1,000 gpm of water through the Mercantile Intertie located within the NSA. The intertie between the two systems currently serves as an emergency connection for both water purveyors. No routine water supply from GSWC is assumed.

4.2.5 Summary of Surface Water Supplies

Table 4-1 presents SCWA's surface water supplies for the wet/average years, drier years, and driest years assuming no constraint on supply capacity. The long-term average supply values presented in Table 4-1 assume that the supplies are all fully utilized with no infrastructure capacity constraints for all of the water year types, except for the amount of appropriative water as described in Section 4.2.2. The frequency of occurrence of these water year types are assumed to be 64 percent, 28 percent, 8 percent of the years respectively, based on an analysis of a historical 70-year hydrologic period (SCWA, 2006, Pg. 7-3). The frequency of occurrence of different water year types may change in the future, such as due to the impacts of climate change.

Table 4-1. Summary of Surface Water Supplies, ac-ft/yr

Water supply sources	Contract/water right/transfer amount	Wet/average year	Drier year	Driest year	Long-term average [b]
U.S. Bureau of Reclamation – CVP Supply (SMUD 1, SMUD 2, and Fazio Water)	45,000	45,000	33,750 [a]	22,500 [a]	40,050
Appropriative Water – SWRCB Permit 21209	71,000	35,000	0	0	22,400
City of Sacramento's American River POU Water Rights	9,300	9,300	0	0	5,952
Other water supplies	9,600	0	9,600	9,600	3,456
Total	134,900	89,300	43,350	32,100	71,858

(a) *CVP drier and driest year supplies are the lesser of these values or 75 and 50 percent of the three year historical average, respectively.*

(b) *Based on full use of all supplies for each water year type, which is different than the projected actual use of supplies. The frequency of occurrence for the wet/average, drier, and driest years assumed to be 64 percent, 28 percent, 8 percent of the years respectively, based on an analysis of a 70-year hydrologic period (SCWA, 2006, Pg. 7-3).*

4.2.6 Historical Use of Surface Water Supplies

The use of surface water in Zone 40 started in 1995 through a contract with Browns Valley Irrigation District. In 1999, delivery of the CVP contract water was started through a wheeling agreement with the City. Surface water has historically has been a minor portion of the supply for Zone 40, as shown on an annual basis on Figure 4-2 and a monthly basis on Figure 4-3. The water supplies in Figure 4-2 are identified by the service area where the water production occurs. Some of the surface water and CSA groundwater produced in the CSA are used in the SSA. Surface water use in Zone 40 has increased starting in 2011 with the startup of the Vineyard SWTP.

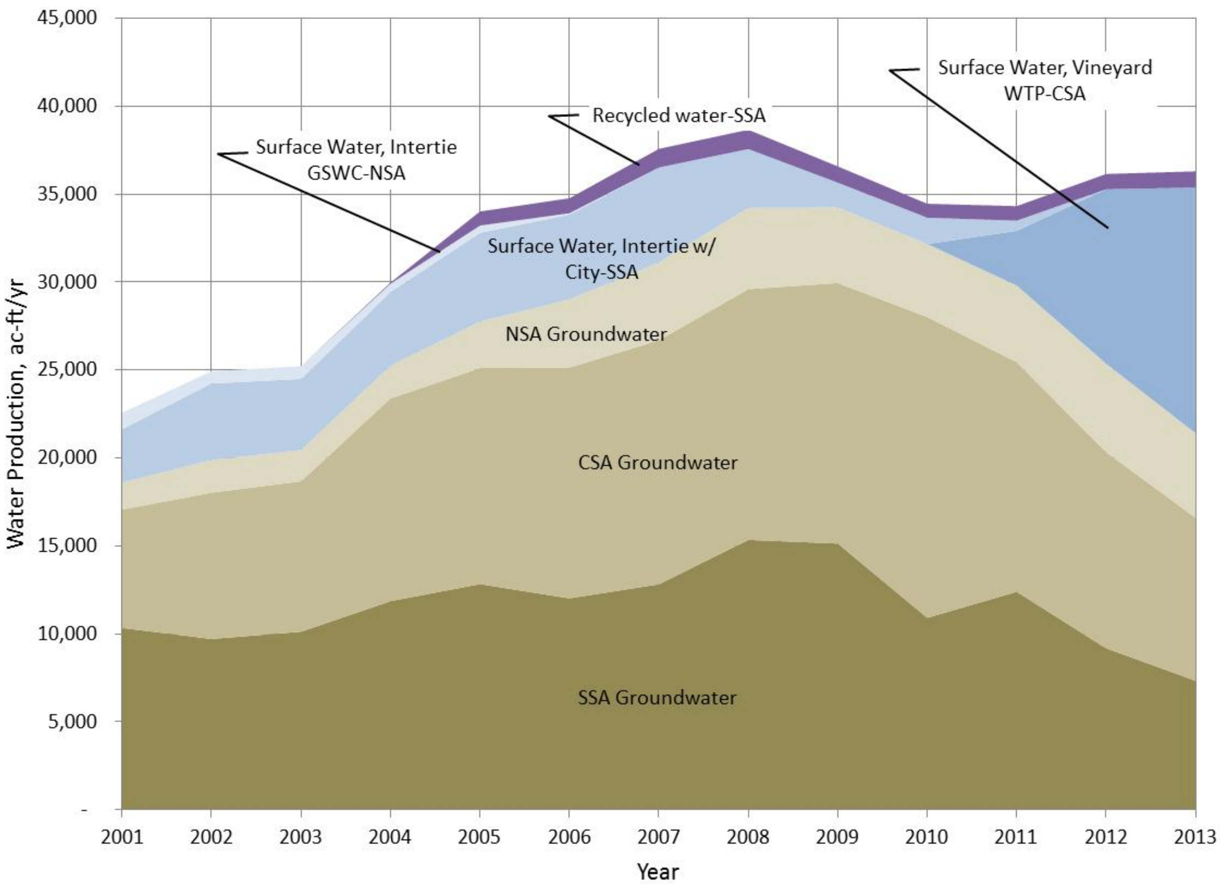


Figure 4-2. Historical Annual Water Supply

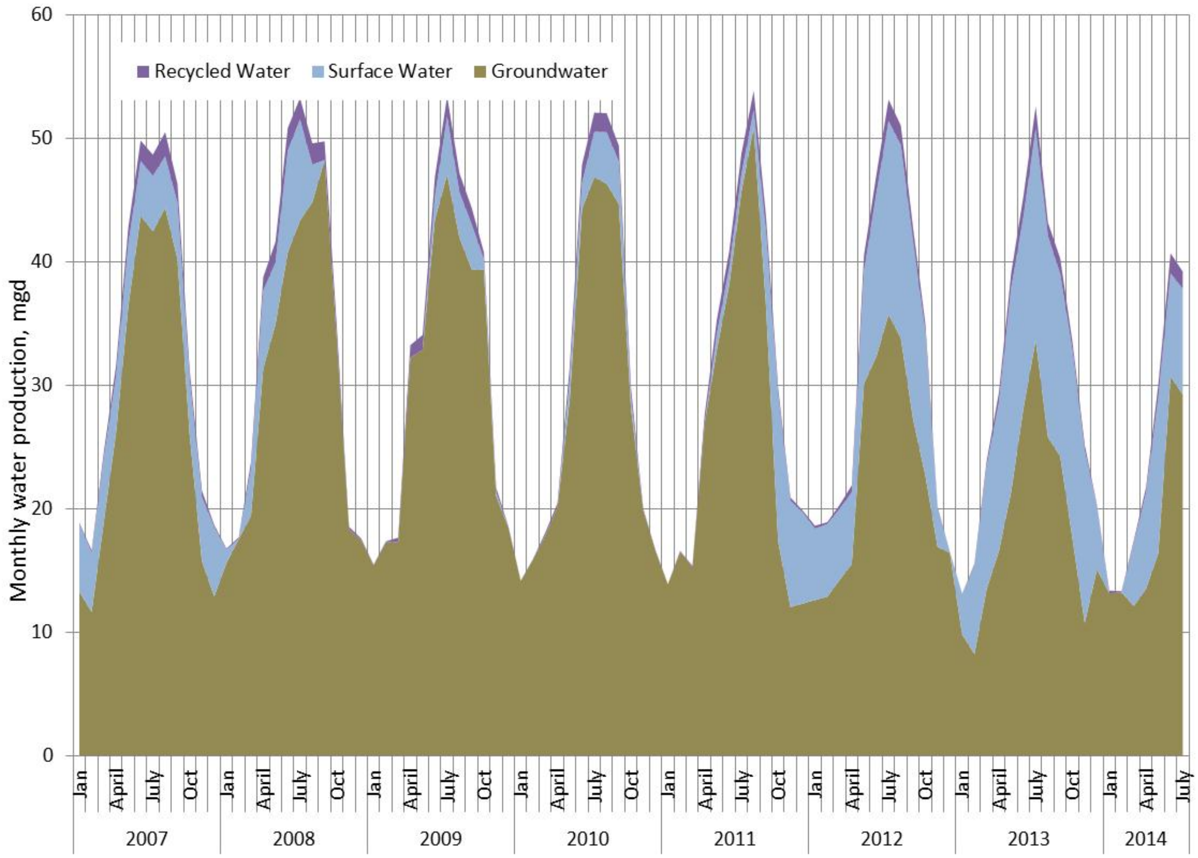


Figure 4-3. Monthly Water Production by Type of Supply

4.3 Groundwater

Zone 40 is supplied groundwater from part of the South American Subbasin (5-21.65) that covers an area of 248,000 acres. The South American Subbasin is not adjudicated and is not considered to be in overdraft according to DWR Bulletin 118 (DWR, 2003). This section describes the Sacramento Central Groundwater Authority (SCGA), the groundwater basin, historical groundwater use, and the remediated groundwater supply.

4.3.1 Sacramento Central Groundwater Authority (SCGA) and Groundwater Management Plan

SCGA was formed in 2006 through a joint powers agreement signed by the Cities of Elk Grove, Folsom, Rancho Cordova, and Sacramento, and the County of Sacramento. SCGA was formed for several purposes including maintaining the long-term sustainable yield of the Central Basin, managing the use of groundwater in the Central Basin, and facilitating the implementation of a conjunctive use program. The Central Basin is defined as the area bounded on the west by the Sacramento River, on the north by the American River, on the south by the Cosumnes River, and on the east by the foothills of the Sierra Nevada Range. The Central Basin's boundaries are similar to the boundaries of the South American Subbasin, although there are some differences. The Water Forum defined the long-term sustainable average annual yield of the Central Basin to be 273,000 ac-ft/yr. Zone 40 lies within a portion of the Central Basin.

The Central Sacramento County Groundwater Management Plan (CSCGMP), which was adopted in 2006 by SCGA, establishes a framework for maintaining sustainable groundwater resources in the Central Basin. This framework includes specific goals, objective, and an action plan to manage the basin and provides guidance to various stakeholders and negotiations for groundwater use.

4.3.2 Groundwater Basin Description

Groundwater in the Central Basin is generally classified as occurring in a shallow or upper unconfined aquifer zone (Laguna or Modesto Formation) and in an underlying deeper semi-confined aquifer zone (Mehrten Formation). These formations are typically composed of lenses of inter-bedded sand, silt, and clay, interlaced with coarse-grained stream channel deposits. The shallow aquifer extends approximately 200 to 300 feet below ground surface (bgs). The deep aquifer is separated from the shallow aquifer by a discontinuous clay layer that serves as a semi-confining layer for the deep aquifer. The base of the potable water portion of the deep aquifer averages approximately 1,400 feet bgs. Groundwater used in the Central Basin is supplied from both the shallow and deeper aquifer systems.

Intensive groundwater extraction from the Central Basin in the past has resulted in a general lowering of groundwater elevations near the center of the basin away from the sources of recharge. These depressions have grown and coalesced into a single cone of depression centered near Elk Grove. In general, the rest of the Central Basin does not show any distinctive patterns with respect to regional groundwater elevations, and the water table tends to mimic the local topography. With the completion of the FRWA project and SCWA's Vineyard WTP, the groundwater levels in the Central Basin are anticipated to stabilize as the conjunctive use program is fully implemented.

Groundwater in the upper aquifer system is of higher quality than that found in the lower aquifer system, although there are some occurrences of arsenic and nitrate. The lower aquifer system contains higher concentrations of iron and manganese, and total dissolved solids (TDS). Water from the upper aquifer generally does not require treatment other than disinfection for public drinking water systems, unless high arsenic or nitrate values are encountered. Wells that pump from the lower aquifer often require treatment for iron and manganese. Most of SCWA's Zone 40 wells have iron and manganese treatment facilities.

Groundwater contamination plumes exist in the NSA that have migrated from the Aerojet/Boeing and Mather properties. SCWA has four operating wells (Mather Housing) in the vicinity of these plumes. There are several other smaller contamination plumes located in other areas of Zone 40.

4.3.3 Historical Use of Groundwater Supplies

Groundwater historically has been a substantial portion of the supply for Zone 40, as shown on an annual basis on Figure 4-2 and a monthly basis on Figure 4-3. The recent completion of the FRWA project and the Vineyard SWTP and the resulting increased use of surface water have resulted in a reduction in the annual use of groundwater in Zone 40 since 2009.

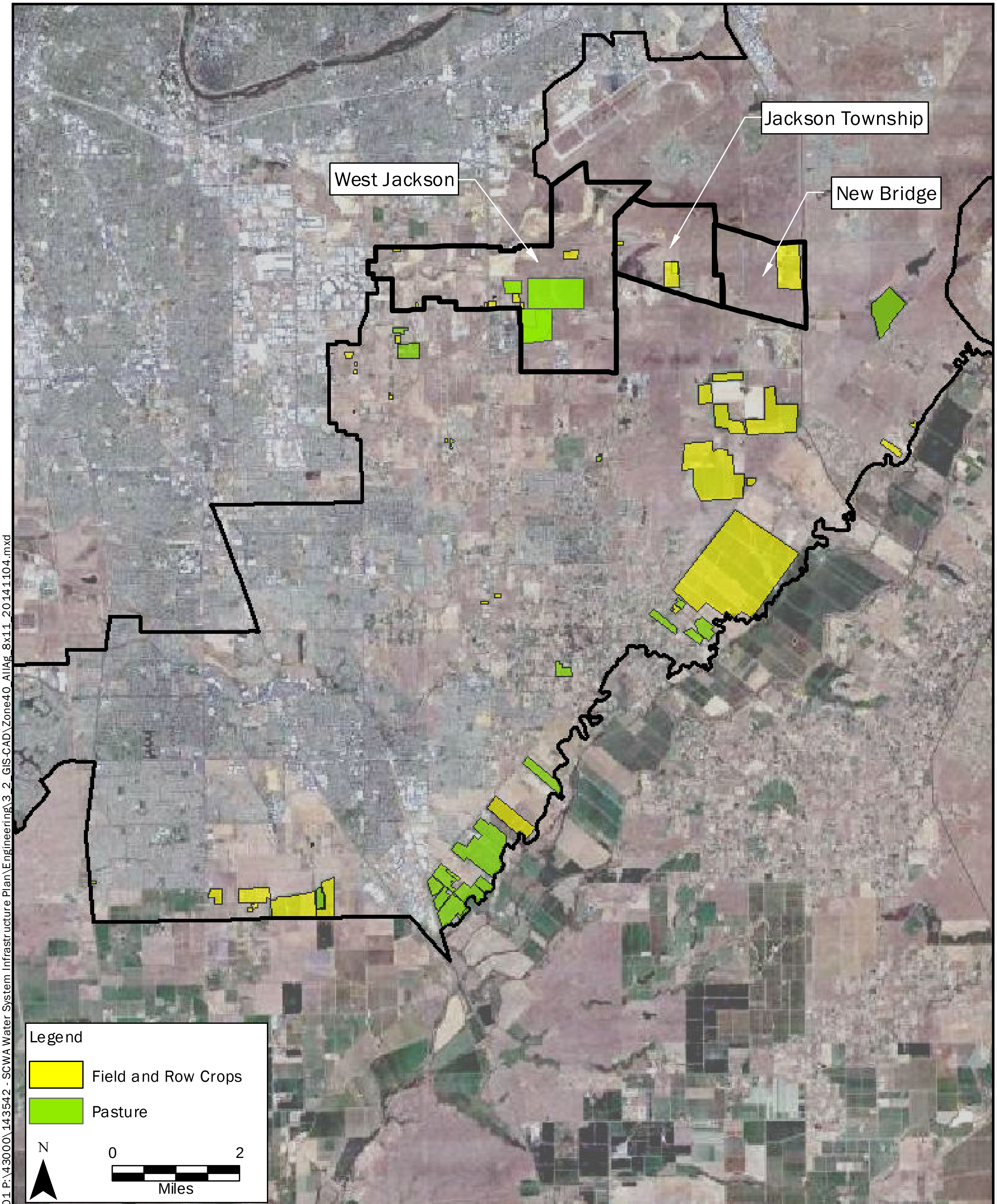
The current groundwater pumping to meet agricultural demands within Zone 40 is estimated based an inspection of aerial photographs to determine existing agricultural acreage for field and row crops and pasture. The aerial photographs are from Google Earth, August 2013. Because the photographs are from late summer, it is assumed that any green area is area that is being irrigated by private wells. Only the land acreage for agricultural uses is included; groundwater pumping for rural domestic uses is not included. Applied water factors for field and row crops and pasture lands are from the technical memorandum titled Sacramento Central Groundwater Authority 2011-2012 Agricultural Demand and Groundwater Pumping Estimates (David's Engineering, 2014).

The estimated agricultural groundwater usage for SCGA from the David's Engineering 2014 estimate for the years 2011 and 2012 is over ten times greater than the estimated agricultural groundwater usage in this analysis for Zone 40. This is due in part to the area of focus in this analysis versus the David's Engineering analysis. This analysis only estimates agricultural acreage within Zone 40 whereas the David's Engineering analysis study area encompasses the entire SCGA area which includes Zone 40 and much of the South American subbasin. Another difference is the approach to what is considered irrigated agricultural land. The David's Engineering analysis includes all acreage in the SCGA area that is potentially under agricultural production based on land use information compiled by the Sacramento Area Council of Governments (SACOG) and updated to reflect 2011 and 2012 cropping based on data from the National Agricultural Statistics Services. This analysis only includes agricultural acreage within Zone 40 that is green in the Google August 2013 aerial photographs.

Table 4-2 summarizes the estimated acreage by agricultural land use type, applied water factor, and agricultural water demand in Zone 40. Figure 4-4 illustrates the areas considered as agricultural land using groundwater within Zone 40.

Table 4-2. Estimated Current Groundwater Pumping to meet Agricultural Demands within Zone 40

Zone 40	Area, acres	Applied water factor, ac-ft/ac/yr	Estimated current agricultural water demand, ac-ft/yr
Field and row crops	2,850	3.5	9,840
Pasture	1,200	2.4	2,890
Total	4,050	--	12,730



Document Path: BCSAC01 P:\43000\143542 - SCWA Water System Infrastructure Plan\Engineering\3_2_GIS-CAD\Zone40_AllAg_8x11_20141104.mxd

DATE	PROJECT	SITE	
11/6/14	143542	**Sacramento County Water Agency**	**Figure 4-4**
Brown AND Caldwell / DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY		TITLE **Zone 40 Irrigated Agricultural Areas**	

4.3.4 Remediated Groundwater

SCWA has a remediated groundwater supply of 8,900 ac-ft/yr in accordance with the terms and conditions in the agreement entitled "Agreement between Sacramento County, SCWA, and Aerojet-General Corporation With Respect To Transfer of GET Water" dated May 18, 2010. The timing and amount of remediated groundwater available is subject to change as a result of on-going negotiations with water purveyors affected by groundwater contamination and with Aerojet/Boeing as their remediation plans may change as directed by various regulatory agencies. The remediated groundwater is discharged into the American River from Aerojet's Groundwater Extraction and Treatment (GET) facilities located in the Rancho Cordova area that are used for groundwater clean-up operations. This remediated groundwater supply is diverted by SCWA from the Sacramento River at Freeport along with SCWA's surface water supplies. A supply allocation of 100 percent in the driest year, drier year, and in a wet and average year is assumed.

4.4 Recycled Water

Recycled water is tertiary treated wastewater obtained from SRCSD that is supplied to the SSA in Zone 40 as a source of non-potable water for irrigation of parks, schools, and rights-of-way. Currently, SCWA provides recycled water in the SSA as part of a pilot project in the Laguna West, Lakeside, and Laguna Stonelake service areas (Phase 1 Area) that are located in the western portion of the Laguna subarea. Recycled water has historically been a small portion of the supply for Zone 40, as shown on an annual basis on Figure 4-2 and a monthly basis on Figure 4-3.

Recycled water supply availability will increase in the future when SRCSD expands its 5 mgd tertiary treatment facility. Recycled water use would increase to a total of 3,300 ac-ft/yr when the Phase 2 recycled water system is completed in the East Franklin and Laguna Ridge areas in the SSA (Phase 2 Area). Recycled water supply is assumed to be available at 100 percent of full supply in wet/average, drier, and driest years.

There is an emerging trend in California to use recycled water as an indirect source of potable water, known as indirect potable reuse. There are a limited number of water suppliers in California that are introducing recycled water into their potable water supplies through groundwater recharge. The City of San Diego is implementing a program that will result in augmenting one of their surface water supply reservoirs with recycled water. Studies are ongoing to develop requirements for direct potable reuse of recycled water. The attractiveness of these approaches is that the enormous costs of recycled water pipeline distribution systems can be avoided. SCWA intends to consider these options as it develops its long term recycled water strategy.

4.5 Water Supply Portfolio

The various water supplies available to SCWA combine to form Zone 40's water supply portfolio. SCWA has implemented a conjunctive use program within Zone 40 that optimizes the use of groundwater and surface water based on hydrologic conditions.

Historically, SCWA relied primarily on groundwater to provide water service to its customers. Existing groundwater pumping capacity plus a relatively small amount of surface water through the Franklin Intertie had been sufficient to meet system wide water demands. With the completion the Freeport project and the Vineyard SWTP, SCWA is now able to more fully implement a conjunctive use program that results in a variation of the mix of supplies based on the water year type.

Conjunctively using surface water and groundwater allows SCWA to reduce surface water diversions and increase groundwater use in dry years. In wet and average years SCWA can increase surface water use and decrease groundwater use, thereby not exceeding the long term sustainable yield of the underlying groundwater basin.

Table 4-3 presents SCWA's unconstrained water supply portfolio for wet/average, drier, and driest years. Table 4-3 also presents the long-term average use on an annual basis of each supply source assuming that all of the available water supplies are fully used for each climate year type. SCWA would have to construct additional supply, treatment, and conveyance facilities to fully access the available water supplies presented in Table 4-3. Figure 4-5 illustrates the Zone 40 available water supply in each year type assuming that supply facilities with adequate capacities are available. The long-term average supply availability may change if the frequency of occurrence of different water year types changes in the future, such as due to the impacts of climate change. Section 5.2 presents the annual supplies that are available with the constraint of the capacity of the facilities and the projected use of the supplies.

Table 4-3. Zone 40 Water Supply Portfolio, ac-ft/yr [a]

Supply source	Wet/average year	Drier year	Driest year	Long-term average [d]
Surface water [b]	89,300	43,350	32,100	71,858
Groundwater [c]	34,900	64,900	71,900	46,260
Recycled water	3,300	3,300	3,300	3,300
Total	127,500	111,550	107,300	121,418

(a) *These water supply values are not constrained by water supply facility capacities. SCWA would have to construct additional supply, treatment, and conveyance facilities to fully access the available water supplies presented in this table.*

(b) *The surface water drier and driest year supplies could be less if the prior 3-year historical CVP use is less than the CVP contract amount.*

(c) *Includes the 8,900 ac-ft/yr remediated groundwater supply. Groundwater supply amounts are the projected annual groundwater use at buildout presented in Section 5.2.*

(d) *Based on full use of all supplies for each water year type. The frequency of occurrence for the wet/average, drier, and driest years assumed to be 64 percent, 28 percent, 8 percent of the years respectively, based on an analysis of a 70-year hydrologic period (SCWA, 2006, Pg. 7-3).*

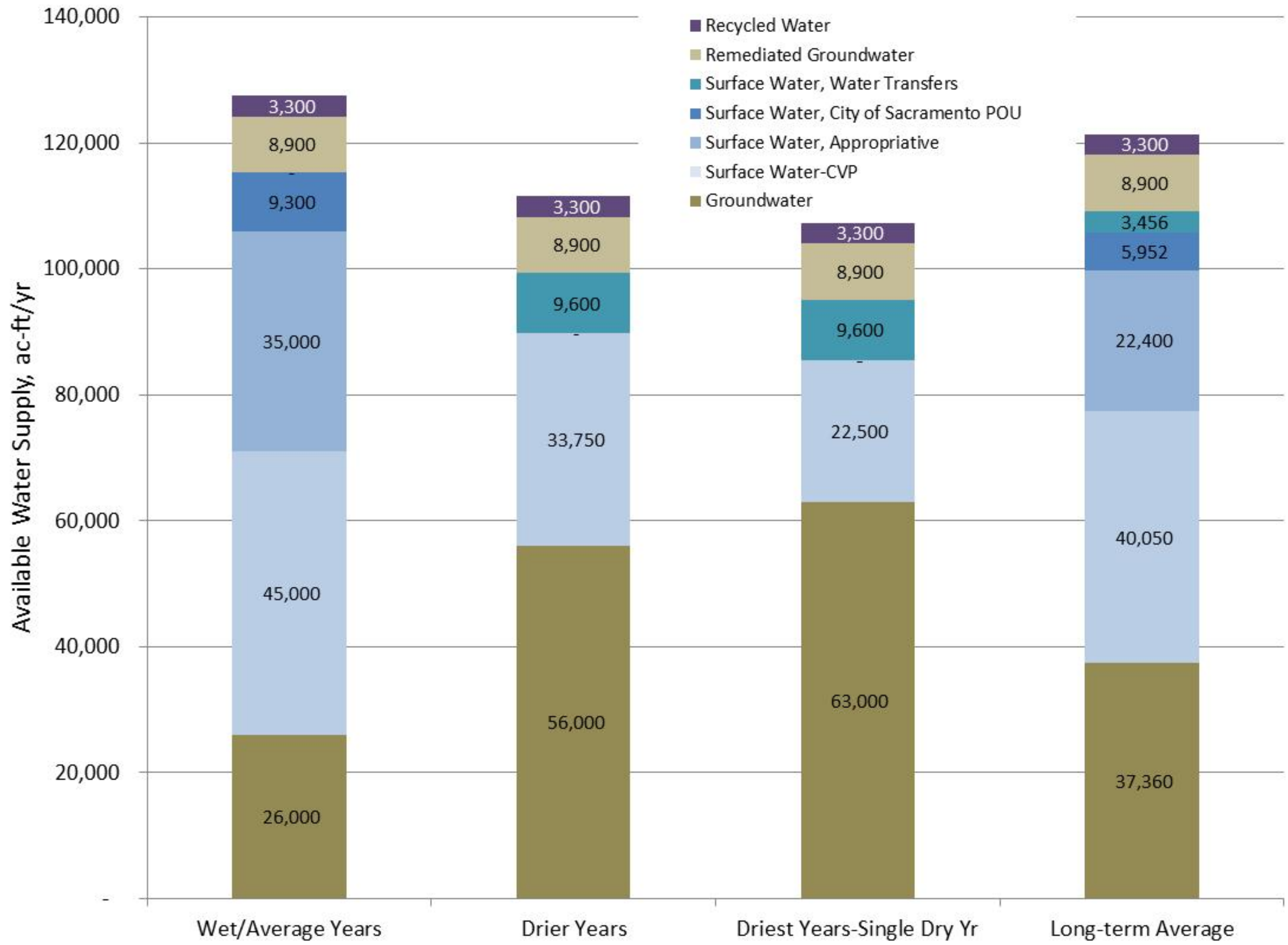


Figure 4-5. Available Water Supplies

4.6 Additional Water Supply Information

This section presents additional water supply information to supplement the information provided in the previous sections.

4.6.1 Surface Water

The CVP and City POU supplies are discussed in this section.

4.6.1.1 Central Valley Project Water

With internal improvements to the City's conveyance system completed in 1999, SCWA began taking delivery of some of the CVP contract water (or "Fazio" water) at the Franklin Intertie for use in the SSA through a long-term treatment and wheeling agreement with the City.

The long term average water supply allocation for CVP contractors north of the Delta for the 1993 to 2013 period has been approximately 85 percent of the contract amount (US, 2013), with full supply allocation for over half of the years. Reclamation's allocations to south of Delta contractors are occasionally lower than to north of Delta contractors, such as SCWA. Table 4-4 presents the frequency of occurrence of historical supply allocations from 1990 to 2013. In 2014 the supply allocation was 50 percent.

For the 25 year period from 1990 to 2014, there were four years where the allocation was set as a percentage of historical use, and not as a percentage of the contract amount (US, 2013). This approach is consistent with the draft M&I shortage policy described earlier. Using an allocation that is expressed as a percent of historical use results in a much smaller dry year supply for a contractor whose actual use is much less than their contract amount. For example, a contractor that actually uses 50 percent of their contract amount would have an allocation of 38 percent of their contract amount if it was based on 75 percent of actual use.

Table 4-4. CVP Annual Allocation and Occurrence Frequency for Urban Contractors North of Delta, 1990 to 2013

Supply, % of Contract	Frequency of Occurrence, %	Year type
25-50	4	Driest
50-75	4	
75 [(a)]	13	Dry
75	8	
85	4	
90-100	4	Wet/average
95	8	
100	54	

Source: US, 2013

[(a)] *Percent of historical use.*

An analysis conducted by Reclamation to estimate the delivery gap between CVP contract amounts and deliveries in all years and in driest years was conducted using 73 years of historical hydrological data. The overall delivery gap for urban contractors was estimated to be approximately 25 percent in all years and 35 percent in the driest years as a percentage of the contract amount (US, 2008).

As shown in Table 4-5, the single dry year supply assumptions made by other CVP M&I contractors in their 2010 Urban Water Management Plans are frequently 75 percent of the contract amount. The CVP contractors that divert from the American River, San Juan Water District, and the City of Folsom, report their single dry surface water supplies in aggregate based on their WFA commitments rather than providing quantities of the specific CVP portion of their overall supplies. CVP allocations in the past do not differentiate American River diverters from Sacramento River diverters except for in 2009 and 2013 when the allocations differed.

Table 4-5. Summary of CVP Supply Assumptions used in 2010 Urban Water Management Plans

M&I Supplier	Contract amount, ac-ft/yr	Single dry year supply, ac-ft/yr	Percent of contract amount
North of Delta			
Placer County Water Agency	31,000	23,250	75
San Juan Water District	24,200	18,150	75
El Dorado Irrigation District	7,550	5,660	75
South of Delta			
Santa Clara Valley Water District	152,500	69,180	45
City of Tracy	10,000	6,500	65

Part of the CVP water supplies is the SMUD assignments. According to the WFA, SCWA would construct groundwater facilities that would be available as an alternative supply for SMUD to meet increased demands in drier years (WFA, 2000). SCWA staff reports that this is not a current contractual obligation.

4.6.1.2 City of Sacramento's American River Place of Use (POU) Water Supply

The City is planning for the wholesale delivery of American River water within the POU including areas outside of the City limits. The City and SCWA had previously been negotiating a Master Wheeling Agreement that would provide surface water from the American River to within the portion of the POU that lies with Zone 40. The negotiations are not proceeding at this time, but will start once the timing for the delivery of POU water is closer at hand. One element of the agreement is that the City would receive the same level of service as City customers.

The previous WSIP stated that an initial 6.5 million gallon per day (mgd) connection would supply the Florin Vineyard Community Plan area, followed by a 19 mgd connection with an annual supply of 10,644 ac-ft/yr (SCWA, 2006, Pg. 4-17).

The City's diversion of its American River water right is subject to the WFA diversion restrictions. The City's diversions at the Fairbairn Water Treatment Plant are reduced when American River flows are less than the Hodge Flow Criteria. American River flows occur below the Hodge Criteria quite often and as a consequence, the City's diversions are frequently reduced. At the time that the diversion amounts were determined for the SCWA it was not believed that the flow standards would be so restricted. The frequency of occurrence of American River flows less than the Hodge criteria and the possible impacts of ongoing efforts such as the Water Forum Flow Management Standard and the Operational Criteria and Plan (OCAP) create uncertainty as to the extent of availability of this City surface water supply to serve SCWA.

The Sacramento Suburban Water District receives American River POU water from the City, and has experienced reductions and curtailments of that supply on a weekly basis in almost all year types. Their agreement with the City provides for a maximum flow rate of 20 mgd. A continuous supply of 20 mgd is equivalent to 22,404 ac-ft/yr. An analysis of the frequency of Hodge flows and their impact on the City's diversion of American River water concluded that the amount of American River POU water available to Sacramento Suburban Water District is 13,100 ac-ft/yr in wet years, 5,600 ac-ft/yr in average years, 1,900 ac-ft/yr in drier years, and no supply in the driest years (SSWD, 2009). These are supplies that are 58, 25, 8, and 0 percent respectively of the total available supply. The water year types used in the analysis are based on the Water Forum definition developed for the American River. These POU supply constraint issues for SSWD may be relevant to the City's POU supply available to SCWA.

It may be possible for the American River POU water to be diverted downstream of the mouth of the American River and avoid the reduction of flows due to Hodge criteria that occurs with a diversion at the Fairbairn SWTP. This supply could potentially be diverted from the Sacramento River at the City's Sacramento River SWTP or at the Freeport diversion for treatment at the Vineyard SWTP. Another option would be to divert the supply at the Sacramento River and then pump it back to the east to the Fairbairn SWTP for treatment. The feasibility of the City moving the point of diversion of the American River POU water to either of these two locations on the Sacramento River would have to be determined.

4.6.2 Groundwater

This section presents additional information on the groundwater supply.

4.6.2.1 Sacramento Central Groundwater Authority and Groundwater Management Plan

The SCGA GMP defines five specific basin management objectives (BMOs) (SCWA, 2006).

1. Maintain the long-term average groundwater extraction rate at or below 273,000 ac-ft/yr.
2. Maintain specific groundwater elevations within all areas of the Central Basin consistent with the WFA.
3. Protect any potential inelastic land surface subsidence by limiting subsidence to no more than 0.007 feet per one foot of drawdown in the groundwater basin.
4. Protect against any adverse impacts to surface water flows in the American, Cosumnes, and Sacramento Rivers.
5. Meet specific water quality objectives.

The SCGA GMP includes a detailed groundwater management implementation plan to comply with the requirements of the BMO's. The Basin Management Report for 2009-2010 stated that total groundwater pumping varied from 251,948 ac-ft/yr to 264,067 ac-ft/yr during the 2006 to 2010 period (SCGA, 2010). Groundwater pumping for agricultural purposes represented approximately two thirds of the total.

4.6.2.2 Groundwater Levels

Groundwater elevations have generally declined consistently from the 1950s and 1960s until 1995. From 1995 to 2003, groundwater levels have increased partially due to the increased use of surface water in the Central Basin by SCWA and other water agencies, and the fallowing of previously irrigated agricultural lands transitioning into new urban development areas in accordance with the Sacramento County and City of Elk Grove General Plans.

4.6.2.3 Groundwater Quality

Principal groundwater contaminant plumes within or near the Central Basin emanate from source areas such as Mather Field, Aerojet, Boeing, the former Army Depot, and various landfills. The presence of these contaminant plumes has impacted some existing municipal wells. Significant remediation efforts/programs by federal, state, and local government agencies are in progress to clean up the contaminated groundwater and to confine the contaminant plumes from further spreading. Currently, remediated groundwater is discharged into natural water bodies and some of it flows out of the Central Basin. There are on-going discussions and negotiations between purveyors and parties responsible for clean-up to keep the remediated groundwater in the Central Basin and put it to beneficial use. The remediated groundwater supply is described in Section 4.3.4. The new drinking water standard for chromium VI may result in further groundwater treatment needs for some wells.

4.6.3 Previous Water Supply Estimates

Several previous documents have presented estimates of the quantities of water supplies available to SCWA during different types of climate years. These previous estimates were reviewed as part of the process to update the water supply estimates for this update. Table 4-6 presents a summary of the previous water supply estimates.

Table 4-6. Previous Water Supply Estimates

Water supply source/year type	Freeport EIR, 2003	WSMP, 2005	WSIP, 2006	2010 UWMP, 2011	Cordova Hills Amendment, 2011
CVP Supply (SMUD and Fazio)					
Contract/water right	45,000	45,000	45,000	45,000	45,000
Wet year		45,000	42,936	45,000	45,000
Average year		38,000		45,000	
Drier year					33,750
Driest year	33,750/22,500	8,700	22,117	8,700	27,000
Long-term average	38,000	39,551		38,000	
Appropriative Water					
Contract/water right					35,000
Wet year		71,000	5,387	71,000	35,000
Average year		21,700		21,700	
Drier year					7,000
Driest year		-	-	-	3,500
Long-term average	16,000	14,586	14,586	21,700	21,700
City of Sacramento POU water rights					
Contract/water right		9,300			9,300
Wet year	12,000	9,300	10,644	9,300	9,300
Average year		9,300		9,300	9,300
Drier year					9,300
Driest year		9,300	9,580	9,300	9,300
Long-term average	9,300	9,300		9,300	
Remediated groundwater					
Contract/water right					8,900
Wet year			16,754	8,900	8,900
Average year				8,900	8,900
Drier year					8,900
Driest year			16,075	8,900	8,900

Table 4-6. Previous Water Supply Estimates

Water supply source/year type	Freeport EIR, 2003	WSMP, 2005	WSIP, 2006	2010 UWMP, 2011	Cordova Hills Amendment, 2011
Long-term average				8,900	
Other water supplies					
Contract/water right					12,000
Wet year		9,600	5,474	-	-
Average year		6,200		5,200	-
Drier year					6,000
Driest year		-	6,783	9,600	12,000
Long-term average	14,500	5,200	5,200	5,200	
Groundwater					
Wet year		27,300	25,504	27,300	3,260
Average year		40,900		15,000	13,930
Drier year					
Driest year		69,900	41,477	69,900	53,790
Long-term average	41,000		40,900	40,900	32,020

Section 5

Water Supply Capacity

This section quantifies the amount of supply capacity that would be needed to meet Zone 40 demands through buildout and describes the hydraulic model analysis. The future water supply capacity is developed to meet the projected maximum day demands while allowing SCWA to vary the mix of supplies based on water year type. The water supply capacity is developed with the approach to increase the use of surface water in wet/average years and groundwater in dry years (conjunctive use program). The maximum day and annual amounts of surface water, groundwater, and recycled water that would be used during wet/average and dry climate years are presented. The amount of storage and pumping capacities needed to meet peak hour demand are developed. The supply capacities developed in this section include the supply for the Elk Grove and Rio del Oro wholesale areas as well as the Zone 40 retail area. Since the remediated groundwater supply is delivered to Zone 40 through the Vineyard SWTP, the surface water supply capacities and use of supply presented in this section include the remediated groundwater.

5.1 Maximum Day Demand Supply Capacity and Use

Zone 40 needs enough water supply capacity to meet the projected future maximum day demand for both wet and dry climate years. The maximum day demand condition is important because the water supply facilities are sized to meet and exceed that condition. The planned future water supply capacity is based on the construction of new groundwater, surface water, and recycled water supply and conveyance facilities that are described in Section 6. The maximum day demand is estimated using the projected annual demands presented in Section 3 with a maximum day demand peaking factor of 2.0.

Both wet year and dry year scenarios are considered in quantifying the needed water supply capacity. The total capacity of all water supply facilities must significantly exceed the maximum day demand because of the requirements of the conjunctive use program.

As mentioned previously, the remediated groundwater is categorized as part of the surface water supply capacity and use since it is conveyed through the surface water facilities. The groundwater capacity and use only reflects groundwater produced from wells owned and operated by SCWA.

The timing of the supply capacities is developed based on three phases. The period from January 2015 to December 2025 is considered Phase 1, January 2026 to December 2035 is considered Phase 2, and Phase 3 is the period from January 2036 through buildout.

Figure 5-1 presents a comparison of the total capacity of the existing water supply facilities to the 2013 maximum day demand for each of the service areas. As shown on Figure 5-1, the capacities of all of the existing water supply facilities exceed the maximum day demands for each service area. All three of the service areas currently have adequate groundwater supply capacity to meet their current maximum day demand without the use of surface water. There is enough surface water supply capacity in the CSA to meet the CSA's current maximum day demand without the use of groundwater. The NSA and the SSA currently have a more limited supply of surface water that cannot fully supply the maximum day demand.

The maximum day demand to supply capacity comparison tables for each of the three service areas are presented in Appendix I. The future supply capacity is based on the proposed supply and conveyance facilities that are presented in Section 6.

5.1.1 North Service Area

The NSA is currently supplied by groundwater from existing groundwater treatment plants. NewBridge and Jackson Township are located in the NSA. The existing groundwater supply facilities have the capacity to supply all of the current maximum day demand. The Mercantile interconnection with Golden State Water Company is only used for emergency purposes.

Surface water supply from the existing Vineyard SWTP would be provided in Phase 1 to replace the current groundwater supply provided by the Anatolia GWTP. The construction of the Phase A NSA Project (P-10) and Phase B NSA Project (S-1) will allow for some of the Vineyard SWTP's existing capacity to be used to supply the NSA. It is assumed that 65 percent of the Vineyard SWTP would be used to supply the NSA. The use of the Mather wells is below their capacities in dry years since SCWA operational staff prefer to minimize their use due to the possible impact to nearby contamination plumes.

5.1.2 Central Service Area

The CSA is currently supplied by groundwater from existing groundwater treatment plants and some direct feed wells and surface water from the Vineyard SWTP. The West Jackson area is located in the CSA. The existing groundwater facilities have the capacity to supply all of the current maximum day demand. Similarly, the Vineyard SWTP's current 50 mgd capacity is more than adequate to supply all of the CSA's current maximum day demand. Once several projects are constructed, including the Phase A NSA Project (P-10) and Phase B NSA Project (S-1), some of the Vineyard SWTP's existing capacity will be used to also supply the NSA.

The future West Jackson GWTP will be used to supply the CSA, although it will be connected to the transmission system such that it could also provide supply to the NSA. There is enough need in the CSA on the maximum demand day in a dry year to be able to use all of the groundwater supply within the CSA.

As described earlier, water supplies produced in the CSA can be delivered to the SSA through the three connections between the CSA and SSA. These connections are located along Highway 99 at Sheldon Road, Bond Road, and Grant Line Road. The total capacity of these connections is approximately 30 mgd. On the maximum day in a wet/average year by 2025, the CSA would able to use all of its surface water supply capacity with no excess capacity to provide to the SSA. Similarly, in a dry year the CSA is able to use all of its groundwater supply capacity with no excess groundwater supply capacity available for the SSA. Additional groundwater and surface water capacity is not needed until Phase 3.

5.1.3 South Service Area

The SSA is currently supplied by surface water from the Franklin intertie and the Vineyard SWTP, groundwater from existing groundwater treatment plants and some direct feed wells, and a small amount of recycled water. The existing groundwater facilities in the SSA have the capacity to supply all of the current maximum day demand.

The proposed GWTPs for Phase 3 would provide a maximum day groundwater supply capacity that exceeds the SSA's projected buildout maximum day demand. These Phase 3 GWTPs could be used to provide dry year groundwater supply to other areas or groundwater storage, or function as additional backup facilities.

As described previously, the three existing connections between the CSA and SSA can be used to supply surface water or groundwater to the SSA. The CSA has minimal to no spare surface water capacity in a wet/average year and no groundwater capacity in a dry year on the maximum demand day. However, the SSA has adequate planned supply facilities to be able to address both the wet/average years and dry years. There is a need to help supply peak hour demands in the SSA as presented in Section 5.4.

New groundwater supply capacity would be needed during Phase 1. Additional groundwater supply capacity would be added in Phases 2 and 3. No new surface water supply capacity is specifically planned for the

SSA, although the planned Phase 3 expansion of the Vineyard SWTP would provide some additional surface water.

5.1.4 Zone 40 Summary

Table 5-1 compares the maximum day demand and supply capacity for Zone 40 from 2013 through buildout. The maximum day use of each type of supply is quantified for the wet/average years and dry years. Figure 5-1 compares the Zone 40 maximum day demands to the supply capacities for each of the phases. As can be seen in Figure 5-1 and consistent with the established conjunctive use program, the total supply capacity exceeds the maximum day demand for each phase, but neither the groundwater nor surface water supply capacity alone can meet the maximum day demand.

Table 5-1. Maximum Day Demand to Supply Comparison for Zone 40 - Cumulative, mgd

Zone 40			Phase 1			Phase 2		Phase 3			
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buidlout (2052)
Maximum day demand											
	Zone 40 total	61.5	69.2	81.2	96.3	112.2	128.1	144.4	161.4	179.0	183.0
Existing supply capacity (a)											
	Groundwater (b)	72.5	72.5	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
	Surface water	61.1	61.1	45.1	28.6	28.6	28.6	28.6	28.6	28.6	28.6
	Recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	Total	136.6	136.6	114.1	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Planned future supply capacity											
	Groundwater	0.0	0.0	0.0	6.5	15.5	33.0	33.0	33.0	53.0	66.0
	surface water (b)	0.0	0.0	16.0	32.5	32.5	32.5	32.5	32.5	82.5	101.6
	Recycled water									2.9	2.9
Total supply capacity											
	Groundwater	72.5	72.5	66.0	72.5	81.5	99.0	99.0	99.0	119.0	132.0
	Surface water	61.1	61.1	61.1	61.1	61.1	61.1	61.1	61.1	111.1	130.2
	Recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	136.6	136.6	130.1	136.6	145.6	163.1	163.1	163.1	236.0	268.1
Use of supply: average/wet years											
	Groundwater	20.4	25.8	21.1	46.6	57.1	65.2	72.9	80.7	68.4	49.5
	Surface water	38.1	40.3	57.1	46.7	52.1	59.9	68.5	77.6	104.7	127.6
	Recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	61.5	69.2	81.2	96.3	112.2	128.1	144.4	161.4	179.0	183.0
Use of supply: dry years											
	Groundwater	58.5	64.3	60.5	68.5	77.1	92.8	100.5	108.3	108.2	108.2
	Surface water	0.0	1.9	17.7	24.8	32.1	32.3	40.9	50.0	65.0	69.0
	Recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	61.5	69.2	81.2	96.3	112.2	128.1	144.4	161.4	179.0	183.0

(a) *Groundwater supply decrease in 2020 due to Anatolia GWTP removed from service.*

(b) *Reduction in existing capacity and added future surface water supply capacity in 2020 and 2025 because planned delivery to NSA from existing Vineyard SWTP accounted as future supply capacity as requested by SCWA staff.*

As shown in Table 5-1, Zone 40 will utilize a varying mixture of groundwater and surface water supplies on the maximum demand day based on whether it is a wet/average year or a dry year. The ability to practice conjunctive use by maximizing the use of surface water in wet and average years and minimizing the use of surface water in dry years is limited by the available surface water and groundwater supply capacities and to some extent by distribution system constraints. Several observations are made regarding the maximum day supply capacity and use that pertains to all three phases:

1. In dry years, there is sufficient groundwater capacity to be able to significantly reduce the amount of surface water use on the maximum day compared to wet/average years.
2. In dry years, most of the groundwater capacity will be utilized on the maximum demand day.
3. In wet years, there is sufficient surface water capacity to be able to supply over half of the maximum day demand.
4. In wet years, up to half of the groundwater capacity will be used to help supply the maximum day demand.

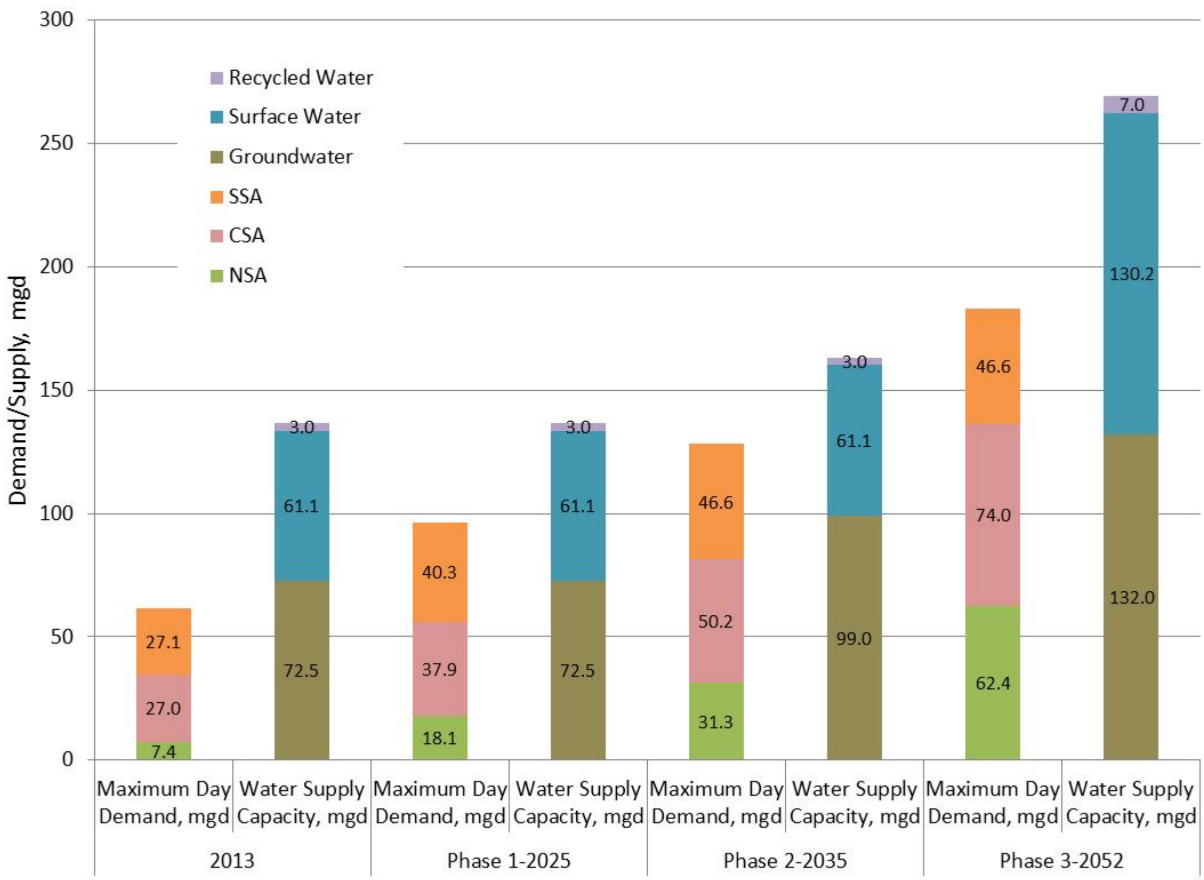


Figure 5-1. Maximum Day Demand to Supply Capacity Comparison by Phase

Figure 5-2 presents the maximum day use of the water supplies by type for wet/average years and dry years for 2013, Phase 1, Phase 2, and Phase 3. Figure 5-3 presents a comparison of the current (2013) maximum day demands to supply capacity for each service area.

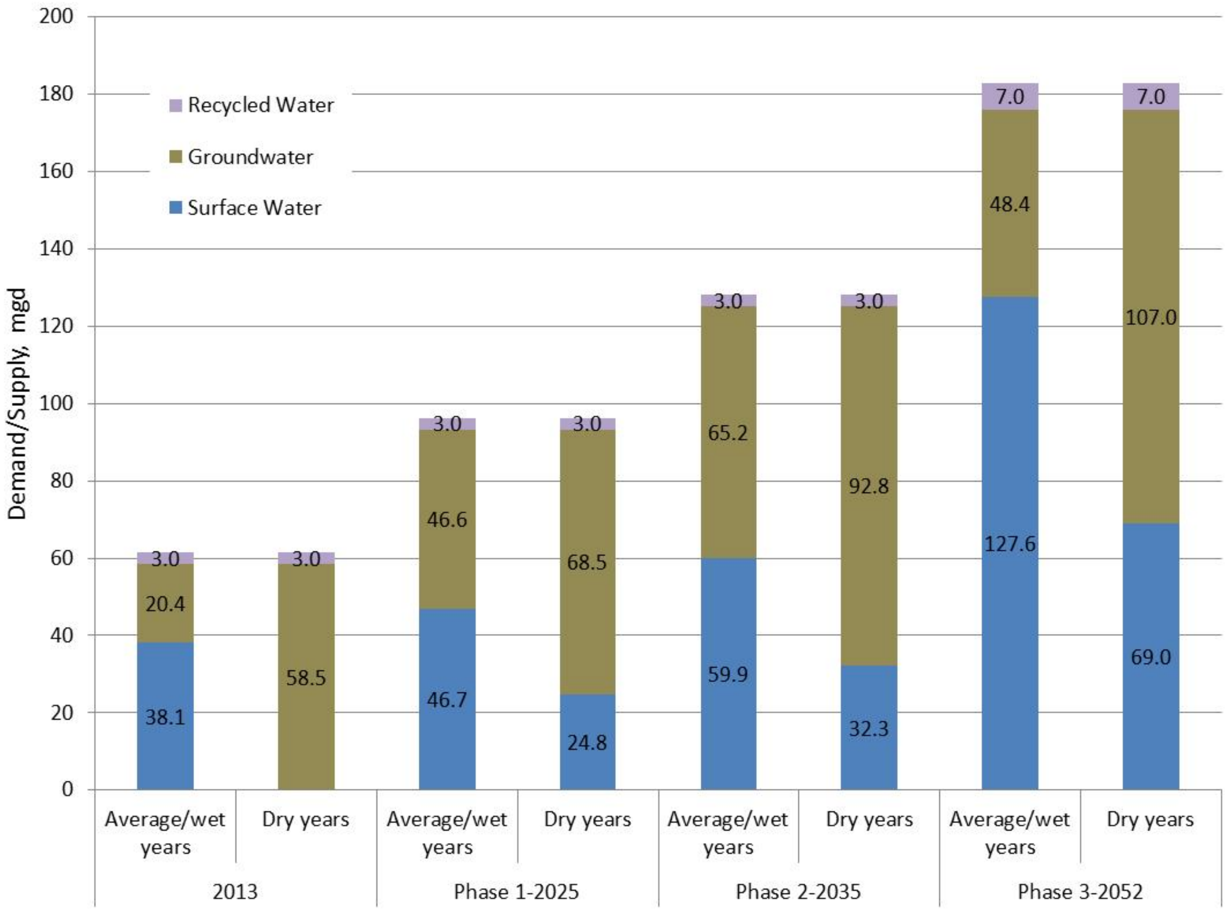


Figure 5-2. Maximum Day Use of Water Supplies by Phase and Climate Year Type

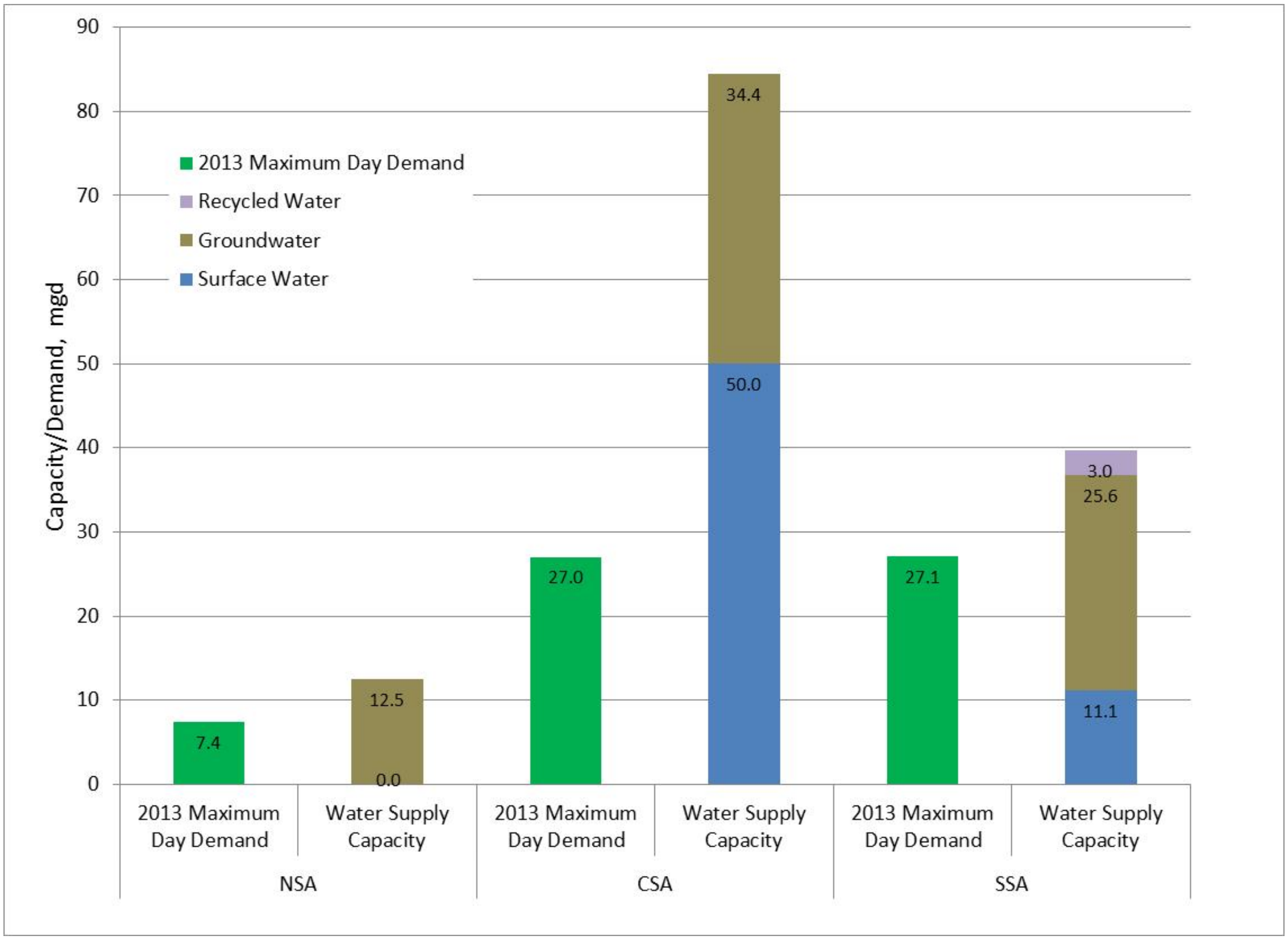


Figure 5-3. 2013 Maximum Day Demand and Supply Capacity by Service Area

5.2 Annual Water Supply Capacity and Use

The available supply capacity and use of supply are presented in this section on an annual basis because the values are directly useable for the development of water supply assessments and urban water management plans. The available water supply amounts that are described in Section 4 represent the full amount of available supply assuming there are no facility capacity constraints. The supply capacities and use of supplies presented in this section are constrained by the supply and conveyance facility capacities presented in Section 5.1.

The annual supply capacity and use are determined using the maximum day supply capacity and use presented in Section 5.1. The proportional capacity and use of each water supply type on an annual basis is assumed to be the same as the mix of supplies on the day of maximum day. It is recognized that SCWA may choose at times to take a different operational approach. The annual supply capacity and use of supply is determined by assuming that the annual average day capacity or use is 50 percent of the capacity or use on the day of maximum demand. For example, a water supply capacity of 50 mgd equates to an annual average day capacity of 25 mgd or an annual capacity of 28,000 ac-ft/yr.

The actual annual use of supplies could differ from the values presented in this section if SCWA took an operational approach that would result in the annual mix of supplies being different than the mix of supplies used during the day of maximum demand. For example, in a dry year groundwater could be used to meet all of the demands in the winter, spring, and fall months. This would result in less surface water and more groundwater being used annually than what is presented in this section. Similarly, in a wet year surface water could be used to meet all demands in the winter, spring, and fall months. This would result in less groundwater and more surface water being used annually than what is presented in this section.

As described in Section 5.1, the remediated groundwater is included in the annual surface water values since it is conveyed through the surface water facilities. The annual groundwater amounts are only for the wells owned and operated by SCWA and excludes the groundwater remediation extraction.

Table 5-2 presents the annual supply to demand comparison for a normal climate year. Table 5-3 presents the annual supply to demand comparison for a single dry year and Table 5-4 presents the comparison for a multiple dry year. The presented supply values are the supplies available to Zone 40 assuming there are no facility supply capacity constraints. The facility improvements needed to expand existing supply capacity are presented in Section 6. Projections of the use of each supply source that consider supply facility capacity constraints for each service area for normal and dry years are presented in Appendix I. Figure 5-4 presents the projected use of water supplies by phase and climate year type.

As can be seen in Tables 5-2, 5-3, and 5-4, as well as in Appendix I, the total water supply is greater than the projected demands. This analysis verifies the sufficiency of the water supply to supply buildout water demands.

Table 5-2. Supply and Demand Comparison-Normal Year, ac-ft/yr - Cumulative

	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Supplies, no facility constraints									
US Bureau of Reclamation-CVP supply	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
Appropriative water [(a)]	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000
City of Sacramento American River POU water rights	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300
Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
Groundwater	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
Supply total	185,500	185,500	185,500	185,500	185,500	185,500	185,500	187,100	187,100
Demand	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
Difference	146,800	140,000	131,600	122,700	113,700	104,600	95,100	86,800	84,600

[(a)] *Only 35,000 ac-ft/yr assumed to be available without the construction of seasonal storage, as described in Section 4.2.2.*

Table 5-3. Supply and Demand Comparison-Single Dry Year - Cumulative, ac-ft/yr									
	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Supplies, no facility constraints									
US Bureau of Reclamation-CVP supply allocation	11,300	16,000	13,100	14,600	16,800	19,200	21,800	22,500	22,500
Appropriative water									
City of Sacramento American River POU water rights									
Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
Groundwater	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
Supply total	101,500	106,200	103,300	104,800	107,000	109,400	112,000	114,300	114,300
Demand	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
Difference	62,800	60,700	49,400	42,000	35,200	28,500	21,600	14,000	11,800

Table 5-4. Supply and Demand Comparison-Multiple Dry Years - Cumulative, ac-ft/yr										
Year		2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
First year	Supplies									
	US Bureau of Reclamation-CVP supply	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
	Appropriative water [(a)]	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000
	City of Sacramento American River POU water rights	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300
	Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
	Groundwater	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
	Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
	Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Supply totals	185,500	185,500	185,500	185,500	185,500	185,500	185,500	187,100	187,100
	Demand	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
	Difference	146,800	140,000	131,600	122,700	113,700	104,600	95,100	86,800	84,600
Second year	Supplies									
	US Bureau of Reclamation-CVP supply	17,000	24,000	19,700	21,900	25,100	28,800	32,600	33,800	33,800
	Appropriative water	-	-	-	-	-	-	-	-	-
	City of Sacramento American River POU water rights	-	-	-	-	-	-	-	-	-
	Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
	Groundwater	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
	Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
	Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Supply totals	107,200	114,200	109,900	112,100	115,300	119,000	122,800	125,600	125,600
	Demand	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
	Difference	68,500	68,700	56,000	49,300	43,500	38,100	32,400	25,300	23,100
Third year	Supplies									
	US Bureau of Reclamation-CVP supply	11,300	16,000	13,100	14,600	16,800	19,200	21,800	22,500	22,500
	Appropriative water	-	-	-	-	-	-	-	-	-
	City of Sacramento American River POU water rights	-	-	-	-	-	-	-	-	-
	Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
	Groundwater	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
	Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
	Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Supply totals	101,500	106,200	103,300	104,800	107,000	109,400	112,000	114,300	114,300
	Demand	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
	Difference	62,800	60,700	49,400	42,000	35,200	28,500	21,600	14,000	11,800

[(a)] *Only 35,000 ac-ft/yr assumed to be available without the construction of seasonal storage, as described in Section 4.2.2.*

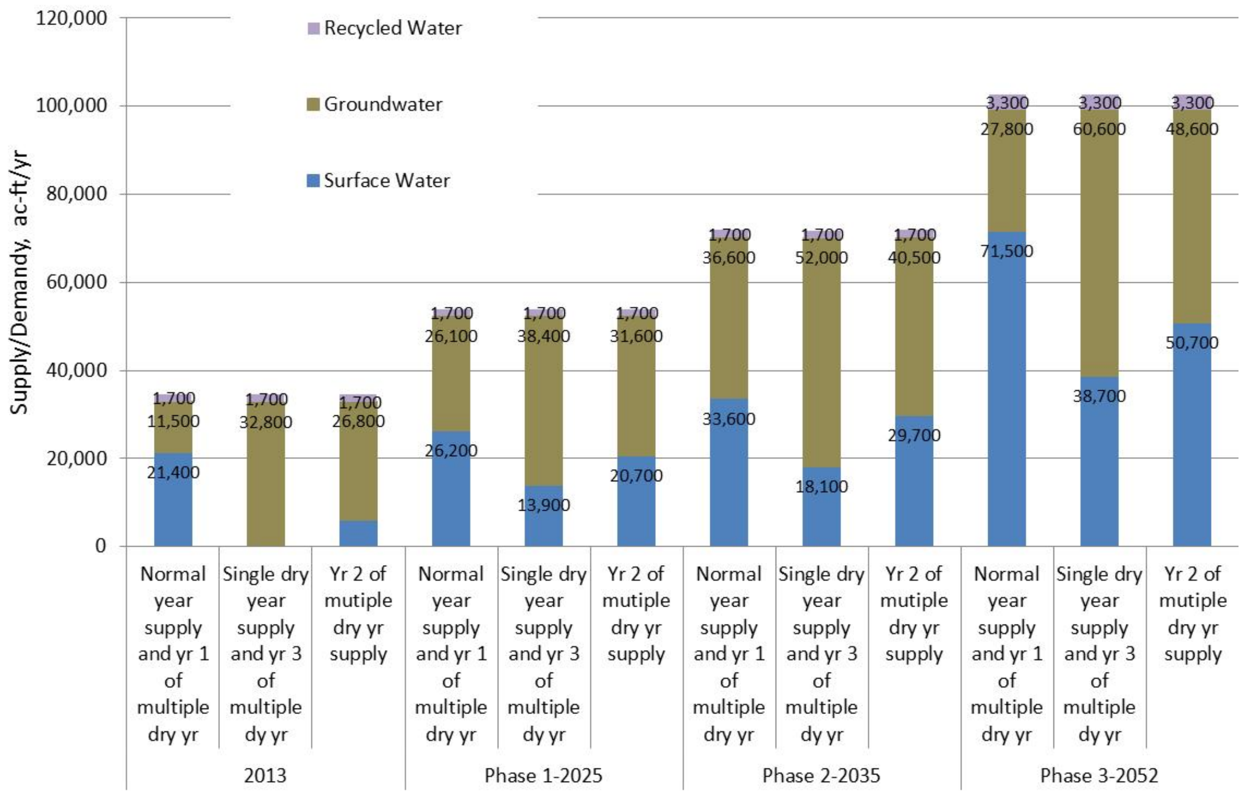


Figure 5-4. Zone 40 Annual Use of Water Supplies by Phase and Climate Year Type

5.3 Conjunctive Use Metrics

The sizing and timing of the construction of the surface water and groundwater supply and conveyance facilities are done to provide SCWA with flexibility to maximize the use of surface water and minimize the use of groundwater in wet and average climate years and to significantly reduce the use of surface water in dry years while still meeting the demands by increasing the use of the groundwater supply. The identified supply facilities should not have excessive over capacity that is not utilized. Table I-5 in Appendix I presents several key conjunctive use metrics for Zone 40.

As shown in Table I-5, the provided surface water and groundwater supply capacities each are less than 100 percent of the demand by the end of Phase 1. While a conjunctive use system can have the capacity constructed where either surface water or groundwater could each solely supply the demand, it is typically not cost effective to provide 100 percent supply redundancy. Surface water use in wet/average years exceeds 50 percent of the demand, and most of the surface water supply capacity is utilized. In dry years surface water use is less than half of the surface water use in wet/average years with most of the groundwater capacity being utilized.

5.4 Storage and Pumping Station Capacity Evaluation

This section presents the storage analysis for each of the service areas that establishes the sizing and timing of future water storage facilities. Since it is not cost effective to size groundwater and surface water supply facilities to supply demands that occur above the maximum day demand rate, water storage is used to supply these short term demands. The short term demands that can last for a few hours are the peak hour demands and fire flow demands.

Since Zone 40 does not have high enough terrain to locate tanks that can provide adequate pressure with gravity flow, ground level tanks must be used in conjunction with pump stations to pump the stored water into the distribution system. The use of elevated storage tanks is typically not cost effective in the larger storage volumes required for Zone 40. The storage evaluation has two elements, consisting of the storage volume and pump station capacity.

1. Storage Volume

The required minimum storage volume is the sum of the following three components:

Equalization Storage. Water is provided for equalization storage to meet the increment of peak demands that exceed the maximum day demand. Equalization storage is assumed to be 20 percent of the maximum day demand.

Emergency Storage. Volume is also required for emergency supplies in the event normal supplies are not available. Emergency storage is assumed to be 1/3 of the average day demand. Many water agencies have criteria to provide greater amounts of emergency storage such as one average day demand. However, since SCWA can utilize the underlying groundwater basin to provide additional volume, the sizing assumption is reasonable.

Fire Flow Storage. Water is stored to provide fire flow. Fire flow storage is assumed as the volume for two fires for each service area, with each fire requiring 3,000 gpm for 3 hours. SCWA also has storage provided by the groundwater basin that can provide a large volume of water. Some building types can have fire flow requirements that are higher. The assumption of having fire storage for two simultaneous fires in each service area provides enough storage for one larger fire flow rate or longer duration fire flow.

2. Pump Station Capacity

Pump stations must have the capacity to supply peak hour demand. The peak hour demand is estimated using a peak hour factor of 2.0 applied to the maximum day demand. There are two situations in Zone 40 that govern the sizing of the pump stations that are used with storage tanks. A pump station that pumps from a standalone storage tank can use its entire pumping capacity to draw water from storage. A pump station that pumps from a tank that is supplied by a GWTP or a SWTP must be sized large enough to be able to pump the supply from both the GWTP and from the storage facility. Only the portion of the pump station capacity that is larger than the GWTP or SWTP capacity is considered to be able to utilize the stored water. Both situations are considered in the storage pump station evaluation.

In situations where a GWTP or SWTP has surplus maximum day capacity, some of that surplus could be used to help supply demands that are greater than the average rate on the maximum demand day. In these types of situations, the required pump station capacity to meet peak hour demand would be less than presented in this analysis.

Table 5-5 and 5-6 present a summary comparison of the planned to required storage volume and pumping station capacities. As shown in Tables 5-5 and 5-6, the planned storage facilities provide more than the required storage volumes and pump station capacities. The detailed storage evaluation tables for each pressure zone are presented in Appendix I. There are opportunities to delay or downsize some of the planned facilities. The SSA has a deficit in peak hour pumping capacity that will continue in Phases 1 and 2. The CSA has a surplus of peak hour pumping and storage capacity that is used to help supply peak hour demands in the SSA. SCWA staff has verified by water system modeling that the pipelines that interconnect the CSA with the SSA have the capacity to convey peak hour supply to the SSA.

Table 5-5. Zone 40 Storage Capacity Evaluation Summary- Cumulative

	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2052)
Provided storage volume, MG				
Existing	42.2	42.2	42.2	42.2
Future	0.0	13.5	17.5	36.0
Total	42.2	55.7	59.7	78.2
Required storage volume, MG				
Equalization	12.3	19.0	25.2	32.9
Fire	3.8	3.8	3.8	3.8
Emergency	10.3	15.8	21.0	27.4
Total	26.4	38.6	50.1	64.2
Difference (provided minus required)	15.8	17.1	9.6	14.0

Table 5-6. Zone 40 Pump Station Capacity Evaluation Summary- Cumulative

	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2052)
Provided pump station capacity from storage, mgd				
Existing	107.6	118.2	112.3	101.3
Future	0.0	20.5	32.6	88.1
Total	107.6	138.7	144.9	189.4
Required pump station capacity from storage, mgd	65.8	96.6	126.2	164.6
Difference (provided minus required)	41.8	42.1	18.7	24.8

5.5 Additional Water Supply Capacity Information

This section presents additional water supply information to supplement the information provided in the previous sections.

5.5.1 Maximum Day Demand Peaking Factor

As stated in Section 5.1, the maximum day to average annual day demand peaking factor is assumed to be 2.0 for the purposes of this plan. Table 5-7 presents the historical maximum month to average annual month peaking factor. Table 5-7 also presents an estimated historical maximum day demand peaking factor assuming that the maximum day demand is 10 percent greater than the maximum month demand. As can be seen in Table 5-7, the estimated average maximum day factor is 1.8, but it has been as high as 1.96 since 2007.

Table 5-7. Maximum Day Demand Peaking Factor

Year	Maximum month demand factor	Estimated maximum day demand factor
2007	1.52	1.67
2008	1.57	1.72
2009	1.66	1.82
2010	1.71	1.89
2011	1.78	1.96
2012	1.66	1.83
2013	1.64	1.80
2014	1.53	1.68
Median	1.65	1.81
Average	1.63	1.80

5.5.2 Spare Capacity

The spare capacities available in the existing supply facilities were quantified based on the analysis of the maximum day capacities of water supply facilities in Section 5.1 and capacities of the storage and pumping facilities in Section 5.4. The spare capacities are of the supply and storage facilities are presented aggregated for each of the three service areas.

Table 5-8 presents the existing supply capacities, use of supply in 2013 on the maximum demand day assuming wet/average years and dry years, and the spare or unused capacities of the surface water and groundwater supply facilities for each service area. As can be seen in Table 5-8, there is spare capacity in both the groundwater and surface water supply facilities. The Vineyard SWTP has 46 percent of its capacity available. The SSA groundwater supply facilities have very limited spare capacity available in a dry year.

Table 5-9 evaluates the spare volumes in the existing storage facilities compared to the required volumes using 2013 demands to determine required volume. There is spare storage volume available in the CSA, but the spare storage volumes are more limited in the NSA main pressure zone and SSA, as shown in Table 5-9.

Table 5-10 presents the spare capacities of the pumping stations at the storage facilities. The SSA does not have any spare pumping capacity, and as described in Section 5.4, the SSA relies on getting some of its peak hour supply from storage and pumping provided from the CSA.

Table 5-8. Maximum Day Supply Spare Capacity Evaluation					
Service area and supply facility	Existing supply capacity, mgd	Use of supply on 2013 maximum day, mgd		Spare capacity	
		Average/wet years	Dry years	mgd	% of total capacity
NSA Existing supply capacity					
Mather Housing GWTP	6.0				
Anatolia GWTP	6.5				
Total NSA groundwater	12.5	7.4	7.4	5.1	41%
CSA Existing supply capacity					
Calvine Meadows GWTP	5.0				
East Elk Grove GWTP	6.5				
East Park GWTP	2.9				
Waterman GWTP	8.6				
Wildhawk GWTP	7.5				
CSA direct feed wells	3.9				
Total CSA groundwater	34.4	0.0	27.0	7.4	22%
Vineyard Surface SWTP	50.0	27.0	0.0	23.0	46%
SSA Existing supply capacity					
Big Horn GWTP	4.5				
Dwight Road GWTP	2.1				
Lakeside GWTP	6.5				
Poppy Ridge GWTP	6.5				
SSA direct feed wells	6.0				
Total SSA groundwater	25.6	13.0	24.1	1.5	6%
Franklin Intertie to City	11.1	11.1	0.0	0.0	0%
SSA Recycled Water	3.0	3.0	3.0	0.0	0%
Total SSA	39.7	27.1	27.1	1.5	4%
Total Zone 40	136.6	61.5	61.5	37.0	27%

Table 5-9. Storage Volume Spare Capacity Evaluation

Service area and supply facility	Existing volume, MG	2013 Required volume, MG	Spare capacity, MG	Spare capacity, % of total
NSA Upper Zone				
North Douglas	3.0	0.5	2.5	83%
NSA Main Zone				
Mather Housing GWTP	0.5			
Anatolia GWTP	4.0			
Mather 1 Main Base	1.0			
Mather 2	0.3			
subtotal	5.8	3.8	2.0	34%
CSA				
Calvine Meadows GWTP	0.4			
East Elk Grove GWTP	3.5			
East Park GWTP	0.5			
Waterman GWTP	7.0			
Wildhawk GWTP	3.0			
Vineyard SWTP equalization in clearwell	6.0			
subtotal	20.4	11.0	9.4	46%
SSA				
Big Horn GWTP	2.0			
Dwight Road GWTP	7.0			
Lakeside GWTP	0.5			
Poppy Ridge GWTP	3.5			
subtotal	13.0	11.0	2.0	15%

Table 5-10. Storage Pump Station Spare Capacity Evaluation								
Service area and storage facility	Existing Pump Station Capacity, mgd			Required pumping capacity, mgd			Spare capacity	
	Peak hour increment	WTP capacity increment	Total	Peak hour increment	Max day increment	Total	mgd	% of total capacity
NSA Upper Zone								
North Douglas	19.4		19.4	4.3	0	4.3	15.1	78%
NSA Main Zone								
Mather Housing GWTP	2.2	3.0	5.2					
Anatolia GWTP/Storage [(a)]	4.7	6.5	11.2					
Mather 1 Main Base	5.2		5.2					
Mather 2	2.0		2.0					
subtotal	14.1	9.5	23.6	7.4	9.5	16.9	6.7	28%
CSA								
Calvine Meadows GWTP	3.8	5.0	8.8					
East Elk Grove GWTP	6.5	6.5	13.0					
East Park GWTP	0.6	2.9	3.5					
Waterman GWTP	17.3	8.6	25.9					
Wildhawk GWTP	11.5	7.5	19.0					
Vineyard SWTP pump station								
subtotal	39.6	30.5	70.1	27.0	30.5	57.5	12.6	18%
SSA								
Big Horn GWTP	4.1	4.5	8.6					
Dwight Road GWTP	12.7	13.2	25.9					
Lakeside GWTP	0.7	6.5	7.2					
Poppy Ridge GWTP	3.9	6.5	10.4					
subtotal	21.4	30.7	52.1	27.1	30.7	57.8	-5.7	-11%

5.5.3 Water Storage and Pumping Facilities

The storage volumes and pumping capacities for each storage facility were compared for each existing and planned storage facility. This comparison is useful to verify if the storage volume and pumping capacity for each storage facility is reasonable and balanced. For a given storage volume, it is typical that the pump station is sized large enough to be able to empty the storage within several hours. A pump station that can empty a tank in one hour is likely too large, and one that takes 12 or more hours is likely too small. The solution is to modify the storage volume and/or pump station capacity for each facility to achieve the optimal balance.

Table 5-11 presents the storage volume and pump station capacity comparison for the existing storage facilities and Table 5-12 presents the information for the future storage facilities. The time to empty storage in hours is computed for each storage facility. The storage volume and pump station sizes of each of the planned future storage facilities were mostly defined by SCWA staff. It is assumed that the pump station capacities represent reliable capacity and that an additional standby pump is included in existing facilities and will be included in future facilities.

Based on the evaluation, it appears that the several of the existing and planned storage facilities have pump stations with capacities that are either too small or too large for the provided storage volumes. This analysis of storage versus pump station capacity can be used in the future to finalize the sizing of the future water storage volumes and associated pump station capacities.

The overall Zone 40 buildout storage volume requirement is 67.9 MG and 202.5 mgd for the increment of pumping capacity that can draw down storage. This works out to an overall average of 8 hours to empty storage. Storage facilities should only significantly vary from this overall average if there is a specific reason for it. There are some instances where the pump station capacities used for the hydraulic modeling described in Section 5.6 differ from the future capacities presented elsewhere in this report. These discrepancies can be resolved in the next update of this document.

Table 5-11. Evaluation of Time to Empty Storage for Existing Facilities

Name	Treatment or feed capacity, mgd	Service area	Storage, MG	Pumps, no	Capacity, ea, gpm	Pump station capacity, mgd	Pumping capacity for pk hr increment	Time to empty storage, hrs
Supply Facilities								
Mather Housing GWTP (50% to ps)	3.0	NSA	0.5	3	1,200	5.2	2.2	5.5
Anatolia GWTP	6.5	NSA	4.0	3	2,600	11.2	4.7	20.3
Calvine Meadows GWTP	5.0	CSA	0.35	2	750	8.8	3.8	2.2
East Elk Grove GWTP	6.5	CSA	3.5	3	3,000	13.0	6.5	13.0
East Park GWTP	2.9	CSA	0.5	1	2,400	3.5	0.6	21.6
Waterman GWTP	8.6	CSA	7.0	6	3,000	25.9	17.3	9.7
Wildhawk GWTP	7.5	CSA	3.0	6	2,200	19.0	11.5	6.3
Big Horn GWTP	4.5	SSA	2.0	3	2,000	8.6	4.1	11.6
Dwight Road GWTP	11.1	SSA	7.0	6	3,000	25.9	14.8	11.3
Lakeside GWTP	6.5	SSA	0.5	2	2,500	7.2	0.7	17.1
Poppy Ridge GWTP	6.5	SSA	3.5	3	2,400	10.4	3.9	21.7
Standalone Storage								
Mather 1 storage		NSA	1.0	3	1,200	5.2	5.2	4.6
North Douglas storage		NSA	3.0	6	2,250	19.4	19.4	3.7

Table 5-12. Evaluation of Time to Empty Storage for Future Facilities at Buildout								
Name	Treatment or feed Capacity MGD	Service area	Storage, MG	Pumps, no	Capacity, ea, gpm	Pump station capacity, mgd	Pumping capacity for pk hr increment, mgd	Time to empty storage, hrs
New Facilities								
West Jackson GWTP	18.0	CSA	4.0	6	2,500	21.6	3.6	26.7
Bond GWTP	6.5	CSA	0.5	3	2,500	10.8	4.3	2.8
Franklin GWTP	7.0	SSA	2.0	6	2,500	21.6	14.6	3.3
Whitelock GWTP	13.0	SSA	3.0	4	2,500	14.4	1.4	51.4
Expansion Facilities								
Anatolia	16.2		4.0			22.5	6.3	15.2
Calvine Meadows GWTP	0.0	CSA		2	2,500	7.2		
Calvine Meadows GWTP total	5.0	CSA	0.4			16.0	11.0	0.8
East Elk Grove GWTP	6.5	CSA		3	3,000	13.0		
East Elk Grove GWTP total	13.0	CSA	3.5			25.9	12.9	6.5
Big Horn GWTP	6.5	SSA		3	2,000	17.0		
Big Horn GWTP total	11.0	SSA	2.0			25.6	14.6	3.3
Poppy Ridge GWTP	8.5	SSA	3.5	3	2,400	17.0		
Poppy Ridge GWTP total	15.0	SSA	7.0			27.4	12.4	13.6
Standalone Storage								
NSA terminal storage total	46.2	NSA	10.0			64.0	17.8	13.5
Suncreek storage		NSA	3.0	5	2,500	18.0	18.0	4.0
Cordova Hills storage		NSA	3.0	6	2,500	21.6	21.6	3.3
White Rock Rd storage		NSA	3.0	4	2,500	14.4	14.4	5.0
North Vineyard Station storage	19.1	CSA	4.0	6	2,500	21.6	2.5	38.4

5.5.4 Water Supply Flow Schematic

The planned flow of water supplies to Zone 40, the three service areas, and the different pressure zones is relatively complex and difficult to describe solely with text. Therefore, a buildout water supply flow diagram is presented for each service area in Figure 5-5, 5-6, and 5-7 to help better visualize how the water supply system is planned to be configured. The storage tanks and GWTPs shown in the diagrams each include a pump station. The inflow into the storage tanks are depicted for the stand alone tanks. As mentioned elsewhere in this document, the planned water system configurations should be optimized before final design is commenced.

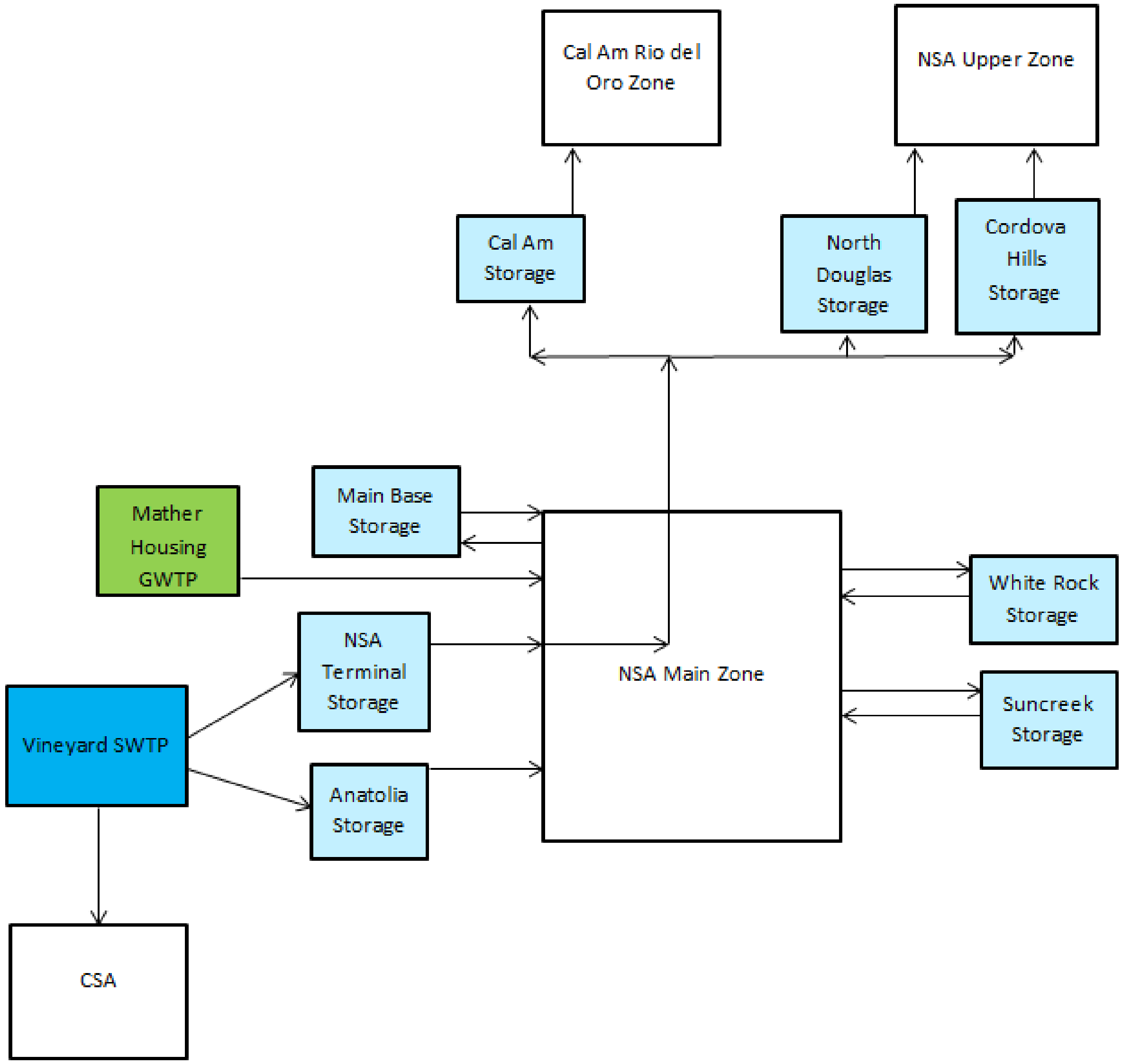


Figure 5-5. NSA Buildout Water Supply Flow Chart

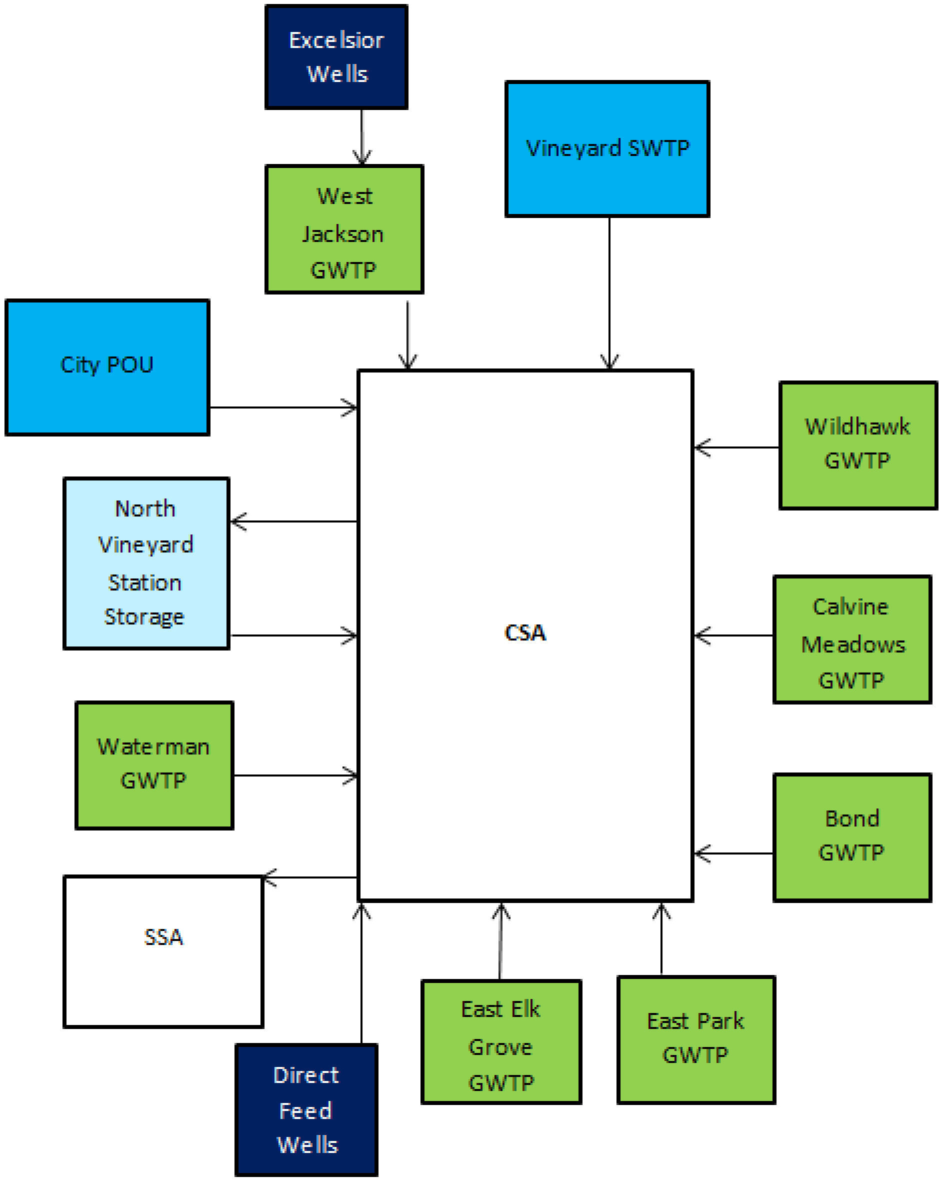


Figure 5-6. CSA Buildout Water Supply Flow Chart

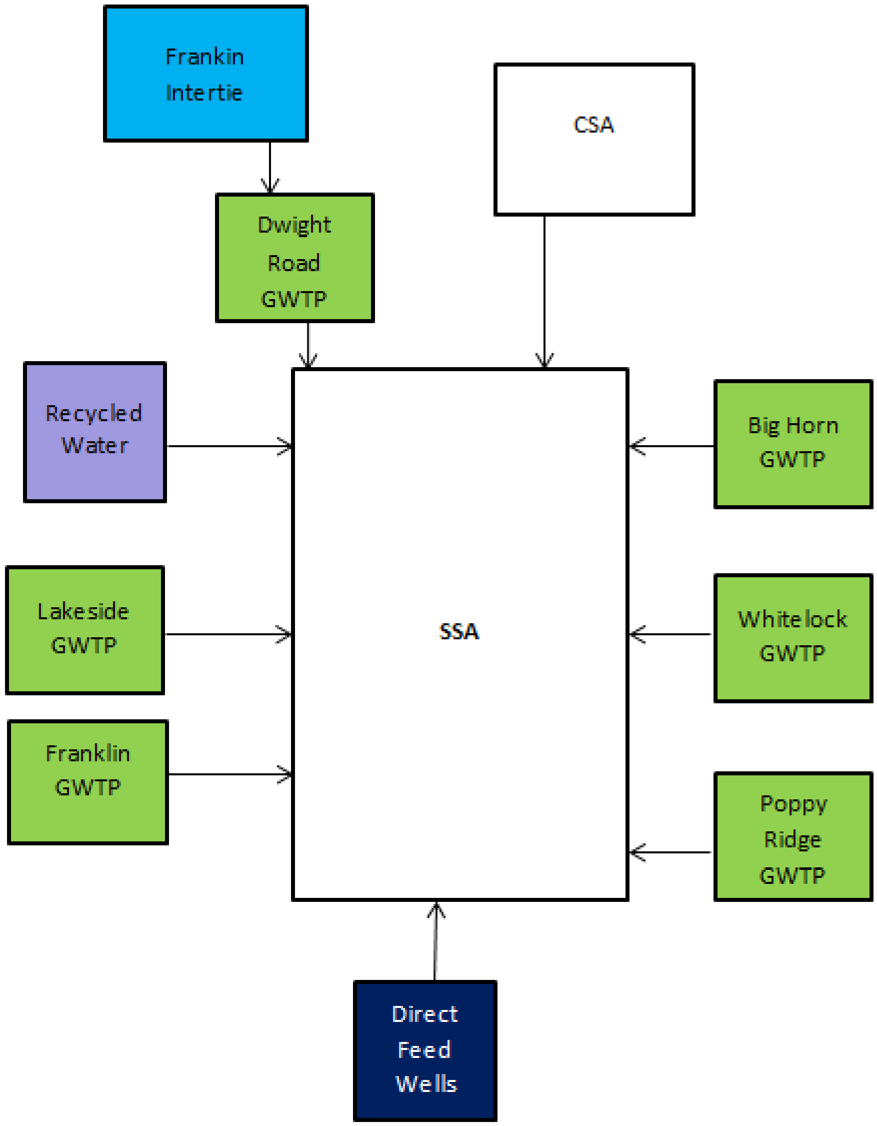


Figure 5-7. SSA Buildout Water Supply Flow Chart

5.6 Hydraulic Model Analysis

The existing and future water system was evaluated by SCWA staff using a hydraulic water system model. The model and analysis is briefly described in this section. A detailed description of the update of the model and the analysis is presented in Appendix G. The model output results are presented in Appendix H.

5.6.1 Modeling Objectives

The water distribution model developed for the Zone 40 WSIP was used to evaluate system performance and to determine the major water facilities requirement at existing, interim (Phase 1 and Phase 2), and build out conditions. The operational settings for groundwater and surface water facilities are developed in the model to provide a general guidance for system operation in order to implement the SCWA's conjunctive use program outlined in the WSMP. Below is a list of modeling objectives:

- Identify water supply facility requirements to meet the water demands for Zone 40. The water demand is updated based on the following information: (1) most recent land use information, (2) the updated unit water demand factors developed in Chapter 3, (3) land use information for proposed development.
- Identify system constraints in the existing water system. The Vineyard SWTP is located in the northeast corner of the CSA. There are system constrains that limit the surface water from the Vineyard SWTP from meeting the water demand in the existing Zone 40 system. These constraints could be: (1) disconnected or undersized transmission mains; or (2) planned transmission mains not yet installed.
- Evaluate the timing of new major facilities to meet the demand growth. The timing of water facilities is typically dictated by the water demand growth or by the need to provide water service to a new development located in a specific area. Although it is very difficult to determine where and when the new growth will occur and at what rate, many times it is estimated based on the best information available such as the status of each proposed development.
- Develop operational settings for groundwater and surface water facilities for max day/peak hour demand under wet/dry conditions in each phase. The surface water supply availability for Zone 40 varies with hydrological conditions. The conjunctive use program outlined in the Zone 40 WSMP calls for maximizing the use of surface water in wet years, and using more groundwater in dry years when the availability of surface water is greatly reduced. The operation controls of groundwater and surface water facilities should be adjusted accordingly to reflect the change in use of surface water and groundwater under different scenarios.
- Evaluate pressure zone delineation. With the addition of new development areas, the water distribution system will be expanded and even reconfigured such as the pressure zone delineation. The goal is to minimize the number of pressure zones for a more effective and robust water distribution system.

5.6.2 Analysis Criteria

This section describes the criteria used to evaluate the Zone 40 water distribution system. These criteria are set forth and consistent with the 2006 County Improvement Standards.

5.6.2.1 Water Supply Capacity Criteria

The water supply capacity criteria are summarized in Table 5-13.

Table 5-13. Water Supply Capacity Criteria

Criteria	Value/description	Reference/description
Water supply capacity	Meet maximum day demand at all times	The capacity of water production (water treatment plants, direct feed wells, and interties) should be equal to or greater than system max day demand.
Water supply reliability	Each pressure zone is capable of meeting MDD with the highest-capacity source offline.	Zone 40 is a conjunctive use system that has the flexibility of using groundwater and surface water conjunctively to meet the water demand based on hydrological condition. However, the NSA will be predominantly served by the Vineyard SWTP in the future. If the Vineyard SWTP is offline, it will be very challenging to meet the max day demand of the NSA. Possible solutions include: 1) water rationing; 2) make groundwater from the CSA system fill the clear well, and then delivered to the NSA.

5.6.2.2 Operating Goals

Table 5-14 lists the operational goals for transmission mains (>=16 inches in diameter) and distribution mains (<16 inches in diameter).

Table 5-14. Operating Goals for T-mains and D-mains

Operating goals		Value/description	Reference/description
Minimum size		T-main: 16 inches D-main: 6 inches	Most of 6-inch D-mains are existing pipes. Future D-mains have a minimum diameter of 8 inches. The minimum size for T-mains is 16 inches in diameter. Sufficient size to carry maximum day plus fire flow or peak hour demands
System pressure operating goals	T-Mains	Minimum: 40 psi, at peak hour Maximum: 75 psi Minimum: 25, max day plus fire flow	These are operating goals. There are occasions when pressure could be higher than the maximum pressure goal.
	D-Mains	Minimum: 35 psi, at peak hour Maximum: 65 psi Minimum: 20, max day plus fire flow, at fire hydrant	These are operating goals. There are occasions when pressure could be higher than the maximum pressure goal.
Maximum velocity		Normal Condition: 5 ft/s Peak hour: 7 ft/s Fire flow: 10 ft/s	
Unit headloss		3 to 5 ft/1,000 ft	

5.6.2.1 Demand Peaking Factors

The maximum day demand scenario and the peak hour demand scenario are of the most interest for Zone 40 water distribution system modeling. The maximum day demand scenario was used to evaluate the adequacy of water supply production capacity and to size large conveyance pipes (eg. the NSA Pipeline and the POU water pipeline). The peak hour demand scenario was used to evaluate the capacity of booster pumps and to size distribution pipelines.

Peaking factors are multipliers to convert between average day demand, maximum day demand, and peak hour demand. Average day demand is average annual demand spreading evenly over 365 days. The peaking factor for maximum day demand over average day demand is 2.0, and the peak hour demand over maximum day demand is 2.0, as presented in Table 5-15.

Table 5-15. Peaking Factors

Demand category	Relative to	Peaking factor
Maximum day demand	Average day demand	2.0
Peak hour demand	Max day demand	2.0

5.6.3 Water Distribution Model Update

This section briefly describes the water distribution model update. More detailed information on the model update is presented in Appendix G.

5.6.3.1 Background

The water distribution model for Zone 40 WSIP is a planning model used for the evaluation of the future water distribution system to meet the projected water demand growth. The model incorporates the existing water system, and adds to it the future water supply facilities, thus developing a model that is capable of evaluating the water system in existing, buildout, and phased conditions.

The water distribution model for Zone 40 has gone through a couple of major updates in the past. The original model was developed by SCWA staff using Cybernet. The model was updated as part of the 2006 WSIP development using H2ONET, which is an advanced AutoCAD based water distribution modeling platform developed by Innovyze. In this WSIP update, the Zone 40 water distribution model is updated using InfoWater (also developed by Innovyze), taking advantage of the state-of-art technology of integrating water distribution modeling and GIS modeling. InfoWater is very helpful because: 1) most land use maps are available in GIS format; 2) all facilities in the model are geo-referenced, and pipes are aligned with roads/streets; 3) maps of modeling inputs and outputs can be easily generated within one place.

The elevation for each junction/node was read automatically into the model from the ground elevation contour map using Infowater's GIS Gateway module. The module is able to extract, interpolate, and assign an elevation value to all junctions/nodes. Figure 5-8 shows the map of elevations for the Zone 40 water distribution system.

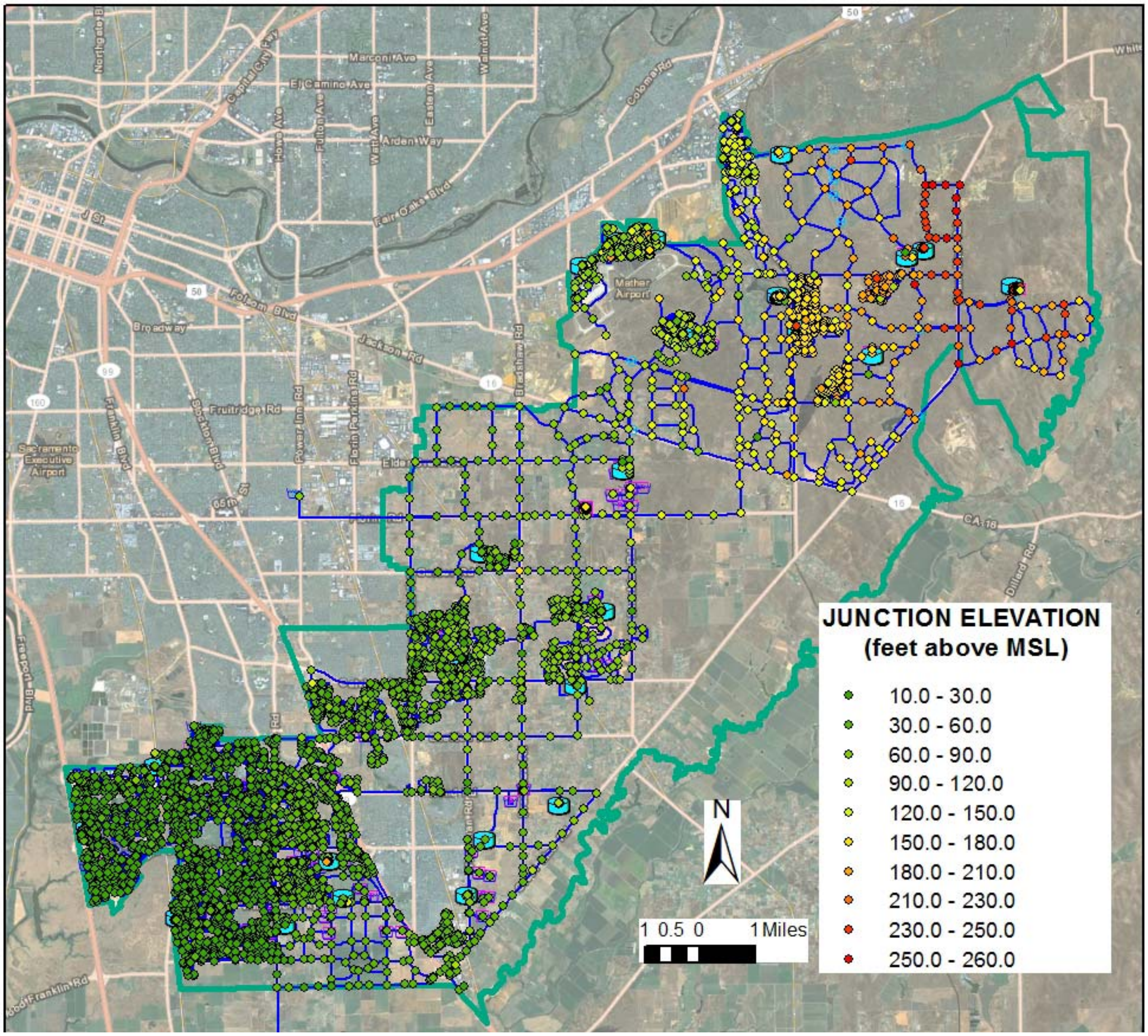


Figure 5-8. Ground Elevation Map for Zone 40 Water Distribution System

5.6.3.2 Pressure Zones

There are three pressure zones in the buildout Zone 40 water distribution system including two pressure zones in the NSA due to its larger variation in ground elevation, and one pressure zone for the CSA and the SSA due to its flat topography. The two pressure zones in the NSA are identified as the NSA Main Pressure Zone and the NSA Upper Pressure Zone. The two pressure zones border along Americanos Boulevard south of Douglas Road. The separation line between the two pressure zones north of Douglas Road is the eastern property boundaries of Rio del Oro. The NSA Upper Pressure Zone occupies the areas east of Americanos Blvd where ground elevations are higher including North Douglas, Cordova Hills, east part of Sun Creek, Douglas 103, Grantline 208, and the remaining area. The NSA Main Pressure Zone refers to the areas west of the NSA Upper Pressure Zone with lower ground elevations. The areas in the NSA Main Pressure Zone include Sunridge, Sun Creek, Arboretum, Mather South, New Bridge, Jackson Township, and Mather Base/Sunrise Corridor. Figure 5-9 shows the pressure zone separation map at buildout.

This WSIP update consolidates the number of pressure zones previously planned in the 2006 WSIP due to: 1) service area expansion; 2) distribution system reconfiguration; and 3) operating settings adjustments. The consolidation of pressure zones simplifies the system operation and maintenance.

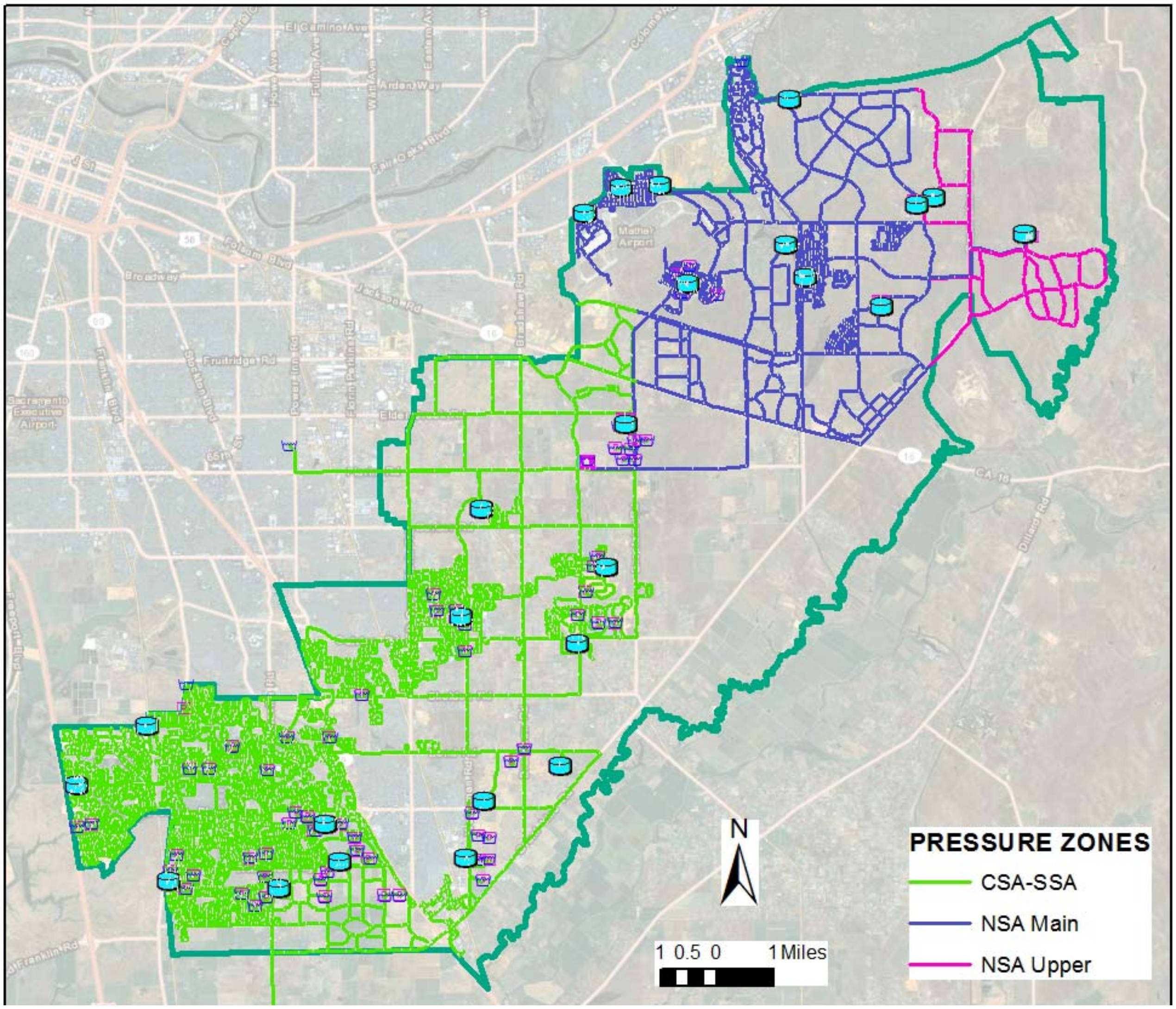


Figure 5-9. Pressure Zone Separation in the Buildout Zone 40 Water Distribution System

5.6.4 Water System Evaluation

The hydraulic model was used to evaluate the existing, Phase 1, Phase 2, and buildout water systems with maximum day and peak hour demands. Both the wet and dry climate conditions were considered. The water supply flows from each supply source for each scenario are presented in Appendix G. The resulting minimum pressures, maximum velocities, and unit headlosses under each of the scenarios in each of the service areas are graphically presented in Appendix H, as well as the pump station information.

Section 6

Water System Facilities & Capital Improvement Program

This section describes the water system facilities needed to serve Zone 40, develops the costs, and presents the Zone 40 CIP for Phases 1, 2, and 3. A facility dependency matrix is also presented.

6.1 Needed Water System Facilities

The water system facilities needed to serve Zone 40 through buildout are defined in this section. The water supply facilities are sized to provide the maximum day surface water and groundwater supply capacities developed in Section 5. The storage tank and pumping station facilities are defined based on the storage evaluation presented in Section 5.4. The water supply, storage, pump station, and pipeline improvements have been identified by SCWA staff and are defined based on water system modeling performed by SCWA staff that is documented in the WSIP.

The sizing and timing of the water supply facilities are developed based on several general conjunctive use guidelines, as described below.

1. The groundwater supply should be able to provide enough maximum day supply in dry years to mitigate the reductions in surface water supply that could occur. The guideline is to be able to provide enough groundwater supply assuming a surface water supply that is reduced in dry years by up to approximately 50 percent of its maximum day use in wet/average years.
2. The surface water supply should be able to supply a significant portion of the maximum day demand in a wet/average year while only using a portion of the groundwater supply capacity. The guideline is to provide enough surface water supply capacity to be able to supply approximately 50 percent or more of the maximum day demand.

The future water system facilities are identified and grouped based on the time period when they would be needed. As described in Section 5.1, the period from January 2015 to December 2025 is considered Phase 1, January 2026 to December 2035 is considered Phase 2, and Phase 3 is the period from January 2036 through buildout.

Each of the planned facilities is identified by a CIP project identification number. Groundwater treatment projects are identified as GWTP followed by a number. Groundwater well projects are identified as GW. Surface water projects are identified as SW, storage projects as S, and pipeline projects as P.

6.1.1 Phase 1 (2016 to 2025)

The water system facilities needed to serve the Phase 1 demands are described for the NSA, CSA, and SSA.

6.1.1.1 North Service Area

The NSA is currently supplied by groundwater from existing groundwater treatment plants (the Anatolia GWTP and the Mather Housing GWTP). There is also a small portion of surface water supply from the Mercantile intertie with GSWC. The Mercantile intertie has shown minimal delivery over the past few years, and it is planned for closure in the future serving only as an emergency backup supply. The existing groundwater facilities have the capacity to meet the maximum day demand, with the Anatolia GWTP being the predominant water supply source and a smaller portion of groundwater from the Mather Housing GWTP. Surface water from the existing Vineyard SWTP cannot be delivered to the NSA due to lack of existing pipelines.

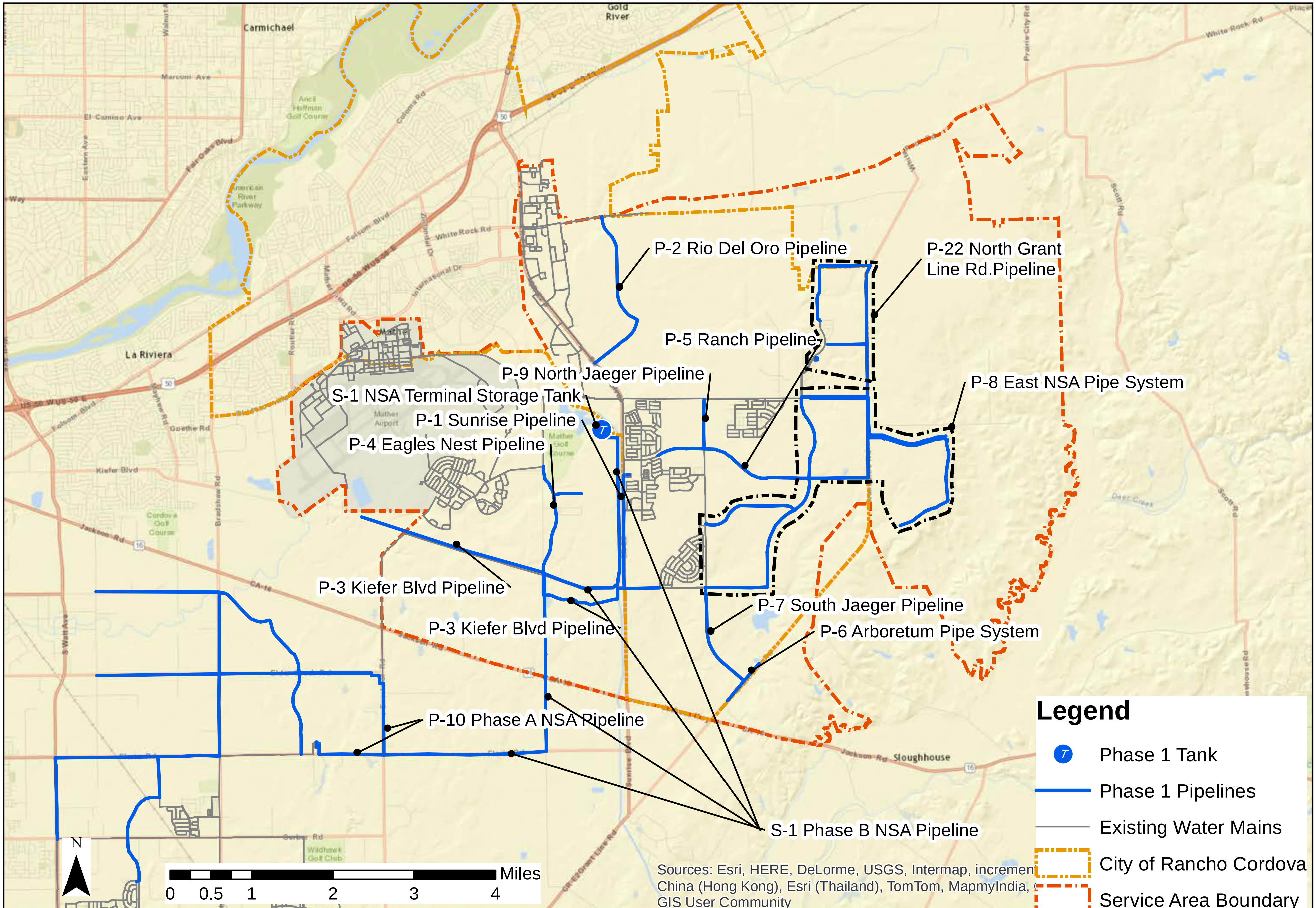
Currently, the Anatolia GWTP has a treatment capacity of 6.5 mgd treating groundwater pumped from the Excelsior well field and conveyed through a seven-mile 30-inch Excelsior raw water pipeline. There are three existing wells at the Excelsior Well Field, but they are getting close to having not enough production capacity. As water demand continues to grow in the NSA, new water supply capacity will be needed to keep up with the demand growth. Two immediate options are available: 1) drill new wells at the Excelsior well field and expand the Anatolia GWTP; 2) construct the Phase A NSA Pipeline to deliver treated water from the Vineyard SWTP to the NSA. The Phase A NSA Pipeline involves converting the existing Excelsior raw water pipeline to convey treated water, in addition to other system modifications.

The Phase A NSA Pipeline option (P-10) was selected by SCWA in order to increase the surface water use in Zone 40 as part of the conjunctive use program. The existing Vineyard SWTP has additional capacity beyond what is needed to supply the CSA's current maximum day demand. The project includes the construction of the segment of the NSA Pipeline (66-inch in diameter) from the Vineyard SWTP to connect to the converted Excelsior raw water pipeline. The treatment unit at the Anatolia GWTP will be disconnected. The Anatolia storage tank will become a terminal storage tank to receive treated water from the Vineyard SWTP via the Phase A NSA Pipeline. The pump station capacity at the Anatolia facility would be expanded as part of P-10 to be able to provide peak hour supply with the supply provided by the Vineyard SWTP. The three existing groundwater wells at the Excelsior Well Field will be put on hiatus and occasionally used to provide groundwater for blending. In the future, the Excelsior well field will pump groundwater to the future West Jackson GWTP (CSA) for treatment located near the Excelsior well field. Once the Phase A NSA Project is completed, surface water can be delivered to the NSA from the Vineyard SWTP up to 11,000 gpm (or 15.8 MGD), which is enough to supply surface water to the NSA for several years until demand grows beyond the capacity of the pipeline.

Once the demand for surface water in the NSA exceeds the capacity of the 30-inch Excelsior pipeline, a new pipeline would be constructed. This new pipeline would be part of the Phase B NSA Project (S-1), which would also include the NSA terminal storage and pumping facility. The Phase B NSA Project (S-1) would provide for conveyance of surface water supply from the Vineyard SWTP to the NSA terminal storage and pumping facility from which the surface water supply would be distributed to the NSA, including peak hour and fire flow needs. The Phase B NSA Pipeline (54-inch in diameter) starts from Florin Road at Excelsior Road, extending east on Florin Road and then turning north in Eagles Nest Road, Kiefer Road, and the west bank of Folsom South Canal, and ultimately ending at the NSA terminal tanks (10 MG) located in Mather South. There may be approaches to optimize the Phase B NSA Project (S-1) by not having all of the Vineyard SWTP surface water supply conveyed to the NSA terminal storage and pumping facility. For example, additional storage facilities could be located in the southern portions of the NSA to be supplied off of either the Phase A or B NSA Project pipelines that would provide the maximum day as well as the peak hour and fire flow supplies for their local areas instead of having to deliver it all from the NSA terminal storage and pumping facility.

During Phase 1, several other pipeline projects would be constructed to deliver water to several areas within the NSA that are likely to experience growth, including the Cordova Hills, Rio del Oro, and Mather South subareas, as well as subareas located in the Sunrise/Douglas region. The locations of the Phase 1 projects in the NSA are shown on Figure 6-1.

P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 9 files\Figure 9-9.pdf



Brown AND Caldwell

DEPARTMENT OF WATER RESOURCES
SACRAMENTO COUNTY
WATER AGENCY

PROJECT	SITE	
148130	**Water System Infrastructure Plan Update**	**Figure 6-1**
DATE	TITLE	
7/30/15	**Phase 1 CIP Projects - NSA - Cumulative**	SCWA-7

6.1.1.2 Central Service Area

The CSA is currently supplied by groundwater (either treated at groundwater treatment plants or directly feed with wellhead disinfection) and surface water from the Vineyard SWTP. The existing capacity of groundwater facilities and of the Vineyard SWTP (50 mgd) each is sufficient to meet CSA's existing water demand. As described in the previous subsection, part of the capacity of Vineyard SWTP will be used to meet the NSA demand after the NSA Pipeline is installed. Furthermore, the capacity of the Vineyard SWTP will be allocated for NSA first because there is limited groundwater supply in the NSA due to groundwater contamination.

During Phase 1, several pipeline projects would be constructed in the CSA to improve the interconnectedness and looping of the transmission system. No new storage facilities are planned for the CSA in Phase 1. The locations of the Phase 1 projects in the CSA are shown on Figure 6-2.

6.1.1.3 South Service Area

The water supply sources for the SSA include groundwater, surface water, and recycled water. Groundwater is produced from the existing groundwater treatment plants (Lakeside GWTP, Poppy Ridge GWTP, and Big Horn GWTP) and several direct feed wells. There are two sources of surface water supply for the SSA. One is from the Franklin Intertie. Through a wholesale agreement between SCWA and the City of Sacramento, the surface water ("Fazio" water) is treated at the City's Sacramento River SWTP, wheeled through the City's distribution system, and finally delivered at the Franklin Intertie to Zone 40. The other surface water source is the Vineyard SWTP. The water from the Vineyard SWTP is supplied to the SSA through three connections between SSA and CSA: Highway 99 at Sheldon Road, Highway 99 at Bond Road, and Highway 99 at Grant Line Road. The water supply for the SSA also consists of a small amount of recycled water.

New groundwater supply facilities would be needed once the maximum day demand for the SSA reaches the existing groundwater and recycled water capacity. The water supply and storage in the SSA would be increased with the expansion of the Poppy Ridge GWTP (GWTP-1). Several pipeline projects would be constructed to deliver water to the Southeast Policy area and improve interconnectivity. The locations of the Phase 1 projects in the SSA are shown on Figure 6-2.

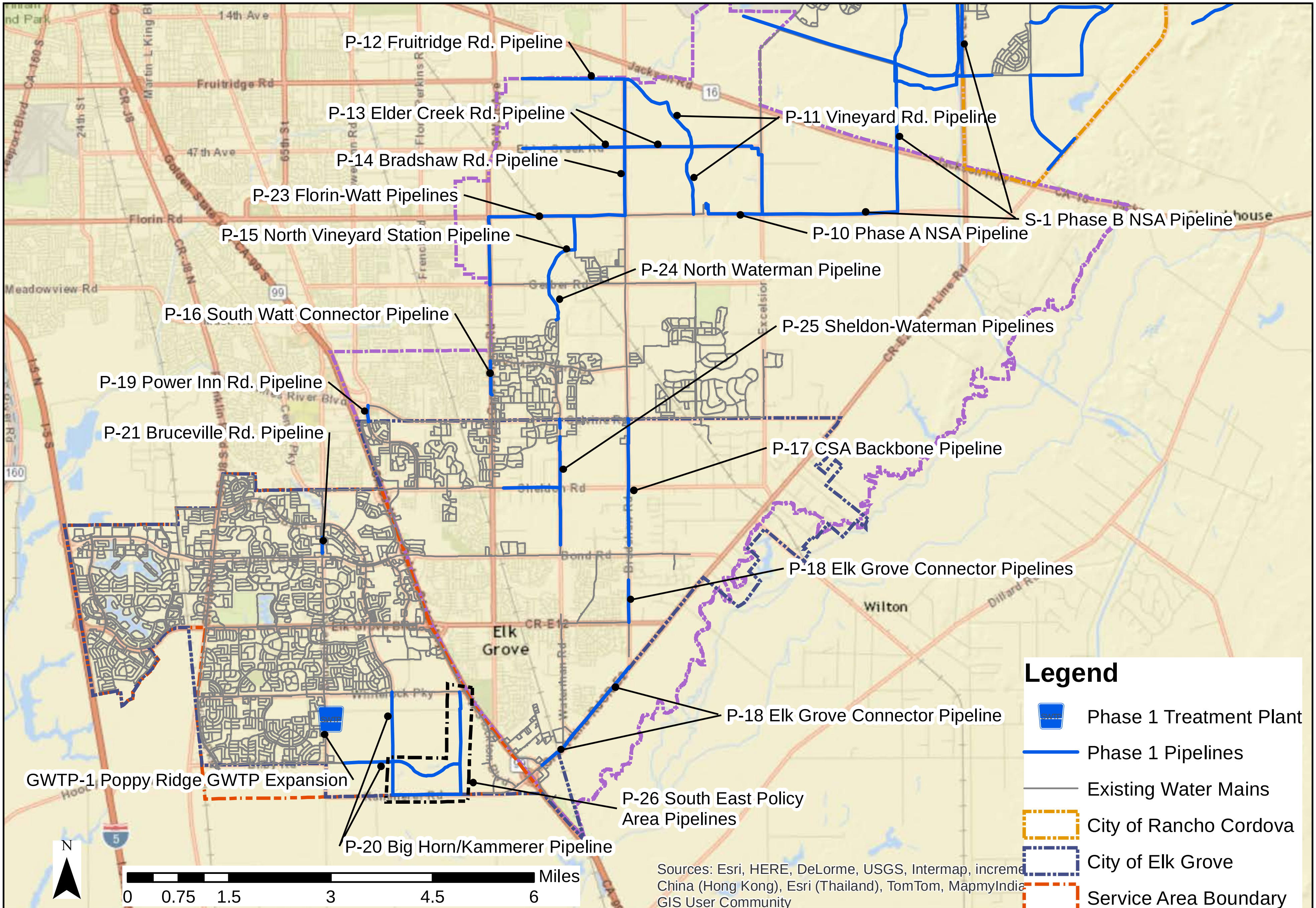
6.1.2 Phase 2 (2026 to 2035)

The water system facilities needed to serve the Phase 2 demands are described for the NSA, CSA, and SSA. The timing for the Phases 2 and 3 pipelines cannot be accurately defined into either Phase 2 or 3 due to the uncertainty about the specific locations and timing of development. Therefore, the pipeline projects for Phases 2 and 3 are not specifically identified by project number.

6.1.2.1 North Service Area

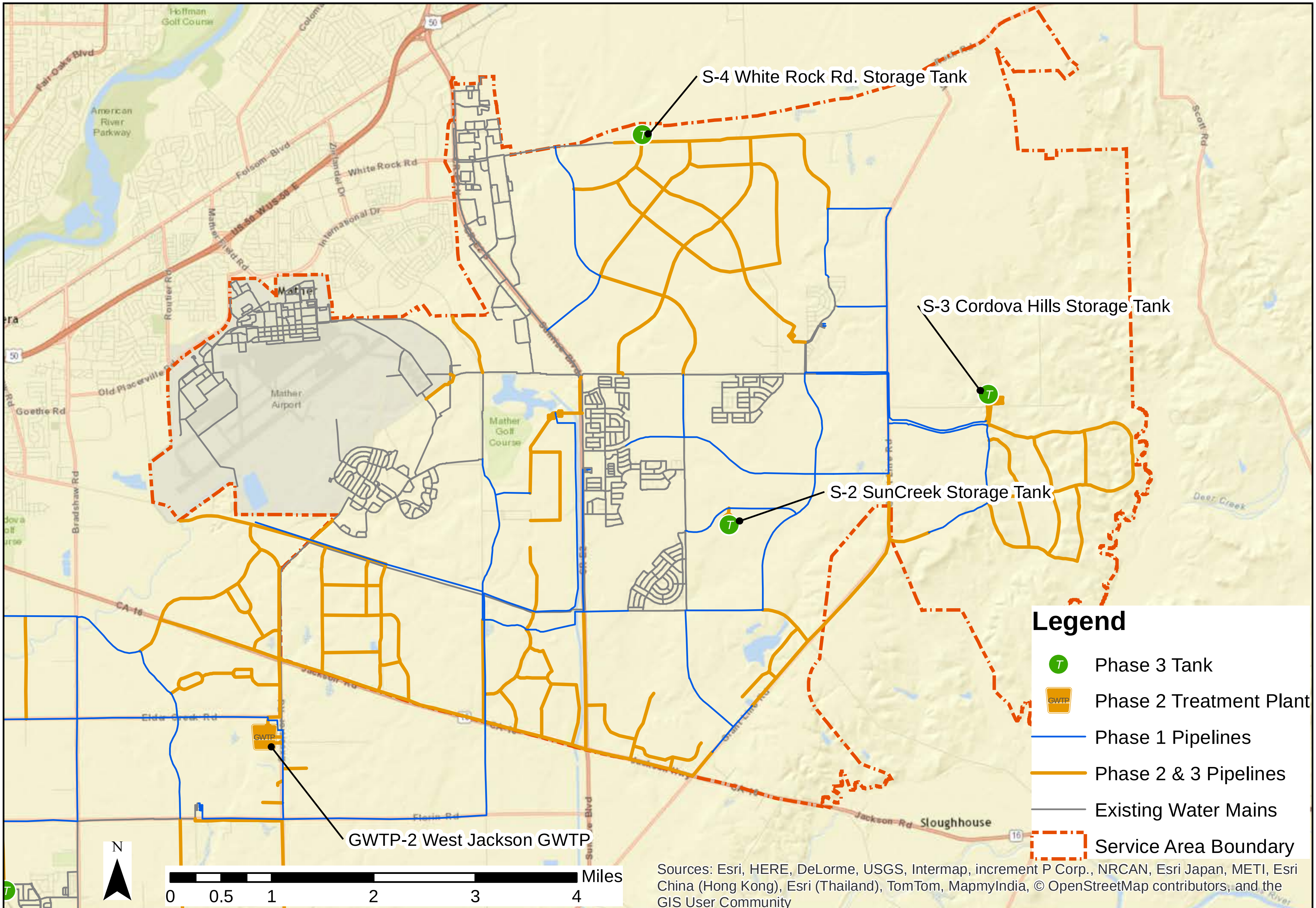
Additional pipelines would be constructed within the NSA to supply increased demand for new development in the NSA. The locations of the Phase 2 projects in the NSA are shown on Figure 6-3.

P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 9 files\Figure 9-10.pdf



Brown AND Caldwell / DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY	PROJECT 148130	SITE Water System Infrastructure Plan Update	Figure 6-2
	DATE 7/30/15	TITLE Phase 1 CIP Projects - CSA & SSA - Cumulative	

P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 9 files\Figure 9-11.pdf



PROJECT 148130	SITE Water System Infrastructure Plan Update	Figure 6-3
DATE 7/30/15	TITLE Phase 2 & 3 CIP Projects - NSA - Cumulative	SCWA-7

Brown AND Caldwell

DEPARTMENT OF WATER RESOURCES SACRAMENTO COUNTY WATER AGENCY

6.1.2.2 Central Service Area

The next water supply facility in the CSA would be the 18 mgd West Jackson GWTP (GWTP-2) that would use the Excelsior well field as its source of groundwater supply. The West Jackson GWTP would be located in the northern part of the CSA. The Excelsior well field would be reactivated to supply the West Jackson GWTP with some additional wells added as part of the GWTP-2 project.

6.1.2.3 South Service Area

The Big Horn GWTP Expansion (GWTP-7) would be constructed in the SSA in Phase 2. Additional pipelines would be constructed within the SSA. The locations of the Phase 2 projects in the SSA are shown on Figure 6-4.

6.1.3 Phase 3 (2036 to Buildout)

The water system facilities needed to serve Phase 3 demands are described for the NSA, CSA, and SSA.

6.1.3.1 North Service Area

In Phase 3, the Vineyard WTP would be expanded to 100 mgd from its present capacity of 50 mgd (SW-1). This added surface water supply capacity would be used to supply both the NSA and the CSA, with some supply for the SSA.

Additional storage facilities would be constructed in the NSA in Phase 3 consisting two storage facilities (S-3 and S-4). Additional pipelines would be constructed within the NSA to supply increased demands. The locations of the Phase 3 projects in the NSA are shown on Figure 6-3.

6.1.3.2 Central Service Area

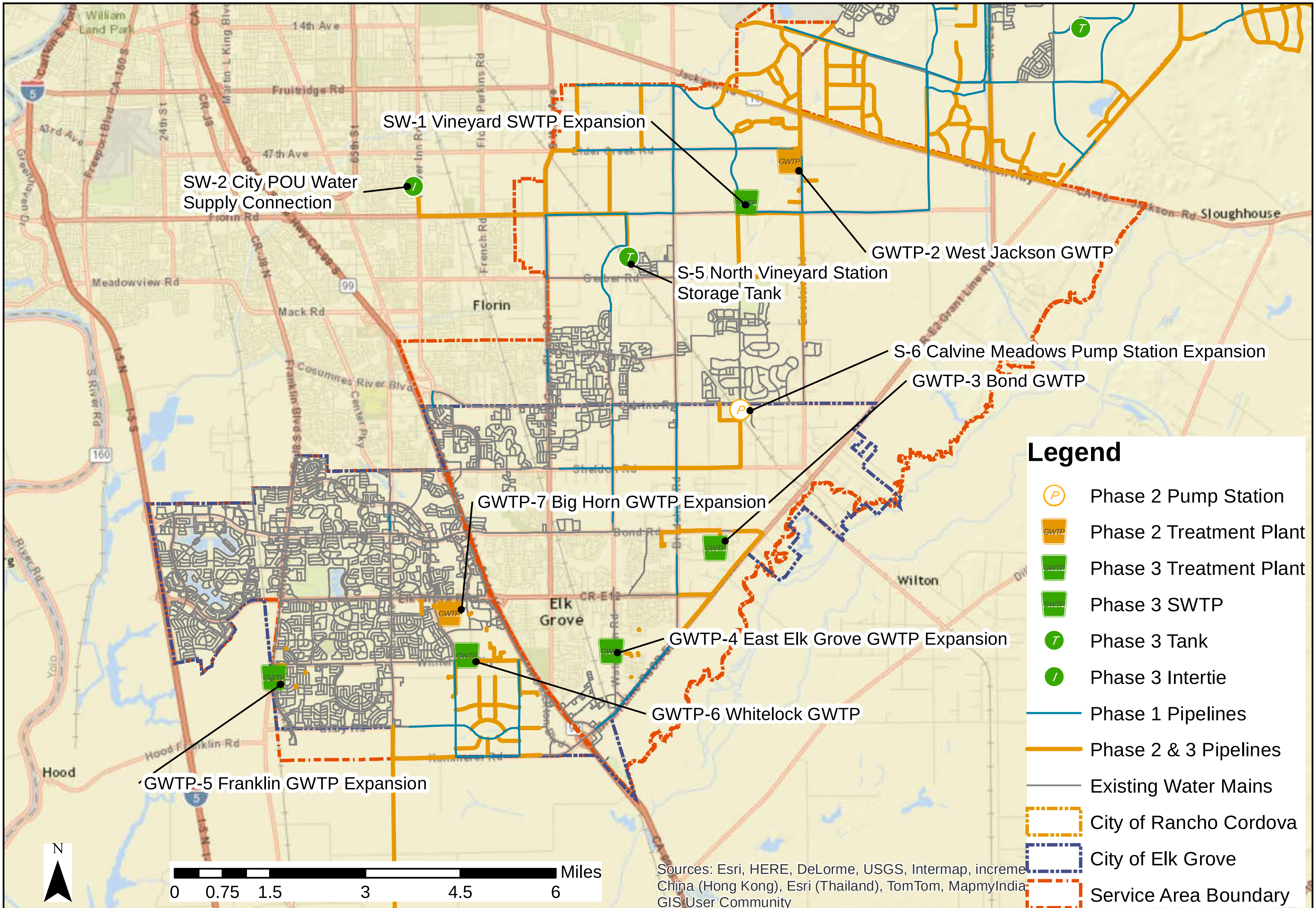
The surface water supply capacity for the CSA would be increased with the expansion of the Vineyard SWTP (SW-1) from 50 mgd to 100 mgd. The groundwater supply capacity would be increased in the CSA by the construction of one new GWTP and the expansion of one of the existing GWTPs (GWTP 3 and GWTP-4). In addition to the storage that would be constructed at these two GWTPs, one additional storage reservoir would be constructed in the CSA (S-5) and the pump station at a storage facility would be expanded (S-6).

Facilities would also be added to deliver the POU surface water (19.1 mgd at maximum day) wholesaled by the City (SW-2). In the 2006 WSIP, it was assumed that the POU would be diverted and treated at the City's Fairbairn WTP, and then conveyed to the City's Florin Reservoir through the transmission main in Power Inn Road. The POU water connection to the City would be established at the Florin Reservoir. The water would be pumped out of Florin Reservoir by low-heard pumps; then it would be conveyed in a dedicated transmission main (POU Water Pipeline), and finally the water would fill the North Vineyard Station Storage tank. From there, the water would be pumped out to the CSA.

The delivery of POU water would be significantly impacted by the Hodge flow standard. Recent studies by the City indicated that the POU water for Zone 40 would be subject to cutbacks under certain hydrologic conditions as opposed to being a highly reliable surface water supply as previously thought. Future study and update would be needed once the availability of the POU water is determined.

Additional pipelines would be constructed within the CSA to supply increased demand. The locations of the Phase 3 projects in the CSA are shown on Figure 6-4.

P:\Shared Folders\Wsplandev\Zone 40\Water System Infrastructure Plan\WSIP Update 2012\Shape files\Figure 9 files\Figure 9-12.pdf



Brown AND Caldwell Department of Water Resources Sacramento County Water Agency	PROJECT 148130 DATE 7/30/15	SITE Water System Infrastructure Plan Update TITLE Phase 2 & 3 CIP Projects - CSA & SSA - Cumulative	Figure 6-4 SCWA-7

6.1.3.3 South Service Area

The groundwater supply capacity would be increased in the SSA by the construction of two new GWTPs (GWTP-5 and GWTP-6). As shown previously in Table 5-3, these two GWTPs would provide a total groundwater supply capacity for the SSA that exceeds the SSA's projected maximum day demand at buildout. Consideration should be given to locating these two proposed GWTPs closer to where there is a need for dry year groundwater supply capacity, such as the CSA.

Facilities would also be added to increase the recycled water supply (RW-1). The recycled water project (RW-1) consists of the construction of pipelines, storage, and pumping capacity to deliver recycled water to new customers in the SSA. New storage would consist of the storage provided at the two GWTPs. Additional pipelines would be constructed within the SSA during Phase 3. The locations of the Phase 3 projects in the SSA are shown on Figure 6-4, except for the recycled water project. The specific configuration of the recycled water project has not been defined.

6.1.4 Summary

The future water system facilities are categorized as supply facilities, storage facilities, and pipelines. Table 6-1 presents the water supply facilities planned for Zone 40. Each GWTP project consists of wells, a groundwater treatment facility, a storage tank, and a pump station that pumps from the storage tank into the distribution system. Some of the GWTP projects already have wells that were previously drilled but not equipped and some would require the equipping and drilling of new wells. Table 6-1 presents the number of wells that would be equipped and/or drilled and equipped for the pertinent GWTP projects.

Table 6-2 presents the storage facility projects planned for Zone 40. Table 6-3 presents the pipeline projects that are 16 inches in diameter or larger planned for Phase 1. Table 6-4 presents the pipelines that would be needed during Phases 2 and 3.

Table 6-1. Additional Supply Facilities

	Supply facility	Treatment/ supply capacity, mgd	Wells		Storage, MG	Pumping station capacity, mgd	Area served	Phase added
			Wells to be drilled and equipped	Wells to be equipped only (already drilled)				
GWTP-1	Poppy Ridge GWTP expansion	6.5		3	3.5	17.0	SSA	Phase 1
GWTP-2	West Jackson GWTP	18.0	5		4.0	21.6	CSA	Phase 2
SW-1	Vineyard WTP expansion	50.0					NSA/CSA	Phase 3
GWTP-3	Bond GWTP	6.5	3		0.5	10.8	CSA	Phase 3
GWTP-4	East Elk Grove GWTP expansion	6.5	2	1		13.0	CSA	Phase 3
SW-2	City POU water supply facilities	19.1					CSA	Phase 3
GWTP-5	Franklin GWTP	7.0	1	3	2.0	21.6	SSA	Phase 3
GWTP-6	Whitelock GWTP	13.0	6		3.0	14.4	SSA	Phase 3
GWTP-7	Big Horn GWTP expansion	8.5	4			17.0	SSA	Phase 2
RW-1	Recycled water supply	4.0					SSA	Phase 3
	Total	139.1	21	7	13.0	115.4		

Table 6-2. Additional Storage Facilities					
	Storage facility	Capacity, MG	Pumping station, mgd	Area served	Phase added
S-1	Phase B NSA Project	10.0	64.0	NSA	1
S-2	Suncreek	3.0	18.0	NSA	3
S-3	Cordova Hills	3.0	21.6	NSA	3
S-4	White Rock	3.0	14.4	NSA	3
S-5	North Vineyard Station	4.0	21.6	CSA	3
S-6	Calvine Meadows Pump Station Expansion		7.2	CSA	3
	Total	23.0	146.8		

Table 6-3. Phase 1 Pipelines				
	Pipeline	Size, in	Length, ft	Area served
P-1	Sunrise Blvd. Pipeline	16	7,371	NSA
P-2	Rio del Oro Pipeline	24	11,593	NSA
P-3	Kiefer Blvd. Pipeline	16-20	22,446	NSA
P-4	Eagles Nest Road Pipeline	20-30	7,239	NSA
P-5	Ranch Pipeline	24	7,000	NSA
P-6	Arboretum Pipe System	16	3,167	NSA
P-7	South Jaeger Pipeline	16	5,238	NSA
P-8	East NSA Pipeline System	16-30	61,389	NSA
P-9	North Jaeger Pipeline	24	6,365	NSA
P-10	Phase A NSA Project	42-66	44,662	NSA
P-11	Vineyard Road Pipeline	16	13,600	CSA
P-12	Fruitridge Road Pipeline	16	7,982	CSA
P-13	Elder Creek Pipeline	16-36	21,343	CSA
P-14	Bradshaw Road Pipeline	16-24	10,599	CSA
P-15	North Vineyard Station (Florin to Gerber) Pipeline	24-36	11,847	CSA
P-16	South Watt Connect Pipeline	24	2,693	CSA
P-17	CSA Backbone Pipeline	24-30	9,948	CSA
P-18	Elk Grove Loop Connector Pipelines	16-24	11,322	CSA
P-19	Power Inn Road Pipeline	24	1,273	CSA
P-20	Big Horn to Kammerer Pipeline	20	7,832	SSA
P-21	Bruceville Road Pipeline	18	1,267	SSA
P-22	North Grant Line Road Pipeline	20-24	17,000	NSA

Table 6-3. Phase 1 Pipelines				
	Pipeline	Size, in	Length, ft	Area served
P-23	Florin-Watt Pipelines	20-24	10,000	CSA
P-24	North Waterman Pipeline	16	3,000	CSA
P-25	Sheldon-Waterman Pipelines	18-24	15,000	CSA
P-26	South East Policy Area Pipelines	18-24	22,000	SSA
	Total	--	343,176	--

Table 6-4. Phase 2 and 3 Pipelines	
Pipeline size, in	Length, ft
16	165,716
18	14,351
20	0
24	67,876
30	5,305
36	29,502
42	3,371
54	40,704
Total	326,825

6.1.5 Project Triggers

The timing for the identified projects depends on the extent, pace, and location of new connections to the water system and the concurrent need to expand water supply capacity and extend water system pipelines. The timing for projects depends primarily on the rate of growth of new connections. Tables 6-5 to 6-7 present the triggers that initiate the need for each project. These tables supplement the timing of new facilities that is presented in sections 5.1 and 5.4 of this report.

The trigger for the groundwater supply projects is the need to meet the maximum day demand in dry years when surface water supplies are reduced. The trigger for the surface water supply projects is the need to supply surface water for a large portion of the maximum day demand. The trigger for storage and pumping facility projects is the need to meet storage volume and peak hour flow rate requirements.

The groundwater treatment projects include storage facilities that are used to meet peak hour and fire demands. The timing of those water supply projects also considers the overall need to meet storage volume and pumping requirements as well as supply for maximum day demand.

Table 6-5. Water Supply Project Triggers			
Project	Supply facility	Trigger [a]	Year [a]
GWTP-1	Poppy Ridge GWTP expansion	Provide dry year maximum day supply to the SSA with some reduction of surface water from the Franklin Intertie.	2025
GWTP-2	West Jackson GWTP	Provide dry year maximum day supply to the CSA with some reduction of surface water from Vineyard SWTP.	2030
SW-1	Vineyard SWTP expansion	Provide surface water in the NSA and CSA approximately 50% of the wet/average year maximum day demand. Assume City POU supply (SW-2) not constructed prior.	2040
GWTP-3	Bond GWTP	Provide dry year maximum day supply to the CSA with some reduction of surface water from the Vineyard SWTP. Assume construct before East Elk Grove (GWTP-4).	2050
GWTP-4	East Elk Grove GWTP expansion	Provide dry year maximum day supply to the CSA with some reduction of surface water from the Vineyard SWTP.	2050
SW-2	City POU water supply facilities	Provide surface water in the CSA for approximately 50% of the wet/average year maximum day demand. Assume Vineyard SWTP (SW-1) constructed prior.	2051
GWTP-5	Franklin GWTP	Provide dry year maximum day supply to the SSA with some reduction of surface water from the Franklin Intertie. Assume Poppy Ridge (GWTP-1) and Big Horn (GWTP-7) constructed prior.	2050
GWTP-6	Whitelock GWTP	Provide dry year maximum day supply to the SSA with some reduction of surface water from the Franklin Intertie. Assume last GWTP.	2052
GWTP-7	Big Horn GWTP expansion	Provide dry year maximum day supply to the SSA with some reduction of surface water from the Franklin Intertie. Assume Poppy Ridge (GWTP-4) constructed prior.	2035
RW-1	Recycled water supply	Expanding recycled water supply could reduce the need for dry year groundwater supplies. The trigger is SRCSD's agricultural irrigation project.	Not applicable.

[a] *The project should generally be constructed before this point is reached.*

Table 6-6. Water Storage Facility Triggers			
	Storage facility	Trigger [a]	Year [a]
S-1	Phase B NSA Project	For the pipeline, when max day use of Vineyard SWTP supply exceeds capacity of the existing 30" pipeline to Anatolia, 16 mgd. Meet storage criteria. See Section 5.4.	2029 for pipeline 2021 for storage volume
S-2	Suncreek	Meet storage criteria. See Section 5.4.	2050
S-3	Cordova Hills	Meet storage criteria. See Table 5-10.	2045
S-4	White Rock	Meet storage criteria. See Table 5-10.	2050
S-5	North Vineyard Station	Meet storage criteria. See Section 5.4.	2040

[a] *The project should generally be constructed before this point is reached.*

Table 6-7. Phase 1 Pipeline Triggers			
	Pipeline	Purpose [(a)]	Trigger [(a)]
P-1	Sunrise Blvd. Pipeline	Supply the NewBridge, Jackson Township, and West Jackson subareas from Anatolia storage facility.	When initial development occurs in these areas.
P-2	Rio del Oro Pipeline	Supply Rio del Oro area.	When initial development occurs in this area.
P-3	Kiefer Blvd. Pipeline	Supply the NewBridge, Jackson Township, and West Jackson subareas from project P-1.	When initial development occurs in these areas.
P-4	Eagles Nest Road Pipeline	Supply Mather South area.	When initial development occurs in this area.
P-5	Ranch Pipeline	Supply Suncreek and Sunridge areas.	As development occurs in this area.
P-6	Arboretum Pipe System	Supply Arboretum area.	When initial development occurs in this area.
P-7	South Jaeger Pipeline	Supply Arboretum area.	When initial development occurs in this area.
P-8	East NSA Pipeline System	Supply Cordova Hills, Sunridge, and Suncreek areas.	When initial development occurs in this area.
P-9	North Jaeger Pipeline	Supply Sunridge and Cordova Hills areas from Anatolia storage facility.	When initial development occurs in these areas.
P-10	Phase A NSA Project	Supply surface water to the NSA from Vineyard SWTP.	Project needed now to meet conjunctive use criteria. Project needed before NSA maximum day demand reaches 12.5 mgd to be able to meet demand with full use of all facilities.
P-11	Vineyard Road Pipeline	Supply West Jackson area from Vineyard SWTP.	When initial development occurs in this area.
P-12	Fruitridge Road Pipeline	Supply West Jackson area.	When initial development occurs in this area.
P-13	Elder Creek Pipeline	Supply West Jackson area.	When initial development occurs in this area.
P-14	Bradshaw Road Pipeline	Supply West Jackson area from Vineyard SWTP and GWTPs to the south.	When initial development occurs in these areas.
P-15	North Vineyard Station (Florin to Gerber) Pipeline	Supply North Vineyard and Florin-Vineyard areas.	When development occurs in these areas.
P-16	South Watt Connect Pipeline	Fill gaps in the backbone transmission system.	Phase 1.
P-17	CSA Backbone Pipeline	Fill gaps in the backbone transmission system.	When a certain amount of additional development occurs in the Vineyard, East Vineyard, and Elk Grove wholesale areas.
P-18	Elk Grove Loop Connector Pipelines	Fill gaps in the backbone transmission system.	When a certain amount of additional development occurs Elk Grove wholesale area.
P-19	Power Inn Road Pipeline	Fill gaps in the backbone transmission system.	Phase 1.
P-20	Big Horn to Kammerer Pipeline	Supply Laguna Ridge and Southeast Policy areas.	When development occurs in these areas.
P-21	Bruceville Road Pipeline	Fill gaps in the backbone transmission system.	Phase 1.
P-22	North Grant Line Road Pipeline	Supply Rio del Oro area.	As Rio del Oro develops.
P-23	Florin-Watt Pipelines	Fill gaps in the backbone transmission system.	As Florin and Vineyard areas develop.
P-24	North Waterman Pipeline	Fill gaps in the backbone transmission system.	As Vineyard develops.
P-25	Sheldon-Waterman Pipelines	Fill gaps in the backbone transmission system.	As Vineyard develops.
P-26	South East Policy Area Pipelines	Supply South East area.	When South East area develops.

[(a)] *The project should generally be constructed before this point is reached.*

6.2 Capital Improvement Plan

The CIP is developed based upon the water facilities identified in Section 6.1. The CIP is presented in three phases as follows:

- Phase 1. 2015 to 2025
- Phase 2. 2026 to 2035
- Phase 3. 2036 to buildout, which is estimated to occur in 2052.

The CIP projects are categorized as surface water projects, groundwater projects, pipeline projects, and storage projects.

The projects presented in the CIP are limited to projects that expand the water supply capacity and the conveyance of water supplies to future customers. Not included in the CIP are the following types of projects and items:

- Projects that rehabilitate or replace existing water system facilities.
- Projects that correct existing system deficiencies, such as areas of inadequate pressure or fire flow.
- Land acquisition.
- Projects that provide for groundwater treatment for constituents other than iron and manganese. For example, projects needed to treat constituents that are found to a limited extent in the Central Basin such as Chromium VI, Arsenic, and Radon are not included.
- Projects that would plan and implement aquifer storage and recovery (ASR).
- Projects that would plan and implement an expanded recycled water supply beyond the project RW-1. For example, not included are projects that consist of indirect potable reuse (IPR) or direct potable reuse (DPR) of treated wastewater.
- Special fees or payments.
- Water system connection fees, such as for future interties with other water agencies.

6.2.1 Basis of Cost Estimates

The cost estimates represent conceptual estimates of the capital costs to construct the water system facilities. Costs should be refined from this conceptual phase as the projects are better defined and proceed into the pre-design and design phases. The cost estimates represent 2014 dollars. Capital cost estimate tables are presented for most of the CIP projects in Appendix B with several exceptions. SCWA provided the cost estimates for the Phase A NSA Project and Phase B NSA Project (P-10 and S-1). The Vineyard SWTP expansion project (SW-1) and recycled water project (RW-1) do not have individual cost estimate tables developed.

Capital costs represent the construction and other costs necessary to get a project completed. Construction costs cover the material, labor, and services necessary to build the identified project. Changes during the design of the project, in the cost of materials, labor, and equipment, and in the bidding environment will cause changes in the estimated cost.

The contingency cost item addresses the uncertainties that are associated with the preliminary sizing of projects. Factors such as unexpected construction conditions, the need for unforeseen construction items, and variations in quantities are some of the items that can increase project cost. An allowance of 25 percent of the construction cost is included to cover such contingencies for the groundwater, surface water, and storage projects.

The engineering, administrative, and legal cost item covers engineering services and items such as legal fees, administrative costs that are typically associated with a project. It is estimated that these costs would be 25 percent of the total of the construction cost plus contingency.

The environmental and permitting cost item is intended to cover services necessary to meet the requirements of the California Environmental Quality Act and services and fees associated with obtaining the necessary permits that would be required. It is estimated that these costs would be 10 percent of the total of the construction cost plus contingency.

The cost estimates for the Phase 1 pipeline projects, which are developer projects, are developed with a different approach. The cost estimates for the developer projects represent the amount that SCWA would pay a developer for a project and do not necessarily represent the total cost of a project. The cost estimates for the pipeline projects are based on the unit costs presented in Schedule C that was issued by SCWA on April 9, 2014. The pipeline projects are characterized as being either in undeveloped areas or under existing pavement to utilize the appropriate Schedule C unit pipeline cost. The Schedule C unit costs are values that have been escalated from unit costs that were developed in 2007 for the development of the Ordinance 18 Schedule C Unit Prices for Zone 40 Credits. The cost estimates for the developer projects include 15 percent for contingency, 8 percent for engineering, and 10 percent for the Construction Management and Inspection Division (CMID).

It is assumed that all future groundwater supply facilities would require groundwater treatment for iron and manganese. The groundwater treatment plant projects each include wells, pipelines from the wells to the treatment plant, treatment facility, storage reservoir, pumping station, and pipeline conveyance to the water distribution system. It is assumed that treatment facilities will not be required for the existing direct feed wells.

The cost for the expansion of the Vineyard SWTP (SW-1) is based on a unit cost of $4 million per mgd capacity. The cost estimate for the recycled water project (RW-1) is assumed to be $20 million, but no recycled water facility project description has been developed for this study. As a comparison, the 2005 WSMP estimated the cost of the recycled water facilities to be $15 million and the 2006 WSIP presented a cost of $11.6 million.

6.2.2 Phase 1 CIP – 10 Year Plan (FY 2015-16 to 2024-25)

The Phase 1 CIP represents the projects that will be constructed over the near term time period and provides the basis for the development of the capacity charge. The development of the Phase 1 CIP requires consideration of the timing and duration of each project. The Phase 1 CIP consists of groundwater, storage, and pipeline projects. No surface water and stand alone storage projects are planned for Phase 1, other than the storage that is part of the GWTP project.

Table 6-8 presents the estimated costs of the Phase 1 water facilities. Included in the Phase 1 CIP is an item for non-specific project costs that cover the labor costs of SCWA's planning, development, and development sections.

The timing of the Phase 1 projects presented in Table 6-8 are based on information SCWA has received from developers' engineers regarding the timing of development projects and keeping a somewhat consistent rate of annual expenditure over the duration of Phase 1. The cost of each project would occur over a duration of several years. All of the projects would be completed by the time the end of Phase 1 is reached.

Table 6-8. Phase 1 CIP Cost Estimate					
Projects		Service Area	Capital Cost	Project Timing	
No.	Name			Start, FY	End, FY
Groundwater Projects (SCWA Projects)					
GWTP-1	Poppy Ridge GWTP Expansion	SSA	$ 13,832,800	2016	2018
	Well site acquisitions	CSA/SSA	$ 180,000	2018	2023
	subtotal		$ 14,012,800		
Regional Transmission and Storage Projects (SCWA Projects)					
S-1	Phase B NSA Project	NSA	$ 84,586,140	2016	2023
P-10	Phase A NSA Project	NSA	$ 10,088,000	2016	2019
	Tank site acquisition	NSA	$ 800,000	2017	2018
	subtotal		$ 95,474,140		
Pipeline Projects (Developer Projects)					
P-1	Sunrise Blv. Pipeline	NSA	$ 2,527,900	2018	2020
P-2	Rio del Oro Pipeline	NSA	$ 3,663,200	2016	2018
P-3	Kiefer Boulevard Pipeline	NSA	$ 7,282,700	2020	2022
P-4	Eagles Nest Road Pipeline	NSA	$ 3,779,200	2019	2021
P-5	Ranch Pipeline	NSA	$ 2,202,300	2023	2025
P-6	Arboretum Pipe System	NSA	$ 1,104,300	2021	2023
P-7	South Jaeger Pipeline	NSA	$ 1,145,500	2020	2022
P-8	East NSA Pipeline System	NSA	$ 18,212,400	2016	2021
P-9	North Jaeger Pipeline	NSA	$ 2,027,300	2017	2018
P-11	Vineyard Road Pipeline	CSA	$ 2,923,000	2021	2023
P-12	Fruitridge Road Pipeline	CSA	$ 2,716,100	2022	2024
P-13	Elder Creek Pipeline	CSA	$ 9,142,600	2021	2025
P-14	Bradshaw Road Pipeline	CSA	$ 4,515,400	2017	2019
P-15	North Vineyard Station (Florin to Gerber) Pipeline	CSA	$ 5,025,600	2018	2020
P-16	South Watt Connect Pipeline	CSA	$ 1,742,400	2019	2021
P-17	CSA Backbone Pipeline	CSA	$ 5,008,300	2023	2025
P-18	Elk Grove Loop Connector Pipelines	CSA	$ 4,715,500	2023	2025
P-19	Power Inn Road Pipeline	CSA	$ 584,300	2024	2025
P-20	Big Horn to Kammerer Pipeline	SSA	$ 2,494,500	2017	2019
P-21	Bruceville Road Pipeline	SSA	$ 509,400	2024	2025
P-22	North Grant Line Road Pipeline	NSA	$ 4,588,800	2022	2024
P-23	Florin-Watt Pipelines	CSA	$ 4,150,400	2023	2025

Table 6-8. Phase 1 CIP Cost Estimate					
Projects		Service Area	Capital Cost	Project Timing	
No.	Name			Start, FY	End, FY
P-24	North Waterman Pipeline	CSA	$ 568,900	2019	2020
P-25	Sheldon-Waterman Pipelines	CSA	$ 5,685,700	2022	2025
P-26	South East Policy Area Pipelines	SSA	$ 5,868,800	2021	2024
	subtotal		$ 102,184,500		
Non-Specific Project Costs			$ 30,000,000	2016	2025
Studies					
	Recycled Water Master Plan		$ 250,000	2016	2025
	Water Master Plan		$ 400,000	2016	2025
	EIR		$ 500,000	2016	2025
	subtotal		$ 1,150,000		
Total			$ 242,821,440		

6.2.3 Phase 2 CIP – 10 Year Plan (2026 to 2035)

Phase 2 represents the 10 year period following the end of Phase 1. Since Phase 2 is further in the future, the timing of projects is more speculative and less precise. The level of precision provided in the Phase 1 CIP is not needed for Phase 2 since the capacity charges are developed using the Phase 1 CIP costs and not the CIP costs from the subsequent phases.

The new pipelines that are needed for Zone 40 during Phases 2 and 3 are defined. However, the timing of when each pipeline project is needed is dependent on the location and timing of development. Therefore, this document does not identify the specific pipe segments that would need to be constructed in either Phase 2 or 3. The approach used for the development of the CIP is to assume that approximately half the cost of the Phases 2 and 3 pipelines would occur in Phase 2 and half would occur in Phase 3. Table 6-9 presents the cost estimate for the Phases 2 and 3 pipelines.

Table 6-10 presents the cost estimate for the Phase 2 CIP projects. The Phase 2 CIP consists of groundwater and pipeline projects. No surface water projects are planned for Phase 2.

Table 6-9. Phases 2 and 3 Pipeline Cost Estimate		
Diameter, in	Length, ft	Capital Cost
16	165,716	$ 68,859,035
18	14,351	$ 6,751,465
20	-	$ -
24	67,876	$ 36,404,178
30	5,305	$ 3,592,897
36	29,502	$ 23,653,481
42	3,371	$ 3,147,171
54	40,704	$ 57,148,073
Total	326,825	$ 199,556,300

Table 6-10. Phase 2 CIP			
Projects		Service Area	Capital Cost
No.	Name		
Groundwater Projects			
GWTP-2	West Jackson GWTP	CSA	$ 28,932,200
GWTP-7	Big Horn GWTP Expansion	SSA	$ 14,744,100
Pipeline Projects		NSA/CSA/SSA	$ 99,778,150
Total			$ 143,454,450

6.2.4 Phase 3 CIP – 17 Year Plan (2036 – Buildout)

The Phase 3 CIP consists of surface water, groundwater, recycled water, storage, and pipeline projects. Table 6-11 presents the cost estimate for the Phase 3 CIP projects. The cost estimate for the City POU supply connection (SW-2) is for the construction of the interconnection and the pipeline to convey the water into the CSA's water transmission system. It does not include the City's capacity buy-in cost that was estimated in 2005 to be $32 million.

Table 6-11. Phase 3 CIP			
Projects		Service Area	Capital Cost
No.	Name		
Surface Water Projects			
SW-1	Vineyard WTP Expansion	NSA/CSA	$ 200,000,000
SW-2	City POU Supply Connection [(a)]	CSA	$ 2,034,400
	subtotal		$ 202,034,400
Groundwater Projects			
GWTP-3	Bond GWTP	CSA	$ 14,725,800
GWTP-4	East Elk Grove GWTP Expansion	CSA	$ 13,687,000
GWTP-5	Franklin GWTP	SSA	$ 18,544,000
GWTP-6	Whitelock GWTP	SSA	$ 26,143,800
	subtotal		$ 73,100,600
Recycled Water Projects			
RW-1	Recycled Water Project	SSA	$ 20,000,000
Storage Projects			
S-2	Suncreek Storage	NSA	$ 11,864,500
S-3	Cordova Hills Storage	NSA	$ 12,848,700
S-4	White Rock Road Storage	NSA	$ 10,880,400
S-5	North Vineyard Station Storage	CSA	$ 5,467,500
S-6	Calvine Meadows Pump Station Expansion	CSA	$ 5,084,800
	subtotal		$ 46,145,900
Pipeline Projects		NSA/CSA/SSA	$ 99,778,150
Total			$ 441,059,050

[(a)] *Does not include the City's capacity buy-in cost.*

6.2.5 CIP Summary

Table 6-12 and Figure 6-5 summarize the Zone 40 CIP costs by project category and phase. The interim NSA and NSA Phase 1 projects in Phase 1 have been categorized as storage projects for the purposes of Table 6-12 and Figure 6-5.

Table 6-12. Zone 40 CIP Cost Summary				
Project Categories	Phase 1	Phase 2	Phase 3	Total
Surface Water Projects			$202,034,400	$202,034,400
Groundwater Projects	$14,012,800	$43,676,300	$73,100,600	$130,789,700
Recycled Water Projects			$20,000,000	$20,000,000
Storage Projects	$95,474,140		$46,145,900	$141,620,040
Pipeline Projects	$102,184,500	$99,778,150	$99,778,150	$301,740,800
Non-Specific Project Costs	$30,000,000			$30,000,000
Studies	$1,150,000			$1,150,000
Total	$242,821,440	$143,454,50	$441,059,050	$827,334,940

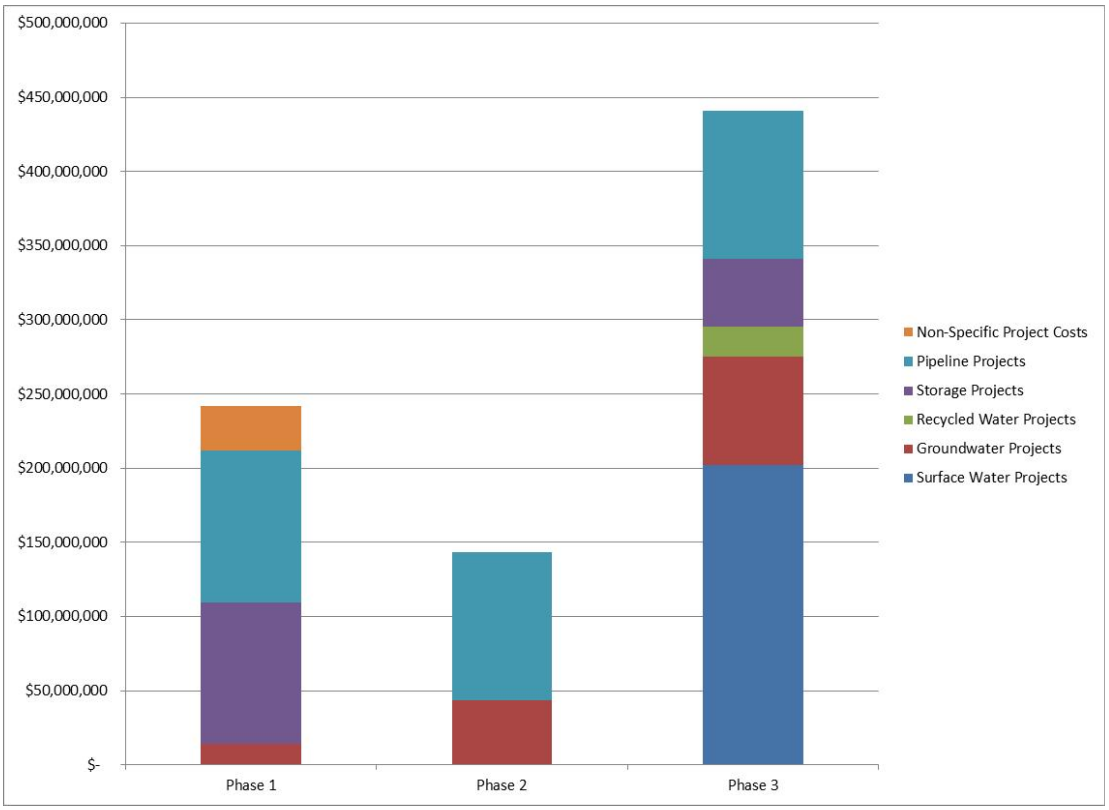


Figure 6-5. CIP Summary by Phase

6.3 Water Facility Dependency Matrix

Specific Phase 1 CIP projects need to be constructed to be able to provide water supply to specific areas where the initial future development occurs. Some of these CIP projects would also provide water service to other areas in the future as they became developed. To provide information to help determine the appropriate cost share for CIP projects, a water facility dependency matrix is presented in Table 6-13. The matrix identifies which CIP projects benefit three planning subareas and the proportional share of the supply capacity and the associated portion of the cost. The share of capacity and cost is based on buildout conditions.

6.4 Additional Water System Facilities Information

This section presents additional water supply information to supplement the information provided in the previous sections.

6.4.1 Timing of Phase B NSA Project

This section evaluates the timing of the need for the Phase B NSA project. This project is the largest cost project in the 10 year Phase 1 CIP; therefore better understanding of what drives the timing of the project is useful.

The most significant factor that influences the timing of the Phase B NSA project is the assumed growth in connections in the NSA. The water demand per connection and the maximum day demand factor have a lesser influence on the project timing.

The key drivers of the project timing are as follows:

1. The trigger for when the latest the Phase B NSA project ($85 million) needs to be brought on line is when the NSA maximum day demand exceeds the combined capacity of the Phase A NSA project supply capacity (16.0 mgd) and the groundwater supply capacity (6.0 mgd), or 22 mgd. This is expected to occur in 2029 with 12,000 connections. The 2010 maximum day demand for the NSA was approximately 7.4 mgd with 4,596 connections.
2. The Phase A NSA project's capacity with the 30 inch pipeline is 16 mgd at a velocity of 5 feet per second.
3. A different assumed growth rate would change the timing of the project need. The assumed growth rate in the NSA used for item 1 above is 300 connections per year, increasing from 2018 to 2020 to 500 connections per year. If the growth rate is alternatively assumed to remain stable at 300 connections per year, it would be 2036 when 12,000 connections is reached. If the assumed growth rate is ramped up to 700 connections per year in 2020, the trigger year would be 2026 to reach 12,000 connections.
4. Another factor is the recent decline in annual and maximum day water use in the NSA. The maximum day demand in 2014 is estimated at 6 mgd compared to 7.4 mgd in 2010. Assuming this lower water use only partially rebounds, the project timing would be 2032 compared to the timing defined in item 1.
5. Using a maximum day factor of 1.8 instead of 2.0 delays the project need by two years or 2031 compared to the timing defined in item 1. Monthly data for Zone 40 show that the maximum day factor for the 8 years from 2007 to 2014 has ranged from 1.7 to 2.0 with a median of 1.8.

Table 6-13. Water Facility Dependency Matrix

Project			NewBridge MDD = 2.4 MGD			Jackson Township MDD = 4.4 MGD			West Jackson MDD = 13.3 MGD			Other areas		
No.	Facility	Cost, $ million	Needs facility	% of cost	Cost portion, $ million	Needs facility	% of cost	Cost portion, $ million	Needs facility	% of cost	Cost portion, $ million	Subarea	% of cost	Cost portion, $ million
1	Sunrise Blvd. Pipeline	$ 2.5	x	25%	$ 0.6	x	25%	$ 0.6				Arboretum, Suncreek	50%	$ 1.3
3	Kiefer Road Pipeline													
	Segment 1	$ 3.8	x	35%	$ 1.3	x	65%	$ 2.5						
	Segment 2	$ 3.5				x	100%	$ 3.5						
10	Phase A NSA Project	$ 10.1	x	4%	$ 0.4	x	7%	$ 0.7				Remainder of NSA	89%	$ 8.9
11	Vineyard Road Pipeline	$ 2.9							x	100%	$ 2.9			
12	Fruitridge Road Pipeline	$ 2.7							x	100%	$ 2.7			
13	Elder Creek Pipeline	$ 9.1							x	50%	$ 4.6	Florin-Vineyard Com Plan	50%	$ 4.6
14	Bradshaw Road Pipeline	$ 4.5							x	50%	$ 2.3	Florin-Vineyard Com Plan	50%	$ 2.3
	Total	$ 39.1			$ 2.4			$ 7.3			$ 12.4			$ 17.0

The Phase A NSA project and the Phase B NSA project are intended for the purpose of conveying surface water to the NSA. Some of the issues that impact these projects are described below:

1. The timing of the storage and pump station components of the Phase B NSA project is not addressed in this description. The storage and pump station facilities are a smaller part of the cost of the project and these facilities could be phased independently of the pipeline portion.
2. Approximately 25 mgd surface water supply is available for the NSA from the current 50 mgd Vineyard SWTP. The constraint is pipeline conveyance capacity.
3. The Phase A NSA project would connect the Vineyard SWTP to an existing 30 inch pipeline that would allow for the conveyance of surface water to the NSA for a $10 million cost. The capacity of the 30 inch pipe is 16 mgd at a velocity of 5 feet per second.
4. The Phase B NSA project consists of approximately 42,000 feet (8 miles) of 66 and 54 inch pipe, two 5 million gallon reservoirs, and pump station for a cost of $85 million. The capacity of the 54 inch pipe would be 51 mgd at a velocity of 5 feet per second. This pipe is sized to convey some of the flow from the future expanded Vineyard SWTP to the NSA. The Vineyard SWTP would likely not be expanded to be able to fully utilize this pipe capacity until the 2035 to 2045 period.
5. The capacity of the current NSA groundwater supply sources totals 12.5 mgd (Mather Housing GWTP and Anatolia GWTP). The construction of the Phase A NSA project would take the Anatolia GWTP and Excelsior well field off line, which would reduce the groundwater supply capacity to 6.0 mgd.
6. It might be possible to bring online the Excelsior well field and the 18 mgd West Jackson GWTP ($20 million) before the Phase B NSA project. The challenge would be to identify some other possibly future pipelines that could be used to convey this water other than the 30 inch line. This would increase the trigger to 40 mgd. This maximum day demand is expected to occur in 2040.

6.4.2 Recommendations

This section presents recommendations for work items that would be useful to better develop and optimize the water supply facilities needed to supply Zone 40. These recommendations could be initiated as part of the future update of this WSIP or as standalone technical analysis. The recommendations are grouped in accordance with the main section titles of this WSIP Update.

1. Existing Water System Description
   a. Identify and describe standby pump capabilities at each pump station.

2. Water Demands
   a. Regularly update connection growth and the associated maximum day demand for each service area since this is the main driver of the timing of the need for CIP projects.
   b. Track and verify that the projected large increase in multifamily and nonresidential land use acres is occurring as projected.
   c. More precisely quantify the nonresidential connections, employment, area, and demand factors.
   d. More precisely quantify the multifamily population, connections, dwelling units, and demand factors.
   e. Quantify the net to gross acre factor for each land use category for existing and proposed development.
   f. Consider incorporating into the demand projections additional water conservation savings including passive savings.
   g. Quantify the existing Elk Grove connections, population, and dwelling units.
   h. Conduct a detailed water system audit that would better characterize and quantify water system losses and other non revenue water use.
   i. Track GPCD and weather normalize the GPCD once the new methodology is developed by the California Department of Water Resources.

j. Clearly meter and track wholesale water deliveries to others, including Elk Grove.

3. Water Supply
   a. Evaluate the optimal mix of surface water, groundwater, and recycled water supplies and facility capacities to provide the best balance between water supply reliability and economics.
   b. Evaluate the impact of varying the assumed frequency of dry years on the long term average use of water supplies.
   c. Evaluate the impacts of the projected increase in groundwater pumping, particularly the groundwater pumping that would occur in the driest years and sequential dry years. Identify the optimal locations to withdraw groundwater considering hydrogeologic factors.
   d. Evaluate the feasibility and benefits of aquifer storage and recovery and quantify its impact on the sizing of the surface water and groundwater supply facilities.
   e. Identify the timing, costs, and reliability of the City POU water.
   f. Consider providing more groundwater supply capacity for the NSA.
   g. Modify the timing of the construction of water supply facilities. This could include changing the timeline for the expansion of the Vineyard WTP, the recycled water expansion, and the City's POU water.
   h. Explore the feasibility of an indirect or direct potable reuse supply.
   i. Utilize some of the surplus supply capacity to provide water to other agencies.

4. Water Supply Capacity
   a. Consider a possible change to the emergency reserve storage criteria and consider having more emergency storage in areas where groundwater supply is not provided.
   b. Conduct a power failure evaluation to ensure that the appropriate water supply facilities have standby power installed to be able to meet system demands during a prolonged power failure.

5. Water System Facilities and CIP
   a. Optimize the configuration of the future NSA system by evaluating several alternative configurations to deliver surface water.
   b. Optimize the amount of storage and pumping capacity provided at each storage and groundwater treatment facility, as well as the geographic spread of those capacities.
   c. Regularly update the CIP project timing to reflect the actual and updated projected water demands.
   d. Conduct a pipe size/energy optimization evaluation to define pipe sizes that provide the lowest overall capital and operating cost.
   e. Update the water distribution system model for:
      i. Groundwater level changes
      ii. Discrepancies between database and model pump station capacities
      iii. Extended period analysis
      iv. Maximum day factor change
      v. Peak hour factor and diurnal variation change
      vi. Distribution system water quality

Section 7

References

Brown and Caldwell. 2010 Census Analysis. February 2012.

Brown and Caldwell. 2010 SCWA Urban Water Management Plan. 2011.

California Department of Water Resources. California's Groundwater. Bulletin 118. Update 2003. October.

Davis Engineering. Sacramento Central Groundwater Authority 2011-2012 Agricultural Demand and Groundwater Pumping Estimates. May 2014.

Freeport Regional Water Authority and US Department of the Interior, Bureau of Reclamation. Freeport Regional Water Project Draft Environmental Impact Report/Environmental Impact Statement. July 2003.

Luhdorff and Scalmanini. Sutter Pointe Specific Plan Groundwater Supply Assessment. 2008.

Sacramento County Water Agency. First Amended and Restated Master Water Agreement between Sacramento County Water Agency and Florin Resource Conservation District/Elk Grove Water Service, Successors-in-Interest to Elk Grove Water Works. June 2002.

Sacramento County Water Agency. Zone 40 Water Supply Master Plan. February 2005.

Sacramento County Water Agency and Water Forum. Central Sacramento County Groundwater Management Plan. February 2006.

Sacramento County Water Agency. Zone 40 Water System Infrastructure Plan. April 2006.

Sacramento County Water Agency. Zone 40 Water Supply Master Plan Amendment for the Cordova Hills Project. December 2011.

Sacramento County Water Agency. Zone 40 Residential Unit Water Demand Factors. August 2013.

Sacramento Central Groundwater Authority. Basin Management Report 2009-2010.

Sacramento Suburban Water District, Water System Master Plan. July 2009.

Sutter Pointe Specific Plan Groundwater Supply Assessment, Table 5-2.

US Department of the Interior, Bureau of Reclamation. Draft Central Valley Project, M&I Water Shortage Policy. September 2001.

US Department of the Interior, Bureau of Reclamation. Water Supply and Yield Study. March 2008.

US Department of the Interior, Bureau of Reclamation. Central Valley Project Municipal and Industrial Water Shortage Policy Scoping Report. July 2011.

US Department of the Interior, Bureau of Reclamation. Summary of Water Supply Allocations. 2013.

Water Forum Agreement. January 2000.

Appendix A: Zone 40 Residential Unit Water Demand Factors Technical Memorandum

SACRAMENTO COUNTY WATER AGENCY

INTER-OFFICE CORRESPONDENCE

Department Of Water Resources

TECHINICAL MEMORANDUM

TO: Kerry Schmitz, Principal Civil Engineer; Darrell Eck, Senior Civil Engineer

FROM: SCWA Staff

DATE: 08/30/2013

SUBJECT: Zone 40 Residential Unit Water Demand Factors

This memo documents an evaluation of current Zone 40 residential unit demand factors based on multiple years of historical water meter data.

BACKGROUND

Water demands based on land use data is the preferred approach in developing water demand projections for existing and new growth areas in Zone 40. Combining land use and historical water demand information links water use and land use to a specific geographic location. This linkage of geography and water demand data becomes more apparent when modeling the water distribution system.

During the Water Forum negotiations (1993 to 2000), Boyle Engineering provided stakeholders with a technical methodology for deriving unit water demand factors based on water use data and county land use data. As a result of this effort a set of unit water demand factors (UWDF) were developed for SCWA and other water purveyors that were based on the Sacramento County regional average water use as described in the "Estimate of Annual Water Demand within Sacramento-Wide Area", (Boyle, May 1995). In this report water demand factors were determined based on 1990 land and water use data rather than actual retail customer data. The report goes on to state:

"To overcome the general incompleteness of the water use information, a methodology was developed wherein the ratio of water demand factors from the 1991 City (of Sacramento) Study was utilized as a basis for apportionment of water use to the specific land use categories in the urban water agencies...the water demand factors were then proportionately scaled up or down to balance the total 1990 water usage with the particular district."

The Water Forum average annual UWDFs were used in determining the unit water demand factors identified in the 2005 Zone 40 Water Supply Master Plan (WSMP), as shown in Table 1. The left column (Land Use Category) identifies the broad land use categories used at the time of the development of the WSMP. The middle column represents the UWDFs for year 2000. The right-hand column represents the UWDFs for Water Forum Buildout – year 2030 which shows reduced unit water demands of 25.6 percent as a result of water conservation measures mandated in the WFA.

Table 1. Zone 40 Unit Water Demand Factors for Year 2000 and Year 2030 in Ac-Ft/Acre

Land UseCategory	2000	2030
Rural Estate	1.57	1.33
Single Family	3.4	2.89
Multi-Family - Low Density	4.36	3.7
Multi-Family - High Density	4.85	4.12
Commercial	3.24	2.75
Industrial	3.19	2.71
Industrial - Unutilized	0	0
Public	1.22	1.04
Public Recreation	4.08	3.46
Mixed Land Use	2.95	2.51
Right-of-Way	0.25	0.21
Vacant	0	0
Agriculture	0	0

Source: 2005 Zone 40 Water Supply Mater Plan, Tables 2-1 and Table 2-2.

HISTORICAL METER DATA

Since the late 90s and early 2000, meters have been installed increasingly on SCWA's existing and new retail customers. Currently, approximately 90% of SCWA's retail customers have active water meters. Meters for the balance of SCWA's retail customers continue to be added/retrofitted, it is projected that nearly all customers will be metered by 2015. For those meters already in use, a large volume of water usage data has been collected for the purpose of billing (for older metered accounts a considerable amount of water usage data is available). For the purposes of this analysis historical meter data was obtained from the County Utilities Billing System (CUBS).

SCWA collects water usage data every two months. Accordingly, annual water use for each customer should be the total of the six readings recorded each year. In addition to water usage data, Assessor's Parcel Number (APN), and the zoning (land use) information are also available as part of the meter data set.

The historical meter data set was then used to evaluate the Zone 40 UWDFs. Specifically,

1) to develop UWDFs based on the SCWA's actual water usage data rather than the Sacramento regional average water usage developed more than a decade ago.
2) to validate the 2030 UWDFs that assume a 25.6 percent (relative to year 2000) reduction in water demand when implementing the water conservation practices recommendated in the WFA.

The resulting UWDF's from this analysis should provide SCWA staff with information relative to meeting the conservation targets set by the WFA and an ability to decide if changes should be made to the UWDFs represented in the water supply master plan.

METHODOLOGY

The meter data set was processed using Microsoft Access (Access). **Figure 1** shows a sample of the meter database. The first column is "ID", containing the sequence number for each record. The second column is "APN" number associated with each customer. APN number is also a field used to filter out customers that are not inside Zone 40. The third column is "ReadingDate" that shows the reading date for each record. The fourth column is "Reading" that shows the actual meter reading for each record in hundred cubic feet (ccf). The fifth column is "Consumption" that shows the water usage in cubic feet. The last column contains the Zoning information for each customer's property.

ID	APN	ReadingDc	Reading	Consumpti	Zoning
668679	12108001590000	10/10/2011	1959	1200	RD 7
668680	12108001590000	10/11/2011	1959	0	RD 7
668681	12108001590000	11/21/2011	1987	2800	RD 7
668682	12108001590000	1/18/2012	2006	1900	RD 7
668683	12108001590000	3/19/2012	2016	1000	RD 7
668684	12108001590000	5/18/2012	2035	1900	RD 7
668685	12108001590000	7/19/2012	2074	3900	RD 7
668686	12108001590000	9/19/2012	2111	3700	RD 7
668687	12108001590000	11/20/2012	2138	2700	RD 7
668688	12108001600000	8/10/2004	1393	0	RD 7
668689	12108001600000	11/19/2004	1463	7000	RD 7
668690	12108001600000	1/21/2005	1478	1500	RD 7
668691	12108001600000	3/17/2005	1501	2300	RD 7
668692	12108001600000	5/17/2005	1534	3300	RD 7
668693	12108001600000	7/20/2005	1599	6500	RD 7
668694	12108001600000	9/15/2005	1650	5100	RD 7
668695	12108001600000	11/17/2005	1693	4300	RD 7
668696	12108001600000	1/19/2006	1717	2400	RD 7
668697	12108001600000	3/16/2006	1731	1400	RD 7
668698	12108001600000	5/19/2006	1760	2900	RD 7
668699	12108001600000	7/20/2006	1822	6200	RD 7
668700	12108001600000	9/19/2006	1880	5800	RD 7
668701	12108001600000	11/16/2006	1917	3700	RD 7
668702	12108001600000	1/16/2007	1937	2000	RD 7
668703	12108001600000	3/13/2007	1954	1700	RD 7
668704	12108001600000	5/19/2007	1985	3100	RD 7
668705	12108001600000	7/20/2007	2043	5800	RD 7
668706	12108001600000	9/24/2007	2115	7200	RD 7
668707	12108001600000	11/20/2007	2150	3500	RD 7

Record: 1 of 2069208 No Filter Search

Figure 1. Sample of Meter Database

There are over 2 million records in the meter database. The meter data needs to be processed properly to assess the water usage of each land use category in a particular year. This was achieved by creating queries in Access. **Figure 2** shows an example of a query created for water ususage for property zoned RD 7 in 2012. For each meter account the query results shows its APN number, lot size, zoning, and total water usage. Average water usage and lot size are then calculated for all the filtered records. The UWDF is then calculated by diving the average water ususage by the average lot size. Figure 3 provides a screenshot of the above referenced query.

Similarily, the UWDFs for each residential land use catagory were calculated for 2005 through 2012. The UWDFs for non-residential land use were not calculated for this TM.

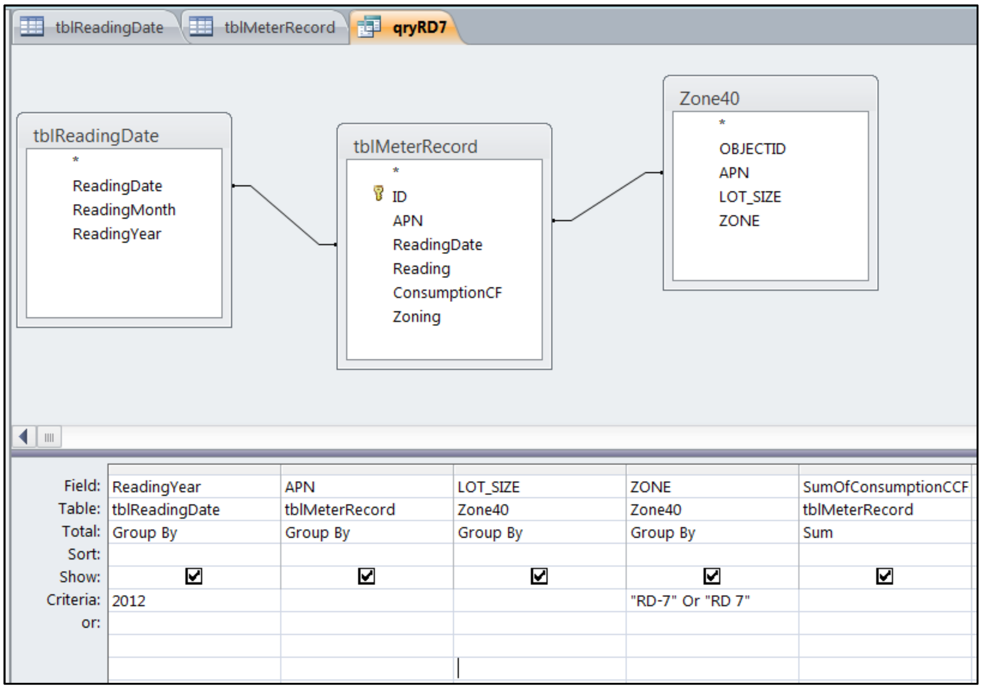


Figure 2. Example of Establishing A Query in the Meter Database

qryRD7

ReadingYear	APN	LOT_SIZE	ZONE	SumOfConsum
2012	06705400110000	5227	RD 7	13000
2012	06705400120000	9591	RD 7	17700
2012	06705400130000	5326	RD 7	12700
2012	06705400140000	5430	RD 7	11400
2012	06705400150000	5430	RD 7	29100
2012	06705400160000	5430	RD 7	25600
2012	06705400170000	5430	RD 7	15000
2012	06705400180000	4978	RD 7	11800
2012	06705400190000	4804	RD 7	19400
2012	06705400200000	6203	RD 7	29300
2012	06705400210000	7787	RD 7	36300
2012	06705400220000	5567	RD 7	4900
2012	06705400230000	5334	RD 7	17900
2012	06705400240000	6207	RD 7	21200
2012	06705400250000	7439	RD 7	27500
2012	06705400260000	6853	RD 7	25900
2012	06705400270000	4675	RD 7	9000
2012	06705400280000	4675	RD 7	66500
2012	06705400290000	4675	RD 7	17900
2012	06705400300000	4675	RD 7	28400
2012	06705400310000	5652	RD 7	32900
2012	06705400320000	4675	RD 7	18600
2012	06705400330000	4675	RD 7	14000
2012	06705400340000	4980	RD 7	23600
2012	06705400350000	5537	RD 7	19400
2012	06705400360000	5086	RD 7	11800
2012	06705400370000	5996	RD 7	35800
2012	06705400380000	6136	RD 7	26800
Total	9507	5899.6		17541.8

Record: 19 of 9507 No Filter Search

Number of Accounts

Average Lot Size (ft^2)

Average Water Usage (ft^3)

Figure 3. Sample Screenshot of the Query Result for RD 7 in 2012

UNIT WATER DEMAND FACTORS BASED ON METER DATA

The UWDF for each residential land use category for each year are shown in **Table 2** below. **Table 2** indicates that there is a significant variation in UWDFs which generally increase with dwelling density. For example, the UWDF is 1.31 Ac-Ft/Acre for RD 1, 2.66 Ac-Ft/Acre for RD 5, and 3.82 Ac-Ft/Acre for RD 20.

Another observation from **Table 2**, despite the varation certain dwelling density groups have UWDFs that are relatively close in value. Based on this “closeness” four residential categories were identified. They include:

1) Very low density residential (VLDR), for RD 1 and RD 2.
2) Low density residential (LDR), for RD 3 to RD 5.
3) Midium density residential (MDR), for RD 7 to RD 15, and
4) High density residential (HDR), for RD 20.

The UWDFs for these four categories are shown **in Figures 4 to 7**, respectively. **Figures 4** to **6** show that for lower density residential categories (MDR and below) the UWDFs increased from 2005 to

2008 and then trended down over the next four years. The trend generally coincides with impacts to the broad national and regional economy, but also could be attributed to the weather, rising water rates, as well as water conservation measures implemented by property owners. For higher density residential (see **Figure 7)** this trend is not repeated. In fact, the UWDF for higher density residential actually increased slightly over the past couple of years.

Table 2. Zone 40 Unit Water Demand Factors Based on Meter Data, Unit: Ac-Ft/Acre

Year	Very Low Density Residential (VLDR)		Low Density Residential (LDR)			Medium Density Residential (MDR)			High Density Residential (HDR)
	RD 1	RD 2	RD 3	RD 4	RD 5	RD 7	RD 10	RD 15	RD 20
2005	1.47	2.06	2.74	2.64	2.95	3.42	2.39	3.70	3.07
2006	1.62	2.10	2.69	3.01	3.22	3.76	3.43	3.66	3.77
2007	1.72	2.33	3.04	3.19	3.43	3.97	3.93	4.13	3.74
2008	1.72	2.35	2.97	3.14	3.34	3.86	3.83	3.11	4.07
2009	1.43	1.99	2.66	2.83	2.98	3.43	3.44	3.19	3.76
2010	1.35	1.86	2.45	2.57	2.73	3.13	3.22	3.20	3.60
2011	1.23	1.80	2.37	2.51	2.66	3.04	3.13	3.16	4.38
2012	1.31	1.99	2.55	2.54	2.66	2.97	2.93	2.96	3.82

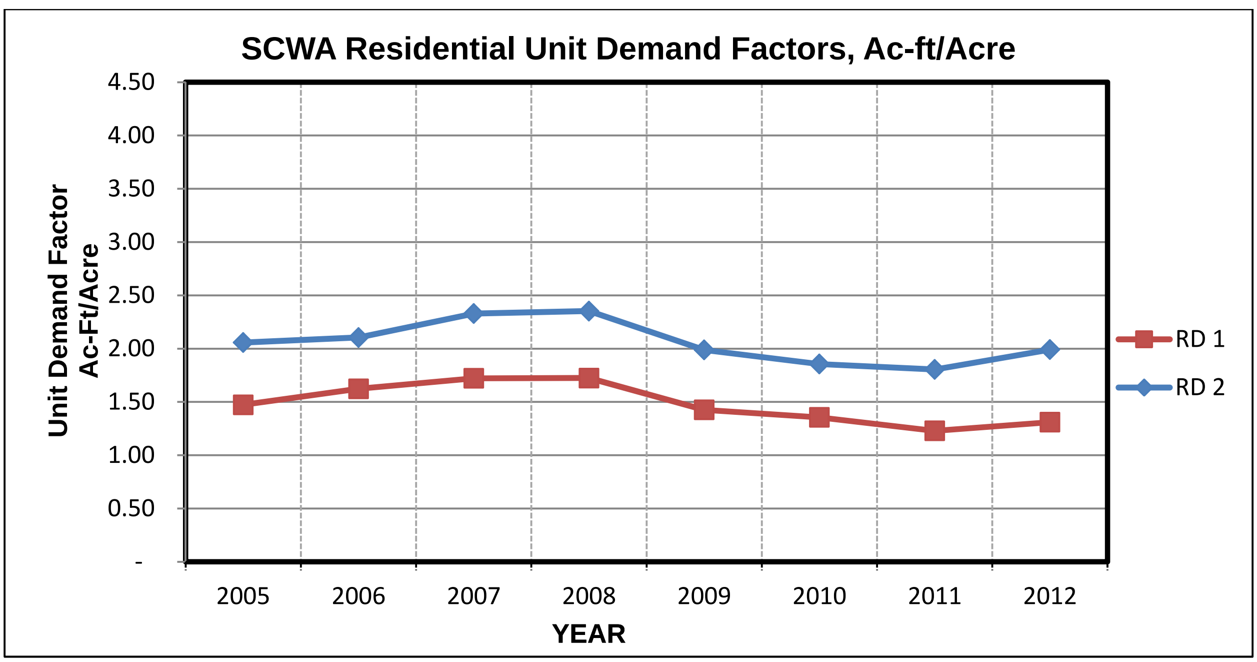


Figure 4. Unit Water Demand Factors for VLDR

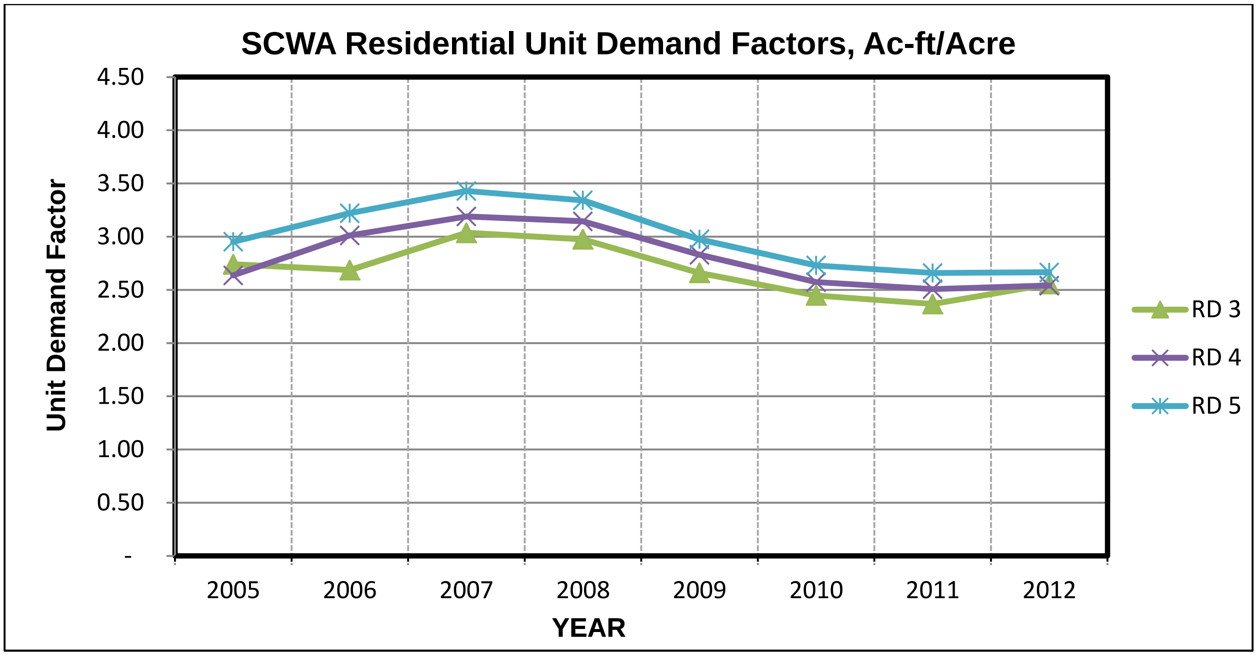


Figure 5. Unit Water Demand Factors for LDR

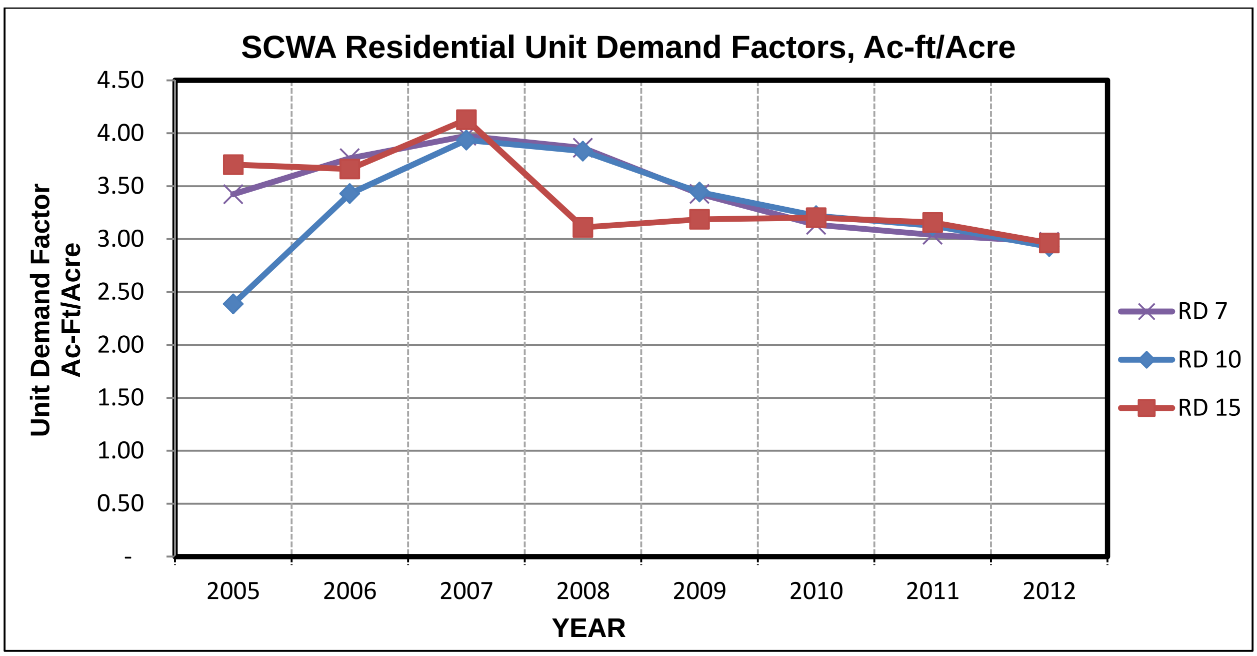


Figure 6. Unit Water Demand Factors for MDR

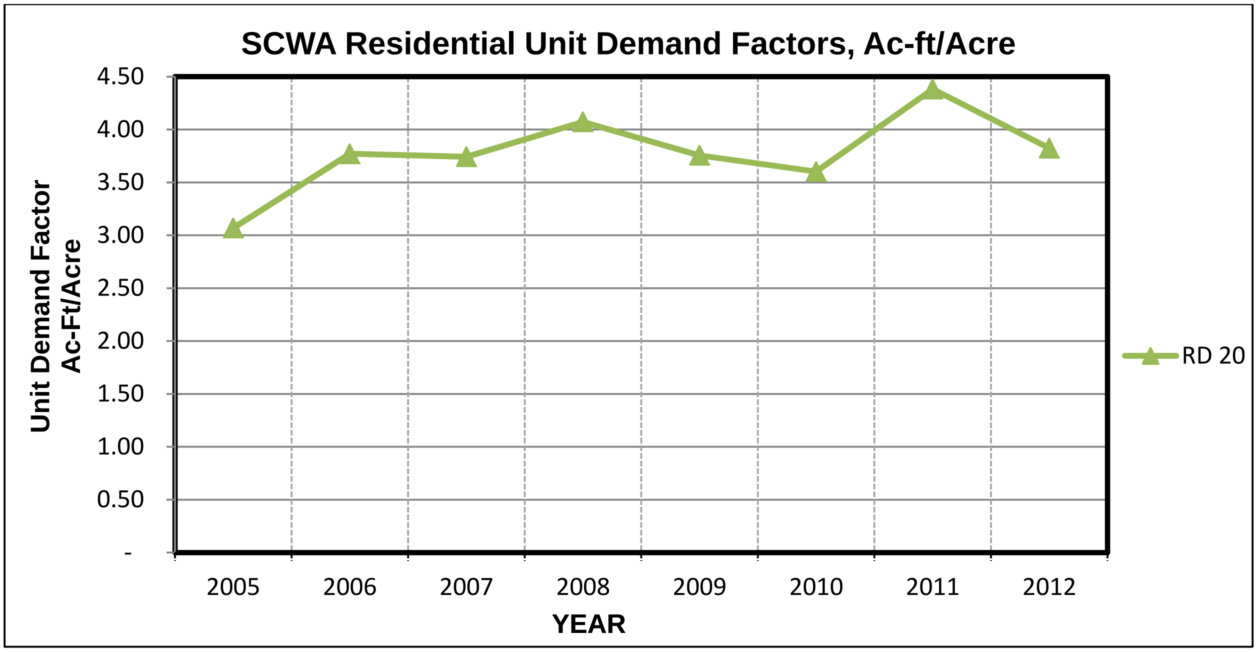


Figure 7. Unit Water Demand Factors for High Density Residential

Table 3 shows the total number of meter accounts for each zoning type from 2005 to 2012. The large majority of meter accounts are associated with RD 4, RD 5, and RD 7 zoning. In 2012, there were 32,930 meter accounts in Zone 40 that were used for this analysis. Of these accounts 0.5% were very low density residential, 64.4% were low density residential, 32.3% were medium density, and 2.7% were high density residential. **Table 4** shows the average lot size in square feet of each residential zoning type.

Table 3. Total Number of Residential Meter Accounts in Zone 40

Year	RD 1	RD 2	RD 3	RD 4	RD 5	RD 7	RD 10	RD 15	RD 20
2005	47	114	179	2,130	13,807	8,120	412	197	684
2006	48	116	200	2,441	15,385	8,853	773	228	737
2007	48	118	202	2,638	16,303	9,071	831	229	765
2008	48	118	209	2,782	16,808	9,302	875	235	868
2009	49	118	209	2,820	17,086	9,377	884	239	881
2010	48	118	209	2,894	17,421	9,423	893	239	887
2011	49	118	209	2,955	17,665	9,445	897	239	897
2012	49	118	209	3,024	17,983	9,507	899	239	902

Table 4. Average Residential Lot Size in Zone 40, 2005 – 2012 in Square Feet

Year	RD 1	RD 2	RD 3	RD 4	RD 5	RD 7	RD 10	RD 15	RD 20
2005	46,044	22,692	11,897	9,592	7,992	5,860	5,803	5,376	11,862
2006	46,292	22,685	11,750	9,720	7,952	5,846	5,267	5,281	11,653
2007	46,292	22,682	11,767	9,717	7,966	5,837	5,375	5,277	12,804
2008	46,292	22,682	11,888	9,738	7,956	5,841	5,380	6,681	11,814
2009	47,036	22,682	11,888	9,752	7,948	5,838	5,385	6,649	11,973
2010	46,292	22,682	11,888	9,777	7,928	5,898	5,372	6,649	11,913
2011	47,036	22,682	11,888	9,775	7,916	5,900	5,371	6,649	11,803
2012	47,036	22,682	11,888	9,770	7,897	5,900	5,373	6,649	12,453

In water supply planning, water demand estimates are typically performed by applying the UWDF to the acreage of a certain land use category. Most often, the density information (dwelling units per acre) are not specified in a land use map, particularly in the general plan process or early planning stages of a development project. Parcels planned for development are generally identified as "very low density residential", "low density residential", "medium density residential", or "high density residential". This necessitates the development of a composite UWDF to represent each category.

By using the information provided in **Tables 2** to **4**, a weighted average UWDF was developed for each category. Further, a three-year moving average was calculated for these composite UWDFs to take into account various hydrologic conditions and weather (see **Table 5)**. An average of the previous three years (as opposed to a longer period) is preferred because it is more representative of the current water use pattern as well as reflective of water conservation measures taken. Therefore, the numbers shown in the last row (highlighted) of **Table 5** are recommended as the current UWDF for each residential category.

Table 5. Three-Year Moving Average Unit Water Demand Factors in Ac-Ft/Acre

Year	Very Low Density Residential (VLDR)	Low Density Residential (LDR)	Midium Density Residential (MDR)	High Density Residential (HDR)
2005				
2006				
2007	2.00	3.15	3.70	3.53
2008	2.10	3.29	3.85	3.86
2009	2.05	3.21	3.75	3.86
2010	1.90	2.98	3.47	3.81
2011	1.72	2.76	3.20	3.91
2012	1.71	2.66	3.05	3.94

NET ACREAGE AND GROSS ACREAGE BASED UNIT WATER DEMAND FACTORS

Net acreage is defined as the acreage of all residential lots in a subdivision excluding minor streets. Gross acreage is defined as the total acreage of a subdivision including all residential lots and minor streets. Typically, approximately 20% of the land is dedicated to minor streets in a subdivision.

To calculate projected water demand for a subdivision, the UWDF corresponding to the planned land use category is multiplied by the acreage of a subdivision. If net acreage is used, then a net acreage based UWDF should be applied. Similarily, if the gross acreage is used then a gross acreage based UWDF should be applied.

The UWDFs developed from meter data and shown in **Table 5** are net acreage based. To convert to gross net acreage based value, the net acreage based UWDF should be reduced by 20% to take into account acreage for minor streets. **Table 6** shows the net acreage and gross acreage based UWDFs.

Table 6. Net Acreage and Gross Acreage Based Water Demand Factors in Ac-Ft/Acre

Land Use Category	Net Acreage Based	Gross Acreage Based
Very Low Density Residential (VLDR)	1.71	1.37
Low Density Residential (LDR)	2.66	2.13
Midium Density Residential (MDR)	3.05	2.44
High Density Residential (HDR)	3.94	3.15

COMPARISION TO WSMP

As mentioned earlier, the UWDF in the WSMP for build-out was developed based on a combination of regional water and land use data and an assumption of a 25.6% demand reduction as a result of conservation measures mandated by the WFA. By using extensive historical meter data, the UWDFs developed in this TM should give staff a higher level of confidence when evaluating future water demands and water supply reliablity. **Table 7** shows how UWDFs developed based on meter data in this TM compared to those in the current WSMP. It should be noted that the UWDFs in the WSMP are gross acreage based values.

As shown in **Table 7**, the UWDFs developed in this TM are lower than those in the WSMP, with the exception of the “very low density residential” category, which is only slightly higher. The UWDF of 2.89 Ac-Ft/Acre for “Single Family Residential” in the WSMP (corresponding ot “Low Density

Residential") is now 2.13 Ac-Ft/Acre based on meter data. The value for "Multi-Family Low Density" (corresponding to "Medium Density Residential") is 3.70 Ac-Ft/Acre in the WSMP as opposed to 2.44 Ac-Ft/Acre based on meter data. For "Multi-Family High Density" (corresponding to "High Density Residential") the value is 4.12 Ac-Ft/Acre in the WSMP compared to 3.15 Ac-ft/Acre based on meter data.

Table 7. Comparison of Unit Water Demand Factors between WSMP and This TM, in Ac-Ft/Acre

Land Use Category in WSMP	Land Use Category in This TM	2030 Unit Water Demand Factor in WSMP	Unit Water Demand Factor Based on Meter Data (Gross Acreage Based)
Rural Estate	Very Low Density Residential (VLDR)	1.33	1.37
Single Family	Low Density Residential (LDR)	2.89	2.13
Multi-Family - Low Density	Midium Density Residential (MDR)	3.70	2.44
Multi-Family - High Density	High Density Residential (HDR)	4.12	3.15

RECOMMENDATIONS

SCWA's meter database provides a extensive historical water use record of its customers. Using a sound statistical approach, along with the land use information in the meter database, a UWDF was developed for each residential density category. This process when compared to the approach taken in the 2005 WSMP has the following advantages:

- The meter data is unique to Zone 40
- The meter data covers a long period of time
- The UWDFs for buildout in the WSMP are projected or targeted numbers assuming a reduction of 25.6% of water use (relative to year 2000) due to improved conservation practices. The UWDFs based on meter data are not projected or targeted numbers instead, they represent the actual historical water use.

The resulting UWDFs indicate that those referenced in the WSMP were overestimated. It also indicates that SCWA has been moving in the right direction with regard to water conservation and demand management. It is recommended that the results documented in this TM should be considered for incorporation in future water supply master plan updates and other water planning documents.

For non-residential/commercial customers, the UWDFs have not been evaluated based on meter data in this TM, primarily due to low number of meter accounts and a greater variation in water use because of significant differences in commercial activities. It is recommended that the UWDFs currently described in the WSMP continue to be used for non-residential/commercial applications until more data becomes available.

Appendix B: Cost Estimates for CIP Projects

Zone 40 Water System Master Plan GWTP-1 Poppy Ridge GWTP Expansion

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 607,200
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Well Drilling and Casing	0	EA	$ 550,000	$ -
Well Pumping Equipment	3	EA	$ 100,000	$ 300,000
Well Piping and Valving	3	EA	$ 150,000	$ 450,000
Well Electrical and Instrumentation	3	EA	$ 200,000	$ 600,000
Groundwater Treatment Plant, FE & Mn Pressure Filters	6.5	MGD	$ 150,000	$ 975,000
Backwash Tank	1	EA	$ 300,000	$ 300,000
Backwash Pump	1	EA	$ 75,000	$ 75,000
Chemical Feed Equipment and Enclosure	1	LS	$ 50,000	$ 50,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Water Storage Tank	3.5	MG	$ 700,000	$ 2,450,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	17.0	MGD	$ 40,000	$ 680,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 8,197,200
Contingencies	1	LS	25%	$ 2,049,300
Engineering, Admin, and Legal	1	LS	25%	$ 2,561,625
Environmental & Permitting	1	LS	10%	$ 1,024,650
TOTAL				**$ 13,832,800**

Zone 40 Water System Master Plan P-1 NSA- Sunrise Blvd. Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume paved
16	-inch	7,371		$ 227	$ 1,673,300	
18	-inch		LF	$ 257	$ -	
20	-inch		LF	$ 264	$ -	
24	-inch		LF	$ 293	$ -	
30	-inch		LF	$ 370	$ -	
36	-inch		LF	$ 438	$ -	
42	-inch		LF	$ 510	$ -	
Butterfly Valves						
16	-inch	8	EA	$ 5,721	$ 45,800	
18	-inch	0	EA	$ 6,866	$ -	
20	-inch	0	EA	$ 7,896	$ -	
24	-inch	0	EA	$ 10,871	$ -	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		8	EA	$ 17,965	$ 143,720	
SUBTOTAL					$ 1,862,820	
Contingencies		1	LS	15%	$ 279,423	
Engineering		1	LS	8%	$ 171,379	
CMID		1	LS	10%	$ 214,224	
TOTAL					**$ 2,527,900**	

Zone 40 Water System Master Plan P-2 NSA- Rio del Oro Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch				$ -	
18 -inch		LF	$ 153	$ -	
20 -inch		LF	$ 166	$ -	
24 -inch	11,593	LF	$ 203	$ 2,353,386	
30 -inch		LF	$ 279	$ -	
36 -inch		LF	$ 342	$ -	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	12	EA	$ 10,871	$ 130,452	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	12	EA	$ 17,965	$ 215,580	
SUBTOTAL				$ 2,699,418	
Contingencies	1	LS	15%	$ 404,913	
Engineering	1	LS	8%	$ 248,346	
CMID	1	LS	10%	$ 310,433	
TOTAL				**$ 3,663,200**	

Zone 40 Water System Master Plan P-3 NSA- Kiefer Road Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume not paved
16	-inch	11,078		$ 134	$ 1,484,400	
18	-inch	6,124	LF	$ 153	$ 936,937	
20	-inch	6,669	LF	$ 166	$ 1,107,100	
24	-inch	2,306	LF	$ 203	$ 468,100	
30	-inch		LF	$ 279	$ -	
36	-inch		LF	$ 342	$ -	
42	-inch		LF	$ 406	$ -	
Butterfly Valves						
16	-inch	12	EA	$ 5,721	$ 68,700	
18	-inch	7	EA	$ 6,866	$ 48,062	
20	-inch	7	EA	$ 7,896	$ 55,272	
24	-inch	3	EA	$ 10,871	$ 32,613	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	500	LF	$ 1,361	$ 680,500	Folsom Canal crossing 18" pipe
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		27	EA	$ 17,965	$ 485,055	
SUBTOTAL					$ 5,366,739	
Contingencies		1	LS	15%	$ 805,011	
Engineering		1	LS	8%	$ 493,740	
CMID		1	LS	10%	$ 617,175	
TOTAL					**$ 7,282,700**	

Zone 40 Water System Master Plan P-4 NSA- Eagles Nest Road Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch				$ -	
18 -inch		LF	$ 153	$ -	
20 -inch	2,043	LF	$ 166	$ 339,200	
24 -inch		LF	$ 203	$ -	
30 -inch	5,196	LF	$ 279	$ 1,449,900	
36 -inch	1,807	LF	$ 342	$ 618,000	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	3	EA	$ 7,896	$ 23,688	
24 -inch	0	EA	$ 10,871	$ -	
30 -inch	6	EA	$ 20,711	$ 124,266	
36 -inch	2	EA	$ 25,061	$ 50,200	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	10	EA	$ 17,965	$ 179,650	
SUBTOTAL				$ 2,784,904	
Contingencies	1	LS	15%	$ 417,736	
Engineering	1	LS	8%	$ 256,211	
CMID	1	LS	10%	$ 320,264	
TOTAL				**$ 3,779,200**	

Zone 40 Water System Master Plan P-5 NSA-Ranch Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines			2020			Assume not paved
16	-inch			$ 134	$ -	
18	-inch		LF	$ 153	$ -	
20	-inch		LF	$ 166	$ -	
24	-inch	7,000	LF	$ 203	$ 1,421,000	
30	-inch		LF	$ 279	$ -	
36	-inch		LF	$ 342	$ -	
42	-inch		LF	$ 406	$ -	
Butterfly Valves						
16	-inch	0	EA	$ 5,721	$ -	
18	-inch	0	EA	$ 6,866	$ -	
20	-inch	0	EA	$ 7,896	$ -	
24	-inch	7	EA	$ 10,871	$ 76,097	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		7	EA	$ 17,965	$ 125,755	
SUBTOTAL					$ 1,622,852	
Contingencies		1	LS	15%	$ 243,428	
Engineering		1	LS	8%	$ 149,302	
CMID		1	LS	10%	$ 186,628	
TOTAL					**$ 2,202,300**	

Zone 40 Water System Master Plan P-6 NSA- Arboretum System

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume paved
16	-inch	3,167		$ 227	$ 719,000	
18	-inch		LF	$ 257	$ -	
20	-inch		LF	$ 264	$ -	
24	-inch		LF	$ 293	$ -	
30	-inch		LF	$ 370	$ -	
36	-inch		LF	$ 438	$ -	
42	-inch		LF	$ 510	$ -	
Butterfly Valves						
16	-inch	4	EA	$ 5,721	$ 22,900	
18	-inch	0	EA	$ 6,866	$ -	
20	-inch	0	EA	$ 7,896	$ -	
24	-inch	0	EA	$ 10,871	$ -	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		4	EA	$ 17,965	$ 71,860	
SUBTOTAL					$ 813,760	
Contingencies		1	LS	15%	$ 122,064	
Engineering		1	LS	8%	$ 74,866	
CMID		1	LS	10%	$ 93,582	
TOTAL					**$ 1,104,300**	

Zone 40 Water System Master Plan P-7 NSA- S. Jaeger Road Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch	5,238		$ 134	$ 701,900	
18 -inch		LF	$ 153	$ -	
20 -inch		LF	$ 166	$ -	
24 -inch		LF	$ 203	$ -	
30 -inch		LF	$ 279	$ -	
36 -inch		LF	$ 342	$ -	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	6	EA	$ 5,721	$ 34,400	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	0	EA	$ 10,871	$ -	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	6	EA	$ 17,965	$ 107,790	
SUBTOTAL				$ 844,090	
Contingencies	1	LS	15%	$ 126,614	
Engineering	1	LS	8%	$ 77,656	
CMID	1	LS	10%	$ 97,070	
TOTAL				**$ 1,145,500**	

Zone 40 Water System Master Plan P-8 NSA- East NSA System

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume not paved
16	-inch	27,571	LF	$ 134	$ 3,694,600	
18	-inch	3,489	LF	$ 153	$ 533,817	
20	-inch		LF	$ 166	$ -	
24	-inch	14,288	LF	$ 203	$ 2,900,464	
30	-inch	16,041	LF	$ 279	$ 4,475,500	
36	-inch		LF	$ 342	$ -	
42	-inch		LF	$ 406	$ -	
Butterfly Valves						
16	-inch	28	EA	$ 5,721	$ 160,200	
18	-inch	4	EA	$ 6,866	$ 27,464	
20	-inch	0	EA	$ 7,896	$ -	
24	-inch	15	EA	$ 10,871	$ 163,065	
30	-inch	17	EA	$ 20,711	$ 352,087	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		62	EA	$ 17,965	$ 1,113,830	
SUBTOTAL					$13,421,027	
Contingencies		1	LS	15%	$ 2,013,154	
Engineering		1	LS	8%	$ 1,234,734	
CMID		1	LS	10%	$ 1,543,418	
TOTAL					**$18,212,400**	

Zone 40 Water System Master Plan P-9 NSA- North Jaeger Road Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch				$ -	
18 -inch		LF	$ 153	$ -	
20 -inch		LF	$ 166	$ -	
24 -inch	6,365	LF	$ 203	$ 1,292,095	
30 -inch		LF	$ 279	$ -	
36 -inch		LF	$ 342	$ -	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	7	EA	$ 10,871	$ 76,097	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	7	EA	$ 17,965	$ 125,755	
SUBTOTAL				$ 1,493,947	
Contingencies	1	LS	15%	$ 224,092	
Engineering	1	LS	8%	$ 137,443	
CMID	1	LS	10%	$ 171,804	
TOTAL				**$ 2,027,300**	

Zone 40 Water System Master Plan P-11 CSA- Vineyard Road Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch	13,600	LF	$ 134	$ 1,822,400	
18 -inch		LF	$ 153	$ -	
20 -inch		LF	$ 166	$ -	
24 -inch		LF	$ 203	$ -	
30 -inch		LF	$ 279	$ -	
36 -inch		LF	$ 342	$ -	
42 -inch		LF	$ 406	$ -	
Butterfly Valves				$ -	
16 -inch	14	EA	$ 5,721	$ 80,100	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	0	EA	$ 10,871	$ -	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	14	EA	$ 17,965	$ 251,510	
SUBTOTAL				$ 2,154,010	
Contingencies	1	LS	15%	$ 323,102	
Engineering	1	LS	8%	$ 198,169	
CMID	1	LS	10%	$ 247,711	
TOTAL				**$ 2,923,000**	

Zone 40 Water System Master Plan P-12 CSA- Fruitridge Road Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume paved
16 -inch	7,982	LF	$ 227	$ 1,812,000	
18 -inch		LF	$ 257	$ -	
20 -inch		LF	$ 264	$ -	
24 -inch		LF	$ 293	$ -	
30 -inch		LF	$ 370	$ -	
36 -inch		LF	$ 438	$ -	
42 -inch		LF	$ 510	$ -	Installation in Major Arterials - Fruitridge Road
Butterfly Valves				$ -	
16 -inch	8	EA	$ 5,721	$ 45,800	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	0	EA	$ 10,871	$ -	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	8	EA	$ 17,965	$ 143,720	
SUBTOTAL				$ 2,001,520	
Contingencies	1	LS	15%	$ 300,228	
Engineering	1	LS	8%	$ 184,140	
CMID	1	LS	10%	$ 230,175	
TOTAL				**$ 2,716,100**	

Zone 40 Water System Master Plan P-13 CSA- Elder Creek Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume paved
16	-inch	10,070	LF	$ 227	$ 2,285,900	
18	-inch		LF	$ 257	$ -	
20	-inch		LF	$ 264	$ -	
24	-inch	5,245	LF	$ 293	$ 1,536,785	
30	-inch	5,861	LF	$ 370	$ 2,168,600	
36	-inch	167	LF	$ 438	$ 73,200	
42	-inch		LF	$ 510	$ -	Installation in Major Arterials - Elder Creek Road
Butterfly Valves					$ -	
16	-inch	11	EA	$ 5,721	$ 63,000	
18	-inch	0	EA	$ 6,866	$ -	
20	-inch	0	EA	$ 7,896	$ -	
24	-inch	6	EA	$ 10,871	$ 65,226	
30	-inch	6	EA	$ 20,711	$ 124,266	
36	-inch	1	EA	$ 25,061	$ 25,100	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		22	EA	$ 17,965	$ 395,230	
SUBTOTAL					$ 6,737,307	
Contingencies		1	LS	15%	$ 1,010,596	
Engineering		1	LS	8%	$ 619,832	
CMID		1	LS	10%	$ 774,790	
TOTAL					**$ 9,142,600**	

Zone 40 Water System Master Plan P-14 CSA- Bradshaw Road Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume paved
16	-inch	5,267	LF	$ 227	$ 1,195,700	
18	-inch		LF	$ 257	$ -	
20	-inch		LF	$ 264	$ -	
24	-inch	5,332	LF	$ 293	$ 1,562,276	
30	-inch		LF	$ 370	$ -	
36	-inch		LF	$ 438	$ -	
42	-inch		LF	$ 510	$ -	Installation in Major Arterials - Bradshaw Blvd.
Butterfly Valves					$ -	
16	-inch	6	EA	$ 5,721	$ 34,400	
18	-inch	0	EA	$ 6,866	$ -	
20	-inch	0	EA	$ 7,896	$ -	
24	-inch	6	EA	$ 10,871	$ 65,226	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	200	LF	$ 1,361	$ 272,200	16" crossing under creek
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		11	EA	$ 17,965	$ 197,615	
SUBTOTAL					$ 3,327,417	
Contingencies		1	LS	15%	$ 499,113	
Engineering		1	LS	8%	$ 306,122	
CMID		1	LS	10%	$ 382,653	
TOTAL					**$ 4,515,400**	

Zone 40 Water System Master Plan P-15 CSA- North Vineyard Station (Florin to Gerber)

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch				$ -	
18 -inch		LF	$ 153	$ -	
20 -inch		LF	$ 166	$ -	
24 -inch	7,853	LF	$ 203	$ 1,594,159	
30 -inch	1,337	LF	$ 279	$ 373,100	
36 -inch	2,657	LF	$ 342	$ 908,700	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	8	EA	$ 10,871	$ 86,968	
30 -inch	2	EA	$ 20,711	$ 41,422	
36 -inch	3	EA	$ 25,061	$ 75,200	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	300	LF	$ 1,361	$ 408,300	24" pipe across RR
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	12	EA	$ 17,965	$ 215,580	
SUBTOTAL				$ 3,703,429	
Contingencies	1	LS	15%	$ 555,514	
Engineering	1	LS	8%	$ 340,715	
CMID	1	LS	10%	$ 425,894	
TOTAL				**$ 5,025,600**	

Zone 40 Water System Master Plan P-16 CSA- South Watt Connect Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume paved
16 -inch				$ -	
18 -inch		LF	$ 257	$ -	
20 -inch		LF	$ 264	$ -	
24 -inch	2,693	LF	$ 293	$ 789,184	
30 -inch		LF	$ 370	$ -	
36 -inch		LF	$ 438	$ -	
42 -inch		LF	$ 510	$ -	Installation in Major Arterials - South Watt
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	3	EA	$ 10,871	$ 32,613	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	300	LF	$ 1,361	$ 408,300	24" pipe across RR
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	3	EA	$ 17,965	$ 53,895	
SUBTOTAL				$ 1,283,992	
Contingencies	1	LS	15%	$ 192,599	
Engineering	1	LS	8%	$ 118,127	
CMID	1	LS	10%	$ 147,659	
TOTAL				**$ 1,742,400**	

Zone 40 Water System Master Plan P-17 CSA- CSA Backbone

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume paved
16 -inch				$ -	
18 -inch		LF	$ 257	$ -	
20 -inch		LF	$ 264	$ -	
24 -inch	4,525	LF	$ 293	$ 1,325,825	
30 -inch	5,423	LF	$ 370	$ 2,006,600	
36 -inch		LF	$ 438	$ -	
42 -inch		LF	$ 510	$ -	Installation in Major Arterials - Bradshaw
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	5	EA	$ 10,871	$ 54,355	
30 -inch	6	EA	$ 20,711	$ 124,266	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	10	EA	$ 17,965	$ 179,650	
SUBTOTAL				$ 3,690,696	
Contingencies	1	LS	15%	$ 553,604	
Engineering	1	LS	8%	$ 339,544	
CMID	1	LS	10%	$ 424,430	
TOTAL				**$ 5,008,300**	

Zone 40 Water System Master Plan P-18 CSA- Elk Grove Loop Connector Pipelines

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume paved
16 -inch	8,340	LF	$ 227	$ 1,893,180	Add 1,700 ft per Carlos' TM figure. Bob's map shows 12 in.
18 -inch		LF	$ 257	$ -	
20 -inch		LF	$ 264	$ -	
24 -inch	2,982	LF	$ 293	$ 873,726	
30 -inch		LF	$ 370	$ -	
36 -inch		LF	$ 438	$ -	
42 -inch		LF	$ 510	$ -	Installation in Major Arterials - Bradshaw and Grantline
Butterfly Valves					
16 -inch	9	EA	$ 5,721	$ 51,500	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	3	EA	$ 10,871	$ 32,613	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	300	LF	$ 1,361	$ 408,300	24" under railroad
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	12	EA	$ 17,965	$ 215,580	
SUBTOTAL				$ 3,474,899	
Contingencies	1	LS	15%	$ 521,235	
Engineering	1	LS	8%	$ 319,691	
CMID	1	LS	10%	$ 399,613	
TOTAL				**$ 4,715,500**	

Zone 40 Water System Master Plan P-19 CSA- Power Inn Road Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume paved
16	-inch				$ -	
18	-inch		LF	$ 257	$ -	
20	-inch		LF	$ 264	$ -	
24	-inch	1,273	LF	$ 293	$ 372,905	
30	-inch		LF	$ 370	$ -	
36	-inch		LF	$ 438	$ -	
42	-inch		LF	$ 510	$ -	
Butterfly Valves						
16	-inch	0	EA	$ 5,721	$ -	
18	-inch	0	EA	$ 6,866	$ -	
20	-inch	0	EA	$ 7,896	$ -	
24	-inch	2	EA	$ 10,871	$ 21,742	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		2	EA	$ 17,965	$ 35,930	
SUBTOTAL					$ 430,577	
Contingencies		1	LS	15%	$ 64,587	
Engineering		1	LS	8%	$ 39,613	
CMID		1	LS	10%	$ 49,516	
TOTAL					**$ 584,300**	

Zone 40 Water System Master Plan P-20 SSA- Big Horn to Kammerer Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch				$ -	
18 -inch		LF	$ 153	$ -	
20 -inch	7,832	LF	$ 166	$ 1,300,200	
24 -inch	1,347	LF	$ 203	$ 273,441	
30 -inch		LF	$ 279	$ -	
36 -inch		LF	$ 342	$ -	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	8	EA	$ 7,896	$ 63,168	
24 -inch	2	EA	$ 10,871	$ 21,742	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	10	EA	$ 17,965	$ 179,650	
SUBTOTAL				$ 1,838,201	
Contingencies	1	LS	15%	$ 275,730	
Engineering	1	LS	8%	$ 169,114	
CMID	1	LS	10%	$ 211,393	
TOTAL				**$ 2,494,500**	

Zone 40 Water System Master Plan P-21 SSA- Bruceville Road Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume paved
16 -inch				$ -	
18 -inch	1,267	LF	$ 257	$ 325,681	
20 -inch		LF	$ 264	$ -	
24 -inch		LF	$ 293	$ -	
30 -inch		LF	$ 370	$ -	
36 -inch		LF	$ 438	$ -	
42 -inch		LF	$ 510	$ -	Installation in Major Arterials - Bruceville Road
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	2	EA	$ 6,866	$ 13,732	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	0	EA	$ 10,871	$ -	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	2	EA	$ 17,965	$ 35,930	
SUBTOTAL				$ 375,343	
Contingencies	1	LS	15%	$ 56,301	
Engineering	1	LS	8%	$ 34,532	
CMID	1	LS	10%	$ 43,164	
TOTAL				**$ 509,400**	

Zone 40 Water System Master Plan P-22 NSA- North Grant Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch				$ -	
18 -inch		LF	$ 153	$ -	
20 -inch	14,000	LF	$ 166	$ 2,324,000	
24 -inch	3,000	LF	$ 203	$ 609,000	
30 -inch		LF	$ 279	$ -	
36 -inch		LF	$ 342	$ -	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	14	EA	$ 7,896	$ 110,544	
24 -inch	3	EA	$ 10,871	$ 32,613	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	17	EA	$ 17,965	$ 305,405	
SUBTOTAL				$ 3,381,562	
Contingencies	1	LS	15%	$ 507,234	
Engineering	1	LS	8%	$ 311,104	
CMID	1	LS	10%	$ 388,880	
TOTAL				**$ 4,588,800**	

Zone 40 Water System Master Plan P-23 CSA- Florin-Watt Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume paved
16	-inch				$ -	
18	-inch		LF	$ 257	$ -	
20	-inch	5,000	LF	$ 264	$ 1,320,000	
24	-inch	5,000	LF	$ 293	$ 1,465,000	
30	-inch		LF	$ 370	$ -	
36	-inch		LF	$ 438	$ -	
42	-inch		LF	$ 510	$ -	
Butterfly Valves						
16	-inch	0	EA	$ 5,721	$ -	
18	-inch	0	EA	$ 6,866	$ -	
20	-inch	5	EA	$ 7,896	$ 39,480	
24	-inch	5	EA	$ 10,871	$ 54,355	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		10	EA	$ 17,965	$ 179,650	
SUBTOTAL					$ 3,058,485	
Contingencies		1	LS	15%	$ 458,773	
Engineering		1	LS	8%	$ 281,381	
CMID		1	LS	10%	$ 351,726	
TOTAL					**$ 4,150,400**	

Zone 40 Water System Master Plan P-24 CSA- North Waterman Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume not paved
16 -inch	3,000	LF	$ 134	$ 402,000	
18 -inch		LF	$ 153	$ -	
20 -inch		LF	$ 166	$ -	
24 -inch		LF	$ 203	$ -	
30 -inch		LF	$ 279	$ -	
36 -inch		LF	$ 342	$ -	
42 -inch		LF	$ 406	$ -	
Butterfly Valves					
16 -inch	3	EA	$ 5,721	$ 17,200	
18 -inch	0	EA	$ 6,866	$ -	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	0	EA	$ 10,871	$ -	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	0	EA	$ 17,965	$ -	
SUBTOTAL				$ 419,200	
Contingencies	1	LS	15%	$ 62,880	
Engineering	1	LS	8%	$ 38,566	
CMID	1	LS	10%	$ 48,208	
TOTAL				**$ 568,900**	

Zone 40 Water System Master Plan P-25 CSA- Sheldon-Waterman Pipeline

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total	Remarks
Pipelines					Assume paved
16 -inch				$ -	
18 -inch	11,000	LF	$ 257	$ 2,827,000	
20 -inch		LF	$ 264	$ -	
24 -inch	4,000	LF	$ 293	$ 1,172,000	
30 -inch		LF	$ 370	$ -	
36 -inch		LF	$ 438	$ -	
42 -inch		LF	$ 510	$ -	
Butterfly Valves					
16 -inch	0	EA	$ 5,721	$ -	
18 -inch	11	EA	$ 6,866	$ 75,526	
20 -inch	0	EA	$ 7,896	$ -	
24 -inch	4	EA	$ 10,871	$ 43,484	
30 -inch	0	EA	$ 20,711	$ -	
36 -inch	0	EA	$ 25,061	$ -	
42 -inch	0	EA	$ 34,444	$ -	
Horizontal Drilling					
30 -inch Casing	0	LF	$ 1,361	$ -	
36 -inch Casing	0	LF	$ 1,361	$ -	
42 -inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly	4	EA	$ 17,965	$ 71,860	
SUBTOTAL				$ 4,189,870	
Contingencies	1	LS	15%	$ 628,481	
Engineering	1	LS	8%	$ 385,468	
CMID	1	LS	10%	$ 481,835	
TOTAL				**$ 5,685,700**	

Zone 40 Water System Master Plan P-26 SSA- South East Policy Area Pipeline

Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total	Remarks
Pipelines						Assume not paved
16	-inch				$ -	
18	-inch	3,000	LF	$ 153	$ 459,000	
20	-inch	14,000	LF	$ 166	$ 2,324,000	
24	-inch	5,000	LF	$ 203	$ 1,015,000	
30	-inch		LF	$ 279	$ -	
36	-inch		LF	$ 342	$ -	
42	-inch		LF	$ 406	$ -	
Butterfly Valves						
16	-inch	0	EA	$ 5,721	$ -	
18	-inch	3	EA	$ 6,866	$ 20,598	
20	-inch	14	EA	$ 7,896	$ 110,544	
24	-inch	5	EA	$ 10,871	$ 54,355	
30	-inch	0	EA	$ 20,711	$ -	
36	-inch	0	EA	$ 25,061	$ -	
42	-inch	0	EA	$ 34,444	$ -	
Horizontal Drilling						
30	-inch Casing	0	LF	$ 1,361	$ -	
36	-inch Casing	0	LF	$ 1,361	$ -	
42	-inch Casing	0	LF	$ 1,902	$ -	
Blow-Off Assembly		19	EA	$ 17,965	$ 341,335	
SUBTOTAL					$ 4,324,832	
Contingencies		1	LS	15%	$ 648,725	
Engineering		1	LS	8%	$ 397,885	
CMID		1	LS	10%	$ 497,356	
TOTAL					**$ 5,868,800**	

Zone 40 Water System Master Plan GWTP-2 West Jackson GWTP

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 1,270,000
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Well Drilling and Casing	5	EA	$ 550,000	$ 2,750,000
Well Pumping Equipment	5	EA	$ 100,000	$ 500,000
Well Piping and Valving	5	EA	$ 150,000	$ 750,000
Well Electrical and Instrumentation	5	EA	$ 200,000	$ 1,000,000
Groundwater Treatment Plant, FE&Mn Pressure Filters	18	MGD	$ 150,000	$ 2,700,000
Backwash Tank	1	EA	$ 300,000	$ 300,000
Backwash Pump	1	EA	$ 75,000	$ 75,000
Chemical Feed Equipment and Enclosure	1	LS	$ 50,000	$ 50,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Water Storage Tank	4	MG	$ 700,000	$ 2,800,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	21.6	MGD	$ 150,000	$ 3,240,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 17,145,000
Contingencies	1	LS	25%	$ 4,286,250
Engineering, Admin, and Legal	1	LS	25%	$ 5,357,813
Environmental & Permitting	1	LS	10%	$ 2,143,125
TOTAL				**$ 28,932,200**

Zone 40 Water System Master Plan GWTP-3 Bond GWTP

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 646,400
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Well Drilling and Casing	3	EA	$ 550,000	$ 1,650,000
Well Pumping Equipment	3	EA	$ 100,000	$ 300,000
Well Piping and Valving	3	EA	$ 150,000	$ 450,000
Well Electrical and Instrumentation	3	EA	$ 200,000	$ 600,000
Groundwater Treatment Plant, FE&Mn Pressure Filters	6.5	MGD	$ 150,000	$ 975,000
Backwash Tank	1	EA	$ 300,000	$ 300,000
Backwash Pump	1	EA	$ 75,000	$ 75,000
Chemical Feed Equipment and Enclosure	1	LS	$ 50,000	$ 50,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Water Storage Tank	0.5	MG	$ 700,000	$ 350,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	10.8	MGD	$ 150,000	$ 1,620,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 8,726,400
Contingencies	1	LS	25%	$ 2,181,600
Engineering, Admin, and Legal	1	LS	25%	$ 2,727,000
Environmental & Permitting	1	LS	10%	$ 1,090,800
TOTAL				**$ 14,725,800**

Zone 40 Water System Master Plan GWTP-4 East Elk Grove GWTP Expansion

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 600,800
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Well Drilling and Casing	2	EA	$ 550,000	$ 1,100,000
Well Pumping Equipment	3	EA	$ 100,000	$ 300,000
Well Piping and Valving	3	EA	$ 150,000	$ 450,000
Well Electrical and Instrumentation	3	EA	$ 200,000	$ 600,000
Groundwater Treatment Plant, FE&Mn Pressure Filters	6.5	MGD	$ 150,000	$ 975,000
Backwash Tank	1	EA	$ 300,000	$ 300,000
Backwash Pump	1	EA	$ 75,000	$ 75,000
Chemical Feed Equipment and Enclosure	1	LS	$ 50,000	$ 50,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Water Storage Tank	0	MG	$ 700,000	$ -
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	13	MGD	$ 150,000	$ 1,950,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 8,110,800
Contingencies	1	LS	25%	$ 2,027,700
Engineering, Admin, and Legal	1	LS	25%	$ 2,534,625
Environmental & Permitting	1	LS	10%	$ 1,013,850
TOTAL				**$ 13,687,000**

Zone 40 Water System Master Plan GWTP-5 Franklin GWTP

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 814,000
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Well Drilling and Casing	1	EA	$ 550,000	$ 550,000
Well Pumping Equipment	4	EA	$ 100,000	$ 400,000
Well Piping and Valving	4	EA	$ 150,000	$ 600,000
Well Electrical and Instrumentation	4	EA	$ 200,000	$ 800,000
Groundwater Treatment Plant, FE&Mn Pressure Filters	7	MGD	$ 150,000	$ 1,050,000
Backwash Tank	1	EA	$ 300,000	$ 300,000
Backwash Pump	1	EA	$ 75,000	$ 75,000
Chemical Feed Equipment and Enclosure	1	LS	$ 50,000	$ 50,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Water Storage Tank	2.0	MG	$ 700,000	$ 1,400,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	21.6	MGD	$ 150,000	$ 3,240,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 10,989,000
Contingencies	1	LS	25%	$ 2,747,250
Engineering, Admin, and Legal	1	LS	25%	$ 3,434,063
Environmental & Permitting	1	LS	10%	$ 1,373,625
TOTAL				**$ 18,544,000**

Zone 40 Water System Master Plan GWTP-6 Whitelock GWTP

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 1,147,600
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Well Drilling and Casing	6	EA	$ 550,000	$ 3,300,000
Well Pumping Equipment	6	EA	$ 100,000	$ 600,000
Well Piping and Valving	6	EA	$ 150,000	$ 900,000
Well Electrical and Instrumentation	6	EA	$ 200,000	$ 1,200,000
Groundwater Treatment Plant, FE&Mn Pressure Filters	13.0	MGD	$ 150,000	$ 1,950,000
Backwash Tank	1	EA	$ 300,000	$ 300,000
Backwash Pump	1	EA	$ 75,000	$ 75,000
Chemical Feed Equipment and Enclosure	1	LS	$ 50,000	$ 50,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Water Storage Tank	3.0	MG	$ 700,000	$ 2,100,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	14.4	MGD	$ 150,000	$ 2,160,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 15,492,600
Contingencies	1	LS	25%	$ 3,873,150
Engineering, Admin, and Legal	1	LS	25%	$ 4,841,438
Environmental & Permitting	1	LS	10%	$ 1,936,575
TOTAL				**$ 26,143,800**

Zone 40 Water System Master Plan GWTP-7 Big Horn GWTP Expansion

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	$ 1	LS	8.00%	$ 647,200
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Well Drilling and Casing	4	EA	$ 550,000	$ 2,200,000
Well Pumping Equipment	4	EA	$ 100,000	$ 400,000
Well Piping and Valving	4	EA	$ 150,000	$ 600,000
Well Electrical and Instrumentation	4	EA	$ 200,000	$ 800,000
Groundwater Treatment Plant, FE&Mn Pressure Filters	8.5	MGD	$ 150,000	$ 1,275,000
Backwash Tank	1	EA	$ 300,000	$ 300,000
Backwash Pump	1	EA	$ 75,000	$ 75,000
Chemical Feed Equipment and Enclosure	1	LS	$ 50,000	$ 50,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Water Storage Tank		MG	$ 700,000	$ -
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	17.0	MGD	$ 40,000	$ 680,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 8,737,200
Contingencies	1	LS	25%	$ 2,184,300
Engineering, Admin, and Legal	1	LS	25%	$ 2,730,375
Environmental & Permitting	1	LS	10%	$ 1,092,150
TOTAL				**$ 14,744,100**

Zone 40 Water System Master Plan SW-2 City POU Water Supply Facilities
Sacramento County Water Agency

Project Element		Quantity	Unit	Unit Cost	Total
Mobilization		1	LS	8.00%	$ 85,072
Pipelines					
16	-inch		LF		$ -
18	-inch		LF		$ -
20	-inch		LF		$ -
24	-inch		LF		$ -
30	-inch		LF		$ -
36	-inch	13,000	LF		$ -
42	-inch		LF	$ 438	$ -
Installation in Major Arterials		1	EA	10.00%	$ -
Butterfly Valves					
16	-inch	0	EA		$ -
18	-inch	0	EA		$ -
20	-inch	0	EA		$ -
24	-inch	13	EA	$ 25,061	$ 325,793
30	-inch	0	EA		$ -
36	-inch	13	EA		$ -
42	-inch	0	EA		$ -
Horizontal Drilling					
30	-inch Casing	0	LF	$ -	$ -
36	-inch Casing	0	LF	$ -	$ -
42	-inch Casing	300	LF	$ 1,902	$ 570,600
Trench Restoration					
Paved		58,500	SF	$ 2	$ 117,000
Blow-Off Assembly		0	EA		$ -
Fire Hydrants		0	EA		$ -
Connection to (E) System		1	EA	$ 50,000	$ 50,000
Abandonment Exist Pipe		0	EA		$ -
Property Acquisition		0	ACRE		$ -
Railroad Crossing Permitting		1	EA	10%	$ 57,060
Canal Crossing Permitting		0	EA	10%	$ -
Highway Crossing Permitting		0	EA	10%	$ -
SUBTOTAL					$1,205,525
Contingencies		1	LS	25%	$ 301,381
Engineering, Admin, and Legal		1	LS	25%	$ 376,727
Environmental & Permitting		1	LS	10%	$ 150,691
TOTAL					**$2,034,400**

Zone 40 Water System Master Plan S-2 Suncreek Storage

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 520,800
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Water Storage Tank	3	MG	$ 700,000	$ 2,100,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	18.0	MGD	$ 150,000	$ 2,700,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 7,030,800
Contingencies	1	LS	25%	$ 1,757,700
Engineering, Admin, and Legal	1	LS	25%	$ 2,197,125
Environmental & Permitting	1	LS	10%	$ 878,850
TOTAL				**$ 11,864,500**

Zone 40 Water System Master Plan S-3 Cordova Hills Storage

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 564,000
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Water Storage Tank	3	MG	$ 700,000	$ 2,100,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	21.6	MGD	$ 150,000	$ 3,240,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 7,614,000
Contingencies	1	LS	25%	$ 1,903,500
Engineering, Admin, and Legal	1	LS	25%	$ 2,379,375
Environmental & Permitting	1	LS	10%	$ 951,750
TOTAL				**$12,848,700**

Zone 40 Water System Master Plan S-4 White Rock Road Storage

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 477,600
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Water Storage Tank	3.0	MG	$ 700,000	$ 2,100,000
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	14.4	MGD	$ 150,000	$ 2,160,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 6,447,600
Contingencies	1	LS	25%	$ 1,611,900
Engineering, Admin, and Legal	1	LS	25%	$ 2,014,875
Environmental & Permitting	1	LS	10%	$ 805,950
TOTAL				**$ 10,880,400**

Zone 40 Water System Master Plan S-5 North Vineyard Station Storage

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 240,000
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Water Storage Tank	0	MG	$ 700,000	$ -
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	8.6	MGD	$ 150,000	$ 1,290,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 3,240,000
Contingencies	1	LS	25%	$ 810,000
Engineering, Admin, and Legal	1	LS	25%	$ 1,012,500
Environmental & Permitting	1	LS	10%	$ 405,000
TOTAL				**$ 5,467,500**

Zone 40 Water System Master Plan S-6 Calvine Meadows Pump Station Expansion

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	8.00%	$ 223,200
Site Grading, Paving, and Landscaping	1	LS	$ 300,000	$ 300,000
Water Storage Tank	0	MG	$ 700,000	$ -
Pump Station Building	1	LS	$ 300,000	$ 300,000
Pumps and Motors	7.2	MGD	$ 150,000	$ 1,080,000
Standby Generator	1	EA	$ 400,000	$ 400,000
Pump Station Electrical and Instrumentation	1	LS	$ 400,000	$ 400,000
Yard Piping	1	LS	$ 300,000	$ 300,000
Connection to (E) System	1	EA	$ 10,000	$ 10,000
Property Acquisition	0	ACRE		$ -
SUBTOTAL				$ 3,013,200
Contingencies	1	LS	25%	$ 753,300
Engineering, Admin, and Legal	1	LS	25%	$ 941,625
Environmental & Permitting	1	LS	10%	$ 376,650
TOTAL				**$ 5,084,800**

Zone 40 Water System Infrastructure Plan Phases 2 and 3 Pipelines

Sacramento County Water Agency

Project Element	Quantity	Unit	Unit Cost	Total
Pipelines				
16 -inch	165,716	LF	$ 227	$ 37,617,700
18 -inch	14,351	LF	$ 257	$ 3,688,326
20 -inch	-	LF	$ 264	$ -
24 -inch	67,876	LF	$ 293	$ 19,887,607
30 -inch	5,305	LF	$ 370	$ 1,962,800
36 -inch	29,502	LF	$ 438	$ 12,921,900
42 -inch	3,371	LF	$ 510	$ 1,719,300
54 -inch	40,704	LF	$ 767	$ 31,220,000
Installation in Major Arterials		EA	10.00%	$ -
Butterfly Valves				
16 -inch	166	EA	$ 6,866	$ 1,139,800
18 -inch	15	EA	$ 7,896	$ 118,440
20 -inch	0	EA	$ 10,871	$ -
24 -inch	68	EA	$ 20,711	$ 1,408,348
30 -inch	6	EA	$ 25,061	$ 150,366
36 -inch	30	EA	$ 34,444	$ 1,033,400
42 -inch	4	EA	$ 52,409	$ 209,700
54 -inch	41	LF	$ 81,362	$ 3,335,900
Horizontal Drilling				
30 -inch Casing	0	LF	$ 1,361	$ -
36 -inch Casing	0	LF	$ 1,361	$ -
42 -inch Casing	0	LF	$ 1,902	$ -
Trench Restoration				
Paved	920,983	SF	$ 2	$ 1,841,966
Blow-Off Assembly	0	EA		$ -
Fire Hydrants	0	EA		$ -
Connection to (E) System	0	EA	$ 10,000	$ -
Abandonment Exist Pipe	0	EA		$ -
Property Acquisition	0	ACRE		$ -
Railroad Crossing Permitting	0	EA	10%	$ -
Highway Crossing Permitting	0	EA	10%	$ -
Highway Crossing Permitting	0	EA	10%	$ -
SUBTOTAL				$ 118,255,553
Contingencies	1	LS	25%	$ 29,563,888
Engineering, Admin, and Legal	1	LS	25%	$ 36,954,860
Environmental & Permitting	1	LS	10%	$ 14,781,944
TOTAL				**$ 199,556,300**

Appendix C: Land Use Information

Table 1. Comparison of Land Use Categories	
Land use categories (used in this report)	Land use categories from other planning documents
Rural Estate	A 2, A 5 (PD), A 10
	AR 1, AR 2, AR-2, AR 5, AR 7
	AR 1-2
	AR 2-5
	ER
	AR-1 to AR-5
	Res Estates
	Rural Estates
	RR
Single Family	LDR
	RD 1, RD 2
	RD 1-3
	RD 2-3, RD 3-4, RD 3-5
	RD 4, RD 4 (SDSP)
	RD 4-6
	RD 5, RD 5 (SDSP)
	RD 5-7
	RD 7, RD 7 (SDSP)
	RD 7-10
	RD -2, RD-3, RD-4, RD-5, RD-7
	SF (RDOSP)
	SFR (1-3)
	SFR (3-5)
	SFR (4-7)
Multi-Family - Low Density	CMDR
	MDR, MDR (7-12)
	MD (RDSOP)
	RD 7-12
	RD10, RD-10, RD-10(MHP)
	RD 15 (SDSP)
Multi-Family - High Density	HD (RDOSP), HDR
	MFR (12-22)

Table 1. Comparison of Land Use Categories	
Land use categories (used in this report)	Land use categories from other planning documents
	MUR
	RD20, RD-20, RD 20 (SDSP)
	RD-15
Commercial	BP, BP (RDOSP)
	C/O, C/O/MF, C/O/MF TOD
	CMU
	COM
	Comm , Comm/ Employment, Comm/O
	Flex Comm
	GC
	LC, LC (SDSP)
	LTC, LTC (RDOSP)
	MUC
	O, OF, OF/MF, Off
	PC
	RTC (RDOSP)
	SC, SC (SDSP)
	Town Center
	VC, VC (RDOSP)
Industrial	HI
	IN
	Industrial, Industrial (E), Industrial (I)
	IR (SM)
	M-1, M-1(SM)
	M-2, M-2 (SSSPA)
	MP
Public	Pub, Public, Public Services
	P/QP, P/QP(RDSOP), PQP
	School, University
	Water Treatment Plant
Public Recreation	CP, CP (RDOSP)
	ES, ES (RDOSP)

Table 1. Comparison of Land Use Categories	
Land use categories (used in this report)	Land use categories from other planning documents
	GB (RDSOP)
	Greenway
	HS/MS (RDOSP)
	LP
	MS, MS (RDOSP)
	NP, NP (RDOSP)
	Park
	POS (H)
	PP, PR (RDOSP)
	PriOS/Rec, PubOs, Rec
	Rec
	Urban Farm
Mixed Land Use	Mixed Use
	MU
	UR
Right-of-Way	Road
	ROW
Non-Irrigated	Avoid, Avoided
	Basin, Canal, Channel
	DB
	DP (RDOSP)
	Drainage, Drainage Channel, Drainage/ Parkway
	Floodplain, Floodway/ Recreation
	Folsom South Canal
	IR, IR (SM)
	M 1, M 2, M 2 (SM), M-1S-R
	Old Landfill
	Open, Open Space, OS (RDOSP)
	POS, POS (H)(SDSP)
	PrSt, SPA
	Stormwater detention, SWD (RDOSP)
	WB

Table 1. Comparison of Land Use Categories	
Land use categories (used in this report)	Land use categories from other planning documents
	Wetland, Wetland (H) (SDSP), Wetland (SDSP), Wetland Preserve
	WP (RDOSP)
Industrial- Unutilized	LI, LI/FS
Agriculture	AG 160, AG160 (SM),
	AG
	AG20
	AG80, AG 80 (SDSP) AG80 (SM)
Self-supported/supplied by others	
EG Wholesale	PriOs/Rec
Grantline 99	PubOs/Rec
Laguna	PriOs/Rec, RsSt
Mather Field	Golf Course
OHWD	A 10, AG2, AG80, AR 2, AR 5, AR 10, C, LC, LI, M 2, P/QP, ROW, RR
Rio Del Oro	PR (RDOSP)
Vineyard Springs	Golf Course

Table 2. Planning Subareas		
Subarea name	Date and agency providing land use data	New/ existing development
NSA		
Arboretum	City of Rancho Cordova 12/4/12	New growth area
Cordova Hills	MacKay & Somps 11/9/12	New growth area
Mather Field	County of Sacramento 5/16/13	Existing
Mather South	Wood Rodgers 5/16/13	New growth area
New Bridge	MacKay & Somps 4/30/13	New growth area
Rio Del Oro	County of Sacramento 3/28/13	Existing
Suncreek	MacKay & Somps 11/9/12	New growth area
Sunridge	County of Sacramento 3/28/13	New growth area
Sunrise	County of Sacramento 3/28/13	Existing
The Ranch at Sunrise	City of Rancho Cordova 12/4/12	New growth area
Undeveloped NSA[a]	Sacramento County General Plan 11/9/11	Existing
CSA		
East Vineyard	County of Sacramento 3/28/13	New growth area
EG Wholesale	City of Elk Grove 12/11/12	Existing
Florin Vineyard Gap	County of Sacramento 1/10/13	Existing
Grantline 99	City of Elk Grove 12/11/12	Existing
Jackson Township	Au Clair Consulting 4/30/13	New growth area
North Vineyard Station	County of Sacramento 1/10/13	Existing
OHWD	County of Sacramento 3/28/13	Existing
Undeveloped CSA[a]	Sacramento County General Plan 11/9/11	Existing
Vineyard	County of Sacramento 3/28/13	Existing
Vineyard Springs	County of Sacramento 1/10/13	Existing
West Jackson	Wood Rodgers 4/30/13	New growth area
SSA		
East Franklin	City of Elk Grove 12/11/12	Existing
Elk Grove Promenade	City of Elk Grove 12/11/12	New growth area
Laguna	City of Elk Grove 12/11/12	Existing
Laguna Ridge	City of Elk Grove 12/11/12	New growth area
South East Policy Area	Wood Rodgers 5/21/13	New growth area
Sterling Meadows	City of Elk Grove 12/11/12	New growth area

[a] *Sacramento County General Plan refers to this area as cropland/agricultural. For this analysis the land use in these areas is labeled as non-irrigated.*

Appendix D: Buildout Acreage and Demand by Subarea

Service area	Subarea	Land acreage from GIS	Net to gross percent increase	Estimated gross acreage	Gross unit demand factor	Buildout water demand
CSA	CSA NORTHEAST					
	Agriculture	7,036	-	7,036	-	-
	Non-Irrigated	82	-	82	-	-
	Subtotal	7,118		7,118		-
CSA	EAST VINEYARD					
	Agriculture	68	-	68	-	-
	Rural Estate	1,429	1.00	1,429	1.37	1,957
	Subtotal	1,497		1,497		1,957
CSA	EG WHOLESALE					
	Commercial	135	1.18	158	2.02	319
	Industrial	75	1.18	88	2.02	178
	Industrial - Unutilized	76	-	76	-	-
	Multi-Family - High Density	16	1.18	18	3.33	61
	Multi-Family - Low Density	50	1.18	59	2.44	143
	Public	2	-	2	0.81	1
	Public Recreation	440	-	440	2.80	1,231
	Right-of-Way	6	-	6	0.18	1
	Rural Estate	1,596	1.18	1,876	1.37	2,570
	Self-Supplied or by Others	19	-	19	-	-
	Single Family	903	1.18	1,061	2.13	2,259
	Subtotal	3,316		3,801		6,764
CSA	FLORIN VINEYARD GAP					
	Commercial	169	1.00	169	2.02	341
	Industrial	1,100	1.00	1,100	2.02	2,223
	Multi-Family - High Density	49	1.00	49	3.33	165
	Multi-Family - Low Density	61	1.00	61	2.44	148
	Non-Irrigated	87	-	87	-	-
	Right-of-Way	31	-	31	0.18	6
	Rural Estate	445	1.00	445	1.37	609
	Single Family	1,447	1.00	1,447	2.13	3,081
	Subtotal	3,387		3,387		6,571
CSA	GRANTLINE 99					
	Commercial	29	1.00	29	2.02	58
	Industrial	274	1.00	274	2.02	553
	Industrial - Unutilized	134	-	134	-	-
	Public	48	-	48	0.81	39
	Right-of-Way	0	-	0	0.18	0
	Self-Supplied or by Others	49	-	49	-	-
	Subtotal	534		534		650

Service area	Subarea	Land acreage from GIS	Net to gross percent increase	Estimated gross acreage	Gross unit demand factor	Buildout water demand
CSA	NORTH VINEYARD STATION					
	Commercial	41	1.03	42	2.02	85
	Multi-Family - High Density	66	1.03	68	3.33	226
	Multi-Family - Low Density	28	1.03	28	2.44	69
	Non-Irrigated	210	-	210	-	-
	Public	13	-	13	0.81	11
	Public Recreation	92	-	92	2.80	256
	Right-of-Way	14	-	14	0.18	3
	Rural Estate	14	1.03	14	1.37	20
	Single Family	1,104	1.03	1,132	2.13	2,410
	Subtotal	1,582		1,614		3,080
CSA	POCKET AT WATT & ELDER CREEK					
	Non-Irrigated	40	-	40	-	-
	Subtotal	40		40		-
CSA	VINEYARD					
	Commercial	295	1.19	350	2.02	706
	Mixed Land Use	123	1.19	146	2.15	314
	Multi-Family - High Density	84	1.19	99	3.33	330
	Multi-Family - Low Density	1,038	1.19	1,232	2.44	3,007
	Non-Irrigated	55	-	55	-	-
	Public	22	-	22	0.81	17
	Public Recreation	226	-	226	2.80	631
	Right-of-Way	1	-	1	0.18	0
	Rural Estate	723	1.19	859	1.37	1,177
	Single Family	1,087	1.19	1,291	2.13	2,750
	Subtotal	3,652		4,280		8,933
CSA	VINEYARD SPRINGS					
	Commercial	25	1.19	30	2.02	61
	Multi-Family - High Density	21	1.19	25	3.33	85
	Non-Irrigated	229	-	229	-	-
	Public Recreation	6	-	6	2.80	15
	Right-of-Way	7	-	7	0.18	1
	Rural Estate	894	1.19	1,062	1.37	1,455
	Self-Supplied or by Others	146	-	146	-	-
	Single Family	1,023	1.19	1,215	2.13	2,588
	Subtotal	2,351		2,719		4,204
CSA	WEST JACKSON					
	Commercial	441	1.00	441	2.02	891
	Industrial	21	1.00	21	2.02	43
	Mixed Land Use	1,006	1.00	1,006	2.15	2,163
	Multi-Family - High Density	34	1.00	34	3.33	112
	Non-Irrigated	838	-	838	-	-
	Public Recreation	341	-	341	2.80	955
	Right-of-Way	297	-	297	0.18	54
	Rural Estate	256	1.00	256	1.37	351
	Single Family	914	1.00	914	2.13	1,947
	Subtotal	4,149		4,149		6,515

Service area	Subarea	Land acreage from GIS	Net to gross percent increase	Estimated gross acreage	Gros s unit demand factor	Buildout water demand
NSA	ARBORETUM					
	Commercial	103	1.00	103	2.02	208
	Multi-Family - High Density	29	1.00	29	3.33	98
	Multi-Family - Low Density	328	1.00	328	2.44	799
	Non-Irrigated	452	-	452	-	-
	Public	97	-	97	0.81	78
	Public Recreation	67	-	67	2.80	189
	Single Family	166	1.00	166	2.13	354
	Subtotal	1,242		1,242		1,726
NSA	CORDOVA HILLS					
	Agriculture	190	-	190	-	-
	Commercial	240	1.00	240	2.02	486
	Multi-Family - High Density	134	1.00	134	3.33	445
	Multi-Family - Low Density	311	1.00	311	2.44	758
	Non-Irrigated	493	-	493	-	-
	Public	106	-	106	0.81	86
	Public Recreation	475	-	475	2.80	1,329
	Rural Estate	65	1.00	65	1.37	89
	Single Family	443	1.00	443	2.13	944
	Subtotal	2,457		2,457		4,136
NSA	JACKSON TOWNSHIP					
	Agriculture	110	-	110	-	-
	Commercial	90	1.00	90	2.02	181
	Mixed Land Use	20	1.00	20	2.15	42
	Multi-Family - High Density	84	1.00	84	3.33	280
	Multi-Family - Low Density	157	1.00	157	2.44	382
	Non-Irrigated	280	-	280	-	-
	Public	5	-	5	0.81	4
	Public Recreation	176	-	176	2.80	493
	Single Family	348	1.00	348	2.13	741
	Subtotal	1,269		1,269		2,123
NSA	MATHER FIELD					
	Commercial	318	1.00	318	2.02	642
	Industrial	659	1.00	659	2.02	1,331
	Non-Irrigated	1,807	-	1,807	-	-
	Public	1,702	-	1,702	0.81	1,379
	Public Recreation	154	-	154	2.80	431
	Self-Supplied or by Others	345	-	345	-	-
	Single Family	395	1.00	395	2.13	841
	Subtotal	5,379		5,379		4,623
NSA	MATHER SOUTH					
	Mixed Land Use	47	1.00	47	2.15	100
	Non-Irrigated	90	-	90	-	-
	Public	10	-	10	0.81	8
	Public Recreation	318	-	318	2.80	891
	Single Family	362	1.00	362	2.13	772
	Subtotal	827		827		1,771

Service area	Subarea	Land acreage from GIS	Net to gross percent increase	Estimated gross acreage	Gross unit demand factor	Buildout water demand
NSA	NEWBRIDGE					
	Agriculture	106	-	106	-	-
	Commercial	39	1.00	39	2.02	78
	Mixed Land Use	13	1.00	13	2.15	28
	Multi-Family - High Density	42	1.00	42	3.33	140
	Multi-Family - Low Density	119	1.00	119	2.44	289
	Non-Irrigated	439	-	439	-	-
	Public	13	-	13	0.81	10
	Public Recreation	44	-	44	2.80	123
	Right-of-Way	48	-	48	0.18	9
	Single Family	237	1.00	237	2.13	504
	Subtotal	1,098		1,098		1,181
NSA	NSA NORTHEAST					
	Agriculture	3,825	-	3,825	-	-
	Non-Irrigated	2,525	-	2,525	-	-
	Subtotal	6,351		6,351		-
NSA	POCKET AREA NEAR BUFFERLAND					
	Agriculture	282	-	282	-	-
	Subtotal	282		282		-
NSA	RIO DEL ORO					
	Commercial	253	1.00	253	2.02	511
	Industrial	350	1.00	350	2.02	706
	Multi-Family - High Density	100	1.00	100	3.33	332
	Multi-Family - Low Density	262	1.00	262	2.44	638
	Non-Irrigated	698	-	698	-	-
	Public	8	-	8	0.81	6
	Public Recreation	419	-	419	2.80	1,173
	Self-Supplied or by Others	54	-	54	-	-
	Single Family	1,535	1.00	1,535	2.13	3,270
NSA	Subtotal	3,677		3,677		6,636
	SUNCREEK					
	Commercial	88	1.00	88	2.02	178
	Multi-Family - High Density	44	1.00	44	3.33	147
	Multi-Family - Low Density	361	1.00	361	2.44	880
	Non-Irrigated	307	-	307	-	-
	Public	12	-	12	0.81	10
	Public Recreation	195	-	195	2.80	546
	Right-of-Way	83	-	83	0.18	15
	Single Family	176	1.00	176	2.13	375
	Subtotal	1,265		1,265		2,151

Service area	Subarea	Land acreage from GIS	Net to gross percent increase	Estimated gross acreage	Gross unit demand factor	Buildout water demand
NSA	SUNRIDGE					
	Agriculture	2	-	2	-	-
	Commercial	128	1.20	154	2.02	311
	Multi-Family - High Density	20	1.20	24	3.33	81
	Multi-Family - Low Density	250	1.20	300	2.44	731
	Non-Irrigated	758	-	758	-	-
	Public Recreation	97	-	97	2.80	270
	Single Family	1,073	1.20	1,288	2.13	2,743
	Subtotal	2,328		2,622		4,137
NSA	SUNRISE					
	Commercial	52	1.25	65	2.02	131
	Industrial	720	1.25	899	2.02	1,817
	Non-Irrigated	85	-	85	-	-
	Subtotal	856		1,049		1,947
NSA	THE RANCH AT SUNRIDGE					
	Commercial	15	1.00	15	2.02	30
	Multi-Family - High Density	13	1.00	13	3.33	43
	Multi-Family - Low Density	140	1.00	140	2.44	343
	Non-Irrigated	202	-	202	-	-
	Public	11	-	11	0.81	9
	Public Recreation	40	-	40	2.80	113
	Single Family	87	1.00	87	2.13	184
	Subtotal	508		508		721
SSA	EAST FRANKLIN					
	Commercial	56	1.24	69	2.02	139
	Industrial	6	1.24	8	2.02	15
	Multi-Family - High Density	78	1.24	97	3.33	323
	Non-Irrigated	9	-	9	-	-
	Public	8	-	8	0.81	6
	Public Recreation	487	-	487	2.80	1,364
	Right-of-Way	33	-	33	0.18	6
	Rural Estate	31	1.24	39	1.37	53
	Single Family	1,431	1.24	1,770	2.13	3,771
	Subtotal	2,139		2,520		5,677
SSA	ELK GROVE PROMENADE					
	Commercial	246	1.00	246	2.02	498
	Industrial - Unutilized	9	-	9	-	-
	Multi-Family - High Density	14	1.00	14	3.33	48
	Subtotal	270		270		545

Service area	Subarea	Land acreage from GIS	Net to gross percent increase	Estimated gross acreage	Gross unit demand factor	Buildout water demand
SSA	LAGUNA					
	Commercial	614	1.25	767	2.02	1,550
	Industrial	43	1.25	54	2.02	109
	Industrial - Unutilized	257	-	257	-	-
	Multi-Family - High Density	205	1.25	256	3.33	853
	Multi-Family - Low Density	162	1.25	202	2.44	493
	Public	49	-	49	0.81	39
	Public Recreation	753	-	753	2.80	2,108
	Right-of-Way	56	-	56	0.18	10
	Rural Estate	608	1.25	760	1.37	1,041
	Self-Supplied or by Others	257	-	257	-	-
	Single Family	2,369	1.25	2,961	2.13	6,307
	Subtotal	5,371		6,371		12,510
SSA	LAGUNA RIDGE					
	Commercial	315	1.09	343	2.02	692
	Industrial	19	1.09	21	2.02	42
	Multi-Family - High Density	86	1.09	93	3.33	310
	Multi-Family - Low Density	24	1.09	26	2.44	64
	Public	19	-	19	0.81	15
	Public Recreation	329	-	329	2.80	921
	Right-of-Way	1	-	1	0.18	0
	Single Family	955	1.09	1,038	2.13	2,211
	Subtotal	1,747		1,870		4,255
SSA	SOUTHEAST POLICY AREA					
	Commercial	321	1.00	321	2.02	649
	Industrial - Unutilized	100	-	100	-	-
	Multi-Family - High Density	75	1.00	75	3.33	249
	Multi-Family - Low Density	100	1.00	100	2.44	244
	Non-Irrigated	111	-	111	-	-
	Public Recreation	120	-	120	2.80	335
	Right-of-Way	0	-	0	0.18	0
	Rural Estate	66	1.00	66	1.37	91
	Single Family	209	1.00	209	2.13	446
	Subtotal	1,103		1,103		2,014
SSA	STERLING MEADOWS					
	Multi-Family - High Density	12	1.00	12	3.33	41
	Multi-Family - Low Density	69	1.00	69	2.44	168
	Public Recreation	39	-	39	2.80	110
	Single Family	70	1.00	70	2.13	149
	Subtotal	190		190		468
All Zone 40						
	Grand total	65,986		69,489		95,297

Note.: Water loss is not included.

Appendix E: 2010 Population Technical Memorandum

Brown AND Caldwell

10540 White Rock Road, Suite 180
Rancho Cordova, California 95670
Tel: 916-444-0123
Fax: 916-635-8805

Draft Technical Memorandum

Prepared for: Sacramento County Water Agency

Project Title: 2010 Urban Water Management Plan

Project No: 140620

Draft Technical Memorandum

Subject: 2010 Population Analysis for Sacramento County Water Agency

Date: August 30, 2011

To: David Zuccaro, Project Manager, Sacramento County Water Agency

From: Paul Selsky, PE, Brown and Caldwell

Limitations:

This is a draft memorandum and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final report.

This technical memorandum (TM) presents an analysis of the 2010 population that is served by the Sacramento County Water Agency (SCWA). The release of the results of the 2010 census allows for a more accurate determination of the number of people served by SCWA. This TM describes the background, methodology, and results.

Background

An estimate of SCWA's population for 2010 was prepared for the 2010 Urban Water Management Plan (Plan). The 2000 population estimate was developed based on an analysis of the 2000 census data that was than brought forward to 2010 based on a correlation to the change in the number of residential customer connections.

The approach used for the Plan is in accordance with the methodology defined by the California Department of Water Resources (DWR) for determining service area population. Per DWR's Methodology 2, SCWA in considered Category 2, which is a water supplier that has an electronic map of the service area and whose service area does not substantially overlap with city boundaries.

The approach used in the Plan to develop the 2000 population was based on census block groups. Estimates were made regarding how much of a given census block group was within SCWA's service area. A total of 117 census block groups were identified. The resulting estimate for 2000 population was then adjusted to reflect a 2010 estimate by adjusting the 2000 population based on the proportional growth in the number of residential service connections.

Methodology

The release of the 2010 census in the spring of 2011 to the census block level of detail allows for the development of a more precise estimate of the year 2010 population served by SCWA.

The methodology used for the analysis consisted of the following steps:

1. The census blocks that are within SCWA's service area were identified by overlaying a geographic information system (GIS) map of SCWA's service areas on a map of the census blocks.
2. Some census blocks that are within SCWA's service area are not served water by SCWA. A map of SCWA's pipelines was used to identify the census blocks that are served water by SCWA. Census blocks that are touched by the pipeline system were kept in the analysis, with the other census blocks removed.
3. Some census blocks that have SCWA transmission pipes but no distribution piping were also removed from the analysis by inspection.
4. The population and housing units within each of the identified census blocks were added up to develop subtotals for each of SCWA's service areas. All of the population in each of the identified census blocks is assumed to be served by SCWA.

Results

A total of 1,752 census blocks were identified to be served by SCWA. Figure 1 presents a map of the census blocks served by SCWA along with the service area boundaries and the water system pipelines. Figure 2 presents the same information as Figure 1 plus the numerical identifier for each census block. Figures 3, 4, and 5 present enlargements of the Central, South, and North Service Areas.

Table 1 summarizes the 2010 population and housing units for each of SCWA's service areas, and compares the results to the estimates that were prepared for the 2010 Plan based on the 2000 census. The population based on the 2010 census is 159,198, which is 3% greater than the 2010 population that was estimated for the Plan.

The number of households represents the total number of single family and multifamily dwelling units added together. Typically there are several multifamily dwelling units on one multifamily water service connection. There is an average of 3 persons per household within SCWA's service areas. The people per household for the smaller service areas of Arden Park Vista, East Walnut Grove, and Hood are noticeably lower, ranging from 2.1 to 2.4 people per household.

The population and housing for the Southwest Tract cannot be accurately determined from the census because the service area is much smaller than the census blocks. The population presented in Table 1 for the Southwest Tract is estimated based on an assumed 3.29 persons per residential connection.

The total number of connections and single family and multifamily residential connections for each service area are also shown on Table 1. Since the information on the number of connections is determined from SCWA records, comparing the census results for population and housing to number of connections provides a way to verify the accuracy of the population analysis.

The population per residential connection for each service area is presented in Table 1, using both the new 2010 population results and the prior population values that were determined for the Plan. The high population per residential connection in East Walnut Grove and Hood may indicate that the population may be estimated too high.

The number of households per residential connection is compared in Table 1. The ratio should be greater than 1.0 because of the impact of multifamily dwelling units. The high ratios for the smaller service areas of Arden Park Vista, East Walnut Grove, and Hood may indicate an overestimate of the number of households.

The number of multifamily dwelling units per multifamily connection is estimated in Table 1 by reducing the total number of households by the number of single family connections, and assuming that the remaining households are all multifamily dwelling units. This is another test to see if the values are reasonable. As shown in Table 1, the comparison indicates that the number of housing units for Arden Park Vista is high.

The census blocks identified as being served by SCWA are available as an Excel file for each service area. The United States 2010 Census Interactive Map provides a means to view graphically on a computer the census blocks and associated population and housing data (http://2010.census.gov/2010census/popmap/). The population and housing information is available from the smallest geographic size as census blocks, to the increasing larger block groups and tracts, and larger physical units. Figure 6 presents views of the interactive map for census blocks, block groups, and tracts.

Table

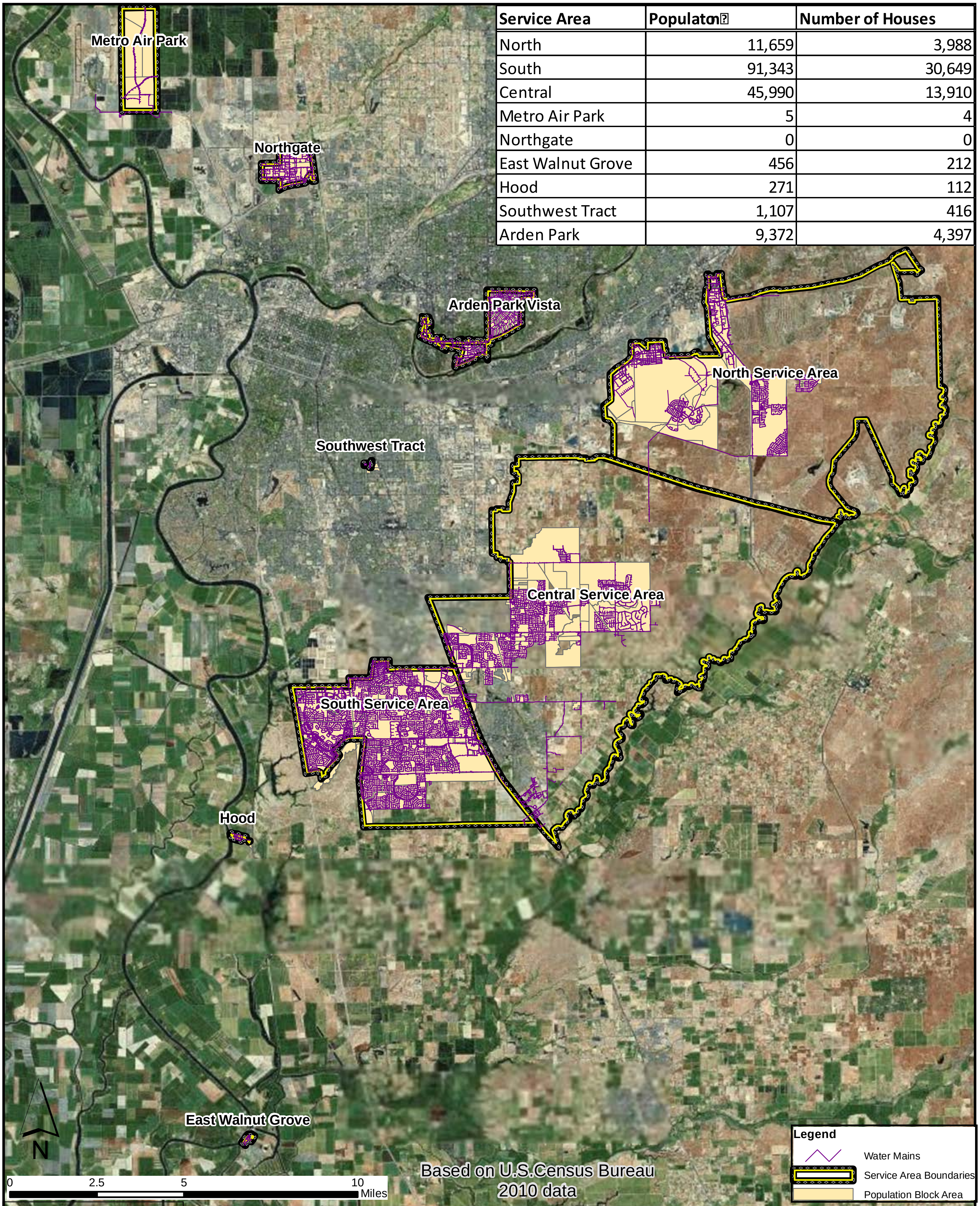
Table 1. 2010 Population

Table 1. 2010 Population															
		Population based on		Population difference		Housing Units	Persons per household	Customer connections				Population per residential connection		Households per residential connection	Multifamily dwelling units per MF connection
Zone 41 Service Areas		2010 census	2000 census and 2010 connections	No.	%			Total	Residential	Single family	Multifamily	2010 census	2000 census and 2010 connections		
Inside Zone 40															
	North	11,659				3,988	2.9								
	Central	45,990				13,910	3.3								
	South	91,343				30,649	3.0								
	subtotal	148,992	144,693	4,299	2.9%	48,547	3.1	45,600	43,871	43,659	212	3.40	3.30	1.11	23.1
Outside Zone 40															
	Arden Park Vista	9,372	9,120	252	2.7%	4,397	2.1	2,991	2,780	2,764	16	3.37	3.28	1.58	102.1
	East Walnut Grove	456	419	37	8.1%	212	2.2	159	120	113	7	3.80	3.49	1.77	14.1
	Hood	271	256	15	5.5%	112	2.4	77	72	72		3.76	3.56	1.56	
	Metro Air Park	5	-	5	100.0%	4	1.3		-						
	Northgate 880	-	-	-		-		262	-						
	Southwest Tract (a)	102	157	(55)	-53.9%			32	31	17	14	3.29	5.06		
	subtotal	10,206	9,952	254	2.5%	4,725	2.2	3,521	3,003	2,966	37	3.40	3.31	1.57	47.5
Total		159,198	154,645	4,553	2.9%	53,272	3.0	49,121	46,874	46,625	249	3.40	3.30	1.14	26.7

[a] *Estimated based on people per connection. See text.*

Figures

Service Area	Population	Number of Houses
North	11,659	3,988
South	91,343	30,649
Central	45,990	13,910
Metro Air Park	5	4
Northgate	0	0
East Walnut Grove	456	212
Hood	271	112
Southwest Tract	1,107	416
Arden Park	9,372	4,397

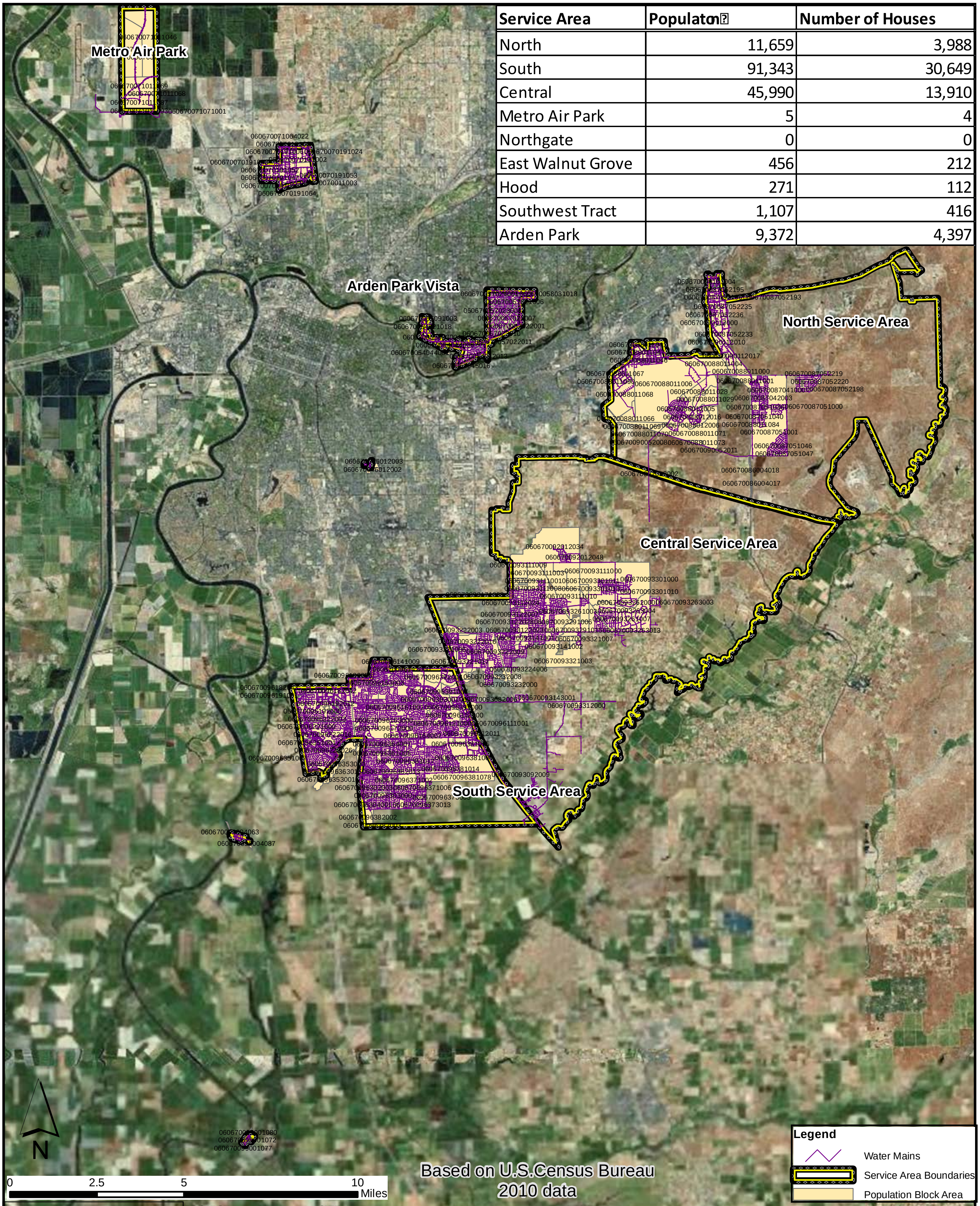


BROWN AND CALDWELL	PROJECT 140620	SITE Sacramento County, Sacramento, CA	Figure
	DATE 8-29-11	TITLE 2010 Census Analysis	1

SCWA-7

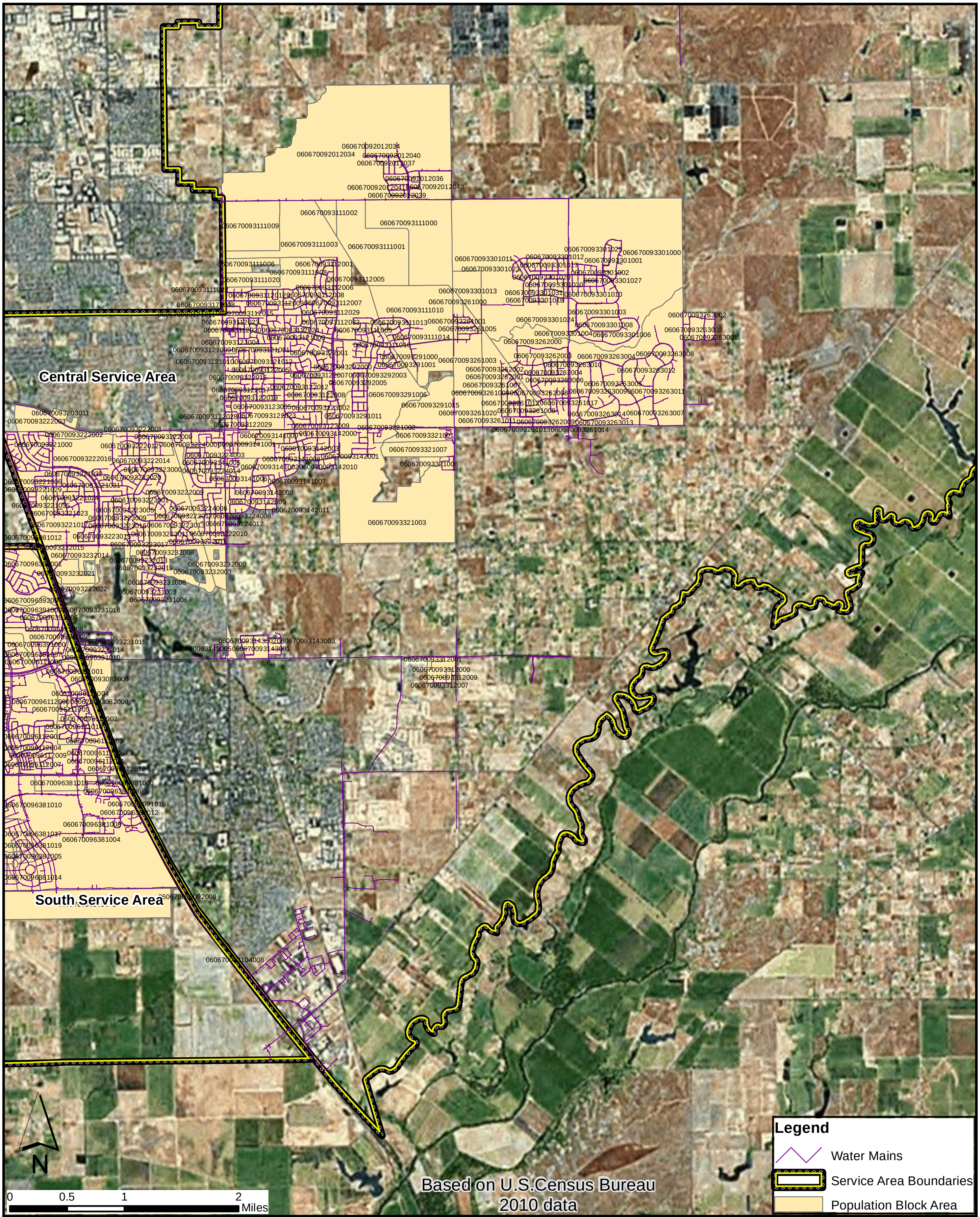
FILE:BCSAC/40000/140620SCWA2010UWMP/GIS/MapDocs/Working/WaterService Area

Service Area	Population	Number of Houses
North	11,659	3,988
South	91,343	30,649
Central	45,990	13,910
Metro Air Park	5	4
Northgate	0	0
East Walnut Grove	456	212
Hood	271	112
Southwest Tract	1,107	416
Arden Park	9,372	4,397



BROWN AND CALDWELL	PROJECT 140620	SITE Sacramento County, Sacramento, CA	Figure 2
	DATE 8-29-11	TITLE 2010 Census Analysis Population Blocks	SCWA-7

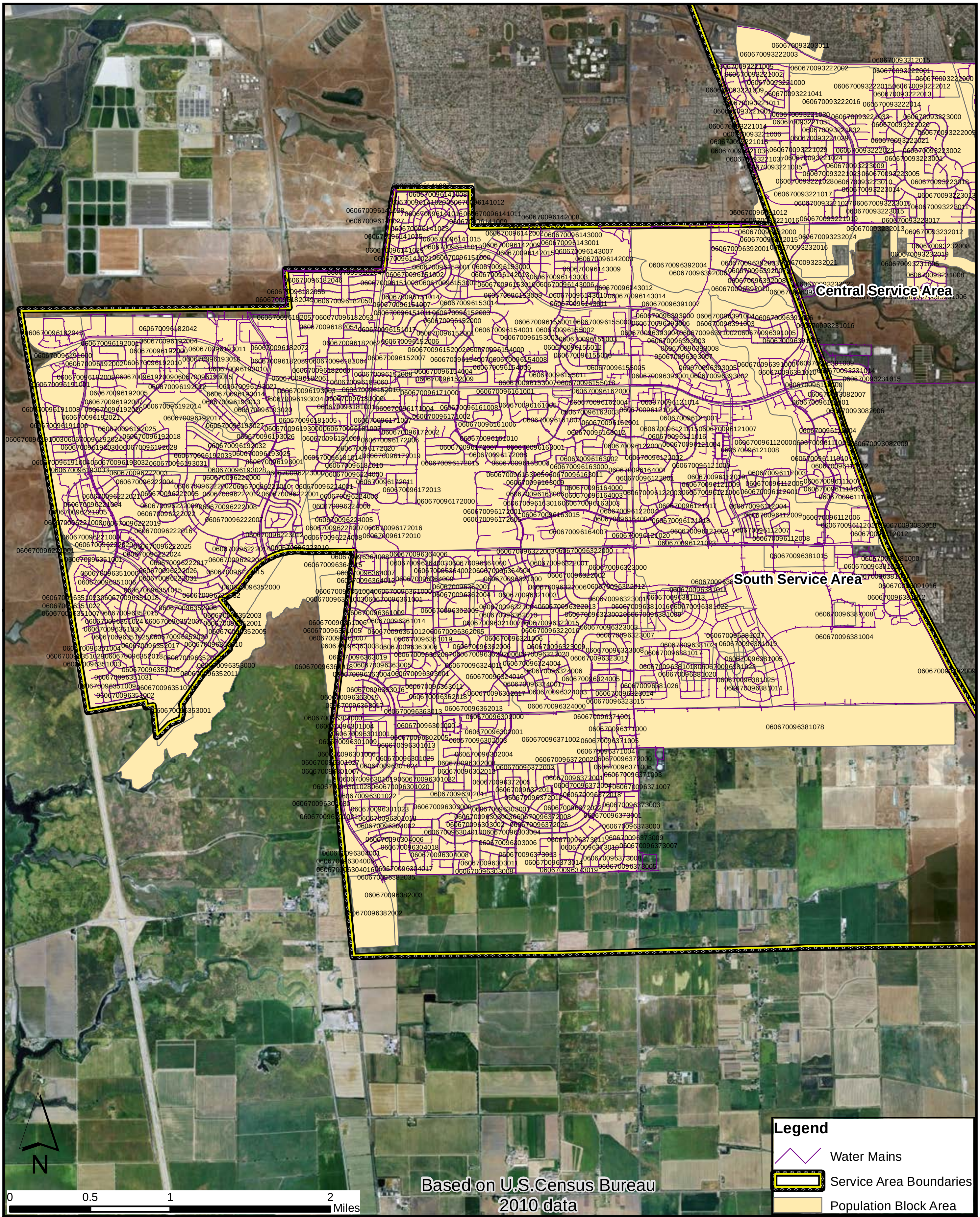
FILE:BCSAC/40000/140620SCWA2010UWMP/GIS/MapDocs/Working/WaterService Area



BROWN AND CALDWELL	PROJECT 140620	SITE Sacramento County, Sacramento, CA	Figure 3
	DATE 8-29-11	TITLE 2010 Census Analysis Central Service Area	

SCWA-7

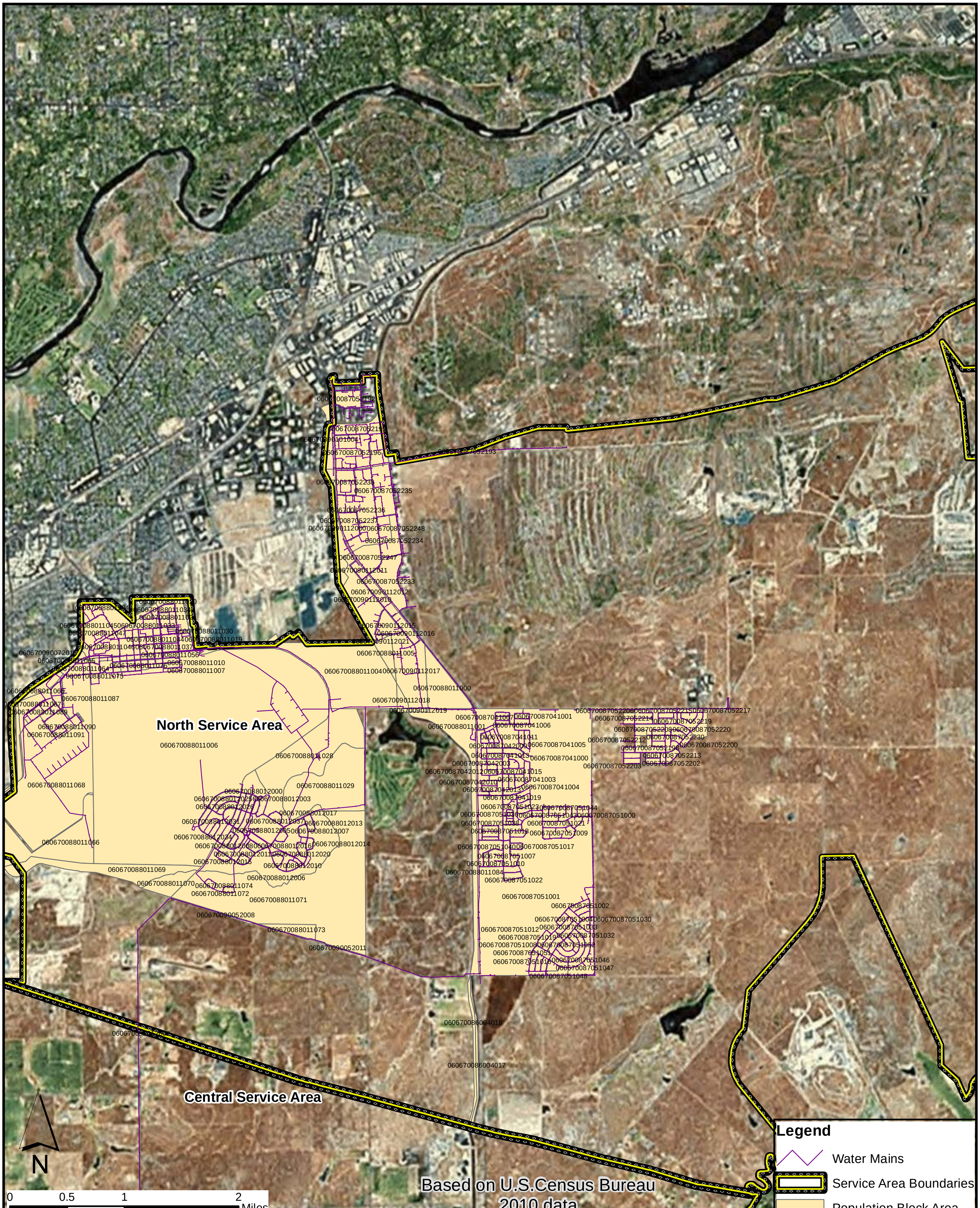
FILE:BCSAC/40000/140620SCWA2010UWMP/GIS/MapDocs/Working/WaterService Area_CentralSA



BROWN AND CALDWELL	PROJECT 140620	SITE Sacramento County, Sacramento, CA	Figure 4
	DATE 8-29-11	TITLE 2010 Census Analysis South Service Area	

SCWA-7

FILE:BCSAC/40000/140620SCWA2010UWMP/GIS/MapDocs/Working/WaterService Area_SouthSA



BROWN AND CALDWELL	PROJECT 140620	SITE Sacramento County, Sacramento, CA	Figure 5
	DATE 8-29-11	TITLE 2010 Census Analysis North Service Area	SCWA-7

FILE:BCSAC/40000/140620SCWA2010UWMP/GIS/MapDocs/Working/WaterService Area_NorthSA

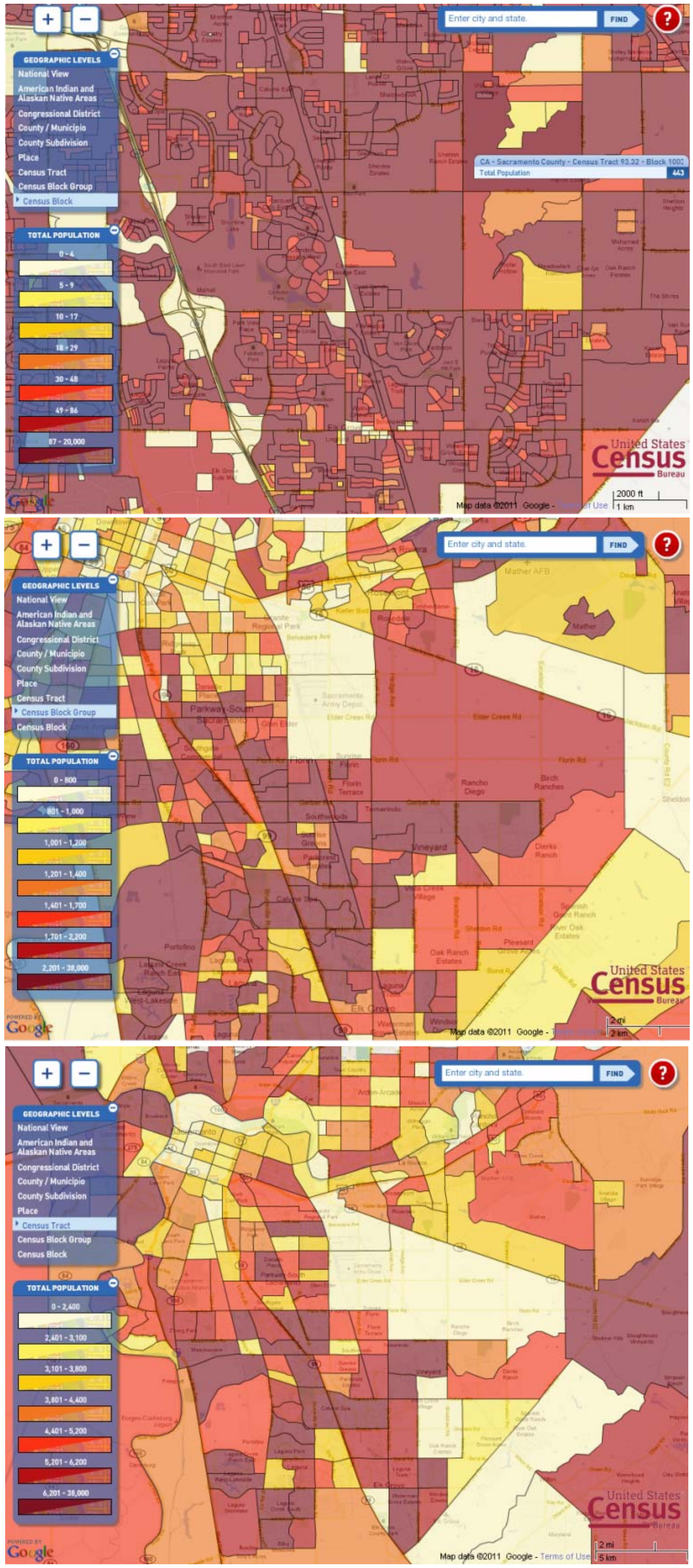


Figure 6. Interactive Population Map for Census Blocks, Block Groups, and Tracts

Appendix F: Detailed Growth Calculations

Projected Connections

	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
NSA High	6,396	10,896	15,396	19,896	24,396	**28,755**	28,755	28,755	28,755	28,755	28,755	28,755	28,755
NSA Med (updated 10/9/14)	5,646	7,496	9,996	12,496	16,096	19,846	23,596	27,346	**28,755**	28,755	28,755	28,755	28,755
NSA Low	5,196	6,696	8,196	9,696	11,196	12,696	14,196	15,696	17,196	18,696	20,196	21,696	23,196
CSA High	17,867	23,682	29,497	35,312	**38,305**	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305
CSA Med (updated 10/9/14)	16,591	18,441	20,941	23,441	27,041	30,791	34,541	38,291	**38,305**	38,305	38,305	38,305	38,305
CSA Low	15,981	17,081	18,181	19,281	20,381	21,481	22,581	23,681	24,781	25,881	26,981	28,081	29,181
SSA High	32,806	**38,129**	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
SSA Med (updated 10/9/14)	30,330	32,830	35,330	37,830	**38,129**	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
SSA Low	30,312	33,767	37,222	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
TOTAL High	57,068	72,706	83,021	93,336	100,830	**105,189**	105,189	105,189	105,189	105,189	105,189	105,189	105,189
TOTAL Med	52,566	58,766	66,266	73,766	81,265	88,765	96,265	103,765	**105,189**	105,189	105,189	105,189	105,189
TOTAL Low	51,488	57,543	63,598	67,105	69,705	72,305	74,905	77,505	80,105	82,705	85,305	87,905	90,505

	2080	2085	2090	2095	2100	2105	2110	2115	2120	2125	2130	2135
NSA High	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755
NSA Med	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755
NSA Low	24,696	26,196	27,696	**28,755**	28,755	28,755	28,755	28,755	28,755	28,755	28,755	28,755
CSA High	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305
CSA Med	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305	38,305
CSA Low	30,281	31,381	32,481	33,581	34,681	35,781	36,881	37,981	**38,305**	38,305	38,305	38,305
SSA High	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
SSA Med	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
SSA Low	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
TOTAL High	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189
TOTAL Med	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189	105,189
TOTAL Low	93,105	95,705	98,305	100,464	101,564	102,664	103,764	104,864	**105,189**	105,189	105,189	105,189

Buildout Year and Annual New Connections

	2010 Connections	Buildout connections at max density assumption	Buildout year by growth scenario			New connections added per year		
			Low	Medium	High	Low	Medium	High
NSA	4,596	28,755	2095	2052	2040	300	Varies	900
CSA	15,541	38,305	2119	2051	2033	220	Varies	1,163
SSA	28,930	38,129	2026	2031	2018	691	Varies	1,938
TOTAL	49,066	105,189	2119	2052	2040	1,211	Varies	4,001

Medium Growth																	
Connections added per year:				**Connections added per year to reach buildout:**													
Service area	**Buildout year**	**Buildout Conn**	**2010 Conn**	**2011**	**2012**	**2013**	**2014**	**2015**	**2,016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
NSA	2052	28,755	4,596	150	150	150	300	300	300	300	350	400	500	500	500	500	500
CSA	2051	38,305	15,541	150	150	150	300	300	300	300	350	400	500	500	500	500	500
SSA	2031	38,129	28,930	200	200	200	400	400	500	500	500	500	500	500	500	500	500
Total		105,189	49,066	500	500	500	1000	1,000	1,100	1,100	1,200	1,300	1,500	1,500	1,500	1,500	1,500
Total connections:																	
Service area	**Buildout Connections**	**2010 Connect**	**Buildout ye**	**2011**	**2012**	**2013**	**2014**	**2015**	**2,016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
NSA	28,755	4,596	2052	4,746	4,896	5,046	5,346	5,646	5,946	6,246	6,596	6,996	7,496	7,996	8,496	8,996	9,496
CSA	38,305	15,541	2051	15,691	15,841	15,991	16,291	16,591	16,891	17,191	17,541	17,941	18,441	18,941	19,441	19,941	20,441
SSA	38,129	28,930	2031	29,130	29,330	29,530	29,930	30,330	30,830	31,330	31,830	32,330	32,830	33,330	33,830	34,330	34,830
Total	105,189	49,066		49,566	50,066	50,566	51,566	52,566	53,666	54,766	55,966	57,266	58,766	60,266	61,766	63,266	64,766
Demand projections factors																	
Service area	**2010 factors, AF/connectio**	**Buildout facto**	**Buildout ye**	**2011**	**2012**	**2013**	**2014**	**2015**	**2,016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
NSA	0.90	1.22	2052	0.910	0.918	0.925	0.933	0.940	0.948	0.955	0.963	0.970	0.977	0.985	0.992	1.000	1.007
CSA	0.97	1.08	2051	0.977	0.980	0.982	0.985	0.987	0.990	0.993	0.995	0.998	1.000	1.003	1.006	1.008	1.011
SSA	0.52	0.68	2031	0.532	0.540	0.547	0.555	0.562	0.570	0.578	0.585	0.593	0.601	0.608	0.616	0.624	0.631
Total	0.70	0.97															
Projected Demands, AFY																	
Service area	2010 demand	Buildout dem	**Buildout ye**	**2011**	**2012**	**2013**	**2014**	**2015**	**2,016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
NSA	4150	34,954	2052	4,321	4,494	4,669	4,986	5,308	5,635	5,965	6,349	6,786	7,327	7,875	8,430	8,994	9,564
CSA	15141.95	41,425	2051	15,329	15,517	15,706	16,043	16,382	16,722	17,064	17,457	17,902	18,449	18,999	19,551	20,106	20,664
SSA	15167	26,108	2031	15,494	15,825	16,159	16,606	17,060	17,577	18,101	18,633	19,173	19,720	20,275	20,838	21,408	21,986
Total	34458.95	102,487		35,144	35,836	36,533	37,635	38,750	39,933	41,130	42,439	43,861	45,496	47,149	48,820	50,508	52,214

Medium Growth																	
Connections added per year:																	
Service area	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**
NSA	500	500	500	500	500	500	600	750	750	750	750	750	750	750	750	750	750
CSA	500	500	500	500	500	500	600	750	750	750	750	750	750	750	750	750	750
SSA	500	500	500	500	500	500	299	-	-								
Total	1,500	1,500	1,500	1,500	1,500	1,500	1,499	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Total connections:																	
Service area	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**
NSA	9,996	10,496	10,996	11,496	11,996	12,496	13,096	13,846	14,596	15,346	16,096	16,846	17,596	18,346	19,096	19,846	20,596
CSA	20,941	21,441	21,941	22,441	22,941	23,441	24,041	24,791	25,541	26,291	27,041	27,791	28,541	29,291	30,041	30,791	31,541
SSA	35,330	35,830	36,330	36,830	37,330	37,830	**38,129**	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
Total	66,266	67,766	69,266	70,766	72,266	73,766	75,265	76,765	78,265	79,765	81,265	82,765	84,265	85,765	87,265	88,765	90,265
Demand projections factors																	
Service area	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**
NSA	1.015	1.022	1.030	1.037	1.044	1.052	1.059	1.067	1.074	1.082	1.089	1.097	1.104	1.111	1.119	1.126	1.134
CSA	1.014	1.016	1.019	1.021	1.024	1.027	1.029	1.032	1.034	1.037	1.040	1.042	1.045	1.047	1.050	1.053	1.055
SSA	0.639	0.647	0.654	0.662	0.669	0.677	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685
Total																	
Projected Demands, AFY																	
Service area	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**
NSA	10,142	10,728	11,320	11,921	12,529	13,144	13,872	14,770	15,679	16,598	17,529	18,472	19,425	20,389	21,365	22,352	23,350
CSA	21,224	21,787	22,352	22,920	23,491	24,064	24,743	25,579	26,420	27,264	28,113	28,965	29,821	30,682	31,546	32,414	33,286
SSA	22,572	23,165	23,766	24,375	24,991	25,615	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108
Total	53,938	55,680	57,439	59,216	61,010	62,822	64,723	66,458	68,207	69,971	71,751	73,545	75,355	77,179	79,019	80,874	82,744

Medium Growth														
Connections added per year:														
Service area	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
NSA	750	750	750	750	750	750	750	750	750	750	659			
CSA	750	750	750	750	750	750	750	750	750	15				
SSA														
Total	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	765	659			
Total connections:														
Service area	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
NSA	21,346	22,096	22,846	23,596	24,346	25,096	25,846	26,596	27,346	28,096	**28,755**	**28,755**	28,755	28,755
CSA	32,291	33,041	33,791	34,541	35,291	36,041	36,791	37,541	38,291	**38,305**	38,305	38,305	38,305	38,305
SSA	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129	38,129
Total	91,765	93,265	94,765	96,265	97,765	99,265	100,765	102,265	103,765	104,530	105,189	105,189	105,189	105,189
Demand projections factors														
Service area	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
NSA	1.141	1.149	1.156	1.163	1.171	1.178	1.186	1.193	1.201	1.208	1.216	1.216	1.216	1.216
CSA	1.058	1.061	1.063	1.066	1.068	1.071	1.074	1.076	1.079	1.081	1.081	1.081	1.081	1.081
SSA	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685	0.685
Total														
Projected Demands, AFY														
Service area	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
NSA	24,359	25,379	26,411	27,453	28,507	29,572	30,648	31,735	32,834	33,944	34,954	34,954	34,954	34,954
CSA	34,161	35,041	35,925	36,812	37,704	38,599	39,499	40,402	41,309	41,425	41,425	41,425	41,425	41,425
SSA	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108	26,108
Total	84,629	86,529	88,444	90,374	92,320	94,280	96,255	98,246	100,252	101,477	102,487	102,487	102,487	102,487

Appendix G: Hydraulic Model Analysis

Appendix G

Hydraulic Model Analysis

Table of Contents

List of Figures

List of Tables

Hydraulic Model Analysis

This hydraulic model analysis document was prepared by Sonoma County Water Agency (SCWA) staff. It describes the water distribution model update and the results of the water system model evaluation. Appendix G presents figures and tables depicting the hydraulic model results.

Section 1 Water Distribution Model Update

This section describes the water distribution model update.

1.1 Water System Facilities

InfoWater separates the network into the following asset categories: pipes, junctions, tanks, reservoirs, valves, and pumps. Table 1 summarizes how the Zone 40 water distribution system is modeled in the modeling software.

Table 1. Model Facilities Categorization

Facilities description	Modeled element
Water distribution pipes (T-mains and D-mains)	Pipes
Pipeline junctions	Junctions/Nodes
Groundwater wells	Fixed HGL reservoir
Surface water supply (The Vineyard SWTP, and surface water interties)	Fixed HGL reservoir
Storage tanks/reservoirs	Tank (mostly cylindrical tank)
Pressure reducing valves/flow control valves	Pressure reducing valves/flow control valves
Booster pumps and well pumps	Pumps

1.1.1 Pipeline Network

The pipeline network in the model consists of existing and future pipelines. The existing pipeline network in the model was imported from the GIS shape file developed by SCWA staff. The shape file keeps record of the all existing pipes in all sizes, including transmission mains, distribution mains, as well as raw water pipelines. The alignment, length, diameter and other attributes were automatically assigned to each pipe into the model during the importation process. After the existing pipe network was imported into the model, a skeletonizing process was performed using the Skeletonizer module in InfoWater to remove pipes less than four inches in diameter and dead-end pipes less than 100 feet in length.

New T-mains are added to the existing pipeline network in different phases through buildout. New T-mains are identified and sized based on water distribution modeling so that the Zone 40 water distribution system can handle the peak hour demand at buildout and interim phases under wet/dry year conditions.

1.1.2 Junctions/Nodes

A junction/node was created each pipeline junction, or where pipeline changes occur in diameter/material. There are nodes added at appropriate locations (for example, approximately every ¼ miles in new T-mains) throughout the water distribution system to serve as demand nodes. A water demand was assigned to each demand node through an automated water demand allocation process in the model, as described in the Section 1.2.

1.1.3 Booster Pump Stations

There are two places where a booster pump station is installed:

- The booster station at a storage tank that pumps the water into the distribution system to provide water to customers with adequate service pressures.
- The booster pump station at a groundwater well that pumps groundwater from groundwater to a centralized groundwater treatment plant for treatment; or pumps directly into the water distribution system after wellhead treatment.

The design point curve is used for all new pumps. The design curve requires the input of the design flow and the design head of a pump to generate a pump curve for modeling. The parameters of existing pumps were obtained from as-built drawings, data provided by O&M staff, and the previous Zone 40 distribution model.

1.1.4 Groundwater Wells/Groundwater Treatment Plants

In the model, groundwater wells are simulated as fixed HGL reservoirs. The groundwater elevation for each groundwater well was obtained using the groundwater elevation contour maps available in the latest basin Biennial Management Report (BMR) for the Sacramento Central Groundwater Basin at http://www.scgah2o.org/documents/2011-2012%20Basin%20Management%20Report.pdf. Groundwater treatment plants are identified in the model if a storage tank is connected with groundwater wells. Table 2 is the list of water supply production facilities in Zone 40. Table 3 shows the list of existing active production wells. The capacity of each existing well was provided by SCWA O&M staff. For future wells, a capacity of 1,500 gpm is assumed.

Table 2. Water Supply Production Facilities in Zone 40

Service Area	Water Supply Source	WTP Name	Existing Facility	Current Capacity (MGD)	Ultimate Capacity (MGD)
Zone40-CSA					
	Groundwater				
		Bond WTP	☐	0	6.5
		Calvine Meadows WTP	☑	10	10
		CSA_DirectFeed	☑	5	5
		East Elk Grove WTP	☑	6.5	13
		East Park WTP	☑	2.9	2.9
		Waterman WTP	☑	8.6	8.6
		Wildhawk WTP	☑	7.5	7.5
		Subtotal		40.5	53.5
	Surface Water				
		POU Connection to City	☐	0	19.1
		Subtotal		0.0	19.1
	Subtotal for Service Area			40.5	72.6
Zone40-CSA&NSA					
	Groundwater				
		West Jackson WTP	☐	0	18
		Subtotal		0.0	18.0
	Surface Water				
		Vineyard Surface WTP	☑	50	100
		Subtotal		50.0	100.0
	Subtotal for Service Area			50.0	118.0
Zone40-NSA					
	Groundwater				
		Anatolia WTP	☑	6.5	0
		Mather Housing WTP	☑	6	6
		Subtotal		12.5	6.0
	Surface Water				
		Mercantile Intertie to GSW	☑	1.44	1.44
		Subtotal		1.4	1.4
	Subtotal for Service Area			13.9	7.4
Zone40-SSA					
	Groundwater				
		Big Horn WTP	☑	4.5	13
		Dwight Road WTP	☑	2.1	2.1
		Franklin WTP	☐	0	7
		Lakeside WTP	☑	6.5	6.5
		Poppy Ridge WTP	☑	6.5	13

Table 2. Water Supply Production Facilities in Zone 40

Service Area	Water Supply Source	WTP Name	Existing Facility	Current Capacity (MGD)	Ultimate Capacity (MGD)
		SSA_DirectFeed	☑	6.5	6.5
		Whitelock WTP	☐	0	13
		Subtotal		26.1	61.1
	Recycled Wate				
		SSA_Recycled Water_SSA	☑	3	7
		Subtotal		3.0	7.0
	Surface Water				
		Franklin Intertie to City	☑	11	11
		Subtotal		11.0	11.0
Subtotal for Service Area				40.1	79.1

Table 3. Zone 40 Existing Active Production Wells

Service Area	Well ID	Well Name	Associated GWTP	Capacity, gpm
Zone40-CSA				
	W-061	CAYMUS	Waterman GWTP	1,600
	W-062	ANDALUSIAN	Direct Feed	1,100
	W-063	EQUINE	Direct Feed	1,000
	W-064	WESTRAY	Waterman GWTP	1,500
	W-065	SHELDON NORTH	Direct Feed	608
	W-066	CALVINE MEADOWS	Calvine Meadows GWTP	1,700
	W-067	WATERMAN RD	Waterman GWTP	1,500
	W-068	TILLOTSON	Waterman GWTP	1,500
	W-069	PERRY RANCH	Waterman GWTP	1,500
	W-073	EAST PARK	East Park GWTP	1,915
	W-076	LEGENDS	Calvine Meadows GWTP	1,750
	W-077	WATERMAN RANCH	East Elk Grove GWTP	1,500
	W-081	SADDLE CREEK	Wildhawk GWTP	1,500
	W-105	AZINGER	Wildhawk GWTP	1,800
	W-106	RODRIGUEZ	Wildhawk GWTP	1,800
	W-112	EAST ELK GROVE ON SITE	East Elk Grove GWTP	1,500
	W-114	WINDSOR DOWNS	East Elk Grove GWTP	1,500

Table 3. Zone 40 Existing Active Production Wells				
Service Area	Well ID	Well Name	Associated GWTP	Capacity, gpm
Zone40-NSA				
	W-087	PLANT WELL	Mather Housing GWTP	1,200
	W-092	VETERANS PARK	Mather Housing GWTP	1,200
	W-095	PITTSFIELD	Mather Housing GWTP	1,600
	W-096	MCROBERTS	Mather Housing GWTP	750
	W-122	EXCELSIOR WW #1	Anatolia GWTP	1,800
	W-123	EXCELSIOR WW #2	Anatolia GWTP	1,800
	W-124	EXCELSIOR WW #3	Anatolia GWTP	1,800
Zone40-SSA				
	W-041	SEASONS	Direct Feed	650
	W-042	BANYON	Direct Feed	760
	W-043	DUCK SLOUGH	Direct Feed	1,000
	W-047	FEATHER CREEK	Direct Feed	800
	W-052	BIG HORN NORTH	Direct Feed	940
	W-055	LAKESIDE WELL	Lakeside GWTP	1,700
	W-056	RIPARIAN	Lakeside GWTP	1,500
	W-070	DWIGHT RD RAW WATER	Dwight Road GWTP	1,500
	W-074	W. STOCKTON BLVD	Direct Feed	500
	W-075	WEST TARON	Lakeside GWTP	1,600
	W-078	POPPY RIDGE ON-SITE WELL	Poppy Ridge GWTP	1,500
	W-109	TERRAZO	Poppy Ridge GWTP	1,500
	W-110	FERRAGAMO	Poppy Ridge GWTP	1,500
	W-129	BIG HORN BLVD #4	Big Horn GWTP	1,500
	W-130	CIVIC CENTER DR WELL	Big Horn GWTP	1,500

1.1.5 Storage Tanks

Most storage tanks in Zone 40 are above ground cylindrical tanks. The elevation of a storage tank in the model refers to tank bottom elevation, typically equal to the ground elevation of the tank location. A couple of elevated existing storage tanks (Mather Housing Tank and Mather Airport Tank) in the Mather area are modeled as variable area tanks. Table 4 is the list of existing and future storage tanks.

Table 4. Existing and Planned Storage Tanks in Zone 40

Service Area	Storage Tank	Existing	Current Capacity (MG)	Ultimate Capacity (MG)
Zone40-CSA				
	Bond	☐	0.5	0.50
	Calvine Meadows	☑	0.35	0.35
	East Elk Grove	☑	7	7.00
	North Vineyard Station	☐	0	4.00
	Vineyard Clear Well	☑	20	20.00
	Waterman	☑	7	7.00
	West Jackson	☐	0	4.00
	Wild Hawk	☑	3	3.00
Subtoal			**37.85**	**45.85**
Zone40-NSA				
	Anatolia	☑	4	4.00
	Cordova Hills	☐	0	3.00
	Mather Airport	☑	0.3	0.30
	Mather Housing	☑	0.5	0.50
	Mather Main Base	☑	1	1.00
	North Douglas	☑	3	3.00
	NSA Terminal Tank	☐	0	10.00
	Suncreek	☐	0	3.00
	White Rock Rd	☐	0	3.00
Subtoal			**8.80**	**27.80**
Zone40-SSA				
	Big Horn	☑	2	2.00
	Dwight Road	☑	7	7.00
	East Franklin	☐	0	2.00
	Lakeside	☑	0.5	0.50
	Poppy Ridge	☑	3.5	7.00
	Whitelock	☐	0	3.00
Subtoal			**13.00**	**21.50**
Grand Total			**59.65**	**95.15**

1.1.6 Valves

The model uses flow control valves (FCVs) and pressure reducing valves (PRVs) to represent valves of different functions. FCVs are used to set a constant flow at the Franklin Intertie and the POU Intertie. FCVs are also used to specify the flow rate filling a storage tank including the North Douglas Storage Tank, the Cordova Hills Storage Tank, and the Cal-Am Storage Tank in Rio del Oro. The flow rate filling these tanks is set equal to the maximum day demand of the area it serves. FCVs are also used for service area boundary separation in Rio del Oro between SCWA and Cal-AM. These FCVs are closed meaning no flow going through these locations in normal operation conditions.

PRVs are used in the model for pressure zone separation. There are three PRVs along the boundary between the NSA Main and the NSA Upper Pressure Zones at the following locations: Americanos Blvd at Douglas Road, Americanos Blvd at Chrysanthy Road, and Grant Line Road at Kiefer Blvd. Two PRVs are needed for pressure zone separation between the NSA Main and the CSA-SSA Pressure Zones at the following locations: Excelsior Road at Jackson Highway, and Excelsior Road at Kiefer Road. Table 5 summarizes the settings for the FCVs and PRVs used in the model.

Table 5. Flow Control Valves and Pressure Reducing Valves in the Model

Model ID	Valve Type	Setting (gpm/psi)	Description
FCV-FRANKLIN	Flow Control Valve	7,640 gpm	The Franklin Intertie to the City of Sacramento (wheeling agreement)
FCV-POU	Flow Control Valve	13,260 gpm	POU Intertie to the City of Sacramento (wholesaling to Zone 40)
FCV_CALAM	Flow Control Valve	4,000 gpm	Control flow filling the Cal-AM storage tank in Rio del Oro (wholesaling to Cal-AM).
FCV_CORHILLS	Flow Control Valve	3,530 gpm	Flow rate for filling storage tank in NSA Upper Pressure Zone
FCV_NDOUGLAS	Flow Control Valve	5,000 gpm	Flow rate for filling storage tank in NSA Upper Pressure Zone
GV_CALAM1	Flow Control Valve	Generally Closed	Service area boundary separation between SCWA and Cal-AM in Rio del Oro
GV_CALAM2			
GV_CALAM3			
GV_CALAM4			
GV_CALAM5			
PRV_AMERICANOS1	Pressure Reducing Valve	40 psi	Pressure zone separation between NSA Upper and NSA Main Pressure Zones
PRV_AMERICANOS2		45 psi	
PRV_AMERICANOS3		40 psi	
PRV_NSA_CSA1	Pressure Reducing Valve	55 psi	Pressure zone separation between NSA Upper and NSA Main Pressure Zones
PRV_NSA_CSA2		53 psi	

1.1.7 Controls Settings

Control settings are used to dictate the operation status for water facilities (most often for pumps) in the model to achieve the operating goals. Control settings are applied to signal a booster pump to turn on or off based on the system demand and system pressures. This is also a method to simulate the conjunctive use operation in the model by manipulating the mix of surface water and groundwater under different hydrologic conditions. In wet years, control settings are set up to allow the system to deliver more surface water and less groundwater, and in dry years, less surface water but more groundwater.

1.1.8 Storage Requirement Criteria

Storage tanks provide peaking, operational flows, emergency storage, and fire flow supply. The locations and sizes of some storage tanks were identified in the 2006 WSIP. This WSIP update re-evaluates and verifies the storage requirement for Zone 40 with the new growth areas and updated water demand projection.

The water supply facilities produce a supply of water equivalent to the average 24-hour water demand throughout the day. During the peak demand hours, the water is released from storage tanks to make up the difference between the average daily flow and the peak hour demand. During the low demand hours of the day (lower than the daily average), the extra water refills the storage tanks. This concept is illustrated in Figure 1. Using storage in the system allows the water supply facilities to be sized for the maximum day demand, which is about half of the peak hour demand.

System storage is also important to provide the higher flows during a fire for short durations (no more than four hours), and for emergency supply if the normal water production source is taken offline for maintenance or during an emergency outage.

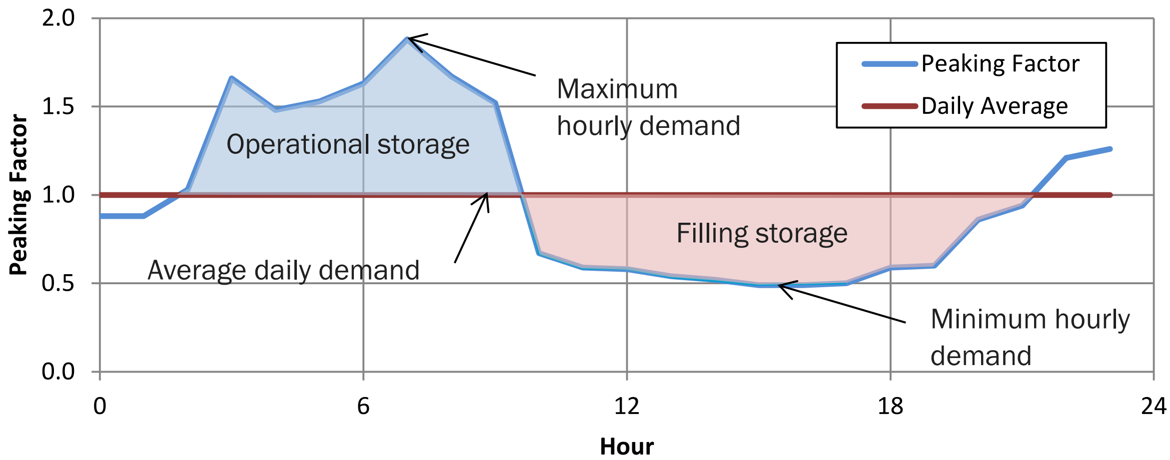


Figure 1. Example Diurnal Curve and Storage Cycling

Analysis of adequacy of storage facilities is carried-out in a two-step process. An initial estimate of storage requirements is done using SCWA design criteria followed by hydraulic modeling to confirm the adequacy of the storage assessment. The initial estimate of storage is done as follows:

Equation 1. Storage required = operational storage + emergency storage + fire flow

Where:

Operational storage = 25% MDD

Emergency storage = 0.5 MG

Fire flow storage = varies based on land use (or building type)

The fire flow storage requirement varies based on land use (or building type). Table 6 provides the flow, duration, and resulting volume requirements for various land uses (or building types). The fire storage criteria used for the storage analysis in Section 5.4 is slightly different. Nevertheless, the same planned storage facilities and their volumes are used in Section 5.4 and for the hydraulic model evaluation.

Table 6. Fire Flow Storage Criteria

Land use type (building type)	Fire flow requirement and duration	Fire flow storage, mg
Single family residential (<3,600 sq ft)	1,500 gpm for 2 hours	0.18
Single family residential (>3,600 sq ft)	2,000 gpm for 2 hours	0.24
Commercial/Industrial	3,000 gpm for 3 hours	0.54
Industrial/Institution	4,000 gpm for 4 hours	0.96

1.2 Water Demands

Determining water demand and its spatial distribution is a very important step for water distribution modeling. Water demand data can be derived from many sources including meter readings and billing records, telemetered system flows, and estimates based on population or land use. The model then uses these data and allocates an appropriate demand to each demand node.

The demand allocation is handled by the "Water Demand Allocator" module in InfoWater (available for a full suite license). It fully automates the geographical allocation of demand nodes to ensure the development and simulation of a reliable water distribution model. Because the source demand data is different for the existing and the build-out conditions, a different water allocation method was used accordingly.

1.2.1 Demand allocation for the existing water system

The source data used for water demand allocation for the existing water system include meter (and billing) data obtain from County Utility Billing (CUB). Each meter record contains information including APN, reading date, meter reading, consumption data, and parcel zoning.

The meter data is saved in a database file without spatial reference so that it cannot be used directly for demand allocation. A couple of additional steps were taken to convert the existing meter database to a geocoded meter data. First, the meter database was joined with the Zone 40 parcel shape file by cross-referencing the field "APN". The process resulted in a shape file containing geo-referenced meter data. Second, the X and Y coordinates were generated for each parcel in the joined shape file. With these two steps, a geocoded meter data (with distinct X and Y coordinates) was created and ready for demand allocation.

InfoWater Demand Allocator uses advanced GIS technology to assign geocoded meter data to digitally designated demand nodes. The closest pipe method was used for allocating meter data. For each meter, the closest pipe was identified, and then the meter demand was split in a weighted fashion and assigned to both ends of the identified closest pipe. For each demand node, all contributing meters were aggregated to represent the total demand imposed on that node. The process is demonstrated in Figure 2. The annual metered consumption data for July 2011 to July 2012 was used for the demand allocation. Because not all customers are metered in Zone 40 at the present, the allocated demand was adjusted by applying a global multiplier to match the total water production for the same period.

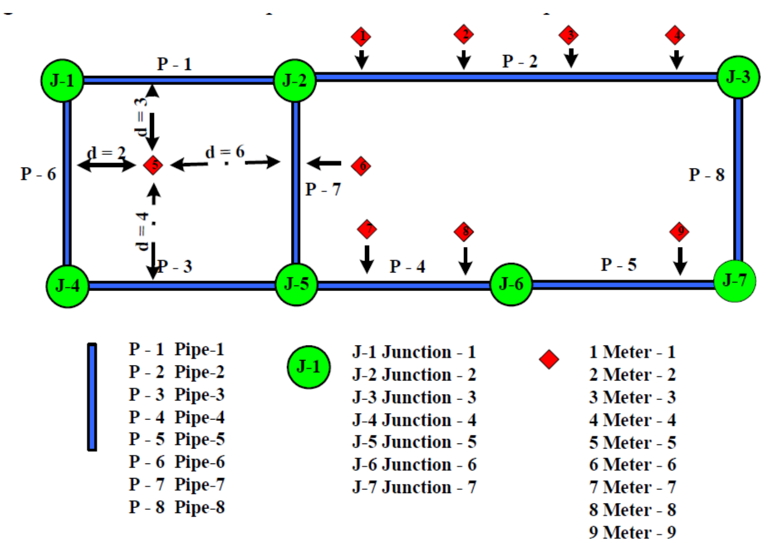


Figure 2. Illustration of Demand Allocation Based on Meter Data

Source: InfoWater Demand Allocation Users Guide, Innovyze

1.2.2 Demand allocation for the build-out water system

The source data used for water demand allocation for the build-out water system is the composite land use shape file that used for build-out demand estimate. The land use shape file contains information for each parcel including land use types/classifications, unit water demand factors, and parcel acreage.

A demand area polygon was automatically created in InfoWater Demand Allocation in the model. The land use shape file was imposed on top of the land use shape file. For each demand node, InfoWater Demand Allocator was able to intersect the land use information underneath the associated demand area polygon, to calculate water demand for each land use type/classification, and to aggregate all intersected water demand and assign it to the demand node. This process is demonstrated in Figure 3. Because the unit water demand factors used in the allocation process are average annual based factors, the resulting water demand in the model is the build-out annual water demand for Zone 40. Proper unit conversion and peaking factors were applied to the annual water demand to obtain the max day demand and the peak hour demand.

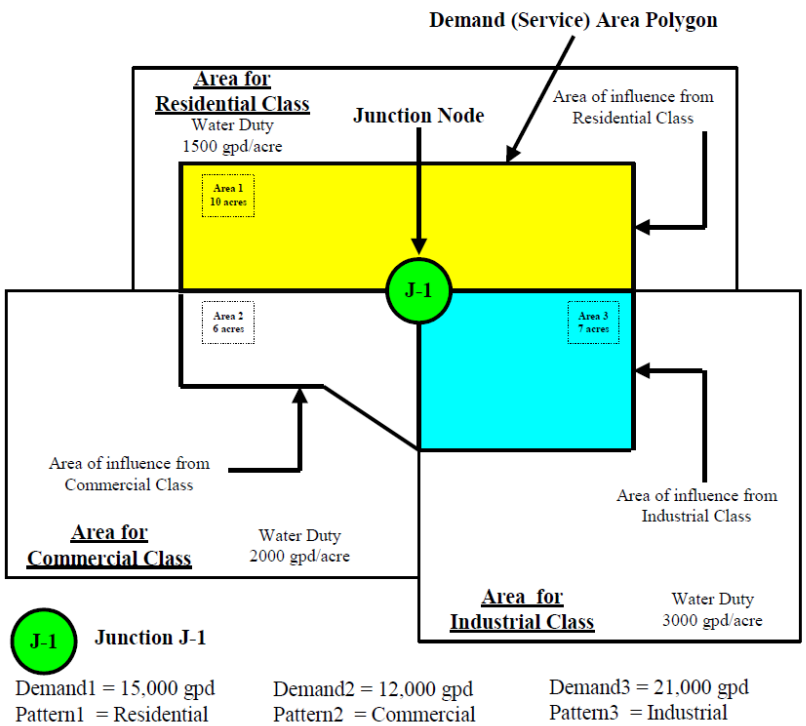


Figure 3. Illustration of Demand Allocation Based on Land Use Shape file

Source: InfoWater Demand Allocation Users Guide, Innovyze

Section 2 Zone 40 Water System Evaluation

The hydraulic model is used to evaluate the distribution system under maximum day and peak hour demand scenarios under wet and dry years conditions for existing, interim (Phase 1, Phase 2), and buildout. These modeling scenarios are summarized in Table 7. The minimum pressures, maximum velocities, and unit headlosses under each of the scenarios in each of the service areas is described in this section. The pipeline improvements as well as the location of supply sources and storage for each scenario are also evaluated using the hydraulic model.

Table 7. System Modeling Scenarios

Phasing	Water Demand and Hydrological Condition			
	Wet		Dry	
	MDD	PHD	MDD	PHD
Existing	x	x	x	x
Phase 1 10-year	x	x	x	x
Phase 2 21-year	x	x	x	x
Buildout	x	x	x	x

2.1 System Evaluation for NSA

This section describes the distribution system evaluation of the NSA.

2.1.1 Modeling Scenarios for NSA Existing System

The NSA currently is hydraulically disconnected with the CSA and the SSA systems consisting of Anatolia, Sunridge Park, Mather Housing, and Mather Base and Sunrise Corridor. It is predominantly served by the Anatolia GWTP that treats groundwater drawn from the Excelsior Well Field approximately 7 miles away. The Mather Housing GWTP serves a small portion of the NSA – mostly the Mather Housing area.

Tables 8 to 9 summarize the system operational settings used in the modeling scenarios (Max Day Demand, Peak Hour Demand, under wet and dry years) for the existing NSA system. Table 8 shows that under Max Day Demand Scenarios the Excelsior Wells were reaching their pumping capacity. The water was treated at the Anatolia GWTP, stored in the Anatolia Storage Tank, and then pumped out into the system through the booster pumps. Only one Mather Housing Well was turned on, and the treated water filled the elevated Mather Housing Storage Tank. The Mather Housing system was fed off the water flowing out of the Mather Housing Storage Tank through gravity. Before the Anatolia GWTP came online, the booster pumps at the Mather Housing GWTP pumped the water out of the storage tank to serve the Mather Base and the Sunrise Corridor areas. As these areas are now served predominantly by the Anatolia GWTP, the booster pumps at the Mather Housing GWTP can be turned off for the most of the time, including in the Max Day Demand scenarios.

Table 8. System Operational Settings for Existing NSA System - Max Day Demand, Wet and Dry Year Modeling Scenarios		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-ANATOLIA1	Anatolia GWTP Booster Pump #1	2,559.75
U-ANATOLIA2	Anatolia GWTP Booster Pump #2	2,559.72
U-ANATOLIA3	Anatolia GWTP Booster Pump #3	0.00
U-ANATOLIA4	Anatolia GWTP Booster Pump #4	0.00
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,808.81
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,803.49
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,794.41
U-MATHERHOUSING1	Mather Housing GWTP Booster Pump #1	0.00
U-MATHERHOUSING2	Mather Housing GWTP Booster Pump #2	0.00
U-MATHERHOUSING3	Mather Housing GWTP Booster Pump #3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,263.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 9 shows the system operational settings for the Peak Hour Demand scenarios (wet year and dry year). Water delivery from both the Anatolia GWTP and the Mather Housing GWTP increased significantly. Nearly all groundwater wells and booster pumps were turned on operating at their full capacity. As the demand continues to grow, the existing water supply may be maxed out soon. Therefore, the immediate addition/expansion of water supply capacity would be required for the NSA.

Table 9. System Operational Settings for Existing NSA System – Peak Hour Demand, Wet and Dry Year Modeling Scenarios		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	1,797.84
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	2,863.90
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	2,863.39
U-ANATOLIA4	Anatolia Storage Tank Booster Pump #4	0.00
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,808.81
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,803.49
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,794.41
U-MATHERHOUSING1	Mather Housing GWTP Booster Pump #1	907.07
U-MATHERHOUSING2	Mather Housing GWTP Booster Pump #2	905.58
U-MATHERHOUSING3	Mather Housing GWTP Booster Pump #3	907.33

Table 9. System Operational Settings for Existing NSA System – Peak Hour Demand, Wet and Dry Year Modeling Scenarios		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,235.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	841.23
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	1,074.63
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	1,007.36
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	888.38

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

The system pressures, flow velocities in pipes, and head losses for existing scenarios (Max Day Demand, Peak Hour Demand in wet and dry year conditions) are shown in Appendix H, Figures H-1, through H-12, respectively. Below are some observations about the modeling results.

- High to excessive high pressures were observed in the Sunrise Corridor area because of its lower ground elevations and closeness to the Anatolia Storage Tank. The system pressures decreased and became moderate as the water (out of the Anatolia Storage Tank) moved further west into the Mather Base area. The Sunridge Park area is located in the east with higher ground elevations, so the system pressures were decent in that area as well. The system pressures in most part of the Anatolia area met the operating goals except a few pockets in the south. The pressures in the Mather Housing area were the lowest (but meet the operating goals) among the NSA because it was mostly fed by the elevated Mather Housing Storage Tank by gravity.
- Flow velocities in T-mains met the operating goals, but there were a few D-mains in the Sunrise Corridor area whose velocities are relatively higher than those in the rest of the NSA. This is because: 1) being an old system, there are no T-mains in the Sunrise Corridor system; and 2) the water from the Anatolia Storage Tank pushes its way through the Sunrise Corridor to serve the Mather Base area to the west.
- Unit head losses also met the operating goals with the exception to a couple of minor D-mains linking between the Mather Housing and the Mather Base areas.

The water supply capacity needs immediate expansion for the NSA to keep with the growth. The required facilities associated with the water supply expansion will occur between now and the end of Phase 1; and those facilities requirements are described in Phase 1. The system improvements recommended for the NSA existing system are focused on addressing the high pressures experienced in some of the NSA. These recommendations for installing pressure-reducing valves at appropriate places are summarized in Table 10. However, these pressure-reducing valves may not be needed at build-out because the excessive high pressures would go away as the system configuration and water demand would be significantly different by then.

Table 10. Recommended Existing Water System Improvements - NSA			
Project name	Size	Quantity	Justification for need
Pressure Reducing Valve on Sunrise Blvd North of Douglas Road	36-in diameter	1	Reduce excessive pressure in Sunrise Corridor
Pressure Reducing Valve on Douglas Road West of Sunrise Blvd	12-in diameter	1	Reduce excessive pressure in Sunrise Corridor

2.1.2 Modeling Scenarios for NSA Phase 1

The Phase A NSA Pipeline would be constructed in early Phase 1 to expand the water supply capacity for the NSA as the existing water supply is being maxed out. The Phase A NSA Pipeline involves converting the existing 30-inch Excelsior Raw Water Pipeline to a treated water pipeline and connecting to the Vineyard SWTP. The Phase A NSA pipeline would instantly increase the water supply capacity by delivering surface water from the Vineyard SWTP to the NSA. The capacity of the Phase A NSA Pipeline is 15.8 MGD. The Phase A NSA Pipeline is currently under design and expected to come online in 2016. However, as development is projected to occur in a number of areas: Sunridge, Sun Creek, The Ranch at Sunridge, Arboretum, Rio del Oro, Cordova Hills, Mather South, New Bridge, and Jackson Township, the Phase A NSA Pipeline may reach its capacity soon. Therefore, the Phase B NSA Pipeline would need to be constructed at the end of Phase 1. The combined conveyance capacity of the Phase A and Phase B NSA Pipelines would be equal or greater than the max day demand of the NSA at buildout.

The mechanism of water delivery through the Phase A and Phase B NSA Pipelines are very similar. The Phase A NSA Pipeline would convey the treated surface water from the Vineyard SWTP and fill the Anatolia Storage Tank. The water would then be pumped out from the Anatolia Storage Tank into the NSA system. Similarly, the Phase B NSA Pipeline would convey the treated surface water from the Vineyard SWTP and fill the NSA Terminal Storage Tank located in the Mather South area. From there, the water would be pumped out to the NSA system. Because of the Phase A NSA Pipeline, the groundwater treatment facility at Anatolia GWTP would be abandoned or relocated. Three existing Excelsior wells would also be temporarily closed, or pump a small portion of groundwater water into the Phase A NSA Pipeline for blending in dry years. These wells will resume operation in Phase 2 to send water to the West Jackson GWTP for treatment located near the well field in the CSA. Figure 4 shows the diagram of the Phase A and Phase B NSA Pipelines compared to the configuration in the 2006 WSIP. The most noticeable change is that the Phase 2 NSA identified in the 2006 WSIP is eliminated in the WSIP Update.

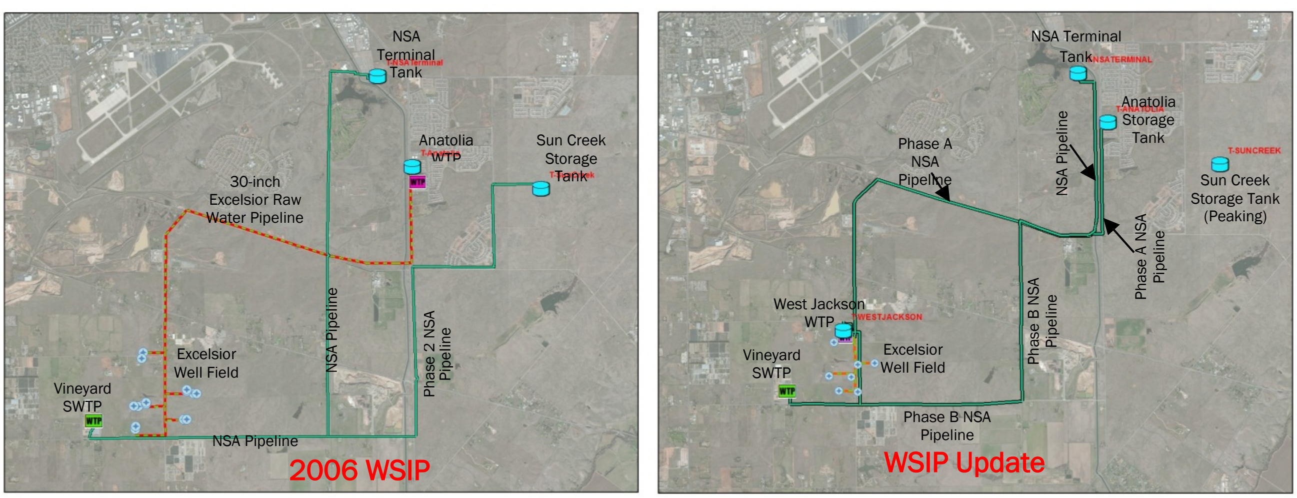


Figure 4. NSA Pipelines in 2006 WSIP and the WSIP Update

Tables 11 and 12 summarize the system operational settings for the modeling scenarios (Max Day Demand, Peak Hour Demand, under wet and dry years) in NSA Phase 1. In this phase, the Vineyard SWTP would become the predominant water supply (in both wet years and dry years), supplemented by groundwater from the Mather Housing GWTP (the Anatolia GWTP being abandoned with the completion of Phase A NSA Pipeline). The system operational settings for NSA Phase 1 were similar for wet year and dry year, but that did not suggest that the operation was not a conjunctive use operation. The conjunctive use program was implemented when the entire Zone 40 was looked at as a whole: the total surface water use in Zone 40 increased in wet years, while groundwater use increased in dry years.

Tables 11 shows that in Max Day Demand Scenarios all groundwater wells were turned off except one Mather Housing Well (W-087). The well pumps groundwater to the Mather Housing GWTP for treatment and the treated water filled the elevated Mather Housing Storage Tank and then entered into the Mather Housing system by gravity. The booster pumps at the Mather Housing GWTP were turned off as well because the rest of the NSA system was predominantly served by the Vineyard SWTP.

The NSA Upper Pressure Zone was served by the North Douglas Storage Tank fed by the distribution system of the NSA Main Pressure Zone.

Table 11. System Operational Settings for Phase 1 NSA System – Max Day Demand, Wet Year and Dry Year Scenarios

PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	6,034.29
U-VSWTP-NSA2	NSA Booster Pump #2	6,034.29
U-VSWTP-NSA3 ~ U-VSWTP-NSA6	NSA Booster Pumps #3 ~ #6	0.00
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	2,939.71
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	2,939.67
U-ANATOLIA3 ~ U-ANATOLIA6	Anatolia Storage Tank Booster Pumps #3 ~ #6	0.00
U-MATHERHOUSING1 ~ U-MATHERHOUSING3	Mather Housing GWTP Booster Pumps #1 ~ 3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,263.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	6,045.89
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	0.00
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	0.00
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	845.19
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	844.27
U-NORTHDOUGLAS3 ~ U-NORTHDOUGLAS6	North Douglas Tank Booster Pumps #3 ~ #6	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Tables 12 shows that in Peak Hour Demand scenarios the water production at the Vineyard SWTP and the Mather Housing GWTP remain the same as that in Max Day Demand scenarios. The difference was that the flow pumped out of the storage tanks increased significantly to meet the peak hour demand.

Table 12. System Operational Settings for Phase 1 NSA System – Peak Hour Demand, Wet Year and Dry Year Scenarios		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	6,034.29
U-VSWTP-NSA2	NSA Booster Pump #2	6,034.29
U-VSWTP-NSA3 ~ U-VSWTP-NSA6	NSA Booster Pumps #3 ~ 6	0.00
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	1,187.16
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	2,943.04
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	2,942.25
U-ANATOLIA4	Anatolia Storage Tank Booster Pump #4	2,927.65
U-ANATOLIA5	Anatolia Storage Tank Booster Pump #5	0.00
U-ANATOLIA6	Anatolia Storage Tank Booster Pump #6	0.00
U-MATHERHOUSING1 ~ U-MATHERHOUSING3	Mather Housing GWTP Booster Pumps #1 ~ #3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,263.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	6,074.62
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	6,074.81
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	0.00
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	1,690.30
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	1,688.63
U-NORTHDOUGLAS3 ~ U-NORTHDOUGLAS6	North Douglas Tank Booster Pump #3	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

The system pressures, flow velocities in pipes, and unit head losses for NSA Phase 1 modeling scenarios (Max Day Demand, Peak Hour Demand in wet and dry year conditions) are illustrated in Appendix H, Figures H-13 through H-24, respectively. Below are some observations:

- System pressures for the most part were within the operating goal range between 40 ~ 75 psi except a few localized spots with lower groundwater elevation, where pressures be higher than the operating goal of 75 psi. Mather Housing – 40 ~ 55 psi; Mather Base – 55 ~ 65 psi; Anatolia - 55 ~ 75 psi; Sunridge Park - 40 ~ 65 psi; Sun Creek – 40 ~ 65 psi. The Upper Pressure Zone has a pressure range of 40 ~ 75 psi.
- Flow velocities in pipes under Phase 1 scenarios were below 4 ft/sec in T-mains. For the most part, the flow velocities were less than 2 ft/sec.
- Head losses under Phase 1 scenarios were relatively small due to lower flow velocities. For the vast majority of pipes, the head loss was less than 1 ft/1000 ft except for a couple of small-size pipes in the Sunrise Corridor.

The water supply facilities in Phase 1 required to meet the demand growth in the NSA include: the Phase A NSA Pipeline, the Phase B NSA Pipeline, the NSA Terminal Storage Tank, and T-mains to extend water service to the new growth areas in Sunridge Specific Plan Area, Rio del Oro, Sun Creek, Arboretum, Cordova Hills, Mather South, New Bridge, and Jackson Township. The recommended water supply facilities in Phase 1 are summarized in Table 13.

Table 13. Recommended Phase 1 Water System Improvements - NSA			
Project name	**Size**	**Quantity**	**Justification for need**
Phase A NSA Pipeline	30-inch	N/A	1. Convert the existing Excelsior raw water pipeline to a transmission pipeline capable of delivering treated water from the Vineyard SWTP to the NSA. 2. Construct the segment of NSA Pipeline (in Florin Road) out of the Vineyard SWTP to connect with the Excelsior pipeline. 3. Abandon the treatment facility at the Anatolia GWTP 4. Reconfigure the piping at the Anatolia GWTP for the conversion.
Phase B NSA Pipeline	66-inch/54-inch	~42,300 feet	Deliver treated water from the Vineyard SWTP to the NSA in conjunction with the Phase A NSA Pipeline.
NSA Terminal Tank	5-MG/each	2	Store the water delivered from the Vineyard SWTP. The water would be pumped out into the NSA system.
NSA Terminal Tank Booster Pumps (East Set)	5,000 gpm, 155 ft	3 (plus one backup)	Pump water to the NSA east of the Folsom South Canal.
Anatolia Storage Tank Booster Pumps	2,600 gpm, 162 ft	2	Add to the existing 4 booster pumps (six in total, plus one backup). Pump water to the NSA.
Various T-mains	16 ~ 42 -inch	~159,150 feet	Deliver water to new growth areas

2.1.3 Modeling Scenarios for NSA Phase 2

With the Phase B NSA Pipeline and the NSA Terminal Storage Tank constructed in Phase 1, no new water production facilities would be constructed in Phase 2. The facilities would be sufficient to deliver the water from the Vineyard SWTP to the NSA to meet the demand growth. The Vineyard SWTP would be the predominant water supply in this phase, supplemented by a small amount of groundwater produced at the Mather Housing GWTP. After the Phase A NSA Pipeline is completed in Phase 1, the Anatolia GWTP would no longer treat the groundwater extracted from the Excelsior Wells. The Excelsior Wells would be temporarily closed until the West Jackson GWTP came online in Phase 2. The Excelsior Wells would pump groundwater to the new West Jackson GWTP (located near the Excelsior Well Field in the CSA) for treatment.

Similar to the water delivery mechanism in Phase 1, the Phase A and Phase B NSA Pipelines would convey the treated surface water from the Vineyard SWTP and fill the Anatolia Storage Tank and NSA Terminal Storage Tank. The water would then be pumped out from the two storage tanks into the NSA system. The North Douglas Storage Tank would be fed by the distribution system of the NSA Main Pressure Zone, and it would serve the NSA Upper Pressure Zone.

Tables 14 to 17 summarize the system operational settings for the modeling scenarios (Max Day Demand, Peak Hour Demand, under wet and dry years) for NSA Phase 2, in which the Vineyard SWTP would be the predominant water supply in both wet years and dry years, supplemented by groundwater from the Mather Housing GWTP .

Table 14 shows that in Max Day Demand, Wet Year Scenario all groundwater wells would be turned off. The Mather Housing system would not be served by the elevated Mather Housing Storage Tank by gravity anymore; instead, it could be served by water pumped out from the Anatolia Storage Tank and the NSA Terminal Storage Tank as well. The booster pumps at the Mather Housing GWTP were turned off indicating that the NSA demand would be met by the Vineyard SWTP alone. The capacity of the Vineyard SWTP would be still 50 mgd in this phase. Assuming the surface water reduction is 50% plus the remediated groundwater, the output from the Vineyard SWTP would be approximately 35 mgd in dry years. A small amount of water supply would be the groundwater produced from the Mather Housing GWTP, as shown in Table 15.

Table 14. System Operational Settings for Phase 2 NSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	9,491.78
U-VSWTP-NSA2	NSA Booster Pump #2	9,491.78
U-VSWTP-NSA3 ~ U-VSWTP-NSA6	NSA Booster Pumps #3 ~ #6	0.00
U-MATHERHOUSING1 ~ U-MATHERHOUSING3	Mather Housing GWTP Booster Pumps #1 ~ #3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	0.00
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	2,975.62
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	3,377.67
U-ANATOLIA3 ~ U-ANATOLIA6	Anatolia Storage Tank Booster Pump #3	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	6,886.64
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	6,886.84
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	0.00
U-MATHERSOUTH1	Mather South Booster Pump #1	0.00
U-MATHERSOUTH2	Mather South Booster Pump #2	0.00
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	1,419.74
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	1,418.30
U-NORTHDOUGLAS3 ~ U-NORTHDOUGLAS6	North Douglas Tank Booster Pumps #3 ~ #6	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Tables 16 and 17 list the system operational settings for the Phase 2 NSA system under Peak Hour Demand, Wet Year, and Dry Year Scenarios. Note that the water production was equal to or close to the max day demand, but the total flow coming out of the storage tanks through the booster pumps nearly doubled.

Table 15. System Operational Settings for Phase 2 NSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	8,933.92
U-VSWTP-NSA2	NSA Booster Pump #2	8,933.92
U-VSWTP-NSA3	NSA Booster Pump #3	0.00
U-VSWTP-NSA4 ~ U-VSWTP-NSA6	NSA Booster Pumps #4 ~ #6	0.00
U-MATHERHOUSING1	Mather Housing GWTP Booster Pump #1	1,623.04
U-MATHERHOUSING2	Mather Housing GWTP Booster Pump #2	0.00
U-MATHERHOUSING3	Mather Housing GWTP Booster Pump #3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,263.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	2,667.65
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	3,109.60
U-ANATOLIA3 ~ U-ANATOLIA6	Anatolia Storage Tank Booster Pumps #3 ~ #6	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	6,362.50
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	6,362.69
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	0.00
U-MATHERSOUTH1	Mather South Booster Pump #1	0.00
U-MATHERSOUTH2	Mather South Booster Pump #2	0.00
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	1,419.74
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	1,418.30
U-NORTHDOUGLAS3 ~ #6	North Douglas Tank Booster Pumps #3 ~ #6	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 16. System Operational Settings for Phase 2 NSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	9,491.78
U-VSWTP-NSA2	NSA Booster Pump #2	9,491.78
U-VSWTP-NSA3 ~ U-VSWTP-NSA6	NSA Booster Pumps #3 ~ #6	0.00
U-MATHERHOUSING1 ~ U-MATHERHOUSING3	Mather Housing GWTP Booster Pumps #1 ~ #6	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	0.00
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	3,055.17
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	3,447.73
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	3,447.21
U-ANATOLIA4 ~ U-ANATOLIA6	Anatolia Storage Tank Booster Pumps #4 ~ #6	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	7,047.78
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	7,048.00
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	0.00
U-MATHERSOUTH1	Mather South Booster Pump #1	3,076.51
U-MATHERSOUTH2	Mather South Booster Pump #2	3,077.47
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	2,174.53
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	2,171.50
U-NORTHDOUGLAS3	North Douglas Tank Booster Pump #3	2,172.10
U-NORTHDOUGLAS4	North Douglas Tank Booster Pump #4	2,171.02
U-NORTHDOUGLAS5	North Douglas Tank Booster Pump #5	2,170.98
U-NORTHDOUGLAS6	North Douglas Tank Booster Pump #6	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 17. System Operational Settings for Phase 2 NSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	8,933.92
U-VSWTP-NSA2	NSA Booster Pump #2	8,933.92
U-VSWTP-NSA3 ~ U-VSWTP-NSA6	NSA Booster Pumps #3 ~ #6	0.00
U-MATHERHOUSING1	Mather Housing GWTP Booster Pump #1	1,513.10
U-MATHERHOUSING2	Mather Housing GWTP Booster Pump #2	1,513.19
U-MATHERHOUSING3	Mather Housing GWTP Booster Pump #3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,258.30
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	1,026.46
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	3,040.41
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	3,434.66
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	3,434.15
U-ANATOLIA4 ~ U-ANATOLIA6	Anatolia Storage Tank Booster Pumps #4 ~ #6	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	7,024.38
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	7,024.59
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	0.00
U-MATHERSOUTH1	Mather South Booster Pump #1	2,706.92
U-MATHERSOUTH2	Mather South Booster Pump #2	2,707.78
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	2,174.85
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	2,172.25
U-NORTHDOUGLAS3	North Douglas Tank Booster Pump #3	2,173.09
U-NORTHDOUGLAS4	North Douglas Tank Booster Pump #4	2,172.32
U-NORTHDOUGLAS5	North Douglas Tank Booster Pump #5	0.00
U-NORTHDOUGLAS6	North Douglas Tank Booster Pump #6	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

System pressures, flow velocities in pipes, and unit head losses for the NSA Phase 2 modeling scenarios (Max Day Demand, Peak Hour Demand in wet and dry year conditions) are illustrated in Appendix H, Figures H-25 through H-36, respectively. Below are some observations.

- System pressures for the most part were within the operating goal range between 40 ~ 75 psi except a few localized spots with lower groundwater elevation, where pressures be higher than the operating goal of 75 psi. Mather Housing – 65 ~ 75 psi; Mather Base – 55 ~ 65 psi; Anatolia - 55 ~ 75 psi; Sunridge Park - 40 ~ 55 psi; Sun Creek – 40 ~ 65 psi. The Upper Pressure Zone has a pressure range of 40 ~ 75 psi.

- Flow velocities in pipes under Phase 2 scenarios were below 4 ft/sec in T-mains. For the most part, the flow velocities under the Max Day Demand scenarios were less than 2 ft/sec. There are a few pipelines in Anatolia, Mather South, and North Douglas that have flow velocities between 2 ~ 3 feet/sec. Flow velocities in Phase 2 are higher than those in Phase 1 because the demand is higher.
- For the vast majority of pipes, the head losses were less than 1 ft/1000ft except for a few small-size pipes in Sunrise Corridor.

The system improvements in Phase 2 would consist of constructing T-mains in order to provide service to new developments and enhance the system hydraulics with more looping. No major new water production faculties would be required in this phase. Table 18 summarizes the recommended water supply system improvements in Phase 2.

Table 18. Recommended Phase 2 Water System Improvements - NSA

Project name	Size	Quantity	Justification for need
Various T-mains	16 ~ 42 -inch	~155,580 feet	Deliver water to new growth areas. Improve Looping.
Booster Pumps at NSA Terminal Tank (West Set)	2,600 gpm, 100ft	2 (plus one backup)	A set of booster pumps that pump water out of NSA Terminal Tank to the NSA west of Folsom South Canal.

2.1.4 Modeling Scenarios for NSA Build-out

The water delivery mechanism for the NSA at buildout would be similar to that of interim phases (Phases 1 and 2). The major water supply source would still be the Vineyard SWTP supplemented by groundwater from the Mather Housing GWTP and the West Jackson GWTP (dry years only). The treated water from the Vineyard SWTP would be conveyed in the Phase A and Phase B NSA Pipelines to fill the NSA Terminal Storage Tank and the Anatolia Storage Tank. By now, there should be two sets of booster pumps equipped at the NSA Terminal Storage Tank. One set consists of six booster pumps (plus one backup) to pump the water in the NSA system east of the Folsom South Canal. The other set consists of four booster pumps (plus one backup) to pump the water into the NSA system west of the Folsom South Canal. The areas on both sides of the South Folsom Canal are inter-connected through the pipelines crossing the Folsom South Canal at Douglas Road, Kiefer Road, and Jackson HWY. The water would be pumped out from the Anatolia Storage Tank into the NSA east of the Folsom South Canal. There would be two peaking facilities constructed in this phase in the NSA Main Pressure Zone: the White Rock Road Storage Tank & booster station, and the Sun Creek Storage Tank & booster station. Both storage tanks would be fed off the NSA Main Pressure Zone during off-peak hours.

The NSA Upper Pressure Zone would be served the North Douglas Storage Tank and the Cordova Hills Storage Tank, each fed by the NSA Main Pressure Zone through one T-main. The T-main filling North Douglas Storage Tank would be a 36-inch pipeline connected to the 42-inch Douglas Road T-main at Douglas Road and Americanos Blvd. The T-main filling Cordova Hills Storage Tank would be a 20-inch T-main connected to the 24-inch Chrysanthy Road T-main at Chrysanthy Road and Grant Line Road.

Tables 19 to 22 summarize the system operational settings of the modeling scenarios (Max Day Demand, Peak Hour Demand, under wet and dry years) for the NSA Buildout.

Table 19 shows that the Vineyard SWTP provided all the water supply for the NSA in Max Day Demand, Wet Year Scenario. With its wells located near the groundwater contaminant plume, the use of Mather Housing GWTP was minimized or turned off if surface water was sufficient to meet the NSA water demand. The booster pumps at the NSA Terminal Tank and the Anatolia Storage Tank pushed water out to the system equivalent to the max day demand. The booster pumps at the peaking facilities (the White Rock Road

Storage Tank and the Sun Creek Storage Tank) were turned off. The water pumped out of the North Douglas Storage Tank and the Cordova Hills Storage Tank was equivalent to the max day demand of the NSA Upper Pressure Zone.

Table 19. System Operational Settings for Buildout NSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	9,379.13
U-VSWTP-NSA2	NSA Booster Pump #2	9,377.46
U-VSWTP-NSA3	NSA Booster Pump #3	9,376.81
U-VSWTP-NSA4	NSA Booster Pump #4	9,377.38
U-VSWTP-NSA5	NSA Booster Pump #5	9,379.33
U-VSWTP-NSA6	NSA Booster Pump #6	0.00
U-MATHERHOUSING1 ~ U-MATHERHOUSING3	Mather Housing GWTP Booster Pumps #1 ~ #3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	0.00
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	2,825.39
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	2,824.80
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	2,824.19
U-ANATOLIA4	Anatolia Storage Tank Booster Pump #4	2,810.32
U-ANATOLIA5	Anatolia Storage Tank Booster Pump #5	0.00
U-ANATOLIA6	Anatolia Storage Tank Booster Pump #6	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	5,802.35
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	5,802.53
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	5,803.31
U-NSATERMINAL4	NSA Terminal Tank Booster Pump #4	5,802.49
U-NSATERMINAL5	NSA Terminal Tank Booster Pump #5	5,802.30
U-NSATERMINAL6	NSA Terminal Tank Booster Pump #6	0.00
U-MATHERSOUTH1	Mather South Booster Pump #1	2,605.53
U-MATHERSOUTH2	Mather South Booster Pump #2	2,606.37
U-MATHERSOUTH3	Mather South Booster Pump #3	0.00
U-MATHERSOUTH4	Mather South Booster Pump #4	0.00
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	2,206.55
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	2,204.46
U-NORTHDOUGLAS3 ~ U-NORTHDOUGLAS6	North Douglas Tank Booster Pumps #3 ~ #6	0.00
U-CORDOVAHILLS1	Cordova Hills Storage Tank Booster Pump #1	2,059.71

Table 19. System Operational Settings for Buildout NSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-CORDOVAHILLS2	Cordova Hills Storage Tank Booster Pump #2	2,059.71
U-CORDOVAHILLS3 ~ U-CORDOVAHILLS5	Cordova Hills Storage Tank Booster Pumps #3 ~ #5	0.00
U-SUNCREEK1 ~ U-SUNCREEK5	SunCreek Storage Tank Booster Pumps #1 ~ #5	0.00
U-WHITEROCKROAD1 ~ U-WHITEROCKROAD4	White Rock Road Tank Booster Pumps #1 ~ #4	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 20 shows the operational control settings for the NSA in Max Day Demand, Dry Year Scenario. It was assumed the Vineyard SWTP operated at 50% of its treatment capacity in dry years at buildout. Therefore, the output of the Vineyard SWTP at buildout is 50 MGD (100 x 50% =50MGD). The entire 50-mgd surface water was delivered to the NSA because of its limited access to groundwater. In this scenario, part of treated groundwater (approximately 13 MGD) from the West Jackson GWTP (located in the CSA) was delivered to the NSA through the Phase A NSA Pipeline. There are six booster pumps (plus one backup) planned for the West Jackson GWTP : four pumps (#1 - #4) that are dedicated for the CSA; and two pumps (#5 and #6) capable of delivering water to both the CSA and the NSA by turning on/off the shut-off valves depending on which way the water needs to go. The Mather Housing GWTP and its wells were also turned on.

Figure 5 is a schematic of the West Jackson GWTP booster pump station. The West Jackson GWTP treats the groundwater pumped from the Excelsior Well Field and pumped out to the CSA system through pumps #1 - #4. In wet years, pumps #5 and #6 can also deliver water to the CSA system by shutting off the valve to the NSA. In dry years, the valve to CSA is closed, so pumps #5 and #6 can deliver water to the NSA for filling the Anatolia Storage Tank through the Phase A NSA Pipeline.

The booster pumps at the NSA Terminal Tank and the Anatolia Storage Tank pushed water out to the system equivalent to the max day demand. Peaking was not needed so booster pumps at White Rock Road Storage Tank and Sun Creek Storage Tank were turned off. The water pumped out of North Douglas Storage Tank and Cordova Hills Storage Tank was equivalent to the max day demand of the NSA Upper Pressure Zone.

Table 20. System Operational Settings for Buildout NSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	8,105.22
U-VSWTP-NSA2	NSA Booster Pump #2	8,104.14
U-VSWTP-NSA3	NSA Booster Pump #3	9,862.09
U-VSWTP-NSA4	NSA Booster Pump #4	9,862.84
U-VSWTP-NSA5	NSA Booster Pump #5	0.00
U-VSWTP-NSA6	NSA Booster Pump #6	0.00
U-WESTJACKSON5	West Jackson Storage Tank Booster Pump #5	4,355.26
U-WESTJACKSON6	West Jackson Storage Tank Booster Pump #6	4,314.95
U-MATHERHOUSING1	Mather Housing GWTP Booster Pump #1	1,245.81
U-MATHERHOUSING2	Mather Housing GWTP Booster Pump #2	1,243.85
U-MATHERHOUSING3	Mather Housing GWTP Booster Pump #3	1,246.14

Table 20. System Operational Settings for Buildout NSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,235.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	841.23
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	1,074.63
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	1,007.36
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	888.38
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	3,025.53
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	3,025.25
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	3,024.83
U-ANATOLIA4	Anatolia Storage Tank Booster Pump #4	0.00
U-ANATOLIA5	Anatolia Storage Tank Booster Pump #5	0.00
U-ANATOLIA6	Anatolia Storage Tank Booster Pump #6	0.00
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	6,169.16
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	6,169.35
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	6,170.16
U-NSATERMINAL4	NSA Terminal Tank Booster Pump #4	6,169.31
U-NSATERMINAL5	NSA Terminal Tank Booster Pump #5	6,169.10
U-NSATERMINAL6	NSA Terminal Tank Booster Pump #6	0.00
U-MATHERSOUTH1	Mather South Booster Pump #1	2,753.67
U-MATHERSOUTH2	Mather South Booster Pump #2	2,754.55
U-MATHERSOUTH3	Mather South Booster Pump #3	0.00
U-MATHERSOUTH4	Mather South Booster Pump #4	0.00
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	1,720.47
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	1,718.61
U-NORTHDOUGLAS3	North Douglas Tank Booster Pump #3	1,719.42
U-NORTHDOUGLAS4 ~ U-NORTHDOUGLAS6	North Douglas Tank Booster Pumps #4 ~ #6	0.00
U-CORDOVAHILLS1	Cordova Hills Storage Tank Booster Pump #1	1,685.96
U-CORDOVAHILLS2	Cordova Hills Storage Tank Booster Pump #2	1,685.96
U-CORDOVAHILLS3 ~ U-CORDOVAHILLS5	Cordova Hills Storage Tank Booster Pumps #3 ~ #5	0.00
U-SUNCREEK1 ~ U-SUNCREEK5	SunCreek Storage Tank Booster Pumps #1 ~ #5	0.00
U-WHITEROCKROAD1 ~ U-WHITEROCKROAD4	White Rock Road Tank Booster Pumps #1 ~ #4	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

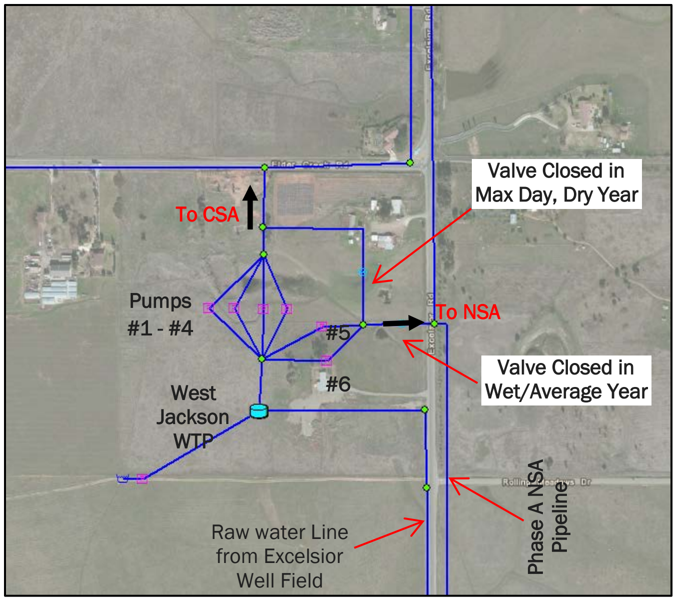


Figure 5. Schematic of West Jackson Booster Pump Station

Table 21 shows the system operational settings for the Peak Hour Demand, Wet Year Scenario. Again, the Vineyard SWTP was the dominant water supply source for the NSA meeting nearly all the water demand. The Mather Housing GWTP and its wells were closed. No flow augment was needed from the West Jack GWTP in wet years. Nearly all booster pumps were turned on to meet the peak hour demand at the Anatolia Storage Tank, the NSA Terminal Tank, the Sun Creek Storage Tank, the White Rock Road Tank, the North Douglas Tank, and the Cordova Hills Tank.

Table 22 shows the system operational settings for the Peak Hour Demand, Dry Year Scenario. The water supply sources included surface water from the Vineyard SWTP, groundwater from the Mather Housing GWTP, and groundwater from the West Jackson GWTP. Nearly all booster pumps were turned on to meet the peak hour demand at the Anatolia Storage Tank, the NSA Terminal Tank, the Sun Creek Storage Tank, the White Rock Road Tank, the North Douglas Tank, and the Cordova Hills Tank.

Table 21. System Operational Settings for Buildout NSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	9,379.13
U-VSWTP-NSA2	NSA Booster Pump #2	9,377.46
U-VSWTP-NSA3	NSA Booster Pump #3	9,376.81
U-VSWTP-NSA4	NSA Booster Pump #4	9,377.38
U-VSWTP-NSA5	NSA Booster Pump #5	9,379.33
U-VSWTP-NSA6	NSA Booster Pump #6	0.00
U-MATHERHOUSING1 ~ U-MATHERHOUSING3	Mather Housing GWTP Booster Pumps #1 ~ #3	0.00
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,263.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	0.00
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	0.00
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	0.00
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	0.00

SCWA-7

Table 21. System Operational Settings for Buildout NSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	2,538.46
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	2,536.99
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	2,535.73
U-ANATOLIA4	Anatolia Storage Tank Booster Pump #4	2,522.56
U-ANATOLIA5	Anatolia Storage Tank Booster Pump #5	2,536.75
U-ANATOLIA6	Anatolia Storage Tank Booster Pump #6	2,537.72
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	5,275.24
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	5,275.40
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	5,276.11
U-NSATERMINAL4	NSA Terminal Tank Booster Pump #4	5,274.53
U-NSATERMINAL5	NSA Terminal Tank Booster Pump #5	5,273.91
U-NSATERMINAL6	NSA Terminal Tank Booster Pump #6	5,273.76
U-MATHERSOUTH1	Mather South Booster Pump #1	2,785.69
U-MATHERSOUTH2	Mather South Booster Pump #2	2,786.57
U-MATHERSOUTH3	Mather South Booster Pump #3	2,789.95
U-MATHERSOUTH4	Mather South Booster Pump #4	2,789.14
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	1,927.70
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	1,924.97
U-NORTHDOUGLAS3	North Douglas Tank Booster Pump #3	1,925.51
U-NORTHDOUGLAS4	North Douglas Tank Booster Pump #4	1,924.54
U-NORTHDOUGLAS5	North Douglas Tank Booster Pump #5	1,924.50
U-NORTHDOUGLAS6	North Douglas Tank Booster Pump #6	0.00
U-CORDOVAHILLS1	Cordova Hills Storage Tank Booster Pump #1	2,477.90
U-CORDOVAHILLS2	Cordova Hills Storage Tank Booster Pump #2	2,477.86
U-CORDOVAHILLS3	Cordova Hills Storage Tank Booster Pump #3	2,477.90
U-CORDOVAHILLS4	Cordova Hills Storage Tank Booster Pump #4	0.00
U-CORDOVAHILLS5	Cordova Hills Storage Tank Booster Pump #5	0.00
U-SUNCREEK1	SunCreek Storage Tank Booster Pump #1	2,756.04
U-SUNCREEK2	SunCreek Storage Tank Booster Pump #2	2,756.04
U-SUNCREEK3	SunCreek Storage Tank Booster Pump #3	2,756.04
U-SUNCREEK4	SunCreek Storage Tank Booster Pump #4	2,756.04
U-SUNCREEK5	SunCreek Storage Tank Booster Pump #5	0.00
U-WHITEROCKROAD1	White Rock Road Tank Booster Pump #1	1,500.52
U-WHITEROCKROAD2	White Rock Road Tank Booster Pump #2	1,501.52
U-WHITEROCKROAD3	White Rock Road Tank Booster Pump #3	1,496.61
U-WHITEROCKROAD4	White Rock Road Tank Booster Pump #4	1,487.39

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 22. System Operational Settings for Buildout NSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-VSWTP-NSA1	NSA Booster Pump #1	8,112.04
U-VSWTP-NSA2	NSA Booster Pump #2	8,110.96
U-VSWTP-NSA3	NSA Booster Pump #3	9,867.70
U-VSWTP-NSA4	NSA Booster Pump #4	9,868.44
U-VSWTP-NSA5	NSA Booster Pump #5	0.00
U-VSWTP-NSA6	NSA Booster Pump #6	0.00
U-WESTJACKSON5	West Jackson Storage Tank Booster Pump #5	4,319.04
U-WESTJACKSON6	West Jackson Storage Tank Booster Pump #6	4,279.04
U-MATHERHOUSING1	Mather Housing GWTP Booster Pump #1	1,308.14
U-MATHERHOUSING2	Mather Housing GWTP Booster Pump #2	1,306.09
U-MATHERHOUSING3	Mather Housing GWTP Booster Pump #3	1,308.49
U-W087	Booster Pump for Mather Housing Well #1 (W-087)	1,235.94
U-W091	Booster Pump for Mather Housing Well #2 (W-091)	841.23
U-W092	Booster Pump for Mather Housing Well #3 (W-092)	1,074.63
U-W095	Booster Pump for Mather Housing Well #4 (W-095)	1,007.36
U-W096	Booster Pump for Mather Housing Well #5 (W-096)	888.38
U-ANATOLIA1	Anatolia Storage Tank Booster Pump #1	2,899.72
U-ANATOLIA2	Anatolia Storage Tank Booster Pump #2	2,898.08
U-ANATOLIA3	Anatolia Storage Tank Booster Pump #3	2,896.66
U-ANATOLIA4	Anatolia Storage Tank Booster Pump #4	2,881.90
U-ANATOLIA5	Anatolia Storage Tank Booster Pump #5	2,897.80
U-ANATOLIA6	Anatolia Storage Tank Booster Pump #6	2,898.90
U-NSATERMINAL#1	NSA Terminal Tank Booster Pump #1	6,040.81
U-NSATERMINAL2	NSA Terminal Tank Booster Pump #2	6,041.00
U-NSATERMINAL3	NSA Terminal Tank Booster Pump #3	6,041.80
U-NSATERMINAL4	NSA Terminal Tank Booster Pump #4	6,041.57
U-NSATERMINAL5	NSA Terminal Tank Booster Pump #5	0.00
U-NSATERMINAL6	NSA Terminal Tank Booster Pump #6	0.00
U-MATHERSOUTH1	Mather South Booster Pump #1	2,906.97
U-MATHERSOUTH2	Mather South Booster Pump #2	2,907.88
U-MATHERSOUTH3	Mather South Booster Pump #3	2,911.39
U-MATHERSOUTH4	Mather South Booster Pump #4	2,910.54
U-NORTHDOUGLAS1	North Douglas Tank Booster Pump #1	2,171.75
U-NORTHDOUGLAS2	North Douglas Tank Booster Pump #2	2,169.15
U-NORTHDOUGLAS3	North Douglas Tank Booster Pump #3	2,169.99

Table 22. System Operational Settings for Buildout NSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-NORTHDOUGLAS4	North Douglas Tank Booster Pump #4	2,169.22
U-NORTHDOUGLAS5	North Douglas Tank Booster Pump #5	0.00
U-NORTHDOUGLAS6	North Douglas Tank Booster Pump #6	0.00
U-CORDOVAHILLS1	Cordova Hills Storage Tank Booster Pump #1	2,385.61
U-CORDOVAHILLS2	Cordova Hills Storage Tank Booster Pump #2	2,385.51
U-CORDOVAHILLS3	Cordova Hills Storage Tank Booster Pump #3	2,385.51
U-CORDOVAHILLS4	Cordova Hills Storage Tank Booster Pump #4	2,385.48
U-CORDOVAHILLS5	Cordova Hills Storage Tank Booster Pump #5	0.00
U-SUNCREEK1	SunCreek Storage Tank Booster Pump #1	2,863.88
U-SUNCREEK2	SunCreek Storage Tank Booster Pump #2	2,863.88
U-SUNCREEK3	SunCreek Storage Tank Booster Pump #3	2,863.88
U-SUNCREEK4	SunCreek Storage Tank Booster Pump #4	2,863.88
U-SUNCREEK5	SunCreek Storage Tank Booster Pump #5	2,863.88
U-WHITEROCKROAD1	White Rock Road Tank Booster Pump #1	1,655.76
U-WHITEROCKROAD2	White Rock Road Tank Booster Pump #2	1,656.84
U-WHITEROCKROAD3	White Rock Road Tank Booster Pump #3	1,651.50
U-WHITEROCKROAD4	White Rock Road Tank Booster Pump #4	1,641.47

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

The system pressures, flow velocities in pipes, and unit head losses for NSA Buildout modeling scenarios (Max Day Demand, Peak Hour Demand in wet and dry year conditions) are illustrated in Appendix H, Figures H-37 through H-48, respectively. Below are some observations.

- System pressures for the most part were within the operating goal range between 40 ~ 75 psi except a few localized spots with lower groundwater elevation, where pressures be higher than the operating goal of 75 psi. Mather Housing – 65 ~ 75 psi; Mather Base – 55 ~ 65 psi; Anatolia - 55 ~ 75 psi; Sunridge Park - 40 ~ 55 psi; Sun Creek – 40 ~ 65 psi. The Upper Pressure Zone has a pressure range of 40 ~ 75 psi.
- Flow velocities were below 5~7 ft/sec in T-mains. For the most part, the flow velocities are within the range between 2 ~ 4 ft/sec.
- For most pipes, the head losses were within 1~2 ft/1000ft. A smaller portion of pipes have a head loss between 2~4 ft/1000ft. There were a couple of pipe with a head loss greater than 5 ft/1000ft, but they are minor pipes (in Sunrise Corridor) or pipes with no D-main connections (Sunrise Blvd T-main between Anatolia Storage Tank and Kiefer Road).

The system improvements after Phase 2 through Buildout include the Sun Creek Storage Tank, the Cordova Hills Storage Tank, and the White Rock Road Storage Tank. The booster pump station at each of the storage tanks is also required to meet the future peak hour demands in the NSA. The recommended system improvements are summarized in Table 23.

Table 23. Recommended Buildout Water System Improvements-NSA			
Project name	**Size**	**Quantity**	**Justification for need**
SunCreek Storage Tank	1.5 MG	2	Peaking for SunCreek, Arboretum, and the Ranch at Sunridge
Cordova Hills Storage Tank	1.5 MG	2	Peaking for Cordova Hills
White Rock Road Storage Tank	1.5 MG	2	Peaking for Rio del Oro
Booster Pumps at SunCreek Storage Tank	2,500 gpm, 150 ft	5 (plus one backup)	Peaking for SunCreek, Arboretum, and the Ranch at Sunridge
Booster Pumps at Cordova Hills Storage Tank	2,100 gpm	5 (plus one backup)	Peaking for Cordova Hills
Booster Pumps at White Rock Road Storage Tank	1,800 gpm, 150 ft	4 (plus one backup)	Peaking for Rio del Oro
Booster Pumps at NSA Terminal Tank (East Set)	5,000 gpm, 150 ft	3 (added to the 3 pumps installed in phase 1)	Meet increase demand in NSA
Booster Pumps at NSA Terminal Tank (West Set)	2,600 gpm, 100 ft	2 (added to the 2 pumps installed in phase 2)	Meet increase demand in NSA

2.2 System Evaluation for the CSA and the SSA

This section describes the distribution system evaluation of the CSA and the SSA because the two services areas are hydraulically connected and are in one pressure zone.

2.2.1 Modeling Scenarios for the Existing CSA and SSA

The Vineyard SWTP is located at the northeast corner of the CSA. The CSA Pipeline on Florin Road and Bradshaw Road connects the Vineyard SWTP to the rest of the CSA system, and connected to the SSA system through three connections along Highway 99 located at Sheldon Road, Bond Road, and Grant Line Road. The existing groundwater treatment plants include the Waterman GWTP, the Wildhawk GWTP, the Calvine Meadows GWTP, the East Park GWTP, and the East Elk Grove GWTP. There are also a number of direct-feed groundwater wells in the CSA system.

The SSA system historically has relied primarily on groundwater supply. Groundwater is treated at the Lakeside GWTP, the Poppy Ridge GWTP, the Big Horn GWTP, and the Dwight Road GWTP. There are a number of direct-feed wells in the SSA system as well. Before the Vineyard SWTP was online, the SSA received surface water treated at the Sacramento River SWTP (City of Sacramento) and wheeled through the City's distribution system, and finally delivered to Zone 40 at the Franklin Intertie. As the pressure at the Franklin Intertie is not sufficient to meet the Zone 40's operating goals, the water needs to be boosted before it enters into the SSA system. It can be boosted through the in-line booster pump in Franklin Blvd; or the water fills the 7-MG Dwight Road Storage Tank at Dwight Road GWTP through a dedicated 24-inch T-main, and then it is pumped out to the SSA system. Because the in-line booster pump in Franklin Blvd has only a limited capacity of 1,100 gpm, the second option is recommended for future operation when the flow exceeds 1,100 gpm. The capacity of The Franklin Intertie is 11 MGD.

After the Vineyard SWTP was online, the SSA system has received surface water from the CSA system primarily through the Sheldon Road connection and the Bond Road connection. There was not surface water going through the Grant Line Road because the distribution system in Elk Grove Wholesale Area is somewhat isolated from the rest of the CSA. The groundwater from the East Park GWTP and the East Elk Grove GWTP is currently the predominant water supply for this part of the CSA. One of the goals for modeling of the existing system is to identify the constraints of the existing water distribution system, so that it provides recommendations for system improvements to expand the use of surface water in Zone 40.

The SSA uses recycled water as well for public landscaping: parks, schools, commercial, and streetscapes. The recycled water system is independent of the potable water distribution system and is not part of this WSIP update effort.

Table 24 shows the system operational setting for Max Day, Wet Year scenario. Because of the surface water delivery from the Vineyard SWTP, groundwater use was reduced. The Waterman GWTP, the Wildhawk GWTP, the Calvine Meadows GWTP , and all direct feed wells were turned off in the CSA. However, the East Park GWTP and the East Elk Grove GWTP were turned on to serve Elk Grove Wholesale Area. Approximately 19,420 gpm (28 MGD) surface water was produced from the Vineyard SWTP, which was much lower than the 50-MGD capacity. The reasons for the under-use of surface water include: 1) low existing demand; 2) no means to deliver surface water to the NSA; and 3) system constraints in the CSA and the SSA system.

In the SSA, the surface water delivered at the Franklin Intertie was 7,640 gpm (11MD). The water filled the Dwight Road Storage Tank, and then pumped out from there to the SSA distribution system. The Lakeside GWTP, the Poppy Ridge GWTP, and the Big Horn GWTP were turned on operating at their treatment capacity. No direct feed wells were turned on in the SSA.

The amount of water moving from CSA to SSA was approximately 6,440 gpm (9.3 MGD), including approximately 4,640 gpm (6.7 MGD) of surface water through the Sheldon Road and Bond Road Connections, and approximately 1,800 gpm (2.6 MGD) groundwater through the Grant Line Road.

Table 24. System Operational Settings for Existing CSA-SSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	6,474.84
U-VSWTP-CSA2	CSA Booster Pump #2	12,948.66
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 - #6	0.00
U-WATERMAN1 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #1 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	0.00
U-W064	Booster Pump for W-064 (Waterman GWTP)	0.00
U-W067	Booster Pump for W-067 (Waterman GWTP)	0.00
U-W068	Booster Pump for W-068 (Waterman GWTP)	0.00
U-W069	Booster Pump for W-069 (Waterman GWTP)	0.00
U-WILDHAWK1 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #1 ~ #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	0.00
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	0.00
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	0.00
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	0.00
U-CALVINEMEADOWS1 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #1 - #4	0.00
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	0.00
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	0.00

Table 24. System Operational Settings for Existing CSA-SSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-EASTPARK	Booster Pump for East Park GWTP	2,234.95
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,673.29
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,673.29
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	2,085.66
U-W114	Booster Pump for W-114 (EEG GWTP)	1,987.08
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00
U-W063	Booster Pump for W-063 (CSA Direct Feed)	0.00
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	2040.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	2600.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	1800.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,834.88
U-DWIGHT2	Dwight Road Tank Booster Pump#2	3,832.53
U-DWIGHT3-6	Dwight Road Tank Booster Pumps#3 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Pump#1	2,147.57
U-POPPYRIDGE2	Poppy Ridge Pump#2	2,147.57
U-POPPYRIDGE3	Poppy Ridge Pump#3	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,626.47
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,585.29
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,505.36
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,504.76
U-BIGHORN3	Big Horn GWTP Booster Pump #3	0.00
U-W129	Booster Pump for W-129 (BIg Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76

Table 24. System Operational Settings for Existing CSA-SSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	0.00
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 25 shows the system operation settings for Max Day, Dry Year scenario of existing conditions. Because of the surface water cutback in surface water, it was assumed that the surface water production in dry year under existing conditions was zero (at both the Vineyard SWTP and the Franklin Intertie). Groundwater was the predominant water supply source, and the majority of groundwater wells were turned on to meet the max day demand. The ones that remained closed were a few direct feed groundwater wells in the CSA.

In the SSA, because no surface water was available at the Franklin Intertie, the Dwight Road Storage Tank and its booster pumps were turned off too. The Lakeside GWTP and the Big Horn GWTP were turned on operating at its treatment capacity. A number of direct feed wells were turned on as well. The Poppy Ridge GWTP was closed.

There was a significant flow moving from the CSA to the SSA in this scenario. The total flow was approximately 9,255 gpm (13.3 MGD).

Table 25. System Operational Settings for Existing CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	0.00
U-VSWTP-CSA2	CSA Booster Pump #2	0.00
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 - #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	2,726.37
U-WATERMAN2	Waterman GWTP Booster Pump #2	2,725.83
U-WATERMAN3	Waterman GWTP Booster Pump #3	2,726.31
U-WATERMAN4 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #4 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,612.90
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,540.64
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,540.64
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,526.89

Table 25. System Operational Settings for Existing CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	**DESCRIPTION**	**FLOW (gpm)**
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,742.82
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,743.16
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,742.08
U-WILDHAWK4 ~ U-WILDHAWK6	Wildhawk GWTP Pump #4 ~ #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1	Calvine Meadows GWTP Booster Pumps #1	0.00
U-CALVINEMEADOWS2	Calvine Meadows GWTP Booster Pumps #2	0.00
U-CALVINEMEADOWS3	Calvine Meadows GWTP Booster Pumps #3	1,555.96
U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #4	1,550.30
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22
U-EASTPARK	Booster Pump for East Park GWTP	2,086.71
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,506.87
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,506.87
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	2,085.66
U-W114	Booster Pump for W-114 (EEG GWTP)	1,987.08
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,226.08
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,132.68
U-W065	Booster Pump for W-065 (CSA Direct Feed)	847.58
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	3,875.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	3,620.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	1,760.00
SSA		
U-DWIGHT1 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps #1 ~ #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	5,649.84

Table 25. System Operational Settings for Existing CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W055	Booster Pump for W-055 (Lakeside GWTP)	1,665.92
U-W056	Booster Pump for W-056 (Lakeside GWTP)	1,492.38
U-W075	Booster Pump for W-075 (Lakeside GWTP)	1,611.63
U-POPPYRIDGE1 ~ U-POPPYRIDGE3	Poppy Ridge Pumps #1 ~ #3	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	0.00
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	0.00
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	0.00
U-BIGHORN1	Big Horn GWTP Booster Pump #1	2,051.61
U-BIGHORN2	Big Horn GWTP Booster Pump #2	2,050.83
U-BIGHORN3	Big Horn GWTP Booster Pump #3	0.00
U-W129	Booster Pump for W-129 (BIg Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	999.72
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,401.99
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,123.24
U-W052	Booster Pump for W-052 (SSA Direct Feed)	1,228.18
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 26 shows the system operation settings in the model for Peak Hour, Wet Year scenario of existing conditions. The total surface water production was approximately 15,480 gpm (22.3MGD). The Waterman GWTP, the Calvine GWTP , and the Wildhawk GWTP were closed in this scenario. However, the storage tanks were filled from the system through an altitude valve during off peak hours. The water was pumped out to meet the peak hour demand. East Park GWTP and East Elk Grove GWTP are turned on to serve Elk Grove Wholesale Area. The direct feed wells in the CSA were turned off in this scenario.

In the SSA, the surface water delivery at the Franklin Intertie was 11 MGD. All groundwater treatment plants were turned on and operated at their full capacity. No direct feed wells in the SSA were turned on.

The flow moving between CSA to SSA was approximately 10,390 gpm (~15 MGD), including 7,960 gpm (11.5 MGD) of surface water through the Sheldon and Bond Connections, and 2,430 gpm (3.5 MGD) groundwater through the Grant Line Road Connection.

Table 26. System Operational Settings for Existing CSA-SSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	5,159.76
U-VSWTP-CSA2	CSA Booster Pump #2	10,318.68
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	3,490.45
U-WATERMAN2	Waterman GWTP Booster Pump #2	3,489.54
U-WATERMAN3	Waterman GWTP Booster Pump #3	3,489.99
U-WATERMAN4	Waterman GWTP Booster Pump #4	3,490.00
U-WATERMAN5 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #5 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	0.00
U-W064	Booster Pump for W-064 (Waterman GWTP)	0.00
U-W067	Booster Pump for W-067 (Waterman GWTP)	0.00
U-W068	Booster Pump for W-068 (Waterman GWTP)	0.00
U-W069	Booster Pump for W-069 (Waterman GWTP)	0.00
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,565.40
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,565.44
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,564.44
U-WILDHAWK4	Wildhawk GWTP Pump #4	2,564.79
U-WILDHAWK5 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #5 ~ #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	0.00
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	0.00
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	0.00
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	0.00
U-CALVINEMEADOWS1 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #1 ~ #4	0.00
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	0.00
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	0.00
U-EASTPARK	Booster Pump for East Park GWTP	2,740.90
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	3,024.98
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	3,024.98
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	3,024.98
U-W077	Booster Pump for W-077 (EEG GWTP)	2,107.47
U-W114	Booster Pump for W-114 (EEG GWTP)	2,107.47
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00

Table 26. System Operational Settings for Existing CSA-SSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W063	Booster Pump for W-063 (CSA Direct Feed)	0.00
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	4,100.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	3,855.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	2,430.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,275.35
U-DWIGHT2	Dwight Road Tank Booster Pump#2	4,167.99
U-DWIGHT3	Dwight Road Tank Booster Pump#3	4,171.37
U-DWIGHT4	Dwight Road Tank Booster Pump#4	4,173.52
U-DWIGHT5 ~U-DWIGHT6	Dwight Road Tank Booster Pumps#5 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	4,829.14
U-W055	Booster Pump for W-055 (Lakeside GWTP)	1,665.92
U-W056	Booster Pump for W-056 (Lakeside GWTP)	1,492.38
U-W075	Booster Pump for W-075 (Lakeside GWTP)	1,611.63
U-POPPYRIDGE1	Poppy Ridge Pump#1	2,857.04
U-POPPYRIDGE2	Poppy Ridge Pump#2	2,857.04
U-POPPYRIDGE3	Poppy Ridge Pump#3	2,857.04
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,626.47
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,585.29
U-BIGHORN1	Big Horn GWTP Booster Pump #1	2,649.67
U-BIGHORN2	Big Horn GWTP Booster Pump #2	2,648.49
U-BIGHORN3	Big Horn GWTP Booster Pump #3	2,648.38
U-W129	Booster Pump for W-129 (BIg Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	0.00
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 27 shows the system operation settings in the model for Peak Hour, Dry Year scenario of existing conditions. No surface water was assumed available at the Vineyard SWTP. All groundwater wells and booster pumps were turned to meet the peak hour demand. In the SSA, no surface water delivery was available at the Franklin Intertie. The Dwight Road Storage tank stored the treated groundwater from well W-070. Water was pumped out into the system through one booster pump.

SSA also received water from CSA moving through the three connections along Hwy 99. The total flow rate was approximately 11,435 gpm (~16.5MGD).

Table 27. System Operational Settings for Existing CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1 ~ U-VSWTP-CSA6	CSA Booster Pumps #1 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	3,961.69
U-WATERMAN2	Waterman GWTP Booster Pump #2	3,960.67
U-WATERMAN3	Waterman GWTP Booster Pump #3	3,961.17
U-WATERMAN4	Waterman GWTP Booster Pump #4	3,961.18
U-WATERMAN3 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #5 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,522.28
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,606.73
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,606.03
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,604.09
U-WILDHAWK4	Wildhawk GWTP Pump #4	2,604.06
U-WILDHAWK5	Wildhawk GWTP Pump #5	2,604.86
U-WILDHAWK5	Wildhawk GWTP Pump #5	2,606.82
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1	Calvine Meadows GWTP Booster Pumps #1	580.62
U-CALVINEMEADOWS2	Calvine Meadows GWTP Booster Pumps #2	580.92
U-CALVINEMEADOWS3	Calvine Meadows GWTP Booster Pumps #3	1,908.12
U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #4	1,901.39
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22

Table 27. System Operational Settings for Existing CSA-SSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-EASTPARK	Booster Pump for East Park GWTP	2,943.60
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	3,260.01
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	3,260.01
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	3,260.01
U-W077	Booster Pump for W-077 (EEG GWTP)	2,107.47
U-W114	Booster Pump for W-114 (EEG GWTP)	2,006.51
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,276.76
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,180.26
U-W065	Booster Pump for W-065 (CSA Direct Feed)	932.83
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	4,290.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	4,360.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	2,785.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	4,857.77
U-DWIGHT2 ~U-DWIGHT6	Dwight Road Tank Booster Pumps#2 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	2,596.16
U-LAKESIDE	Lakeside GWTP booster pumps	5,682.89
U-W055	Booster Pump for W-055 (Lakeside GWTP)	1,665.92
U-W056	Booster Pump for W-056 (Lakeside GWTP)	1,492.38
U-W075	Booster Pump for W-075 (Lakeside GWTP)	1,611.63
U-POPPYRIDGE1	Poppy Ridge Pump#1	3,230.38
U-POPPYRIDGE2	Poppy Ridge Pump#2	3,230.38
U-POPPYRIDGE3	Poppy Ridge Pump#3	3,230.38
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,626.47
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,585.29
U-BIGHORN1	Big Horn GWTP Booster Pump #1	2,910.99
U-BIGHORN2	Big Horn GWTP Booster Pump #2	2,909.71
U-BIGHORN3	Big Horn GWTP Booster Pump #3	2,909.60
U-W129	Booster Pump for W-129 (BIg Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76

Table 27. System Operational Settings for Existing CSA-SSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W041	Booster Pump for W-041 (SSA Direct Feed)	977.34
U-W042	Booster Pump for W-042 (SSA Direct Feed)	1,161.86
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,579.72
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,262.70
U-W052	Booster Pump for W-052 (SSA Direct Feed)	1,398.76
U-W074	Booster Pump for W-074 (SSA Direct Feed)	745.73

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

The system pressures, flow velocities in pipes, and unit head losses for all existing modeling scenarios (Max Day Demand, Peak Hour Demand in wet and dry year conditions) are shown in Appendix H, Figures H-1, through H-12 , respectively. Below are some observations.

- The system pressures in the max day scenarios were maintained between 55 – 65 psi in the SSA, and 40 – 65 psi in the CSA.
- In the peak hour and wet year scenario, the system pressures in the most part of SSA (east of Franklin Blvd) were maintained between 40 – 55 and 55 – 65 in the area west of Franklin Blvd. In the CSA, pressures were higher in the Vineyard area in the north than Elk Grove Wholesale Area in the south.
- In the peak hour and dry year scenario, the system pressures in the eastern part of the SSA dropped below 40 psi despite that all facilities were turned on and that the SSA received a lot of water from the CSA. This means that the SSA water system has reached its supply and distribution capacity, new water supply facilities are required immediately. In the CSA, the system pressure pattern remained similar to that of max day, dry year scenario.
- Flow velocities in the pipes met the operating goals at peak hour, although the pipes in the Vineyard area (southwest of the Waterman GWTP) and pipes in the Grantline 99 area experienced higher flow velocities. The higher flow velocities were a result of water moving from the CSA to the SSA through these areas. The system improvements would be needed to facilitate the flow movement from the CSA to the SSA.
- The head losses in pipes met the operating goals.

The system improvements recommended for the existing CSA-SSA are summarized in Table 28.

Table 28. Recommended Existing System Improvements – CSA-SSA			
Project name	Size	Quantity	Justification for need
T-main in Elk Grove Florin Rd between Vintage Park Dr to Cobble Crest Dr	24-in diameter	2,700 LF	Eliminate disconnection in the T-main; Improve flow movement capacity to deliver more surface water from the Vineyard SWTP to SSA.
T-main in Power Inn Rd between Calvine Rd and Geneva Pointe Dr	24-in diameter	1,270 LF	Eliminate disconnection in the T-main; Improve flow movement capacity to deliver more surface water from the Vineyard SWTP to SSA.
T-main in Bruceville Rd between Di Lusso Dr and Laguna Blvd	18-in diameter	1,270 LF	Eliminate disconnection in the T-main; Improve flow movement capacity to deliver more surface water from the Vineyard SWTP to SSA.

2.2.2 Modeling Scenarios for CSA and SSA Phase 1

This section evaluates the water system of the CSA and the SSA in Phase 1 under Max Day Demand, Peak Hour Demand in Wet Year and Dry Year scenarios. In this phase, steady growth is anticipated in the CSA and the SSA. In addition to the system improvements identified for the existing system, new water facilities would be added to meet the new growth. Operation wise, the Vineyard SWTP was assumed to produce 50 MGD of water in wet years and 35 MGD in dry years. The output in dry years reflects an approximate 50% surface water reduction plus remediated groundwater. The water system will continue to implement the conjunctive use program by maximizing surface water in wet years and relying more on groundwater in dry years.

Table 29 shows the system operational settings for Max Day, Wet Year scenario. The output of the Vineyard SWTP to NSA was approximately 17 MGD, with the remaining water (33 MGD) went to the CSA/SSA. The surface water delivered at The Franklin Intertie was 7,640 gpm (11MD). The water would fill the Dwight Road Storage Tank and then be pumped out from there to the SSA distribution system. The surface water alone was not sufficient to meet the max day demand, so groundwater supply would be needed to make up the deficit. However, not all groundwater facilities would have to be turned on, nor would have to operate at the full capacity in this scenario. All direct feed wells were turned off.

There was a significant flow moving from the CSA to the SSA totaling approximately 15,960 gpm (23 MGD): including approximately 5,715 gpm (8.2 MGD) of water through the Sheldon Road Connection, 5,120 gpm (7.4 MGD) through the Bond Road Connection, and approximately 5,120 gpm (7.4 MGD) through the Grant Line Road.

Table 29. System Operational Settings for Phase 1 CSA-SSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	0.00
U-VSWTP-CSA2	CSA Booster Pump #2	11,489.82
U-VSWTP-CSA3	CSA Booster Pump #3	11,489.82
U-VSWTP-CSA4 ~ U-VSWTP-CSA6	CSA Booster Pumps #4 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	3,837.37
U-WATERMAN2	Waterman GWTP Booster Pump #2	3,836.83
U-WATERMAN3 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #3 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,612.90
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,540.64
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,559.40
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,526.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,832.72
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,833.01
U-WILDHAWK3 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #3 ~ #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69

Table 29. System Operational Settings for Phase 1 CSA-SSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #1 ~ #4	0.00
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	0.00
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	0.00
U-EASTPARK	Booster Pump for East Park GWTP	1,604.80
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,122.22
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,122.22
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	2,072.83
U-W114	Booster Pump for W-114 (EEG GWTP)	1,975.66
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00
U-W063	Booster Pump for W-063 (CSA Direct Feed)	0.00
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	5,715.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	5,120.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	5,125.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,632.08
U-DWIGHT2	Dwight Road Tank Booster Pump#2	3,629.84
U-DWIGHT3-6	Dwight Road Tank Booster Pumps#3 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Pump#1	1,773.01
U-POPPYRIDGE2	Poppy Ridge Pump#2	1,773.01
U-POPPYRIDGE3	Poppy Ridge Pump#3	1,773.01
U-POPPYRIDGE4 ~ U-POPPYRIDGE6	Poppy Ridge Booster Pump #4 - #6	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26

Table 29. System Operational Settings for Phase 1 CSA-SSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	0.00
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	0.00
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,628.81
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,834.68
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	0.00
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,924.86
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,924.12
U-BIGHORN3	Big Horn GWTP Booster Pump #3	0.00
U-W129	Booster Pump for W-129 (BIg Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	0.00
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 30 shows the system operating settings for Max Day, Dry Year scenario. The output of the Vineyard SWTP was assumed 35 MGD in this scenario, with 17 MGD delivered to the NSA and 18 MGD to the CSA/SSA. The surface water delivered at The Franklin Intertie was zero. The Dwight Road Storage Tank stored the treated groundwater water from the Dwight Road GWTP. The Calvine Meadows GWTP and the Lakeside GWTP were turned off. The Poppy Ridge GWTP operated at half of its capacity. All direct feed wells were turned on.

The flow moving from CSA to SSA was approximately 13,790 gpm (20 MGD): including approximately 4,614 gpm (6.6 MGD) of water through the Sheldon Road Connection, 4,614 gpm (6.6 MGD) through the Bond Road Connection, and approximately 4,652 gpm (6.7 MGD) through Grant Line Road.

Table 30. System Operational Settings for Phase 1 CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	0.00
U-VSWTP-CSA2	CSA Booster Pump #2	12,892.16
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	4,088.63
U-WATERMAN2	Waterman GWTP Booster Pump #2	4,088.06
U-WATERMAN3 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #3 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,612.90
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,540.64
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,559.40
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,526.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,874.90
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,875.09
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,874.50
U-WILDHAWK4 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #4 ~ #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #1 ~ #4	0.00
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	0.00
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	0.00
U-EASTPARK	Booster Pump for East Park GWTP	1,827.05
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,347.67
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,347.67
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	2,072.83
U-W114	Booster Pump for W-114 (EEG GWTP)	1,975.66
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,294.26
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,196.16
U-W065	Booster Pump for W-065 (CSA Direct Feed)	831.36
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	4,615.00

Table 30. System Operational Settings for Phase 1 CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	4,615.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	4,560.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,707.09
U-DWIGHT2 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps#2 ~ #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	2,596.16
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Pump#1	1,781.51
U-POPPYRIDGE2	Poppy Ridge Pump#2	1,781.51
U-POPPYRIDGE3	Poppy Ridge Pump#3	1,781.51
U-POPPYRIDGE4 ~ U-POPPYRIDGE6	Poppy Ridge Booster Pump #4 - #6	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	0.00
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	0.00
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,628.81
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,834.68
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	0.00
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,928.86
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,928.11
U-BIGHORN3	Big Horn GWTP Booster Pump #3	0.00
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76
U-W041	Booster Pump for W-041 (SSA Direct Feed)	831.37
U-W042	Booster Pump for W-042 (SSA Direct Feed)	980.84
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,380.90
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,106.31
U-W052	Booster Pump for W-052 (SSA Direct Feed)	1,205.33
U-W074	Booster Pump for W-074 (SSA Direct Feed)	647.86

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 31 shows the system operational settings for Peak Hour, Wet Year scenario. The output of the Vineyard SWTP and the surface water delivered at Franklin were similar to those in Max Day, Wet Year scenarios, but more booster pumps would need to be turned to the peak hour demand. All water treatment plants and directly feed wells in the SSA were turned on. The only facilities remained closed were the Calvine Meadows GWTP and the direct feed wells in the CSA. In addition, the SSA received approximately 14,230 gpm (20.5 MGD) water from the CSA: approximately 3,360 gpm (4.8 MGD) through the Sheldon Road Connection, approximately 4,920 gpm (7.1 MGD) through the Bond Road Connection, and approximately 5,950 gpm (8.6 MGD) through the Grant Line Road Connection. Overall, the water system of CSA/SSA would be adequate to handle the peak hour demand in wet years.

Table 31. System Operational Settings for Phase 1 CSA-SSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	0.00
U-VSWTP-CSA2	CSA Booster Pump #2	13,155.03
U-VSWTP-CSA3	CSA Booster Pump #3	13,155.03
U-VSWTP-CSA4 ~ U-VSWTP-CSA6	CSA Booster Pumps #4 - #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	4,171.95
U-WATERMAN2	Waterman GWTP Booster Pump #2	4,170.89
U-WATERMAN3	Waterman GWTP Booster Pump #3	4,171.41
U-WATERMAN4	Waterman GWTP Booster Pump #4	4,171.42
U-WATERMAN5	Waterman GWTP Booster Pump #5	0.00
U-WATERMAN6	Waterman GWTP Booster Pump #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,612.90
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,540.64
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,559.40
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,526.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,830.42
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,830.25
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,829.36
U-WILDHAWK4	Wildhawk GWTP Pump #4	2,829.50
U-WILDHAWK5	Wildhawk GWTP Pump #5	2,830.06
U-WILDHAWK6	Wildhawk GWTP Pump #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #1 ~ #4	0.00

Table 31. System Operational Settings for Phase 1 CSA-SSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	0.00
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	0.00
U-EASTPARK	Booster Pump for East Park GWTP	2,460.15
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	3,086.07
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	3,086.07
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	3,086.07
U-W077	Booster Pump for W-077 (EEG GWTP)	2,083.62
U-W114	Booster Pump for W-114 (EEG GWTP)	1,985.26
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00
U-W063	Booster Pump for W-063 (CSA Direct Feed)	0.00
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	3,360.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	4,920.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	5,950.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,916.72
U-DWIGHT2	Dwight Road Tank Booster Pump#2	3,914.33
U-DWIGHT3	Dwight Road Tank Booster Pump#3	3,917.79
U-DWIGHT4	Dwight Road Tank Booster Pump#4	3,920.22
U-DWIGHT5	Dwight Road Tank Booster Pump#5	0.00
U-DWIGHT-6	Dwight Road Tank Booster Pump#6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	3,660.90
U-W055	Booster Pump for W-055 (Lakeside GWTP)	1,665.92
U-W056	Booster Pump for W-056 (Lakeside GWTP)	1,492.38
U-W075	Booster Pump for W-075 (Lakeside GWTP)	1,611.63
U-POPPYRIDGE1	Poppy Ridge Pump#1	2,459.97
U-POPPYRIDGE2	Poppy Ridge Pump#2	2,459.97
U-POPPYRIDGE3	Poppy Ridge Pump#3	2,459.97
U-POPPYRIDGE4	Poppy Ridge Booster Pump #4	2,459.97
U-POPPYRIDGE5	Poppy Ridge Booster Pump #5	2,459.97
U-POPPYRIDGE6	Poppy Ridge Booster Pump #6	2,459.97

Table 31. System Operational Settings for Phase 1 CSA-SSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,533.44
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,515.28
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,527.10
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	1,513.11
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,571.79
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	1,516.10
U-BIGHORN1	Big Horn GWTP Booster Pump #1	2,538.95
U-BIGHORN2	Big Horn GWTP Booster Pump #2	2,537.82
U-BIGHORN3	Big Horn GWTP Booster Pump #3	2,537.71
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76
U-W041	Booster Pump for W-041 (SSA Direct Feed)	908.95
U-W042	Booster Pump for W-042 (SSA Direct Feed)	1,062.72
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,471.88
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,178.86
U-W052	Booster Pump for W-052 (SSA Direct Feed)	1,307.23
U-W074	Booster Pump for W-074 (SSA Direct Feed)	699.82

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 32 shows the system operational settings for Peak Hour, Dry Year scenario. The output of the Vineyard SWTP was similar to that in Max Day, Dry Year scenarios, and the surface water delivered at the Franklin Intertie was zero. Due to the surface water reduction in dry years, groundwater made up the majority of the water supply. In this scenario, all groundwater treatment plants and booster pumps would be turned on and operating at their full capacity. All direct feed wells were turned on as well.

In addition, the SSA received approximately 21,720 gpm (31.3 MGD) water from the CSA through three connections: approximately 7,695 gpm (11.1 MGD) through the Sheldon Road Connection, approximately 6,770 gpm (9.7 MGD) through the Bond Road Connection, and approximately 7,250 gpm (10.5 MGD) through the Grant Line Road Connection.

Overall, the water system of CSA/SSA was adequate to handle the peak hour demand in dry years, but the system capacity would be maxed out at the end of Phase 1, especially for the SSA system. The flows through the three connections between the CSA and the SSA had reached the maximum capacity of each connection (24-inch), indicating that expanding groundwater treatment capacity, booster pump capacity, and storage would be necessary.

Table 32. System Operational Settings for Phase 1 CSA-SSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	0.00
U-VSWTP-CSA2	CSA Booster Pump #2	13,369.21
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	3,875.03
U-WATERMAN2	Waterman GWTP Booster Pump #2	3,873.22
U-WATERMAN3	Waterman GWTP Booster Pump #3	3,873.13
U-WATERMAN4	Waterman GWTP Booster Pump #4	3,872.74
U-WATERMAN5	Waterman GWTP Booster Pump #5	3,873.30
U-WATERMAN6	Waterman GWTP Booster Pump #6	3,875.50
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,522.28
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,611.16
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,610.45
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,608.51
U-WILDHAWK4	Wildhawk GWTP Pump #4	2,608.48
U-WILDHAWK5	Wildhawk GWTP Pump #5	2,609.28
U-WILDHAWK6	Wildhawk GWTP Pump #6	2,611.25
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWN1	Calvine Meadows GWTP Booster Pump #1	580.40
U-CALVINEMEADOWN2	Calvine Meadows GWTP Booster Pump #2	580.71
U-CALVINEMEADOWN3	Calvine Meadows GWTP Booster Pump #3	1,907.41
U-CALVINEMEADOWN4	Calvine Meadows GWTP Booster Pump #4	1,900.67
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22
U-EASTPARK	Booster Pump for East Park GWTP	2,492.72
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	3,151.49
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	3,151.49

Table 32. System Operational Settings for Phase 1 CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	3,151.49
U-W077	Booster Pump for W-077 (EEG GWTP)	2,083.62
U-W114	Booster Pump for W-114 (EEG GWTP)	1,985.26
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,257.88
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,166.76
U-W065	Booster Pump for W-065 (CSA Direct Feed)	873.29
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	7,700.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	6,770.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	7,250.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	4,747.87
U-DWIGHT2 ~ U-DWIGHT-6	Dwight Road Tank Booster Pump#2 ~ #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	2,596.16
U-LAKESIDE	Lakeside GWTP booster pumps	5,490.57
U-W055	Booster Pump for W-055 (Lakeside GWTP)	1,665.92
U-W056	Booster Pump for W-056 (Lakeside GWTP)	1,492.38
U-W075	Booster Pump for W-075 (Lakeside GWTP)	1,611.63
U-POPPYRIDGE1	Poppy Ridge Pump#1	2,869.37
U-POPPYRIDGE2	Poppy Ridge Pump#2	2,869.37
U-POPPYRIDGE3	Poppy Ridge Pump#3	2,869.37
U-POPPYRIDGE4	Poppy Ridge Booster Pump #4	2,869.37
U-POPPYRIDGE5	Poppy Ridge Booster Pump #5	2,869.37
U-POPPYRIDGE6	Poppy Ridge Booster Pump #6	2,869.37
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,533.44
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,515.28
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,527.10
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	1,513.11
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,571.79
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	1,516.10
U-BIGHORN1	Big Horn GWTP Booster Pump #1	2,863.78
U-BIGHORN2	Big Horn GWTP Booster Pump #2	2,862.52
U-BIGHORN3	Big Horn GWTP Booster Pump #3	2,862.41

Table 32. System Operational Settings for Phase 1 CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,507.64
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,606.76
U-W041	Booster Pump for W-041 (SSA Direct Feed)	962.81
U-W042	Booster Pump for W-042 (SSA Direct Feed)	1,143.93
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,560.44
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,246.38
U-W052	Booster Pump for W-052 (SSA Direct Feed)	1,372.44
U-W074	Booster Pump for W-074 (SSA Direct Feed)	730.85

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

The system pressures, flow velocities in pipes, and unit head losses for the CSA/SSA Phase 1 modeling scenarios (Max Day Demand, Peak Hour Demand in Wet and Dry Year conditions) are illustrated in Appendix H, Figures H-13 through H-24, respectively. Below are some observations:

- System pressures for Max Day Demand scenarios (both in wet and dry years) were between 50 ~ 75 psi. System pressures for Peak Hour Demand scenarios were between 40 ~ 65 psi.
- Flow velocities in pipes under Phase 1 scenarios were below 7 ft/sec during peak hour. For the most part, the flow velocities were less than 4 ft/sec.
- Head losses under Phase 1 scenarios met the operating goal of less than 5 ft/1000ft. For the vast majority of the pipes, the head loss was less than 1 ft/1000ft except for a couple of small-size pipes.

The system improvements in Phase 1 refer to the facilities that would be constructed between present to the end of Phase 1. These recommended facilities are summarized in Table 33. The expansion of the Poppy Ridge GWTP (including wells, booster pumps, and storage tank) is on the top of the list of system improvements. The need for its expansion was demonstrated in the modeling of the existing system, particularly under Peak Hour Demand, Dry Year Scenario. The modeling results show that the capacity of groundwater supply and peaking facility in the SSA was not adequate. There was some groundwater supply redundancy in the CSA early in Phase 1, but the system constraints limited the flow moving from the CSA to the SSA. The flow moving from the CSA to the SSA could be greatly enhanced with the construction of the T-main in Bradshaw Rd between Calvine Rd and Bond Rd.

The T-main in Bradshaw Rd between Calvine Rd and Bond Rd is recommended in Phase 1 as well. The construction of this segment of T-main would connect Elk Grove Wholesale Area to the rest of the CSA, allowing more surface water delivered from the Vineyard SWTP. It would enhance the robustness of the CSA water system to move more water to the SSA. As a result, the water supply reliability would be improved for both the CSA and the SSA.

Other system improvements are mostly related to the new growth. New T-mains would be installed to provide water service to new growth areas including Laguna Ridge, South East Policy Area, North Vineyard Station, Florin Vineyard Community Plan, and West Jackson etc. The sizes of these facilities were determined in the system modeling for buildout, but were verified in the modeling for interim phases.

Table 33. Recommended Phase 1 System Improvements – CSA-SSA			
Project name	Size	Quantity	Justification for need
Poppy Ridge GWTP Expansion	6.5 mgd	6.5 mgd	Improve water supply capacity and reliability in SSA
Poppy Ridge GWTP New Wells	1,500 gpm each	4 (including one backup)	Increase water supply capacity and liability in SSA
Poppy Ridge Storage Tank Expansion	3.5 MG	1	Add one 3.5-MG storage tank to the existing 3.5-MG storage tank resulting a total 7-MG storage
Poppy Ridge Booster Pump Expansion	2,400 gpm/110 ft	4 (including one backup)	Increase pumping capacity to meet max day and peak hour demands
T-main in Bradshaw Rd between Calvine Rd and Bond Rd	30-in /24-in diameter	5,420 LF of 30-in, 4,525 LF of 24-in	Enhance water supply reliability for Elk Grove Wholesale Area. Increase surface water use. Improve flow capacity to move more water from CSA to SSA.
T-main in Grant Line Rd between Waterman Rd and Hwy 99	24-in diameter	2,980 LF	Eliminate disconnection in the T-main; Improve flow capacity to move more water from CSA to SSA.
Other Various T-mains	16 ~ 42-inch	112,525 LF	Provide water to new growth areas and improve the pipeline network looping: Laguna Ridge, South East Policy Area, North Vineyard Station, Florin Vineyard Community Plan, and West Jackson.

2.2.3 Modeling Scenarios for CSA and SSA Phase 2

This section evaluates the water system of the CSA and the SSA in Phase 2 under Max Day Demand, Peak Hour Demand in Wet Year and Dry Year scenarios. The model included the new water facilities that would be constructed during this phase. The treatment capacity of the Vineyard SWTP was still 50 MGD. It was assumed that the Vineyard SWTP would produce 50 MGD of surface water in wet years and 35 MGD in dry years. The output in dry years reflected approximate 50% surface water reduction and remediated groundwater. Operation wise, the water system would continue to implement the conjunctive use program by maximizing surface water in wet years and relying more on groundwater in dry years.

Table 34 shows the system operational settings for Max Day, Wet Year scenario. The surface water production out of the Vineyard SWTP would meet the need of the NSA demand first because of the limited groundwater supply in the NSA. The remaining of the surface water would be delivered to the CSA and SSA. In this phase, the delivery of surface water to NSA was approximately 27 MGD, with the remaining 23 MGD went to the CSA/SSA. In the SSA, the surface water delivered at The Franklin Intertie is 7,640 gpm (11MD). The water would fill the Dwight Road Storage Tank and then pumped out from there to the SSA distribution system. The surface water alone was not sufficient to meet the max day demand, so groundwater supply would make up the deficit. However, not all groundwater facilities had to be turned on. Some of them closed or partially operated: 1) all direct feed wells were turned off; 2) the East Park GWTP, the Poppy Ridge GWTP, and the Lakeside GWTP were turned off; 3) the other GWTPs partially operated.

The total flow moving from the CSA to the SSA was approximately 16,000 gpm (23 MGD): approximately 5,940 gpm (8.6 MGD) of water through the Sheldon Road Connection, 5,105 gpm (7.4 MGD) through the Bond Road Connection, and approximately 4,955 gpm (7.0 MGD) through the Grant Line Road Connection.

Table 34. System Operational Settings for Phase 2 CSA-SSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	5,687.12
U-VSWTP-CSA2	CSA Booster Pump #2	11,373.32
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	3,805.25
U-WATERMAN2	Waterman GWTP Booster Pump #2	3,804.72
U-WATERMAN3 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #3 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,522.28
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,732.15
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,732.49
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,731.42
U-WILDHAWK4 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #4 ~ #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1	Calvine Meadows GWTP Booster Pumps #1	467.14
U-CALVINEMEADOWS2	Calvine Meadows GWTP Booster Pumps #2	467.40
U-CALVINEMEADOWS3	Calvine Meadows GWTP Booster Pumps #3	1,534.51
U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #4	1,528.92
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22
U-EASTPARK	Booster Pump for East Park GWTP	0.00
U-W073	Booster Pump for W-073 (East Park GWTP)	0.00
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,086.42
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,086.42
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	2,086.42
U-EASTELKGROVE4 ~ U-EASTELKGROVE6	East Elk Grove GWTP Booster Pumps #4 ~ #6	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	0.00
U-W079	Booster Pump for W-079 (EEG GWTP)	2,020.74
U-W114	Booster Pump for W-114 (EEG GWTP)	0.00

Table 34. System Operational Settings for Phase 2 CSA-SSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W135	Booster Pump at W-135 (EEG GWTP)	0.00
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	0.00
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	2,045.57
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,428.82
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	4,583.25
U-WESTJACKSON3 ~ U-WESTJACKSON6	West Jackson Storage Tank Booster Pump #3 ~ #6	0.00
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,891.96
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,843.27
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,836.92
U-EXCELSIOR4	Booster Pump for Excelsior #4	0.00
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,867.61
U-EXCELSIOR6	Booster Pump for Excelsior No.6	0.00
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,908.14
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00
U-W063	Booster Pump for W-063 (CSA Direct Feed)	0.00
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	5,940.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	5,105.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	4,955.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,625.56
U-DWIGHT2	Dwight Road Tank Booster Pump#2	3,623.32
U-DWIGHT3 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps#3 ~ #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Pump#1	0.00
U-POPPYRIDGE2	Poppy Ridge Pump#2	0.00
U-POPPYRIDGE3	Poppy Ridge Pump#3	0.00
U-POPPYRIDGE4 ~ U-POPPYRIDGE6	Poppy Ridge Booster Pump #4 - #6	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	0.00

Table 34. System Operational Settings for Phase 2 CSA-SSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	0.00
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	0.00
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	0.00
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	0.00
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	0.00
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,913.13
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,912.39
U-BIGHORN3 ~ U-BIGHORN6	Big Horn GWTP Booster Pumps #3 ~ #6	0.00
U-W-126	Booster Pump for Big Horn GWTP on site well	0.00
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	0.00
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	1,518.65
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,506.79
U-W130	Booster Pump for W-130 (Big Horn GWTP)	0.00
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	0.00
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	1,594.80
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,648.38
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,648.38
U-WHITELOCKE3 ~ U-WHITELOCKE6	White Locke GWTP Booster Pumps #3 ~ #6	0.00
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	1,590.05
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	0.00
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	0.00
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,621.91
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	0.00
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	0.00
U-W-WHITELOCKEON SITE	White Locke GWTP On site Well Pump	1,507.80
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	0.00
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 35 shows the system operational settings for Max Day, Dry Year scenario. Because of the surface water cutback in dry years, the production of the Vineyard SWTP was assumed 35 MGD (assuming 50% surface water cutback plus remediated groundwater). Approximately 26.5 MGD of surface water went to the NSA, the remaining 8.5 MGD went to the CSA/SSA. In the SSA, the surface water delivered at the Franklin Intertie was assumed zero. What filled Dwight Road Storage Tank was the treated groundwater from the Dwight Road GWTP. Nearly all groundwater treatment plants were turned on operating near their full capacity. Direct feed wells in the SSA were turned off.

The total flow moving from the CSA to the SSA was approximately 13,420 gpm (19.3 MGD): approximately 5,100 gpm (7.3 MGD) of water through the Sheldon Road Connection, approximately 4,320 gpm (6.2 MGD) through the Bond Road Connection, and approximately 4,000 gpm (5.8 MGD) through the Grant Line Road Connection.

Table 35. System Operational Settings for Phase 2 CSA-SSA System – Max Day Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	5,922.45
U-VSWTP-CSA2 ~ U-VSWTP-CSA6	CSA Booster Pumps #2 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	3,838.58
U-WATERMAN2	Waterman GWTP Booster Pump #2	3,838.04
U-WATERMAN3 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #3 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,612.90
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,540.64
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,559.40
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,526.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,770.29
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,770.65
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,769.55
U-WILDHAWK4 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #4 ~ #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1	Calvine Meadows GWTP Booster Pumps #1	474.83
U-CALVINEMEADOWS2	Calvine Meadows GWTP Booster Pumps #2	475.09
U-CALVINEMEADOWS3	Calvine Meadows GWTP Booster Pumps #3	1,559.82
U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #4	1,554.15
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,496.80

Table 35. System Operational Settings for Phase 2 CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-EASTPARK	Booster Pump for East Park GWTP	1,372.10
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	1,750.85
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	1,750.85
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	1,750.85
U-EASTELKGROVE4 ~ U-EASTELKGROVE6	East Elk Grove GWTP Booster Pumps #4 ~ #6	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	1,497.25
U-W079	Booster Pump for W-079 (EEG GWTP)	1,489.93
U-W114	Booster Pump for W-114 (EEG GWTP)	1,503.89
U-W135	Booster Pump at W-135 (EEG GWTP)	1,509.65
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	0.00
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	0.00
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	0.00
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,466.91
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	4,622.53
U-WESTJACKSON3	West Jackson Storage Tank Booster Pump #3	4,695.65
U-WESTJACKSON4 ~ U-WESTJACKSON6	West Jackson Storage Tank Booster Pumps #4 ~#6	0.00
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,816.09
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,822.54
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,809.00
U-EXCELSIOR4	Booster Pump for Excelsior #4	1,921.54
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,819.90
U-EXCELSIOR6	Booster Pump for Excelsior No.6	1,818.08
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,822.51
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,224.84
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,133.99
U-W065	Booster Pump for W-065 (CSA Direct Feed)	809.70
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	5,100.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	4,320.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	4,000.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,517.50
U-DWIGHT2 ~ U-DWIGHT6	Dwight Road Tank Booster Pump#2 ~ #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	2,596.16

Table 35. System Operational Settings for Phase 2 CSA-SSA System – Max Day Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Pump#1	1,253.34
U-POPPYRIDGE2	Poppy Ridge Pump#2	1,253.34
U-POPPYRIDGE3	Poppy Ridge Pump#3	1,253.34
U-POPPYRIDGE4 ~ U-POPPYRIDGE6	Poppy Ridge Booster Pump #4 - #6	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,533.44
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,515.28
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	0.00
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	0.00
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	0.00
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,593.33
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,592.57
U-BIGHORN3	Big Horn GWTP Booster Pump #3	1,592.50
U-BIGHORN4 ~ U-BIGHORN6	Big Horn GWTP Booster Pumps #4 ~ #6	0.00
U-W-126	Booster Pump for Big Horn GWTP on site well	0.00
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	0.00
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	1,518.65
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,506.79
U-W130	Booster Pump for W-130 (Big Horn GWTP)	0.00
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	0.00
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	1,594.80
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,299.76
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,299.76
U-WHITELOCKE3	White Locke GWTP Booster Pump #3	2,299.76
U-WHITELOCKE4 ~ U-WHITELOCKE6	White Locke GWTP Booster Pumps #4 ~ #6	0.00
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	1,584.92
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	1,607.66
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	1,580.54
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,615.99
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	1,542.33

Table 35. System Operational Settings for Phase 2 CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	0.00
U-W-WHITELOCKEON SITE	White Locke GWTP on site Well Pump	1,507.80
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	0.00
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 36 shows the system operational settings for Peak Hour Demand, Wet Year scenario. The Vineyard SWTP was operating at its full capacity of 50 MGD in wet years. Approximately 27 MGD of surface water from the Vineyard SWTP went to the NSA, and the remaining 23 GMD went to the CSA and the SSA. In the SSA, the surface water delivered at The Franklin Intertie was at its maximum capacity of 11 MGD. The water would fill the Dwight Road Storage Tank and then pumped out to the SSA system. All groundwater treatment plants were turned on except the Lakeside GWTP. The booster pump stations operated at a full or near full capacity, but all direct feed wells were closed in this scenario.

The total flow moving from the CSA to the SSA was approximately 10,415 gpm (15 MGD): approximately 2,730 gpm (3.9 MGD) of water through the Sheldon Road Connection, 3,330 gpm (4.8 MGD) through the Bond Road Connection, and approximately 4,355 gpm (6.3 MGD) through the Grant Line Road Connection.

Table 36. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	6,494.12
U-VSWTP-CSA2	CSA Booster Pump #2	12,987.20
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	4,143.07
U-WATERMAN2	Waterman GWTP Booster Pump #2	4,142.02
U-WATERMAN3	Waterman GWTP Booster Pump #3	4,142.54
U-WATERMAN4	Waterman GWTP Booster Pump #4	4,142.55
U-WATERMAN5 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #5 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,522.28
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89

Table 36. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,830.08
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,828.65
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,828.46
U-WILDHAWK4	Wildhawk GWTP Pump #4	2,828.73
U-WILDHAWK5	Wildhawk GWTP Pump #5	2,829.63
U-WILDHAWK6	Wildhawk GWTP Pump #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1	Calvine Meadows GWTP Booster Pumps #1	682.62
U-CALVINEMEADOWS2	Calvine Meadows GWTP Booster Pumps #2	682.97
U-CALVINEMEADOWS3	Calvine Meadows GWTP Booster Pumps #3	2,244.07
U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #4	2,236.33
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22
U-EASTPARK	Booster Pump for East Park GWTP	0.00
U-W073	Booster Pump for W-073 (East Park GWTP)	0.00
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,194.89
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,194.89
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	2,194.89
U-EASTELKGROVE4	East Elk Grove GWTP Booster Pump #4	2,194.89
U-EASTELKGROVE5	East Elk Grove GWTP Booster Pump #5	2,194.89
U-EASTELKGROVE6	East Elk Grove GWTP Booster Pump #6	2,194.89
U-W077	Booster Pump for W-077 (EEG GWTP)	1,517.43
U-W079	Booster Pump for W-079 (EEG GWTP)	1,513.87
U-W114	Booster Pump for W-114 (EEG GWTP)	1,521.62
U-W135	Booster Pump at W-135 (EEG GWTP)	1,530.20
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	1,519.37
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	1,533.27
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,888.74
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	5,057.36
U-WESTJACKSON3	West Jackson Storage Tank Booster Pump #3	5,136.55
U-WESTJACKSON4 ~ U-WESTJACKSON6	West Jackson Storage Tank Booster Pumps #4 ~ #6	0.00

Table 36. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-W122	Booster Pump for Excelsior Well #1 (W-122)	0.00
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,877.98
U-W124	Booster Pump for Excelsior Well #3 (W-124)	0.00
U-EXCELSIOR4	Booster Pump for Excelsior #4	1,921.54
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,867.61
U-EXCELSIOR6	Booster Pump for Excelsior No.6	0.00
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,908.14
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00
U-W063	Booster Pump for W-063 (CSA Direct Feed)	0.00
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	2,730.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	3,330.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	4,355.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,712.11
U-DWIGHT2	Dwight Road Tank Booster Pump#2	3,709.82
U-DWIGHT3	Dwight Road Tank Booster Pump#3	3,713.13
U-DWIGHT4	Dwight Road Tank Booster Pump#4	3,715.45
U-DWIGHT5-6	Dwight Road Tank Booster Pumps#5 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Pump#1	1,840.94
U-POPPYRIDGE2	Poppy Ridge Pump#2	1,840.94
U-POPPYRIDGE3	Poppy Ridge Pump#3	1,840.94
U-POPPYRIDGE4	Poppy Ridge Booster Pump #4	1,840.94
U-POPPYRIDGE5	Poppy Ridge Booster Pump #5	1,840.94
U-POPPYRIDGE6	Poppy Ridge Booster Pump #6	1,840.94
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,557.33
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,533.16
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,553.95

Table 36. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,688.73
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	1,717.15
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,963.09
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,961.20
U-BIGHORN3	Big Horn GWTP Booster Pump #3	1,960.39
U-BIGHORN4	Big Horn GWTP Booster Pump #4	1,960.40
U-BIGHORN5	Big Horn GWTP Booster Pump #5	1,960.85
U-BIGHORN6	Big Horn GWTP Booster Pump #6	1,962.04
U-W-126	Booster Pump for Big Horn GWTP on site well	0.00
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	1,469.71
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	1,460.81
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,458.06
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,491.32
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	0.00
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	1,589.60
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,657.11
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,657.11
U-WHITELOCKE3	White Locke GWTP Booster Pump #3	2,657.11
U-WHITELOCKE4	White Locke GWTP Booster Pump #4	2,361.09
U-WHITELOCKE5	White Locke GWTP Booster Pump #5	2,361.09
U-WHITELOCKE6	White Locke GWTP Booster Pump #6	2,361.09
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	1,581.58
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	1,575.54
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	1,548.89
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,612.12
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	1,542.33
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	0.00
U-W-WHITELOCKEON SITE	White Locke GWTP On site Well Pump	1,507.80
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	0.00
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 37 shows the system operational settings for Peak Hour Demand, Dry Year scenario. Because of surface water cutback in dry years, the production of the Vineyard SWTP was assumed 35 MGD (assuming 50% surface water cutback plus remediated groundwater). Approximately 26 MGD of surface water from the Vineyard SWTP went to NSA, the remaining 9.0 MGD went to the CSA and the SSA. In the SSA, the surface water delivered at the Franklin Intertie was assumed zero. What filled the Dwight Road Storage Tank was the treated groundwater from the Dwight Road GWTP. Nearly all groundwater treatment plants were turned on operating near full capacity. All but a couple of direct feed wells in SSA were turned on as well.

The total flow moving from the CSA to the SSA was approximately 13,970 gpm (20.1 MGD): including approximately 5,055 gpm (7.3 MGD) of water through the Sheldon Road Connection, approximately 4,030 gpm (5.8 MGD) through the Bond Road Connection, and approximately 4,885 gpm (7.0 MGD) through the Grant Line Road Connection.

Table 37. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	6,368.46
U-VSWTP-CSA2	CSA Booster Pump #2	0.00
U-VSWTP-CSA3 ~ U-VSWTP-CSA6	CSA Booster Pumps #3 ~ #6	0.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	4,056.53
U-WATERMAN2	Waterman GWTP Booster Pump #2	4,055.50
U-WATERMAN3	Waterman GWTP Booster Pump #3	4,056.01
U-WATERMAN4	Waterman GWTP Booster Pump #4	4,056.02
U-WATERMAN5 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #5 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,522.28
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,779.78
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,779.46
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,777.76
U-WILDHAWK4	Wildhawk GWTP Pump #4	2,778.03
U-WILDHAWK5	Wildhawk GWTP Pump #5	2,779.11
U-WILDHAWK6	Wildhawk GWTP Pump #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1	Calvine Meadows GWTP Booster Pumps #1	609.76

Table 37. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-CALVINEMEADOWS2	Calvine Meadows GWTP Booster Pumps #2	610.08
U-CALVINEMEADOWS3	Calvine Meadows GWTP Booster Pumps #3	2,004.11
U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #4	1,997.09
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22
U-EASTPARK	Booster Pump for East Park GWTP	1,974.94
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,052.72
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,052.72
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	2,052.72
U-EASTELKGROVE4	East Elk Grove GWTP Booster Pump #4	2,052.72
U-EASTELKGROVE5	East Elk Grove GWTP Booster Pump #5	2,052.72
U-EASTELKGROVE6	East Elk Grove GWTP Booster Pump #6	2,052.72
U-W077	Booster Pump for W-077 (EEG GWTP)	1,517.43
U-W079	Booster Pump for W-079 (EEG GWTP)	1,513.87
U-W114	Booster Pump for W-114 (EEG GWTP)	1,521.62
U-W135	Booster Pump at W-135 (EEG GWTP)	1,530.20
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	1,519.37
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	1,533.27
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,345.35
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	4,497.18
U-WESTJACKSON3	West Jackson Storage Tank Booster Pump #3	4,568.55
U-WESTJACKSON4	West Jackson Storage Tank Booster Pump #4	4,513.61
U-WESTJACKSON5	West Jackson Storage Tank Booster Pump #5	4,520.84
U-WESTJACKSON6	West Jackson Storage Tank Booster Pump #6	4,479.16
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,816.09
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,822.54
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,809.00
U-EXCELSIOR4	Booster Pump for Excelsior #4	1,921.54
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,819.90
U-EXCELSIOR6	Booster Pump for Excelsior No.6	1,818.08
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,822.51
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,280.36
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,187.03
U-W065	Booster Pump for W-065 (CSA Direct Feed)	854.22

Table 37. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	5,055.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	4,030.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	4,885.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	4,158.77
U-DWIGHT2 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps#2 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	2,596.16
U-LAKESIDE	Lakeside GWTP booster pumps	2,796.20
U-W055	Booster Pump for W-055 (Lakeside GWTP)	1,665.92
U-W056	Booster Pump for W-056 (Lakeside GWTP)	1,492.38
U-W075	Booster Pump for W-075 (Lakeside GWTP)	1,611.63
U-POPPYRIDGE1	Poppy Ridge Pump#1	1,878.94
U-POPPYRIDGE2	Poppy Ridge Pump#2	1,878.94
U-POPPYRIDGE3	Poppy Ridge Pump#3	1,878.94
U-POPPYRIDGE4	Poppy Ridge Booster Pump #4	1,878.94
U-POPPYRIDGE5	Poppy Ridge Booster Pump #5	1,878.94
U-POPPYRIDGE6	Poppy Ridge Booster Pump #6	1,878.94
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,533.44
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,515.28
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,527.10
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	1,513.11
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,571.79
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	1,516.10
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,977.58
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,975.68
U-BIGHORN3	Big Horn GWTP Booster Pump #3	1,974.86
U-BIGHORN4	Big Horn GWTP Booster Pump #4	1,974.87
U-BIGHORN5	Big Horn GWTP Booster Pump #5	1,975.32
U-BIGHORN6	Big Horn GWTP Booster Pump #6	1,976.52
U-W-126	Booster Pump for Big Horn GWTP on site well	0.00
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	1,467.35
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	1,457.58
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,455.35

Table 37. System Operational Settings for Phase 2 CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,488.94
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	1,355.69
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	1,485.97
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,672.67
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,672.67
U-WHITELOCKE3	White Locke GWTP Booster Pump #3	2,672.67
U-WHITELOCKE4	White Locke GWTP Booster Pump #4	2,380.04
U-WHITELOCKE5	White Locke GWTP Booster Pump #5	2,380.04
U-WHITELOCKE6	White Locke GWTP Booster Pump #6	2,380.04
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	1,584.92
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	1,607.66
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	1,580.54
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,615.99
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	0.00
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	0.00
U-W-WHITELOCKEON SITE	White Locke GWTP On site Well Pump	1,507.80
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	1,040.20
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,441.98
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,155.63
U-W052	Booster Pump for W-052 (SSA Direct Feed)	1,257.41
U-W074	Booster Pump for W-074 (SSA Direct Feed)	680.04

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

The system pressures, flow velocities in pipes, and unit head losses for the CSA/SSA Phase 2 modeling scenarios (Max Day Demand, Peak Hour Demand in Wet and Dry Year conditions) are illustrated in Appendix H, Figures H-25 through H-36, respectively. Below are some observations:

- The system pressures were maintained between 55 ~ 75 psi in the SSA under all modeling scenarios. In the CSA, the system pressures were between 40 ~ 75 psi.
- Flow velocities in pipes were below 7 ft/sec at peak hour. For the most part, the flow velocities were less than 4 ft/sec.
- Head losses met the operating goal of less than 5 ft/1000ft. For the vast majority of pipes, the head loss was less than 1 ft/1000ft.

The system improvements in Phase 2 refer to the facilities that would be constructed from the beginning of Phase 2 to the end of Phase 2. These system improvement recommendations are summarized in Table 38.

The construction of Whitelocke GWTP (including wells, booster pumps, storage tank) and the expansion of Big Horn GWTP (including wells and booster pumps) in SSA would occur in Phase 2. These two facilities would be necessary in order to meet the peak hour demand, particularly in dry years. In the CSA, the West Jackson GWTP would be required in this phase. The West Jackson GWTP would treat groundwater pumped from the Excelsior Well Field. Three existing Excelsior wells currently feed the Anatolia GWTP in the NSA for treatment. With the construction of NSA Pipeline Phase A, these three wells would be temporarily closed until the West Jackson GWTP is built so that they would pump groundwater to the West Jackson GWTP for treatment instead. Another four Excelsior wells would be drilled in Phase 2 to meet the new growth in West Jackson area, as well as enhance the water supply reliability in the CSA/SSA system, particularly in dry years. Another facility improvement required in the CSA is the expansion of the East Elk Grove GWTP (including wells, booster pumps, and storage). The East Elk Grove GWTP would be a very important water supply source for Elk Grove Wholesale Area and the southeastern portion of the SSA, particularly in dry years when surface water was significantly reduced.

Other system improvements include T-mains to provide water service to the new growth areas. The sizes of these facilities were determined in the system modeling for builtout, but verified in interim phases.

The system improvements recommendations for Phase 2 in CSA and SSA are summarized in Table 38.

Table 38. Recommended Phase 2 System Improvements – CSA-SSA

Project name	Size	Quantity	Justification for need
Big Horn GWTP Expansion	6.5 mgd	6.5 mgd	Improve water supply capacity and reliability in SSA
Big Horn GWTP New Wells	1,500 gpm each	5 (including one backup)	Increase groundwater water supply capacity and liability in SSA
Big Horn GWTP Booster Pump Expansion	2,000 gpm/120 ft	4 (including one backup)	Increase pumping capacity to meet the peak hour demand
White Locke GWTP	13 mgd	13 mgd	Improve water supply capacity and reliability in SSA
White Locke GWTP Wells	1,500 gpm each	7 (including one backup)	Improve water supply capacity and reliability in SSA
White Locke GWTP Storage Tank	3 mg	2x1.5 mg	Increase system peaking capacity
White Locke Booster Pumps	2,500 gpm/130 ft	6 (including one backup)	Increase booster pump capacity to meet max day and peak hour demands
Various T-mains	16 ~ 24-inch	61,700 LF	Provide water to new growth areas and improve the pipeline network looping

2.2.4 Modeling Scenario for the CSA and SSA at Buildout

This section evaluates the water system of the CSA and the SSA at buildout under Max Day Demand and Peak Hour Demand in Wet Year and Dry Year scenarios. In this phase, water demand would continue to grow across Zone 40. New water facilities would be added to meet the increased water demand including the expansion of the Vineyard SWTP and the POU water facilities. The expansion of the Vineyard SWTP would increase its treatment capacity from 50 MGD to 100 MGD. The POU water facilities would add additional 19.1 mgd surface water capacity.

Operation wise, the water system will continue to implement the conjunctive use program by maximizing the use of surface water in wet years and relying more on groundwater in dry years. The Vineyard SWTP was assumed to produce 100 MGD of water in wet years and 50 MGD in dry years. The POU water was assumed to deliver surface water at its full capacity of 19.1 mgd both in wet years and in dry years. Discussions between the City and SCWA indicated that the reliability and delivery of the POU water to Zone 40 could change in the future. The changes to the POU water delivery and reliability would probably change the water supply portfolio and the way the system would operate. Therefore, this assumption used in this study regarding the POU water will need to be revisited. When the specifics of those changes are defined, an update to the Zone 40 water system planning may be needed.

Table 39 shows the system operational settings for Max Day, Wet Year scenario. The production of the Vineyard SWTP would meet the need of the NSA demand first because of the limited groundwater supply in the NSA, and the remaining of the surface water would be delivered to the CSA and the SSA. In this scenario, the delivery of surface water to NSA was approximately 62 MGD, so the remaining 38 MGD went to the CSA and the SSA. The POU water with a flow rate of 13,260 gpm (19.1 MGD) would fill the North Vineyard Station Tank through a dedicated 36-inch transmission pipeline (the POU Water Pipeline), and then pumped out to the CSA system.

In the SSA, the surface water delivered at the Franklin Intertie was 7,640 gpm (11 MGD) in this scenario. The water would fill the Dwight Road Storage Tank and then pumped out into the SSA distribution system. The total surface water delivered to the CSA and the SSA was 68.1 MGD by adding up the flows at the Vineyard SWTP, POU Water, and at the Franklin Intertie. However, surface water alone was not sufficient to meet the max day demand, so groundwater supply would have to make up for the deficit. The majority of the groundwater facilities were turned off in this scenario including the Calvine Meadows GWTP , the Bond GWTP, the East Park GWTP , the Poppy Ridge GWTP, the Big Horn GWTP , the Franklin GWTP , and the Lakeside GWTP . Nearly all direct feed wells were turned off as well.

The total flow moving from the CSA to the SSA was approximately 18,315 gpm (26.4 MGD): including approximately 6,840 gpm (9.9 MGD) of water through the Sheldon Road Connection, 5,830 gpm (8.4 MGD) through the Bond Road Connection, and approximately 5,645 gpm (8.1 MGD) through the Grant Line Road Connection.

Table 39. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Wet Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	5,387.10
U-VSWTP-CSA2	CSA Booster Pump #2	10,772.29
U-VSWTP-CSA3	CSA Booster Pump #3	10,772.73
U-VSWTP-CSA4 ~ U-VSWTP-CSA6	CSA Booster Pumps #4 ~ #6	0.00
U-NVSTATION1	North Vineyard Station Tank Booster Pump #1	3,821.76
U-NVSTATION2	North Vineyard Station Tank Booster Pump #2	3,821.76
U-NVSTATION3	North Vineyard Station Tank Booster Pump #3	3,821.76
U-NVSTATION4 ~ U-NVSTATION6	North Vineyard Station Tank Booster Pumps #4 ~ #6	0.00
POU Intertie	POU Intertie filling North Vineyard Station Storage Tank	13,260.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	3,830.55
U-WATERMAN2	Waterman GWTP Booster Pump #2	3,830.01
U-WATERMAN3 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #3 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,522.28
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80

Table 39. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,773.66
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,774.19
U-WILDHAWK3 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #3 - #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	0.00
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,820.85
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,827.08
U-CALVINEMEADOWS1 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #1 ~ #4	0.00
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	0.00
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	0.00
U-EASTPARK	Booster Pump for East Park GWTP	0.00
U-W073	Booster Pump for W-073 (East Park GWTP)	0.00
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,488.11
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,488.11
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	2,488.11
U-EASTELKGROVE4 ~ U-EASTELKGROVE6	East Elk Grove GWTP Booster Pumps #4 ~ #6	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	1,790.48
U-W079	Booster Pump for W-079 (EEG GWTP)	1,767.61
U-W114	Booster Pump for W-114 (EEG GWTP)	0.00
U-W135	Booster Pump at W-135 (EEG GWTP)	0.00
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	1,764.27
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	1,789.75
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,227.20
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	4,375.36
U-WESTJACKSON3	West Jackson Storage Tank Booster Pump #3	4,445.00
U-WESTJACKSON4 ~ U-WESTJACKSON6	West Jackson Storage Tank Booster Pumps #4 ~ #6	0.00
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,816.09
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,822.54
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,809.00
U-EXCELSIOR4	Booster Pump for Excelsior #4	1,921.54
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,819.90
U-EXCELSIOR6	Booster Pump for Excelsior No.6	1,818.08
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,822.51

Table 39. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-BOND-WTP1 ~ U-BOND-WTP3	Bond GWTP Booster Pumps #1 ~ #3	0.00
U-W085	Booster Pump at W-085 (Bond GWTP)	0.00
U-W113	Booster Pump at W-113 (Bond GWTP)	0.00
U-W-BONDWTP	Booster Pump for Bond GWTP On site Well	0.00
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00
U-W063	Booster Pump for W-063 (CSA Direct Feed)	0.00
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	6,840.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	5,830.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	5,645.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,917.80
U-DWIGHT2	Dwight Road Tank Booster Pump#2	3,915.41
U-DWIGHT3 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps#3 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1 ~ U-POPPYRIDGE6	Poppy Ridge Pumps #1 - #6	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	0.00
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	0.00
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	0.00
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	0.00
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	0.00
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	0.00
U-BIGHORN1 ~ U-BIGHORN6	Big Horn GWTP Booster Pumps #1 ~ #6	0.00
U-W-126	Booster Pump for Big Horn GWTP on site well	0.00
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	0.00
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	0.00
U-W129	Booster Pump for W-129 (Big Horn GWTP)	0.00
U-W130	Booster Pump for W-130 (Big Horn GWTP)	0.00
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	0.00

Table 39. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	0.00
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,970.50
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,970.50
U-WHITELOCKE3	White Locke GWTP Booster Pump #3	2,970.50
U-WHITELOCKE4 ~ U-WHITELOCKE6	White Locke GWTP Booster Pumps #4 ~ #6	0.00
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	1,584.92
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	1,607.66
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	1,580.54
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,615.99
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	0.00
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	0.00
U-W-WHITELOCKEON SITE	White Locke GWTP On site Well Pump	1,507.80
U-FRANKLINWTP1 ~ U-FRANKLINWTP5	Booster Pumps #1 ~ #5 at Franklin GWTP	0.00
U-W086	Booster Pump for Franklin GWTP on site well	0.00
U-W115	Booster Pump for Well W-115 (Franklin GWTP)	0.00
U-W117	Booster Pump for Well W-117 (Franklin GWTP)	0.00
U-W132	Booster Pump for Well W-132 (Franklin GWTP)	0.00
U-W133	Booster Pump for Well W-133 (Franklin GWTP)	0.00
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,142.80
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 40 shows the system operational settings for the Max Day, Dry Year scenario. In this scenario, the production of the Vineyard SWTP was assumed to be 50 MGD due to surface water cutback in dry years. All of its production would be delivered to the NSA, leaving no delivery for the CSA/SSA. Even with all the surface water production supplied to the NSA, it would still not be sufficient to meet the max day demand of the NSA. Therefore, a portion of treated groundwater from the West Jackson GWTP would be delivered to the NSA through the Phase A NSA Pipeline.

The only surface water received in the CSA would be the POU water in this scenario, assumed 19.1 mgd. The POU water would fill the North Vineyard Station Tank through the POU Water Pipeline, and then pumped out to the CSA system. In the SSA, the surface water delivered at the Franklin Intertie was assumed zero in dry years. Groundwater supply provided the most of the water supply to the CSA and SSA in this scenario, as reflected in the status of each groundwater well in the table.

The total flow moving from CSA to SSA was approximately 11,780 gpm (17 MGD): including approximately 4,200 gpm (6 MGD) of water through the Sheldon Road Connection, 3,725 gpm (5.4 MGD) through the Bond Road Connection, and approximately 3,855 gpm (5.6 MGD) through the Grant Line Road Connection.

Table 40. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1 ~ U-VSWTP-CSA6	CSA Booster Pumps #1 ~ #6	0.00
U-NVSTATION1	North Vineyard Station Tank Booster Pump #1	4,797.78
U-NVSTATION2	North Vineyard Station Tank Booster Pump #2	4,797.78
U-NVSTATION3	North Vineyard Station Tank Booster Pump #3	4,797.78
U-NVSTATION4 ~ U-NVSTATION6	North Vineyard Station Tank Booster Pumps #4 ~ #6	0.00
POU Intertie	POU Intertie filling North Vineyard Station Storage Tank	13,260.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	4,094.07
U-WATERMAN2	Waterman GWTP Booster Pump #2	4,093.50
U-WATERMAN3 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #3 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,496.80
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,897.07
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,897.27
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,896.66
U-WILDHAWK4 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #4 - #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1	Calvine Meadows GWTP Booster Pump #1	701.94
U-CALVINEMEADOWS2	Calvine Meadows GWTP Booster Pump #2	702.30
U-CALVINEMEADOWS3 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #3 ~ #4	0.00
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22
U-EASTPARK	Booster Pump for East Park GWTP	0.00
U-W073	Booster Pump for W-073 (East Park GWTP)	0.00
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,082.76
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,082.76

Table 40. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	2,082.76
U-EASTELKGROVE4 ~ U-EASTELKGROVE6	East Elk Grove GWTP Booster Pumps #4 ~ #6	0.00
U-W077	Booster Pump for W-077 (EEG GWTP)	1,993.05
U-W079	Booster Pump for W-079 (EEG GWTP)	1,897.45
U-W114	Booster Pump for W-114 (EEG GWTP)	0.00
U-W135	Booster Pump at W-135 (EEG GWTP)	0.00
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	0.00
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	1,920.98
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,765.98
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	4,930.83
U-WESTJACKSON3	West Jackson Storage Tank Booster Pump #3	5,008.26
U-WESTJACKSON4	West Jackson Storage Tank Booster Pump #4	0.00
U-WESTJACKSON5	West Jackson Storage Tank Booster Pump #5 (water pumped to NSA in dry year)	4,355.26
U-WESTJACKSON6	West Jackson Storage Tank Booster Pump #6 (water pumped to NSA in dry year)	4,314.95
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,816.09
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,822.54
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,809.00
U-EXCELSIOR4	Booster Pump for Excelsior #4	1,921.54
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,819.90
U-EXCELSIOR6	Booster Pump for Excelsior No.6	1,818.08
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,822.51
U-BOND-WTP1	Bond GWTP Booster Pump #1	2,770.60
U-BOND-WTP2	Bond GWTP Booster Pump #2	2,780.06
U-BOND-WTP3	Bond GWTP Booster Pump #3	0.00
U-W085	Booster Pump at W-085 (Bond GWTP)	1,426.28
U-W113	Booster Pump at W-113 (Bond GWTP)	1,469.41
U-W-BONDWTP	Booster Pump for Bond GWTP on site Well	1,517.30
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,304.65
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,205.87
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	4,200.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	3,725.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	3,855.00

Table 40. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
	SSA	
U-DWIGHT1 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps#1 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Booster Pump #1	1,501.49
U-POPPYRIDGE2	Poppy Ridge Booster Pump #2	1,501.49
U-POPPYRIDGE3	Poppy Ridge Booster Pump #3	1,501.49
U-POPPYRIDGE4 ~ U-POPPYRIDGE6	Poppy Ridge Pumps #4 - #6	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	0.00
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	0.00
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,628.81
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,834.68
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	0.00
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,747.79
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,746.96
U-BIGHORN3	Big Horn GWTP Booster Pump #3	1,746.89
U-BIGHORN4 ~ U-BIGHORN6	Big Horn GWTP Booster Pumps #4 ~ #6	0.00
U-W-126	Booster Pump for Big Horn GWTP on site well	1,566.52
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	0.00
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	1,518.65
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,506.79
U-W130	Booster Pump for W-130 (Big Horn GWTP)	0.00
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	0.00
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	1,594.80
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,452.63
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,452.63
U-WHITELOCKE3	White Locke GWTP Booster Pump #3	2,452.63
U-WHITELOCKE4 ~ U-WHITELOCKE6	White Locke GWTP Booster Pumps #4 ~ #6	0.00
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	0.00

Table 40. System Operational Settings for Buildout CSA-SSA System – Max Day Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	1,610.87
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	1,583.70
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,682.03
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	0.00
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	0.00
U-W-WHITELOCKEON SITE	White Locke GWTP on site Well Pump	1,507.80
U-FRANKLINWTP1	Booster Pump #1 at Franklin GWTP	1,934.26
U-FRANKLINWTP2	Booster Pump #2 at Franklin GWTP	1,933.83
U-FRANKLINWTP3 ~ U-FRANKLINWTP5	Booster Pumps #3 ~ #5 at Franklin GWTP	0.00
U-W086	Booster Pump for Franklin GWTP on site well	1,540.60
U-W115	Booster Pump for Well W-115 (Franklin GWTP)	0.00
U-W117	Booster Pump for Well W-117 (Franklin GWTP)	1,831.76
U-W132	Booster Pump for Well W-132 (Franklin GWTP)	0.00
U-W133	Booster Pump for Well W-133 (Franklin GWTP)	1,770.02
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	975.23
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,371.53
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,101.63
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	0.00

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 41 shows the system operational settings for Peak Hour, Wet Year scenario. The delivery of surface water to the NSA was approximately 62 MGD, with the remaining 38 MGD supplied to the CSA/SSA. The delivery of the POU water was 13,260 gpm (19.1 MGD) that would fill the North Vineyard Station Tank, and then pumped out to the CSA system. In the SSA, the delivery at the Franklin Intertie was 7,640 gpm (11MD) that would fill the Dwight Road Storage Tank and then pumped out there to the SSA distribution system. The total surface water delivery in the CSA and the SSA was 68.1 MGD. However, the surface water alone was not sufficient to meet the water demand, so the groundwater supply would make up for the deficit. The Waterman GWTP and the Calvine Meadows GWTP, as well a number of direct feed wells were closed in this scenario.

The total flow moving from the CSA to the SSA was approximately 13,030 gpm (18.8 MGD): including approximately 4,170 gpm (6.0 MGD) of water through the Sheldon Road Connection, 3,620 gpm (5.2 MGD) through the Bond Road Connection, and approximately 5,240 gpm (7.6 MGD) through the Grant Line Road Connection.

Table 41. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
CSA		
U-VSWTP-CSA1	CSA Booster Pump #1	6,009.88
U-VSWTP-CSA2	CSA Booster Pump #2	12,017.67
U-VSWTP-CSA3	CSA Booster Pump #3	12,018.16
U-VSWTP-CSA4 ~ U-VSWTP-CSA6	CSA Booster Pumps #4 ~ #6	0.00
U-NVSTATION1	North Vineyard Station Tank Booster Pump #1	4,347.79
U-NVSTATION2	North Vineyard Station Tank Booster Pump #2	4,347.79
U-NVSTATION3	North Vineyard Station Tank Booster Pump #3	4,347.79
U-NVSTATION4	North Vineyard Station Tank Booster Pump #4	4,347.79
U-NVSTATION5	North Vineyard Station Tank Booster Pump #5	4,347.79
U-NVSTATION6	North Vineyard Station Tank Booster Pump #6	3,948.17
POU Intertie	POU Intertie filling North Vineyard Station Storage Tank	13,260.00
U-WATERMAN1 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #1 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	0.00
U-W064	Booster Pump for W-064 (Waterman GWTP)	0.00
U-W067	Booster Pump for W-067 (Waterman GWTP)	0.00
U-W068	Booster Pump for W-068 (Waterman GWTP)	0.00
U-W069	Booster Pump for W-069 (Waterman GWTP)	0.00
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,862.51
U-WILDHAWK2	Wildhawk GWTP Pump #2	2,862.54
U-WILDHAWK3	Wildhawk GWTP Pump #3	2,861.83
U-WILDHAWK4	Wildhawk GWTP Pump #4	2,862.07
U-WILDHAWK5 ~ U-WILDHAWK6	Wildhawk GWTP Pumps #5 - #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWS1 ~ U-CALVINEMEADOWS4	Calvine Meadows GWTP Booster Pumps #1 ~ #4	0.00
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	0.00
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	0.00
U-EASTPARK	Booster Pump for East Park GWTP	0.00
U-W073	Booster Pump for W-073 (East Park GWTP)	0.00
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,377.56
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,377.56
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	2,377.56

Table 41. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-EASTELKGROVE4	East Elk Grove GWTP Booster Pump #4	2,377.56
U-EASTELKGROVE5	East Elk Grove GWTP Booster Pump #5	2,377.56
U-EASTELKGROVE6	East Elk Grove GWTP Booster Pump #6	2,377.56
U-W077	Booster Pump for W-077 (EEG GWTP)	1,527.82
U-W079	Booster Pump for W-079 (EEG GWTP)	1,526.17
U-W114	Booster Pump for W-114 (EEG GWTP)	1,530.76
U-W135	Booster Pump at W-135 (EEG GWTP)	1,540.78
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	1,528.61
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	1,545.69
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,395.52
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	4,548.92
U-WESTJACKSON3	West Jackson Storage Tank Booster Pump #3	4,621.01
U-WESTJACKSON4	West Jackson Storage Tank Booster Pump #4	4,565.52
U-WESTJACKSON5	West Jackson Storage Tank Booster Pump #5	4,428.07
U-WESTJACKSON6	West Jackson Storage Tank Booster Pump #6	4,269.99
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,805.86
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,811.68
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,800.02
U-EXCELSIOR4	Booster Pump for Excelsior #4	1,921.54
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,819.90
U-EXCELSIOR6	Booster Pump for Excelsior No.6	1,818.08
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,822.51
U-BOND-WTP1	Bond GWTP Booster Pump #1	3,117.96
U-BOND-WTP2	Bond GWTP Booster Pump #2	3,128.43
U-BOND-WTP3	Bond GWTP Booster Pump #3	0.00
U-W085	Booster Pump at W-085 (Bond GWTP)	1,426.28
U-W113	Booster Pump at W-113 (Bond GWTP)	1,469.41
U-W-BONDWTP	Booster Pump for Bond GWTP On site Well	1,517.30
U-W062	Booster Pump for W-062 (CSA Direct Feed)	0.00
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,251.99
U-W065	Booster Pump for W-065 (CSA Direct Feed)	0.00
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	4,170.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	3,620.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	5,240.00

Table 41. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pump#1	3,946.08
U-DWIGHT2	Dwight Road Tank Booster Pump#2	3,943.67
U-DWIGHT3	Dwight Road Tank Booster Pump#3	3,947.16
U-DWIGHT4	Dwight Road Tank Booster Pump#4	3,949.60
U-DWIGHT5 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps#5 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	7,640.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	0.00
U-LAKESIDE	Lakeside GWTP booster pumps	0.00
U-W055	Booster Pump for W-055 (Lakeside GWTP)	0.00
U-W056	Booster Pump for W-056 (Lakeside GWTP)	0.00
U-W075	Booster Pump for W-075 (Lakeside GWTP)	0.00
U-POPPYRIDGE1	Poppy Ridge Booster Pump #1	2,376.35
U-POPPYRIDGE2	Poppy Ridge Booster Pump #2	2,376.35
U-POPPYRIDGE3	Poppy Ridge Booster Pump #3	2,376.35
U-POPPYRIDGE4	Poppy Ridge Booster Pump #4	2,376.35
U-POPPYRIDGE5 ~ U-POPPYRIDGE6	Poppy Ridge Pumps #5 - #6	0.00
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,626.47
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,585.29
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	0.00
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	0.00
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	0.00
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	0.00
U-BIGHORN1	Big Horn GWTP Booster Pump #1	2,314.99
U-BIGHORN2	Big Horn GWTP Booster Pump #2	2,313.66
U-BIGHORN3	Big Horn GWTP Booster Pump #3	2,313.38
U-BIGHORN4	Big Horn GWTP Booster Pump #4	2,313.88
U-BIGHORN5 ~ U-BIGHORN6	Big Horn GWTP Booster Pumps #5 ~ #6	0.00
U-W-126	Booster Pump for Big Horn GWTP on site well	1,566.52
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	0.00
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	1,518.65
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,506.79
U-W130	Booster Pump for W-130 (Big Horn GWTP)	0.00
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	0.00

Table 41. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Wet Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	1,594.80
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,941.93
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,941.93
U-WHITELOCKE3	White Locke GWTP Booster Pump #3	2,941.93
U-WHITELOCKE4	White Locke GWTP Booster Pump #4	2,702.11
U-WHITELOCKE5	White Locke GWTP Booster Pump #5	2,702.11
U-WHITELOCKE6	White Locke GWTP Booster Pump #6	2,702.11
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	1,578.73
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	1,545.06
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	1,518.86
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,608.83
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	1,358.17
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	1,338.09
U-W-WHITELOCKEON SITE	White Locke GWTP On site Well Pump	0.00
U-FRANKLINWTP1	Booster Pump #1 at Franklin GWTP	2,756.43
U-FRANKLINWTP2	Booster Pump #2 at Franklin GWTP	2,755.84
U-FRANKLINWTP3 ~ U-FRANKLINWTP5	Booster Pumps #3 ~ #5 at Franklin GWTP	0.00
U-W086	Booster Pump for Franklin GWTP on site well	0.00
U-W115	Booster Pump for Well W-115 (Franklin GWTP)	1,723.13
U-W117	Booster Pump for Well W-117 (Franklin GWTP)	0.00
U-W132	Booster Pump for Well W-132 (Franklin GWTP)	0.00
U-W133	Booster Pump for Well W-133 (Franklin GWTP)	1,736.33
U-W041	Booster Pump for W-041 (SSA Direct Feed)	0.00
U-W042	Booster Pump for W-042 (SSA Direct Feed)	0.00
U-W043	Booster Pump for W-043 (SSA Direct Feed)	0.00
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,177.25
U-W052	Booster Pump for W-052 (SSA Direct Feed)	0.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	696.76

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

Table 42 shows the system operational settings for Peak, Dry Year scenario. The total production of the Vineyard SWTP was assumed 50 MGD, but all of its production would be delivered to the NSA, leaving no output for the CSA/SSA. However, the surface water production from the Vineyard SWTP alone was not enough to meet the max day demand of the NSA. A portion of treated groundwater from the West Jackson GWTP would be delivered to the NSA through the Phase A NSA Pipeline.

The only surface water received in the CSA was the POU water in this scenario, which was assumed 19.1 MGD. The POU water would fill the North Vineyard Station Tank through the 36-inch POU Water Pipeline, and then pumped out to the CSA system. In the SSA, the surface water delivered at the Franklin Intertie was assumed zero in dry years. What filled the Dwight Road Tank and pumped out the SSA system would be the treated groundwater from the Dwight Road GWTP. Groundwater was the major water supply for the CSA and the SSA. The majority of the groundwater wells and the booster pumps were turned on in order to meet the peak hour demand, as reflected in the table.

The total flow moving from the CSA to the SSA was approximately 10,990 gpm (15.8 MGD): including approximately 3,785 gpm (5.4 MGD) of water through the Sheldon Road Connection, 3,050 gpm (4.4 MGD) through the Bond Road Connection, and approximately 4,155 gpm (6.0 MGD) through the Grant Line Road Connection.

Table 42. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Dry Year Scenario

PUMP ID	DESCRIPTION	FLOW (gpm)
	CSA	
U-VSWTP-CSA1 ~ U-VSWTP-CSA6	CSA Booster Pumps #1 ~ #6	0.00
U-NVSTATION1	North Vineyard Station Tank Booster Pump #1	4,885.03
U-NVSTATION2	North Vineyard Station Tank Booster Pump #2	4,885.03
U-NVSTATION3	North Vineyard Station Tank Booster Pump #3	4,885.03
U-NVSTATION4	North Vineyard Station Tank Booster Pump #4	4,885.03
U-NVSTATION5	North Vineyard Station Tank Booster Pump #5	4,885.03
U-NVSTATION6	North Vineyard Station Tank Booster Pump #6	4,442.67
POU Intertie	POU Intertie filling North Vineyard Station Storage Tank	13,260.00
U-WATERMAN1	Waterman GWTP Booster Pump #1	4,213.92
U-WATERMAN2	Waterman GWTP Booster Pump #2	4,212.85
U-WATERMAN3	Waterman GWTP Booster Pump #3	4,213.38
U-WATERMAN4	Waterman GWTP Booster Pump #4	4,213.39
U-WATERMAN5 ~ U-WATERMAN6	Waterman GWTP Booster Pumps #5 - #6	0.00
U-W061	Booster Pump for W-061 (Waterman GWTP)	1,600.42
U-W064	Booster Pump for W-064 (Waterman GWTP)	1,522.28
U-W067	Booster Pump for W-067 (Waterman GWTP)	1,496.80
U-W068	Booster Pump for W-068 (Waterman GWTP)	1,511.89
U-W069	Booster Pump for W-069 (Waterman GWTP)	1,511.49
U-WILDHAWK1	Wildhawk GWTP Pump #1	2,881.11
U-WILDHAWK2	WildHawk GWTP Pump #2	2,880.94
U-WILDHAWK3	WildHawk GWTP Pump #3	2,880.02
U-WILDHAWK4	WildHawk GWTP Pump #4	2,880.17
U-WILDHAWK5	WildHawk GWTP Pump #5	2,880.75
U-WILDHAWK6	WildHawk GWTP Pump #6	0.00
U-W081	Booster Pump for W-081 (Wildhawk GWTP)	1,502.69
U-W082	Booster Pump for W-082 (Wildhawk GWTP)	1,506.42

Table 42. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W105	Booster Pump for W-105 (Wildhawk GWTP)	1,814.46
U-W106	Booster Pump for W-106 (Wildhawk GWTP)	1,821.05
U-CALVINEMEADOWN1	Calvine Meadows GWTP Booster Pump #1	724.95
U-CALVINEMEADOWN2	Calvine Meadows GWTP Booster Pump #2	725.32
U-CALVINEMEADOWN3	Calvine Meadows GWTP Booster Pump #3	2,383.52
U-CALVINEMEADOWN4	Calvine Meadows GWTP Booster Pump #4	2,375.37
U-W066	Booster Pump for W-066 (Calvine Meadows GWTP)	1,691.21
U-W076	Booster Pump for W-076 (Calvine Meadows GWTP)	1,760.22
U-EASTPARK	Booster Pump for East Park GWTP	1,972.26
U-W073	Booster Pump for W-073 (East Park GWTP)	1,919.72
U-EASTELKGROVE1	East Elk Grove GWTP Booster Pump #1	2,054.38
U-EASTELKGROVE2	East Elk Grove GWTP Booster Pump #2	2,054.38
U-EASTELKGROVE3	East Elk Grove GWTP Booster Pump #3	2,054.38
U-EASTELKGROVE4	East Elk Grove GWTP Booster Pump #4	2,054.38
U-EASTELKGROVE5	East Elk Grove GWTP Booster Pump #5	2,054.38
U-EASTELKGROVE6	East Elk Grove GWTP Booster Pump #6	2,054.38
U-W077	Booster Pump for W-077 (EEG GWTP)	1,527.82
U-W079	Booster Pump for W-079 (EEG GWTP)	1,526.17
U-W114	Booster Pump for W-114 (EEG GWTP)	1,530.76
U-W135	Booster Pump at W-135 (EEG GWTP)	1,540.78
U-EEG-ON SITE	Booster Pump for EEG GWTP on site well	1,505.59
U-W-PASCALWAY	Booster Pump at Pascal Way Well (EEG GWTP)	1,528.61
U-W-FIELDSTONESOUTH	Booster Pump at Field Stone South Well (EEG GWTP)	1,545.69
U-WESTJACKSON1	West Jackson Storage Tank Booster Pump #1	4,992.74
U-WESTJACKSON2	West Jackson Storage Tank Booster Pump #2	5,164.55
U-WESTJACKSON3	West Jackson Storage Tank Booster Pump #3	5,245.22
U-WESTJACKSON4	West Jackson Storage Tank Booster Pump #4	5,183.12
U-WESTJACKSON5	West Jackson Storage Tank Booster Pump #5 (water pumped to NSA in dry year)	4,319.04
U-WESTJACKSON6	West Jackson Storage Tank Booster Pump #6 (water pumped to NSA in dry year)	4,279.04
U-W122	Booster Pump for Excelsior Well #1 (W-122)	1,816.09
U-W123	Booster Pump for Excelsior Well #2 (W-123)	1,822.54
U-W124	Booster Pump for Excelsior Well #3 (W-124)	1,809.00
U-EXCELSIOR4	Booster Pump for Excelsior #4	1,921.54
U-EXCELSIOR5	Booster Pump for Excelsior No. 5	1,819.90

Table 42. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-EXCELSIOR6	Booster Pump for Excelsior No.6	1,818.08
U-EXCELSIOR7	Booster Pump for W-EXCLESIOR7	1,822.51
U-BOND-WTP1	Bond GWTP Booster Pump #1	2,822.30
U-BOND-WTP2	Bond GWTP Booster Pump #2	2,831.91
U-BOND-WTP3	Bond GWTP Booster Pump #3	2,828.69
U-W085	Booster Pump at W-085 (Bond GWTP)	1,426.28
U-W113	Booster Pump at W-113 (Bond GWTP)	1,469.41
U-W-BONDWTP	Booster Pump for Bond GWTP On site Well	1,517.30
U-W062	Booster Pump for W-062 (CSA Direct Feed)	1,338.26
U-W063	Booster Pump for W-063 (CSA Direct Feed)	1,241.03
U-W065	Booster Pump for W-065 (CSA Direct Feed)	866.82
CSA-SSA Sheldon Road Connection	Sheldon Road & Hwy 99	3,785.00
CSA-SSA Bond Road Connection	Bond Road & Hwy 99	3,050.00
CSA-SSA Grant Line Road Connection	Grant Line Road & Hwy 99	4,155.00
SSA		
U-DWIGHT1	Dwight Road Tank Booster Pumps#1	4,108.53
U-DWIGHT2 ~ U-DWIGHT6	Dwight Road Tank Booster Pumps#2 - #6	0.00
The Franklin Intertie	The Franklin Intertie filling Dwight Road Tank	0.00
U-W070	Booster Pump for W-070 (Dwight Road GWTP)	2,596.16
U-LAKESIDE	Lakeside GWTP booster pumps	2,966.10
U-W055	Booster Pump for W-055 (Lakeside GWTP)	1,665.92
U-W056	Booster Pump for W-056 (Lakeside GWTP)	1,492.38
U-W075	Booster Pump for W-075 (Lakeside GWTP)	1,611.63
U-POPPYRIDGE1	Poppy Ridge Booster Pump #1	1,724.25
U-POPPYRIDGE2	Poppy Ridge Booster Pump #2	1,724.25
U-POPPYRIDGE3	Poppy Ridge Booster Pump #3	1,724.25
U-POPPYRIDGE4	Poppy Ridge Booster Pump #4	1,724.25
U-POPPYRIDGE5	Poppy Ridge Booster Pump #5	1,724.25
U-POPPYRIDGE6	Poppy Ridge Booster Pump #6	1,724.25
U-W078	Booster Pump for W-078 (Poppy Ridge GWTP)	1,508.26
U-W109	Booster Pump for W-109 (Poppy Ridge GWTP)	1,533.44
U-W110	Booster Pump for W-110 (Poppy Ridge GWTP)	1,515.28
U-W116	Booster Pump for Well W-116 (Poppy Ridge GWTP)	1,527.10
U-W119	Booster Pump for Well W-119 (Poppy Ridge GWTP)	1,513.11
U-W120	Booster Pump for Well W-120 (Poppy Ridge GWTP)	1,571.79

Table 42. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W121	Booster Pump for Well W-121 (Poppy Ridge GWTP)	1,516.10
U-BIGHORN1	Big Horn GWTP Booster Pump #1	1,928.04
U-BIGHORN2	Big Horn GWTP Booster Pump #2	1,926.17
U-BIGHORN3	Big Horn GWTP Booster Pump #3	1,925.37
U-BIGHORN4	Big Horn GWTP Booster Pump #4	1,925.38
U-BIGHORN5	Big Horn GWTP Booster Pump #5	1,925.83
U-BIGHORN6	Big Horn GWTP Booster Pump #6	1,927.00
U-W-126	Booster Pump for Big Horn GWTP on site well	0.00
U-W127	Booster Pump for well W-127 (Big Horn GWTP)	1,467.35
U-W128	Booster Pump for Well W-128 (Big Horn GWTP)	1,457.58
U-W129	Booster Pump for W-129 (Big Horn GWTP)	1,455.35
U-W130	Booster Pump for W-130 (Big Horn GWTP)	1,488.94
U-W-AUTOCITY	Booster Pump for Auto City Well (Big Horn GWTP)	1,355.69
U-W-LAGUNASPRING	Booster Pump for Laguna Spring Well (Big Horn GWTP)	1,485.97
U-WHITELOCKE1	White Locke GWTP Booster Pump #1	2,608.36
U-WHITELOCKE2	White Locke GWTP Booster Pump #2	2,608.36
U-WHITELOCKE3	White Locke GWTP Booster Pump #3	2,608.36
U-WHITELOCKE4	White Locke GWTP Booster Pump #4	2,301.50
U-WHITELOCKE5	White Locke GWTP Booster Pump #5	2,301.50
U-WHITELOCKE6	White Locke GWTP Booster Pump #6	2,301.50
U-W-ARBORRANCH	Booster Pump for Whitelock GWTP off site well Arbor Ranch	1,578.73
U-W-MADEIRAEAST1	Madeira East 1 Well Pump (Whitelock GWTP)	1,545.06
U-W-MADEIRAEAST2	Madeira East 2 Well Pump (Whitelock GWTP)	1,518.86
U-W-MADEIRASOUTH	Booster Pump for Whitelock GWTP off site well at Madeira South	1,608.83
U-W-STERLINGMEADOWS1	Sterling Meadows 1 Well Pump (Whitelock GWTP)	1,358.17
U-W-STERLINGMEADOWS2	Sterling Meadows 2 Well Pump (Whitelock GWTP)	1,338.09
U-W-WHITELOCKEON SITE	White Locke GWTP On site Well Pump	0.00
U-FRANKLINWTP1	Booster Pump #1 at Franklin GWTP	2,156.26
U-FRANKLINWTP2	Booster Pump #2 at Franklin GWTP	2,155.03
U-FRANKLINWTP3	Booster Pump #3 at Franklin GWTP	2,153.89
U-FRANKLINWTP4	Booster Pump #4 at Franklin GWTP	2,154.53
U-FRANKLINWTP5	Booster Pump #5 at Franklin GWTP	2,155.54
U-W086	Booster Pump for Franklin GWTP on site well	1,540.60
U-W115	Booster Pump for Well W-115 (Franklin GWTP)	1,598.20
U-W117	Booster Pump for Well W-117 (Franklin GWTP)	1,721.89
U-W132	Booster Pump for Well W-132 (Franklin GWTP)	1,499.81

Table 42. System Operational Settings for Buildout CSA-SSA System – Peak Hour Demand, Dry Year Scenario		
PUMP ID	DESCRIPTION	FLOW (gpm)
U-W133	Booster Pump for Well W-133 (Franklin GWTP)	1,543.54
U-W041	Booster Pump for W-041 (SSA Direct Feed)	865.14
U-W042	Booster Pump for W-042 (SSA Direct Feed)	1,037.25
U-W043	Booster Pump for W-043 (SSA Direct Feed)	1,437.47
U-W047	Booster Pump for W-047 (SSA Direct Feed)	1,153.90
U-W052	Booster Pump for W-052 (SSA Direct Feed)	1,260.00
U-W074	Booster Pump for W-074 (SSA Direct Feed)	674.53

Note: System Operational Settings are for modeling purpose only; the actual operations may differ.

The system pressures, flow velocities in pipes, and unit head losses for CSA/SSA Buildout modeling scenarios (Max Day Demand, Peak Hour Demand in Wet and Dry Year conditions) are illustrated in Appendix H, Figures H-37 through H-48, respectively. Below are some observations:

- The system pressures were maintained between 40 ~ 75 psi except the POU area under max day, wet year scenario.
- Flow velocities in pipes were below 7 ft/sec during peak hour. For the most part, the flow velocities were less than 4 ft/sec.
- Head losses met the operating goal of less than 5 ft/1000ft. For the vast majority of pipes, the head loss was less than 1 ft/1000ft.

The system improvements in this phase refer to the facilities that would be constructed after Phase 2 through buildout. These system improvements recommendations are summarized in Table 43. The expansion of the Vineyard SWTP would add another 50 mgd treatment capacity to the existing 50 mgd, so the ultimate capacity would be 100 mgd. The Vineyard SWTP at buildout would be able to treat all the surface water supplies (less POU water) identified in the Zone 40 WSMP plus the remediated groundwater. The expansion would greatly increase the water supply capacity and reliability in Zone 40.

The facilities related to the delivery of the POU water are also recommended in this phase. These facilities include the 36-inch POU Water Pipeline and the North Vineyard Station Storage Tank and Booster Pump Station. The POU Pipeline would convey the water from the POU Intertie (with the City's system) to the North Vineyard Station Storage Tank (4.0 MG), and pumped out from there into the CSA system.

The groundwater facilities recommended in this phase include the Bond GWTP (6.5 mgd), the Franklin GWTP (7 mgd), and their associated facilities (groundwater wells, booster pumps, and storage tanks). The groundwater treatment plants would increase the water supply capacity and reliability in dry years. Other system improvements include T-mains to serve the new growth areas.

Table 43. Recommended System Improvements for CSA-SSA after Phase 2 through Buildout			
Project name	**Size**	**Quantity**	**Justification for need**
Vineyard SWTP	50 mgd	50 mgd	Increase treatment capacity from 50 mgd to 100 mgd. Improve water supply capacity and reliability in Zone 40
POU Water Pipeline	36-inch	23,070 LF	Convey POU water from POU Intertie to North Vineyard Station Storage Tank
North Vineyard Station Storage Tank	4 mg	2x2.0 mg	Store POU water and provide peaking for the CSA system
North Vineyard Station Booster Pump Station	4,500 gpm/145 ft	7 (including one backup)	Pump POU water out from North Vineyard Station Storage Tank to the CSA system.
Bond GWTP	6.5 mgd	6.5 mgd	Improve water supply capacity and reliability in CSA
Wells for Bond GWTP	1500 gpm/well	3	Extract groundwater and send to Bond GWTP for treatment
Franklin GWTP	7.0 mgd	7.0 mgd	Improve water supply capacity and reliability in SSA
Wells for Franklin GWTP	1500 gpm/well	4	Extract groundwater and send to Franklin GWTP for treatment
Various T-mains	16 ~ 36-inch	84,180 LF	Provide water to new growth areas. Improve looping of the pipeline network

Appendix H: Hydraulic Model Results

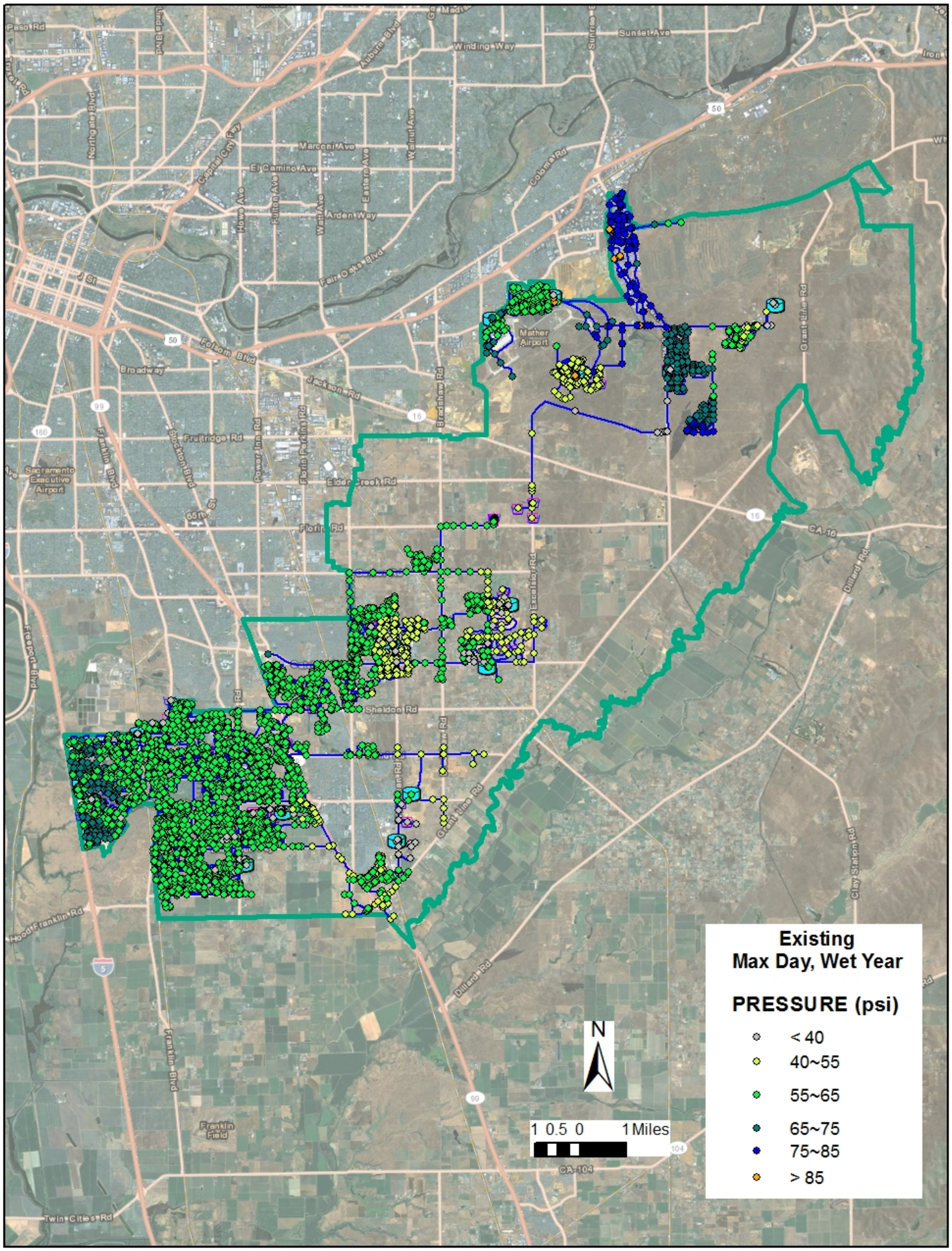


Figure H-1. System Pressures for Existing, Max Day, Wet Year Scenario

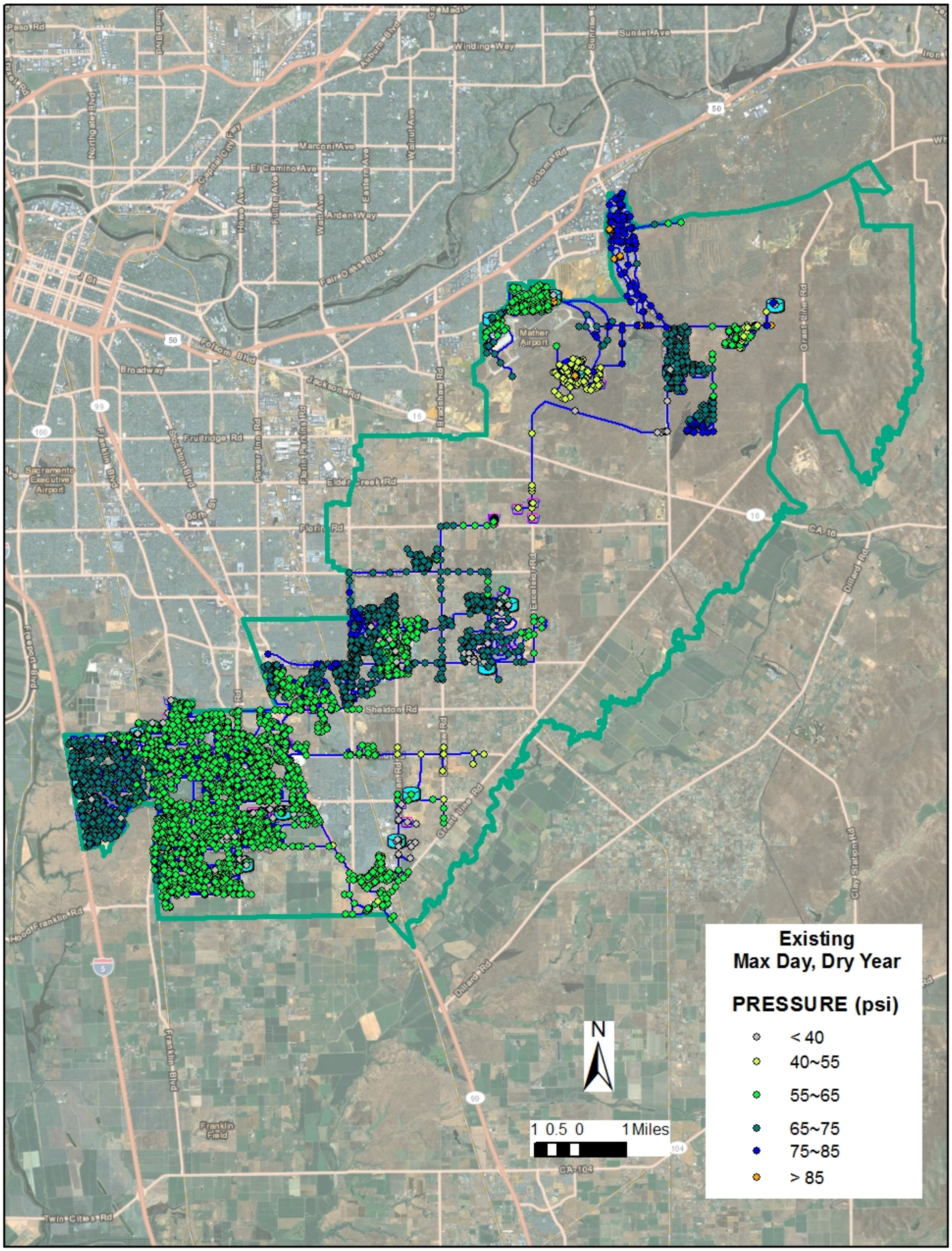


Figure H-2. System Pressures for Existing, Max Day, Dry Year Scenario

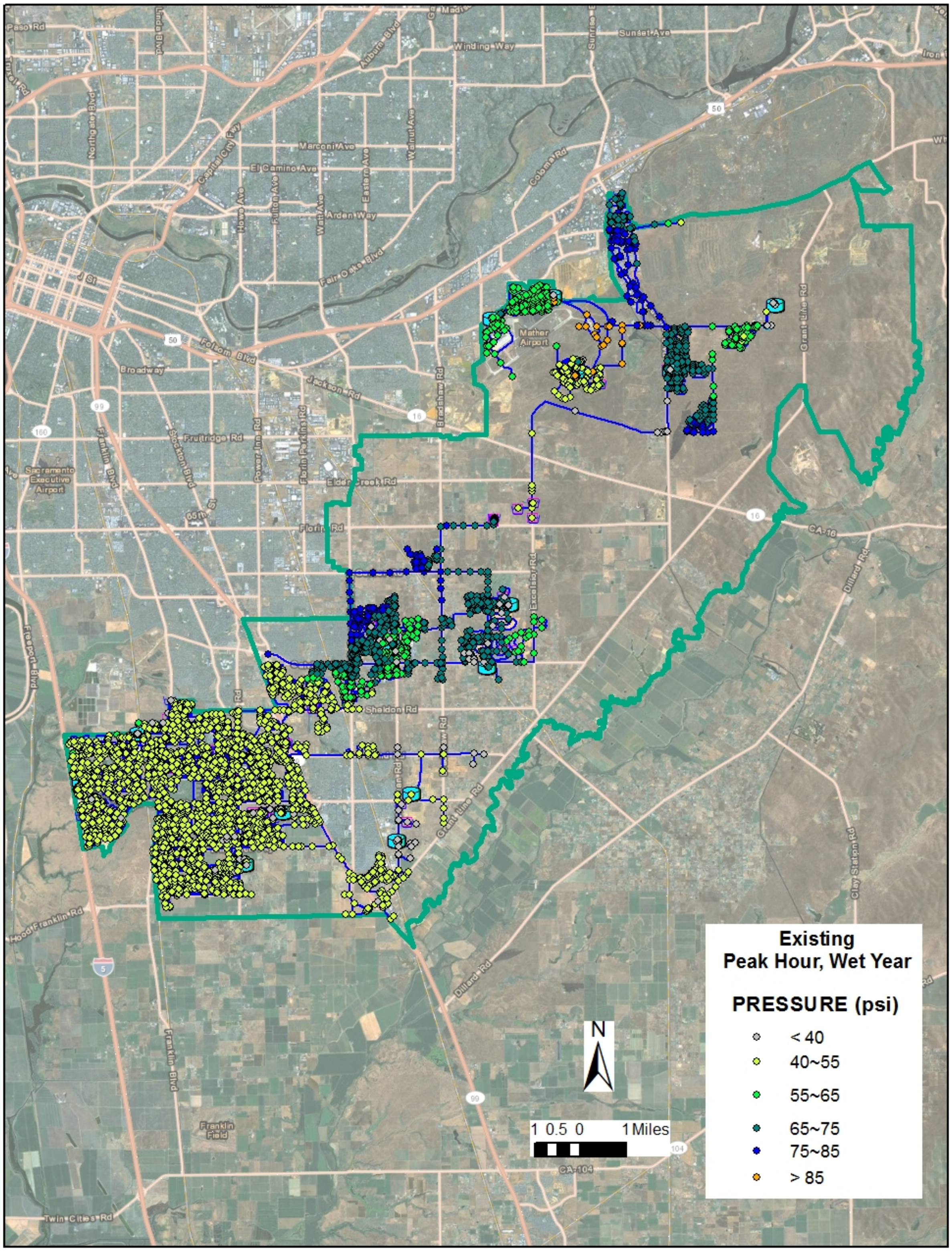


Figure H-3. System Pressures for Existing, Peak Hour, Wet Year Scenario

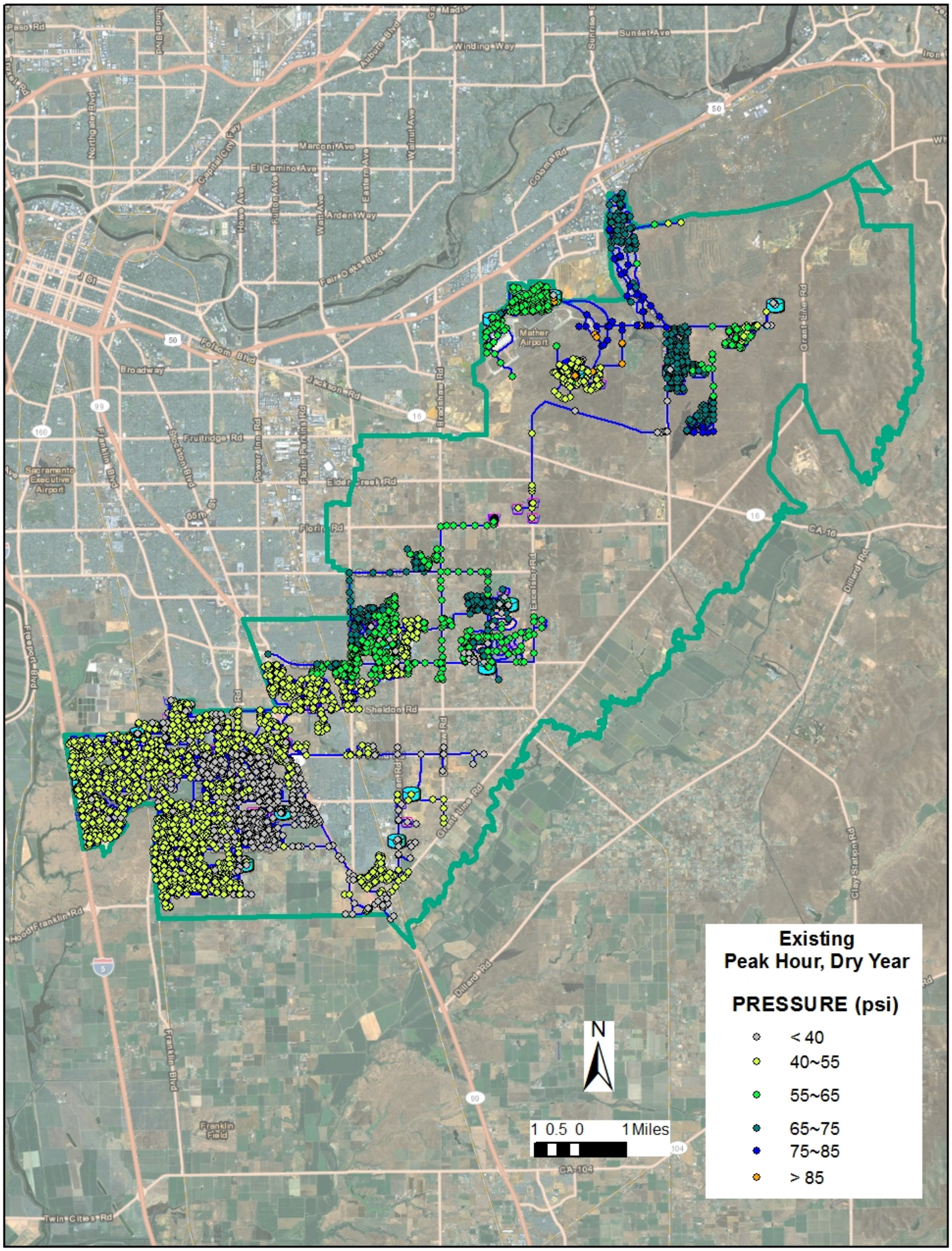


Figure H-4. System Pressures for Existing, Peak Hour, Dry Year Scenario

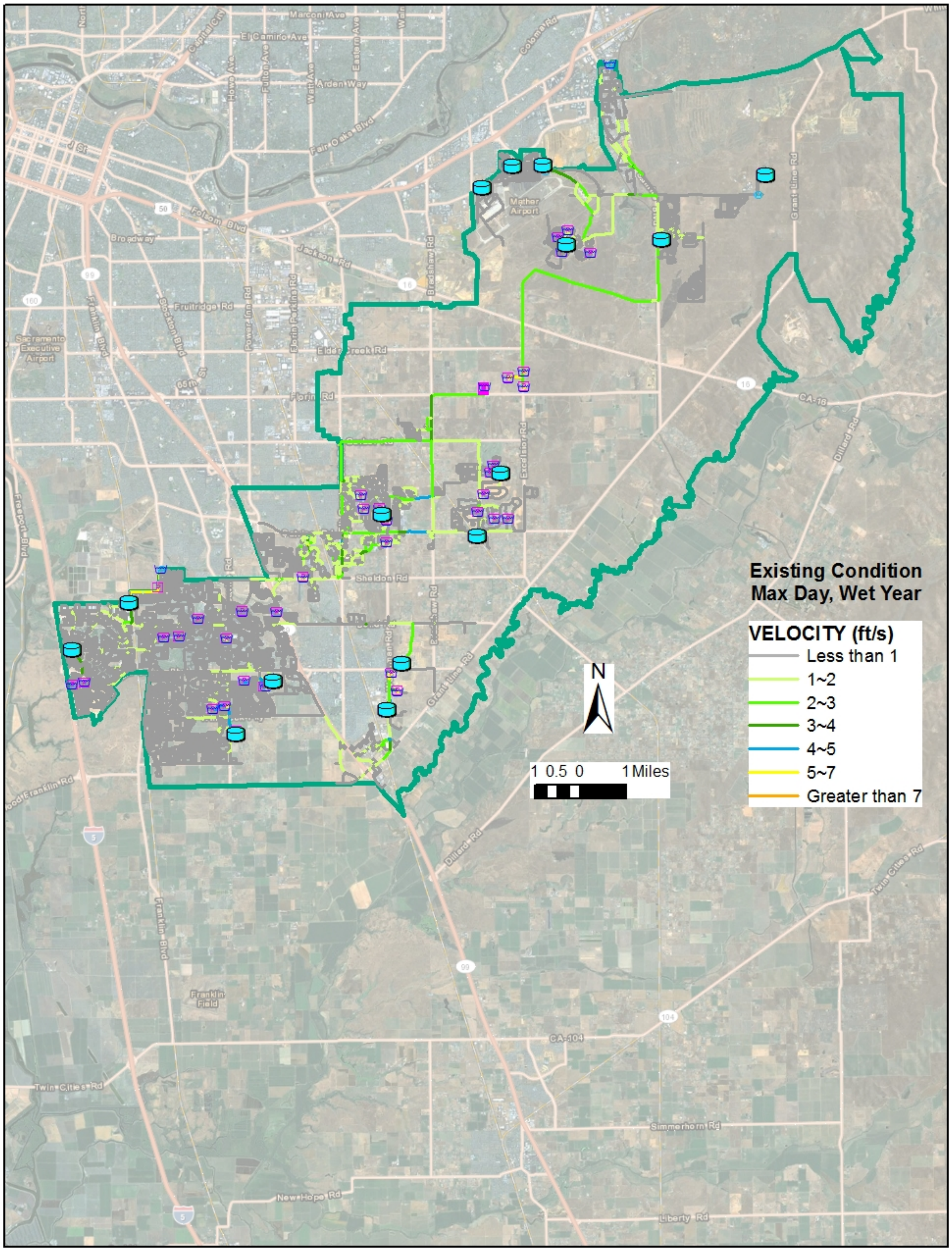


Figure H-5. Pipe Velocities for Existing, Max Day, Wet Year Scenario

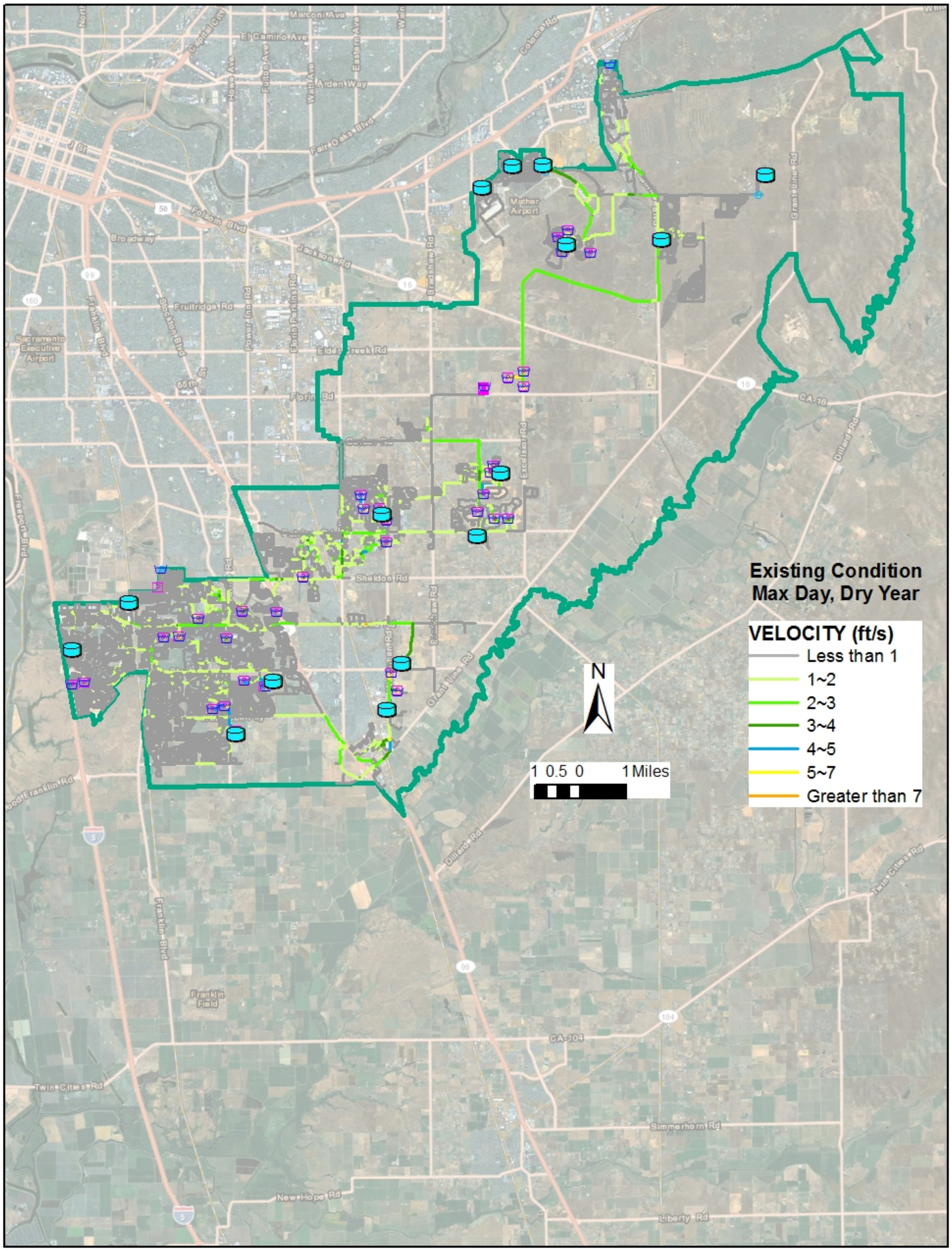


Figure H-6. Pipe Velocities for Existing, Max Day, Dry Year Scenario

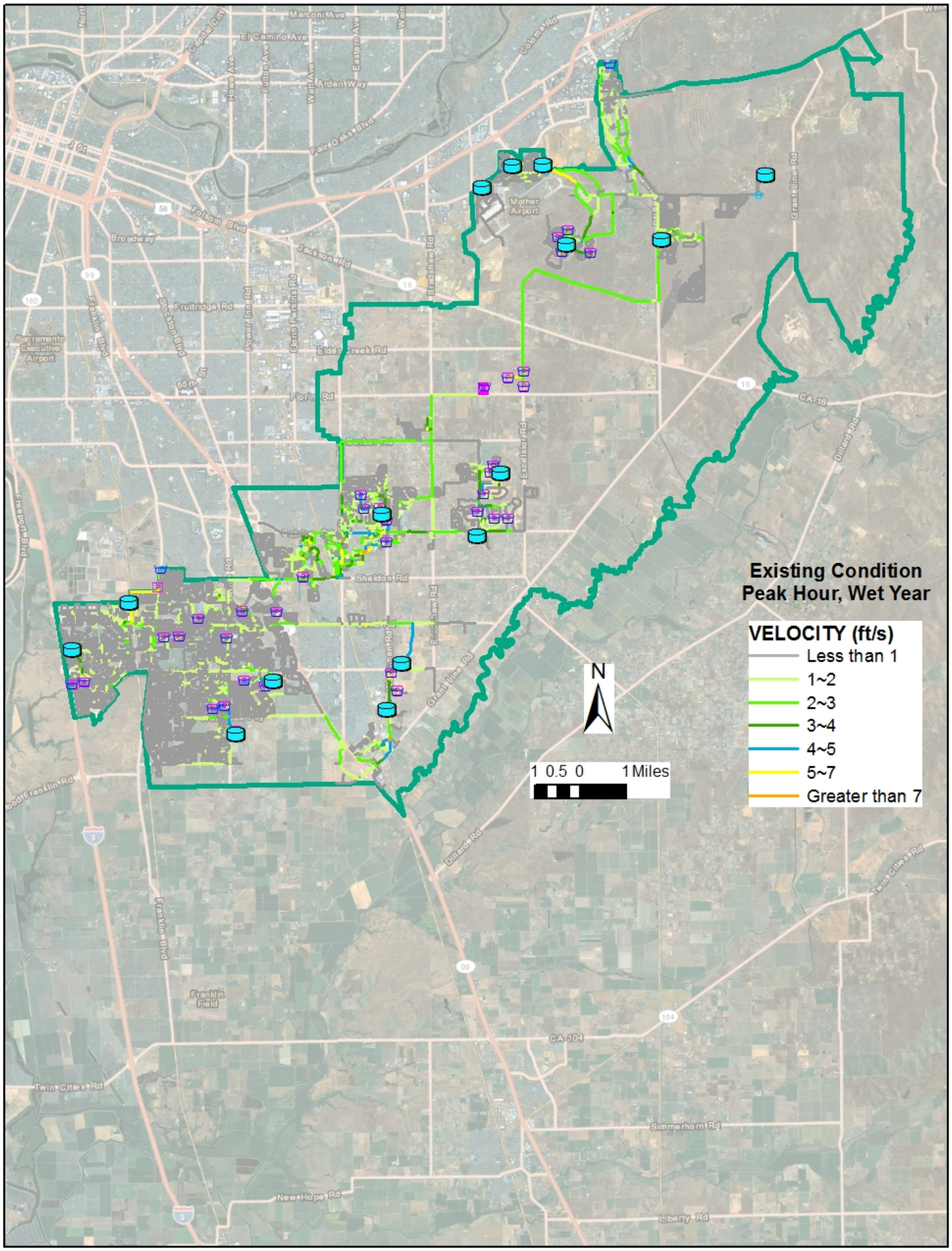


Figure H-7. Pipe Velocities for Existing, Peak Hour, Wet Year Scenario

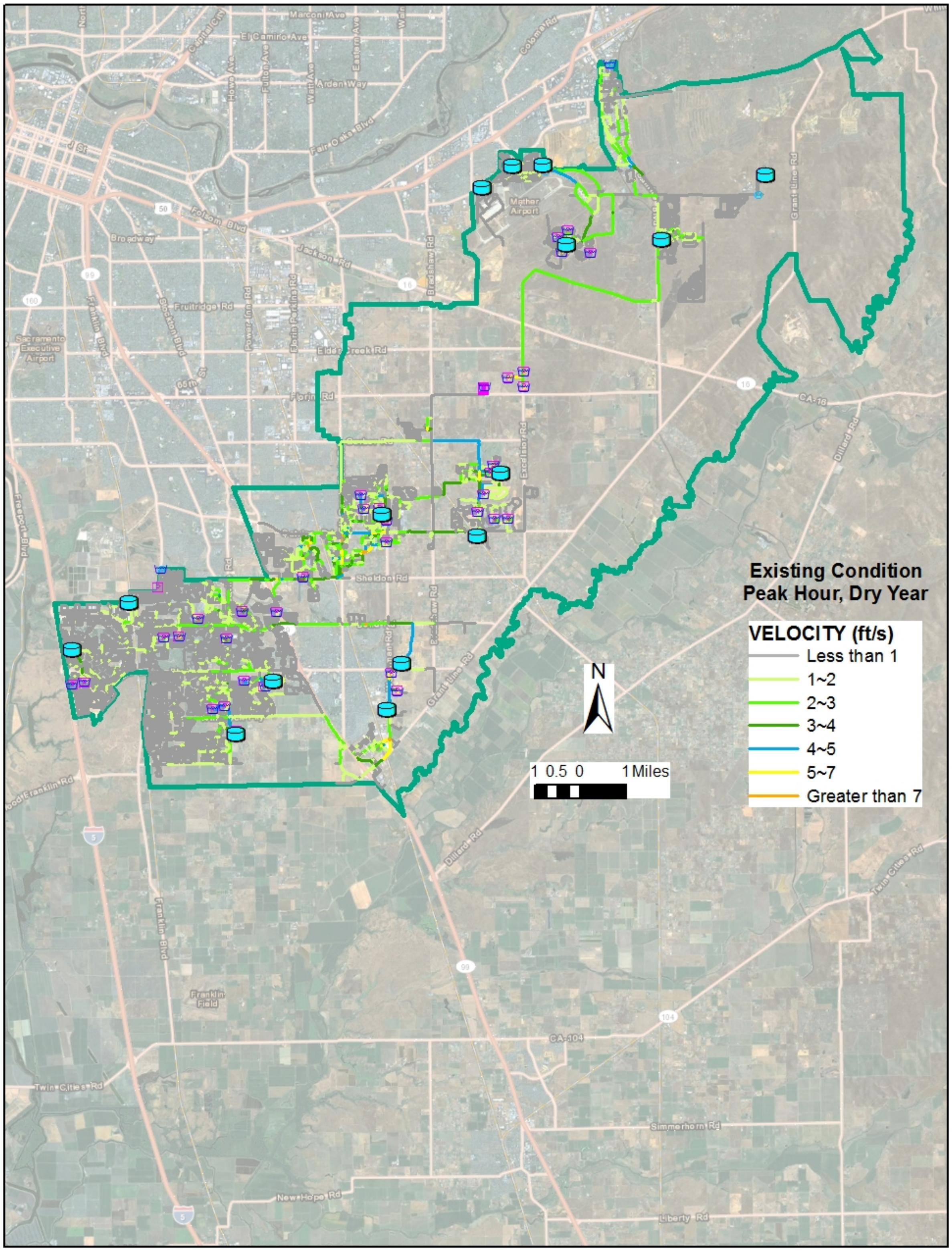


Figure H-8. Pipe Velocities for Existing, Peak Hour, Dry Year Scenario

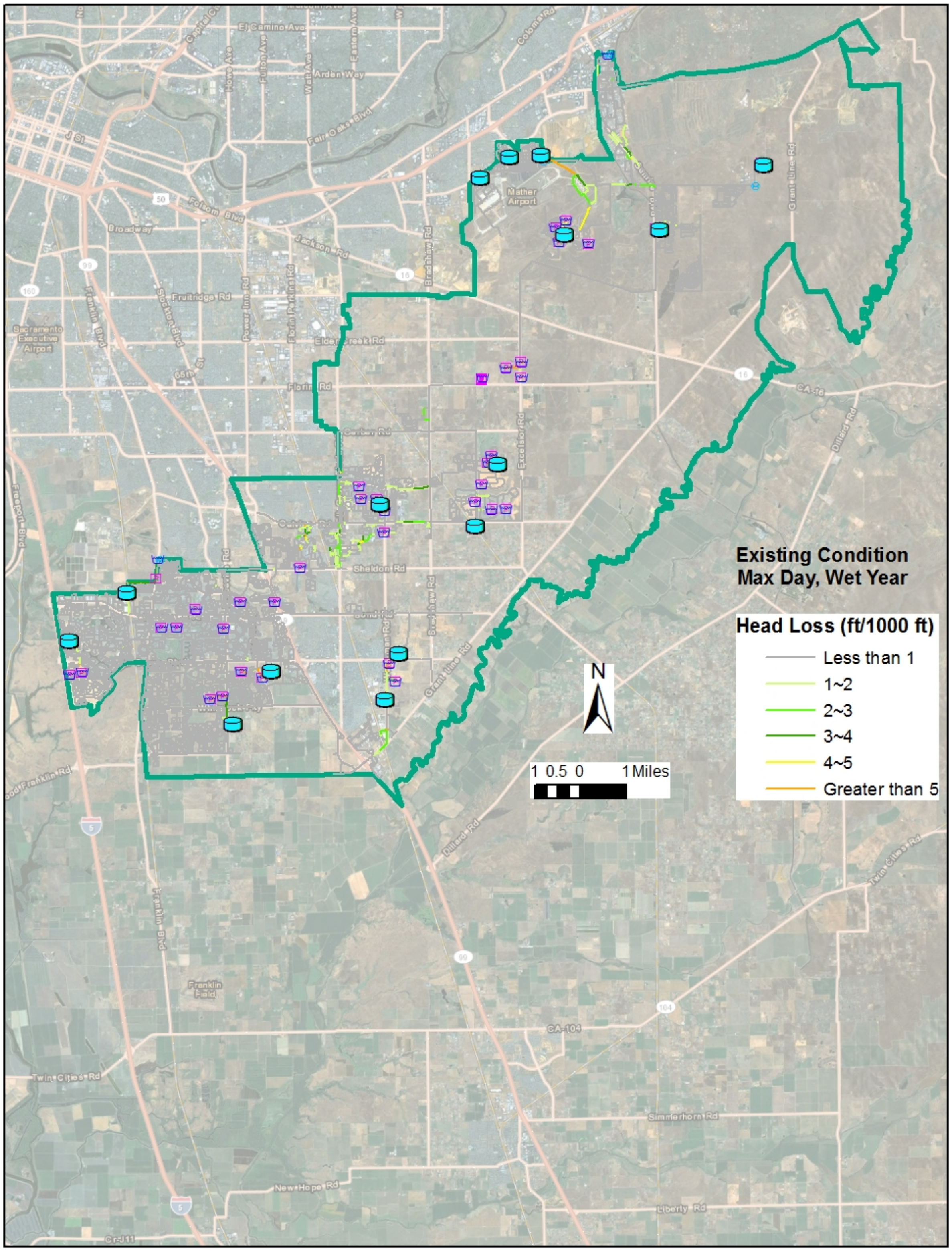


Figure H-9. Head Losses for Existing, Max Day, Wet Year Scenario

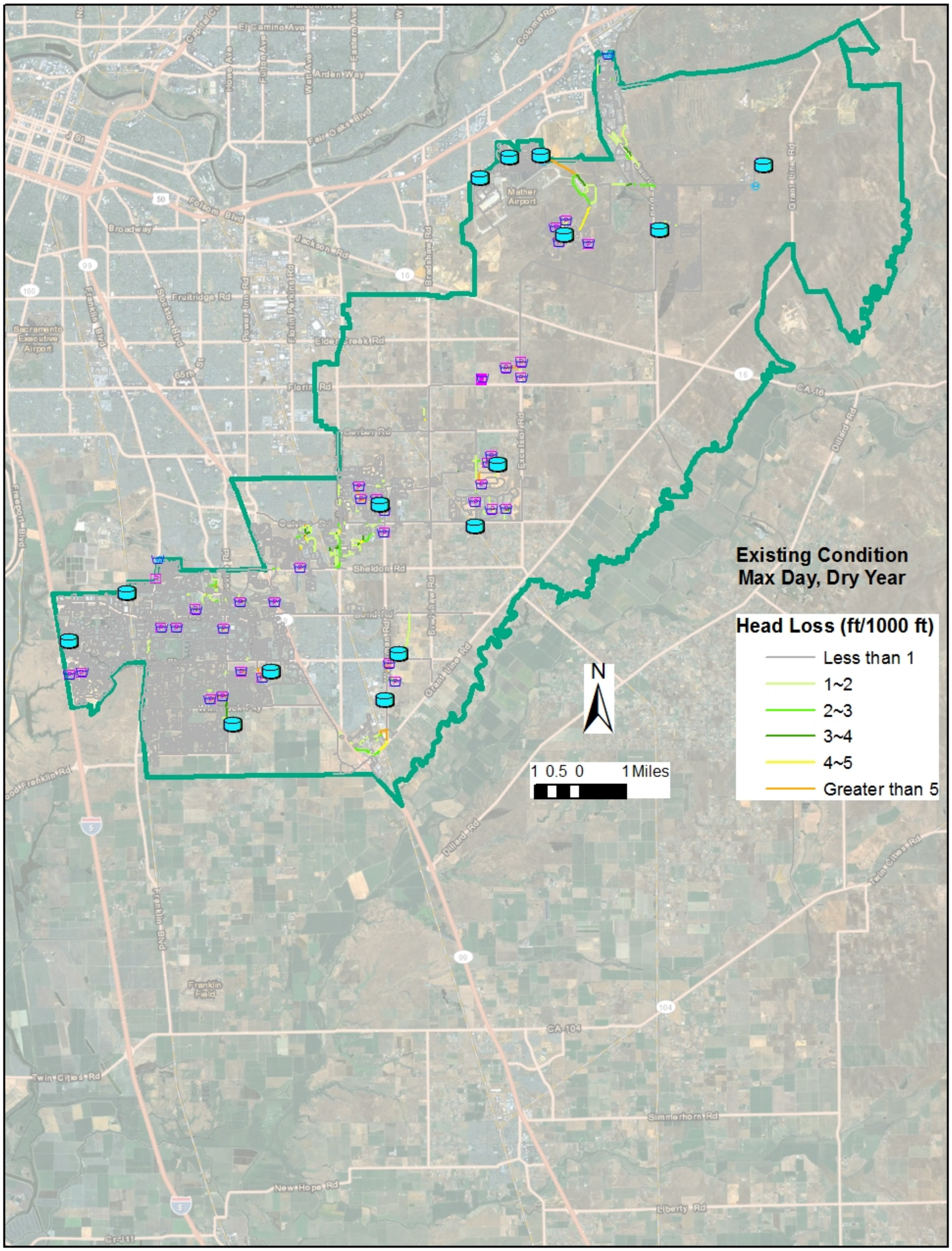


Figure H-10. Head Losses for Existing, Max Day, Dry Year Scenario

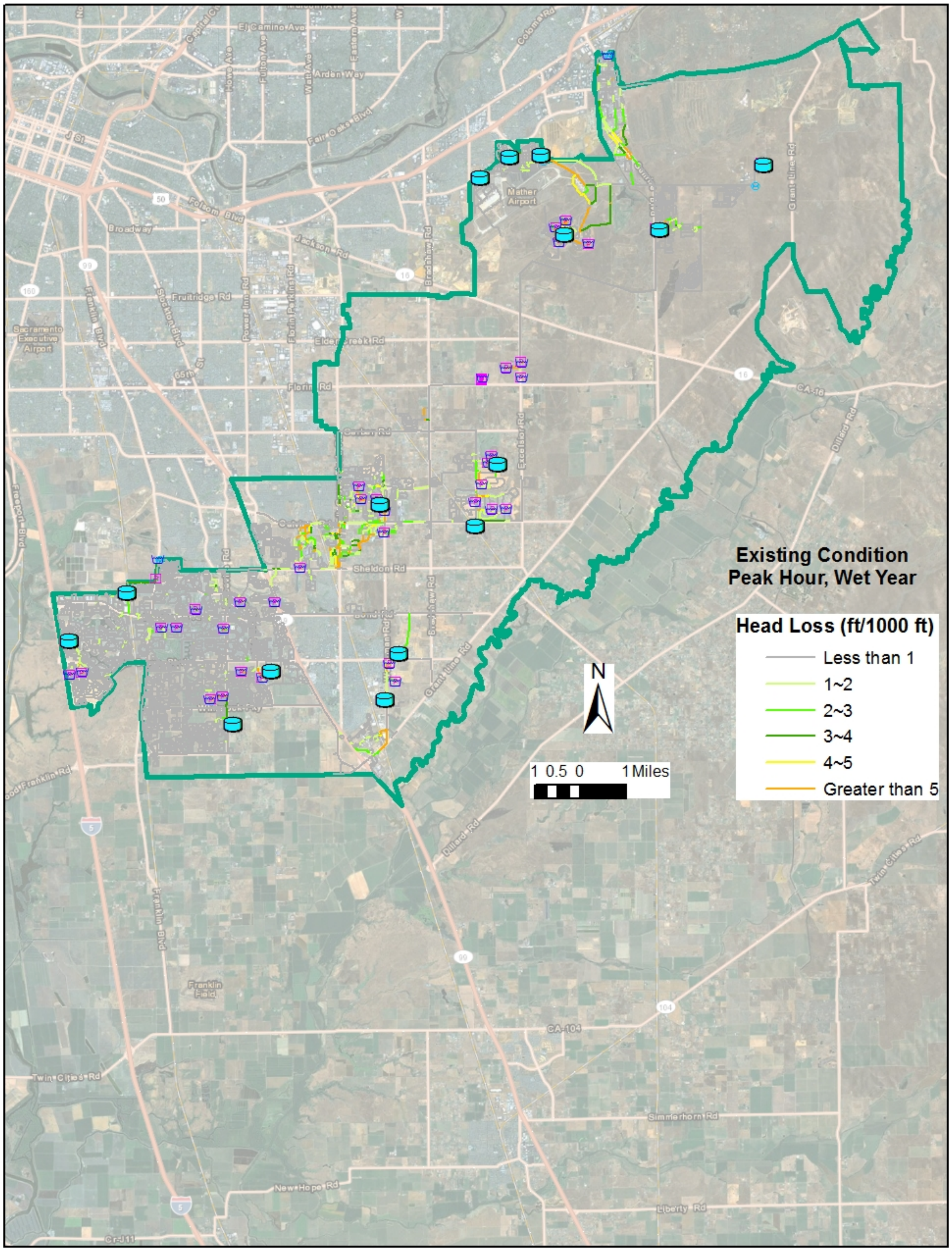


Figure H-11. Head Losses for Existing, Peak Hour, Wet Year Scenario

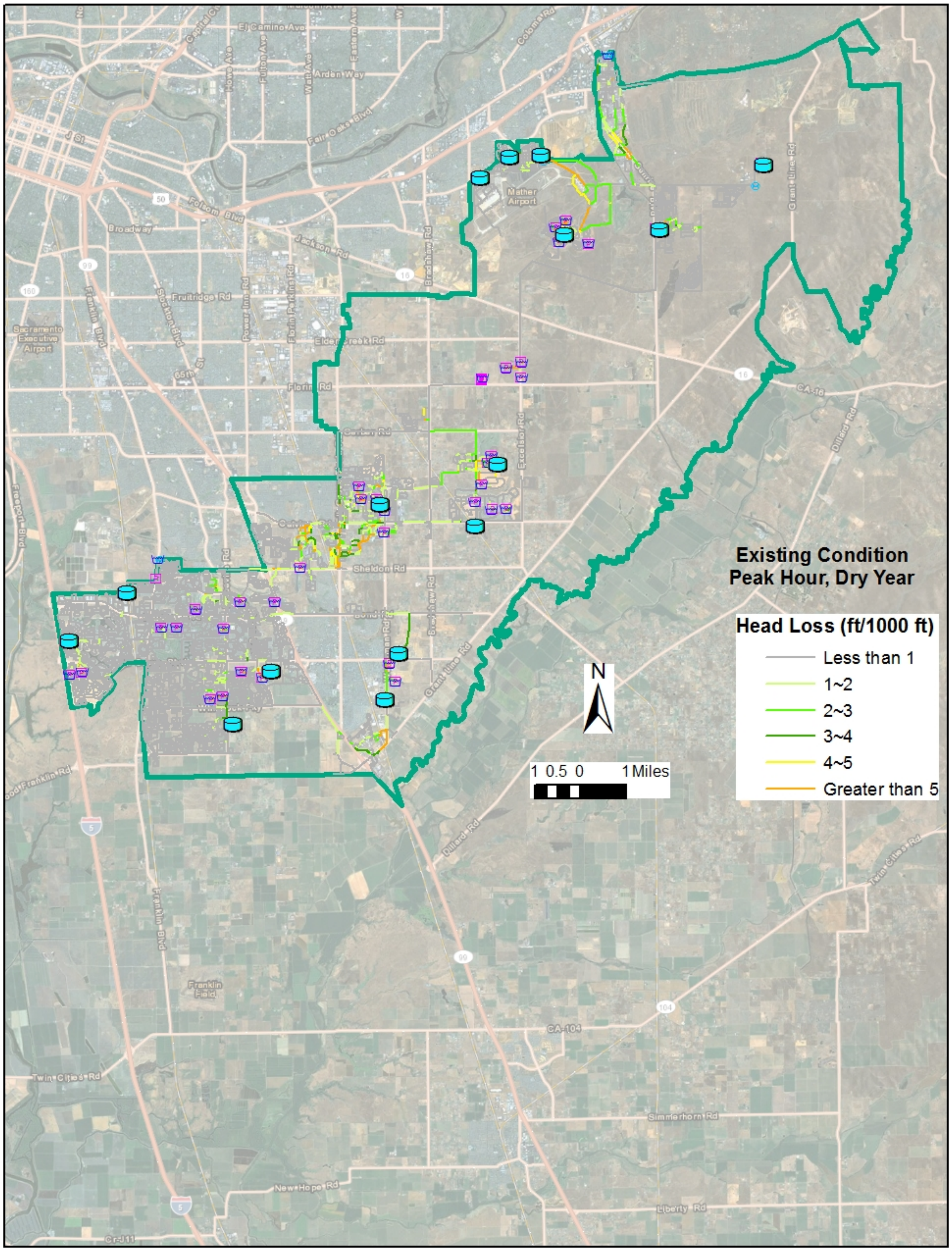


Figure H-12. Head Losses for Existing, Peak Hour, Dry Year Scenario

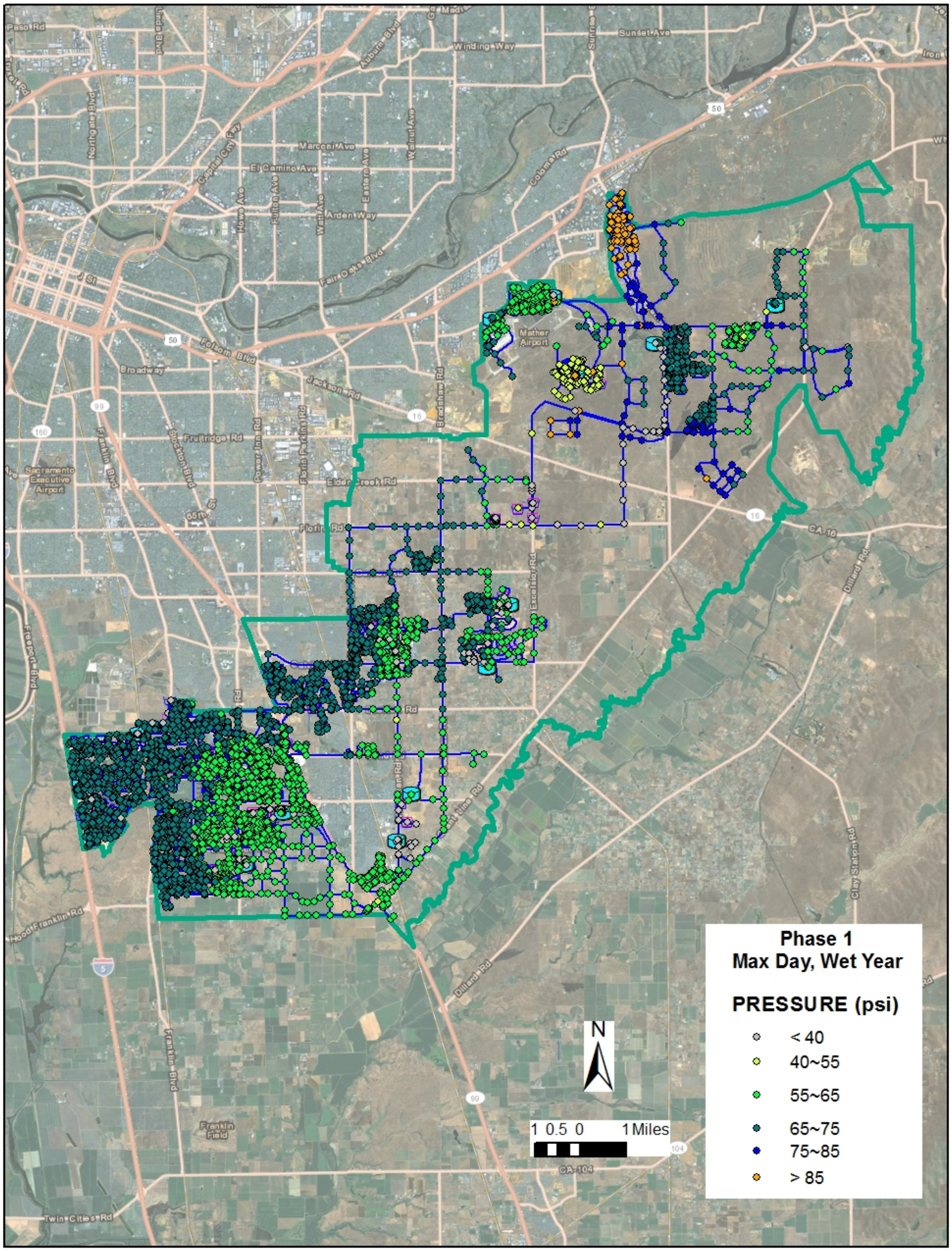


Figure H-13. System Pressures for Phase 1, Max Day, Wet Year Scenario

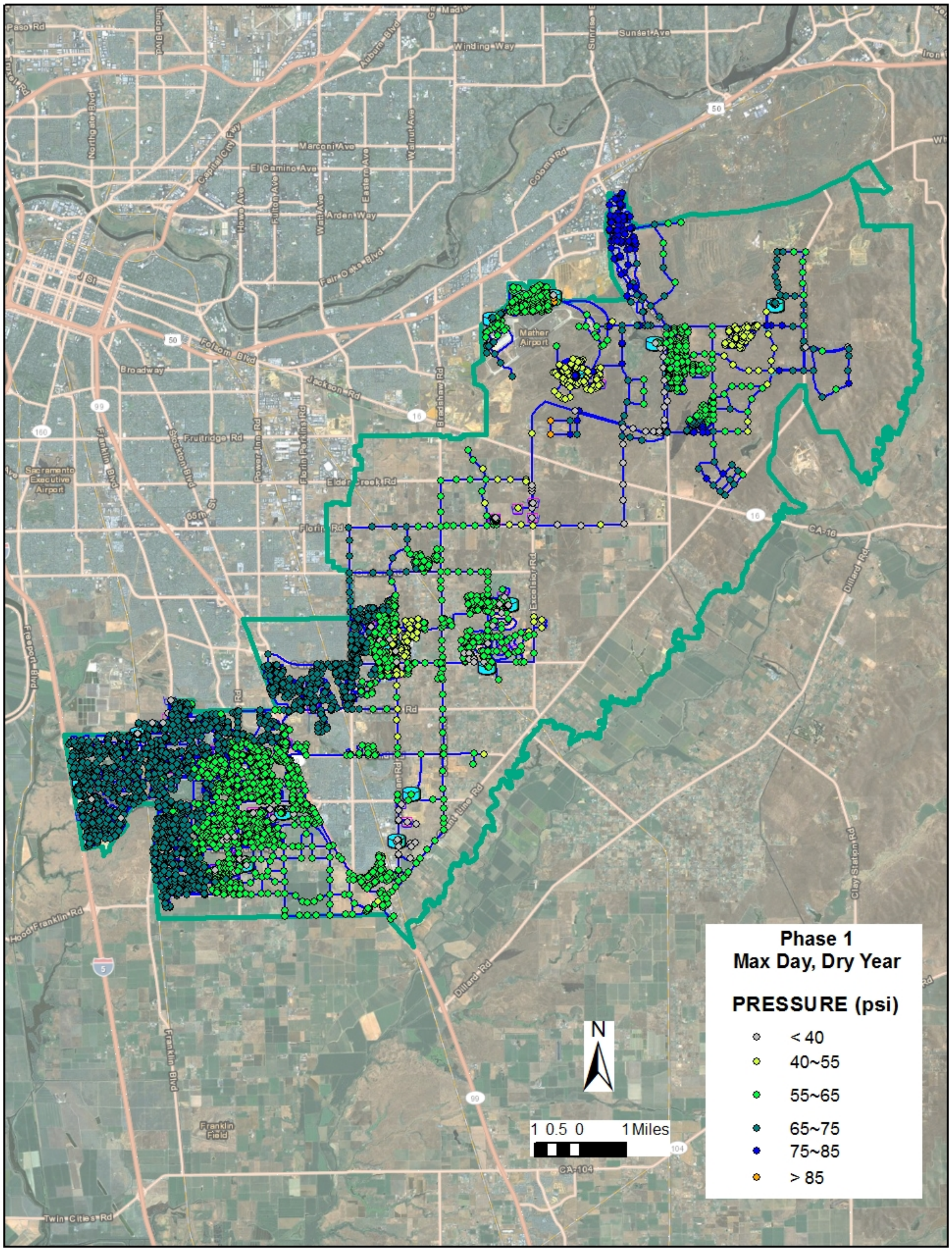


Figure H-14. System Pressures for Phase 1, Max Day, Dry Year Scenario

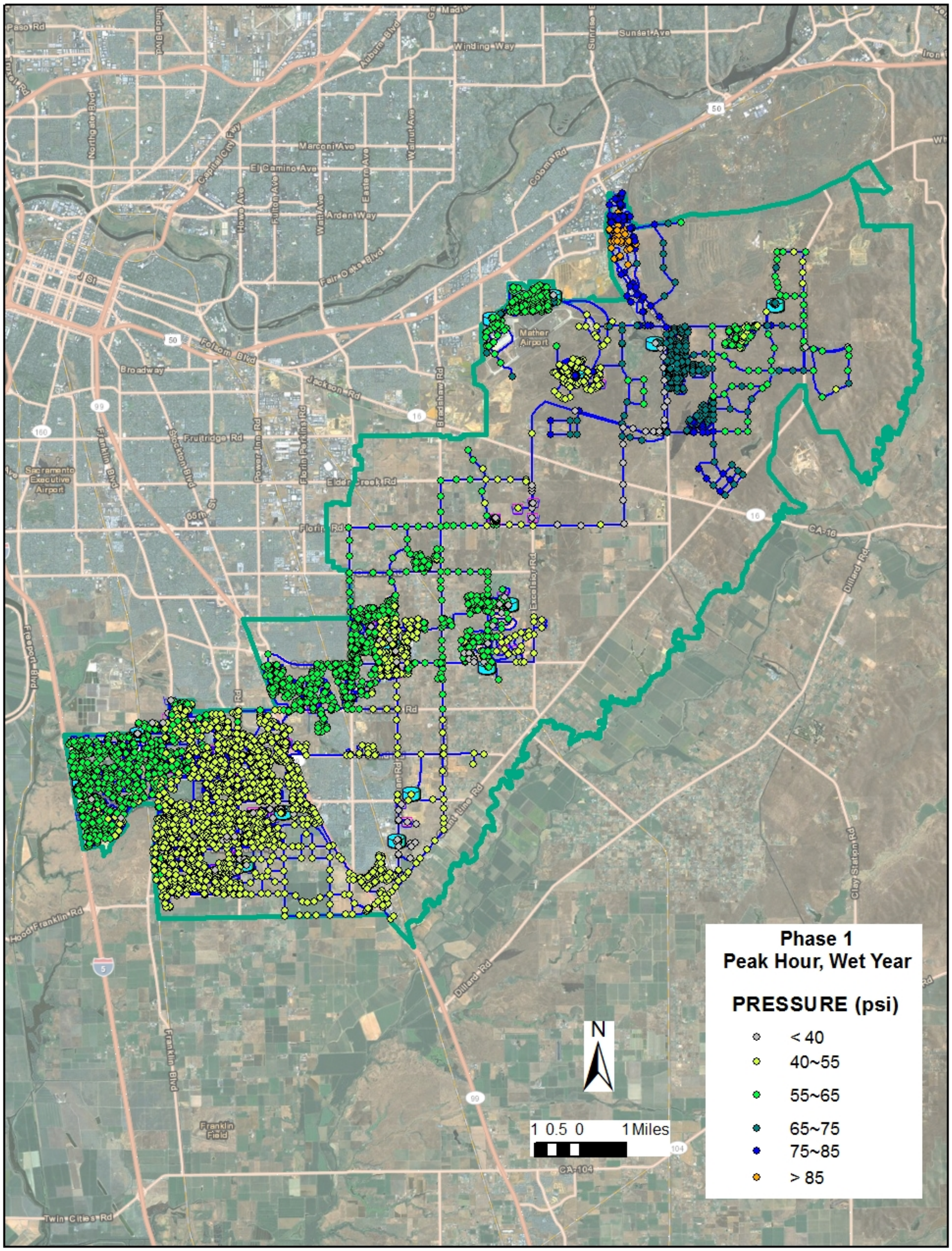


Figure H-15. System Pressures for Phase 1, Peak Hour, Wet Year Scenario

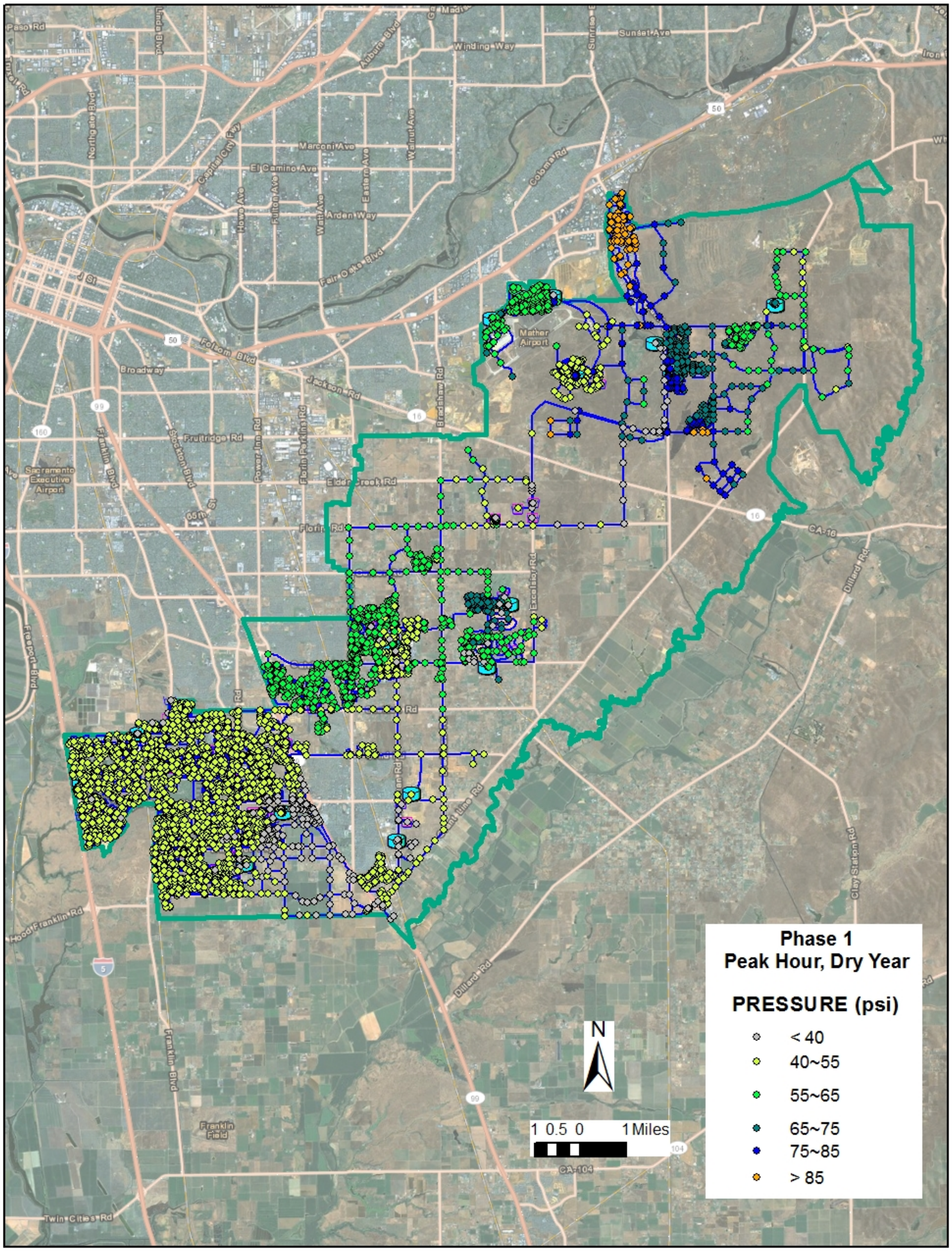


Figure H-16. System Pressures for Phase 1, Peak Hour, Dry Year Scenario

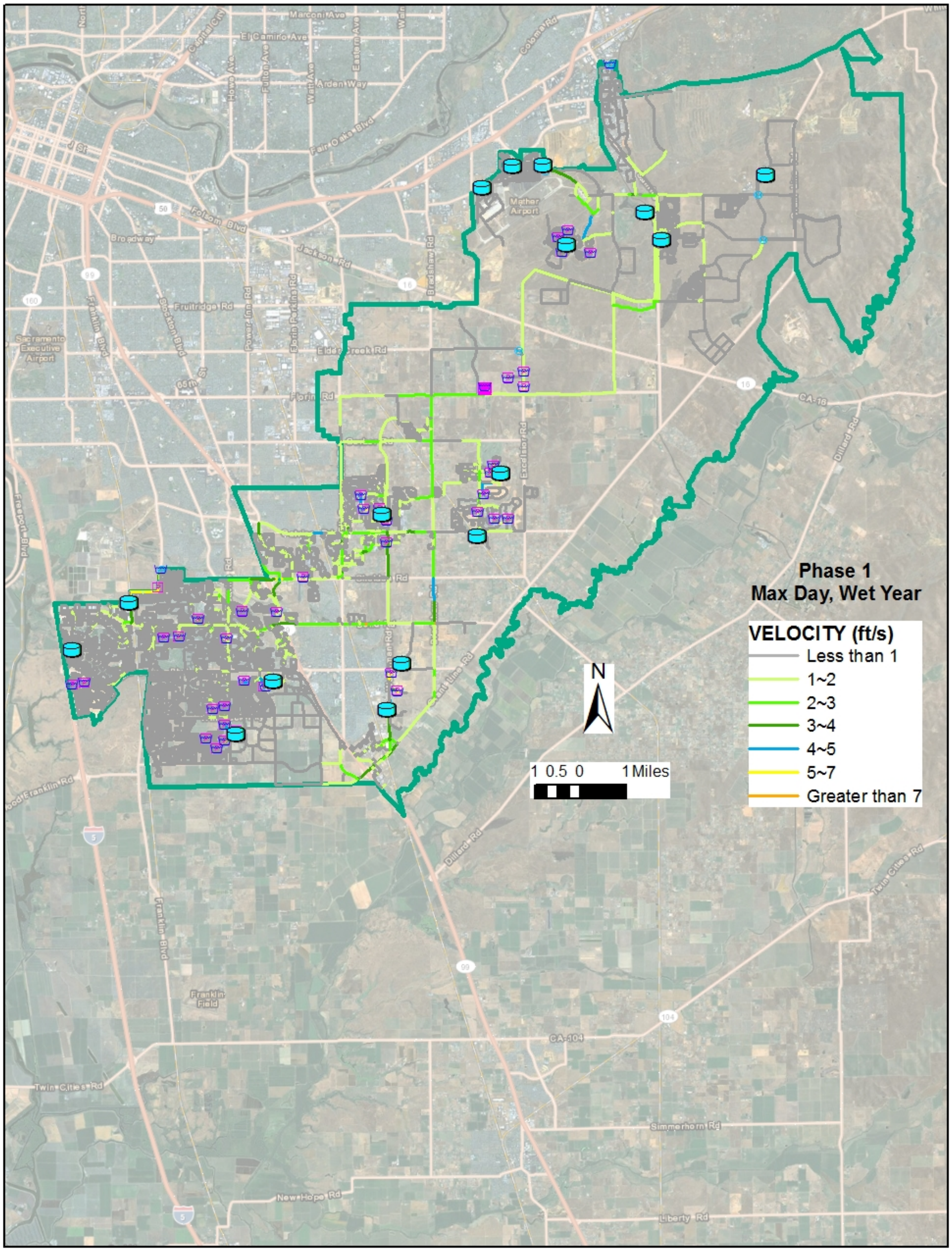


Figure H-17. Pipe Velocities for Phase 1, Max Day, Wet Year Scenario

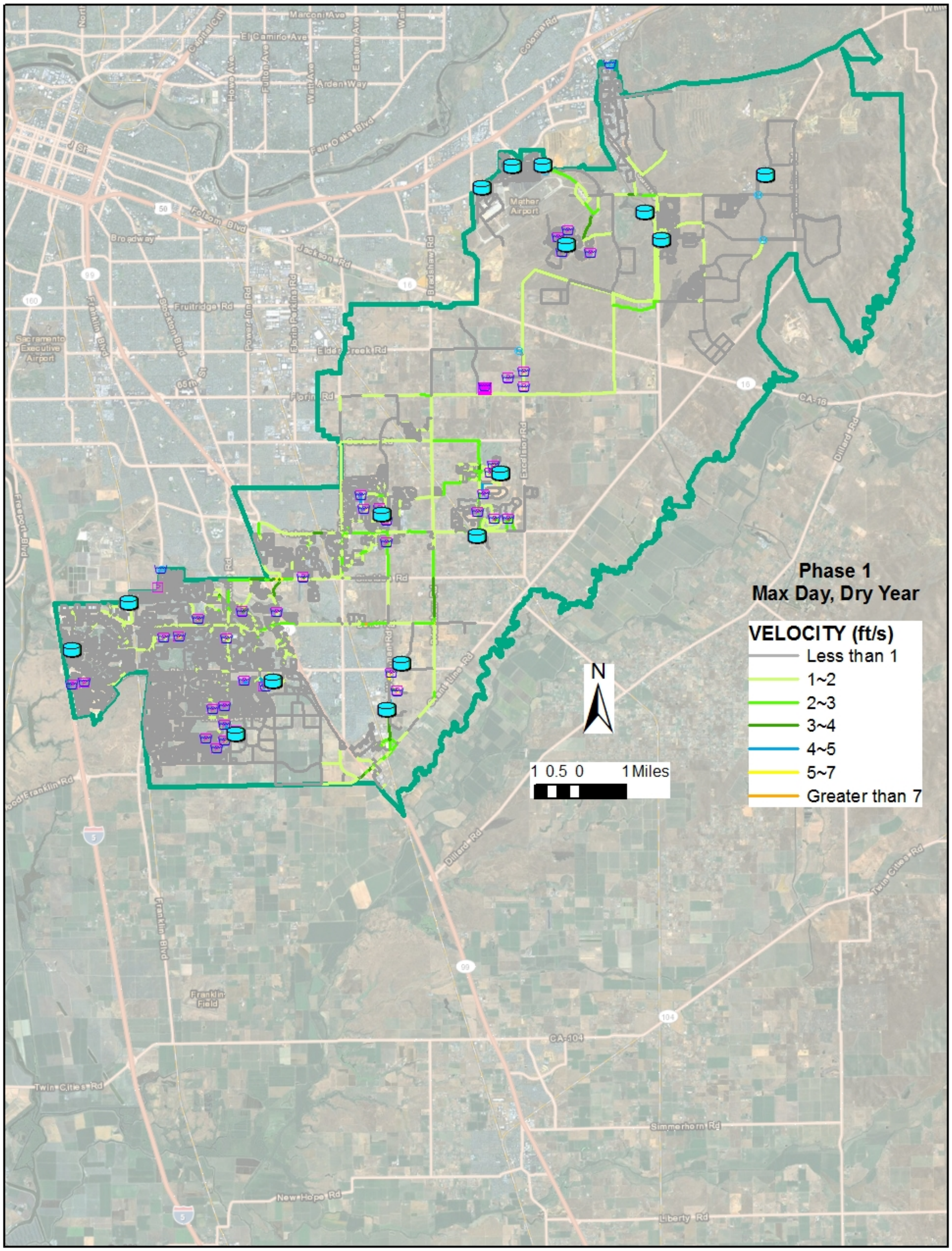


Figure H-18. Pipe Velocities for Phase 1, Max Day, Dry Year Scenario

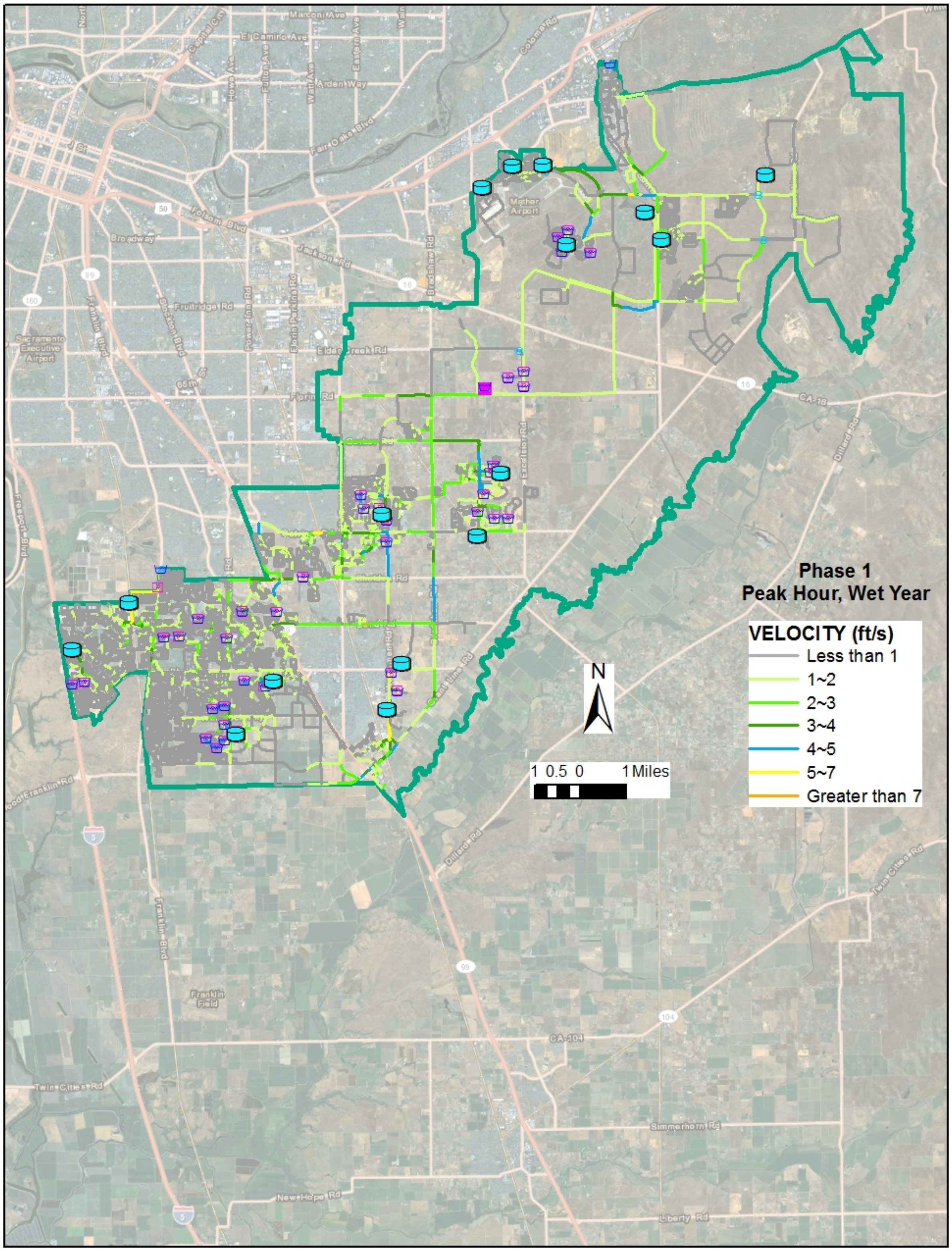


Figure H-19. Pipe Velocities for Phase 1, Peak Hour, Wet Year Scenario

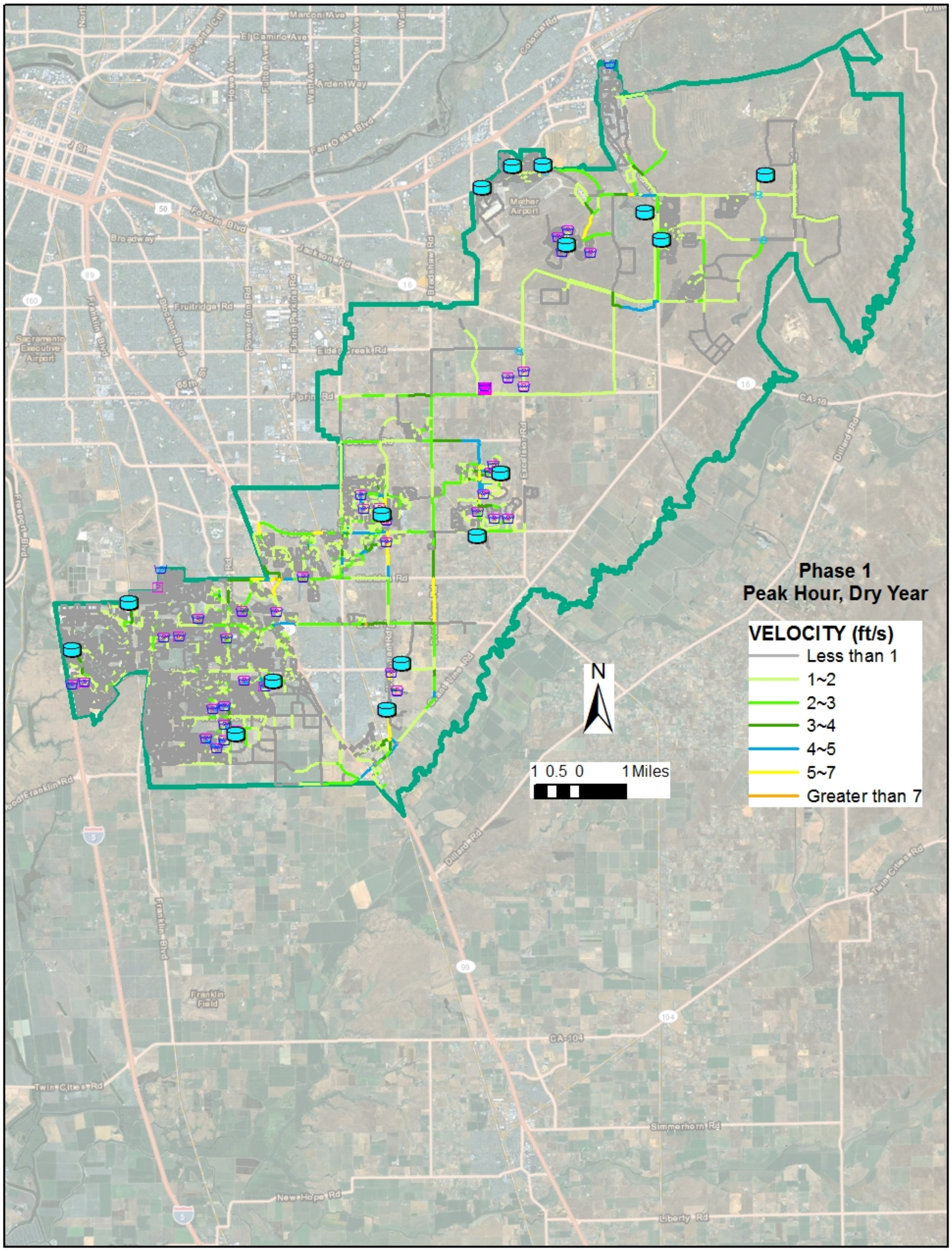


Figure H-20. Pipe Velocities for Phase 1, Peak Hour, Dry Year Scenario

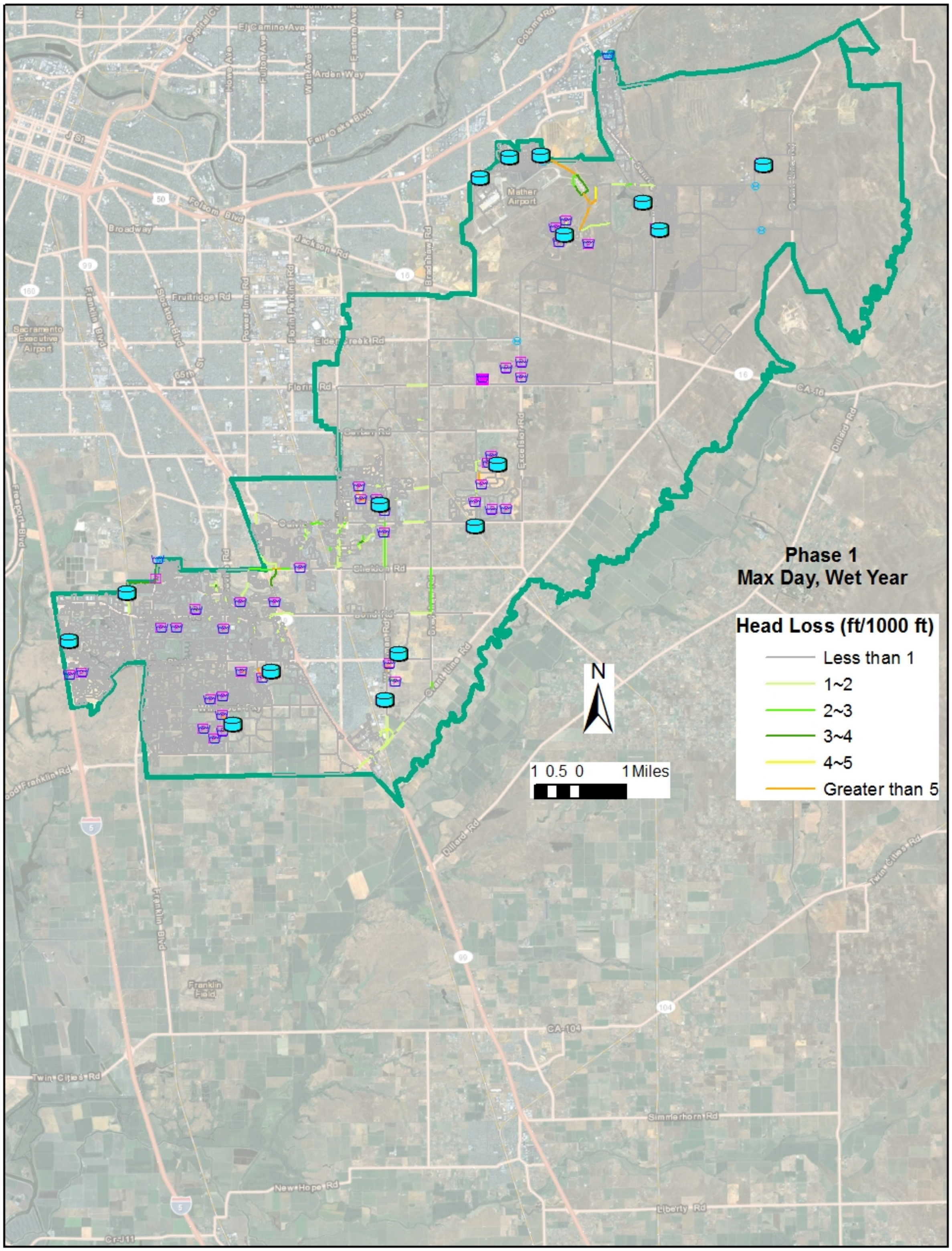


Figure H-21. Head Losses for Phase 1, Max Day, Wet Year Scenario

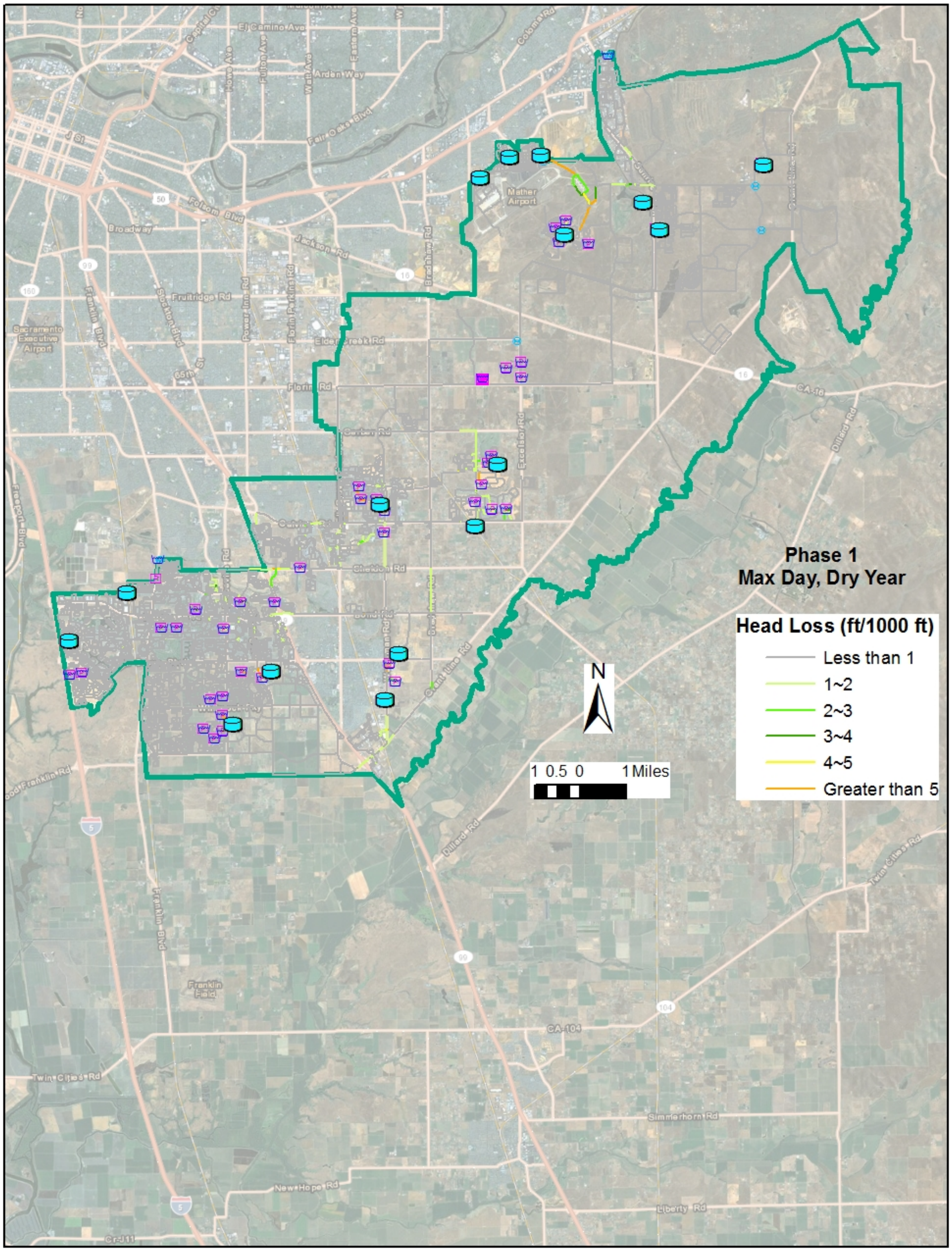


Figure H-22. Head Losses for Phase 1, Max Day, Dry Year Scenario

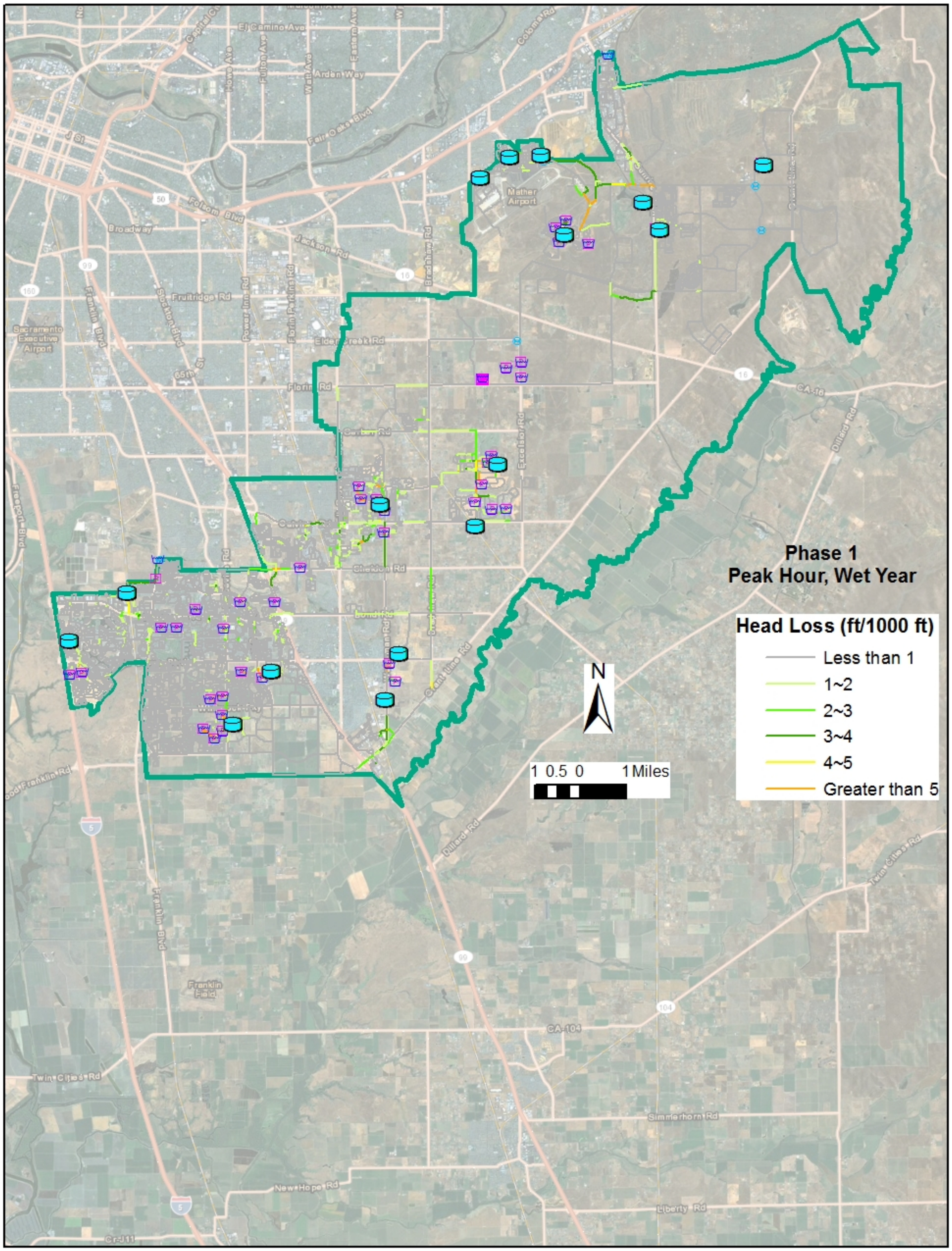


Figure H-23. Head Losses for Phase 1, Peak Hour, Wet Year Scenario

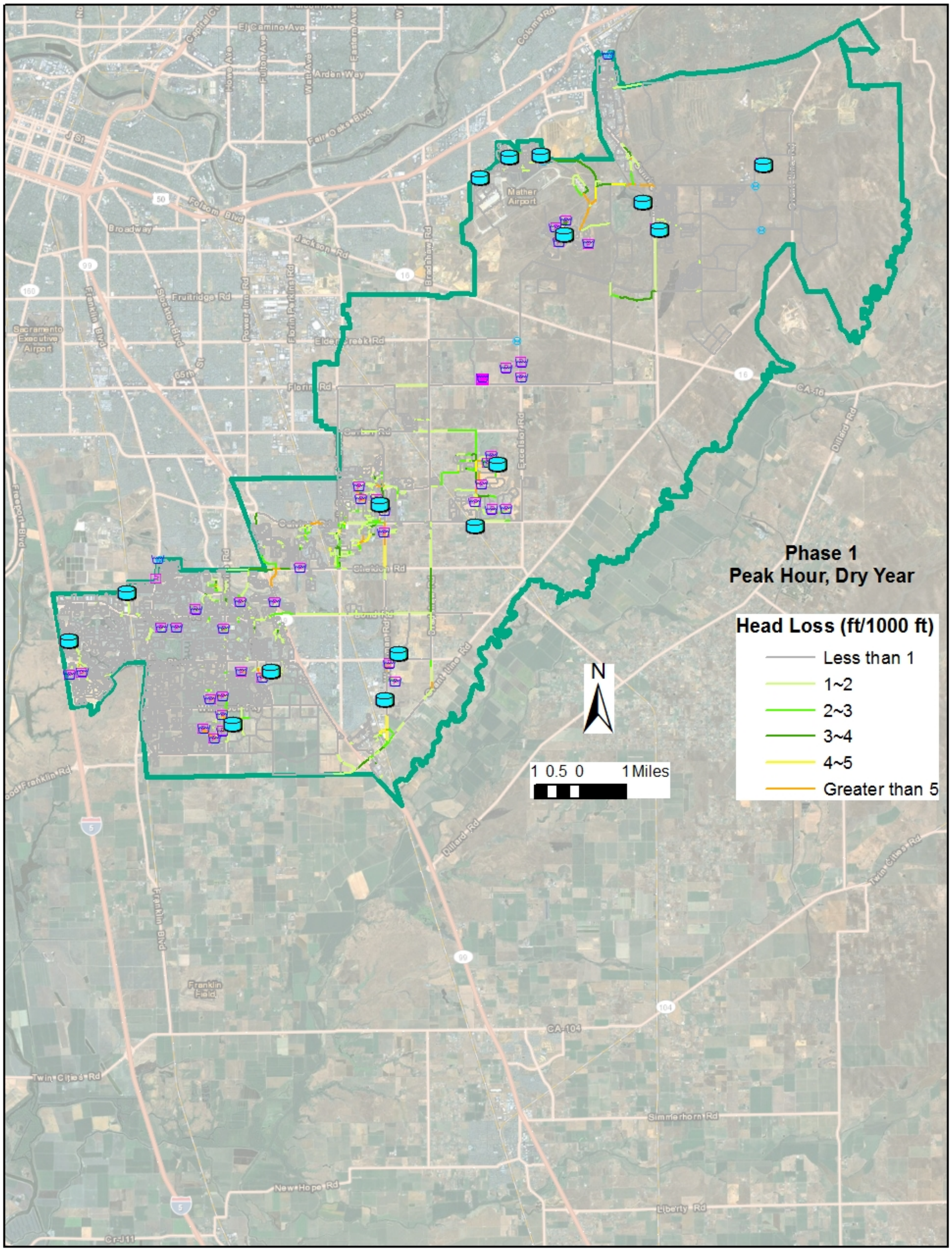


Figure H-24. Head Losses for Phase 1, Peak Hour, Dry Year Scenario

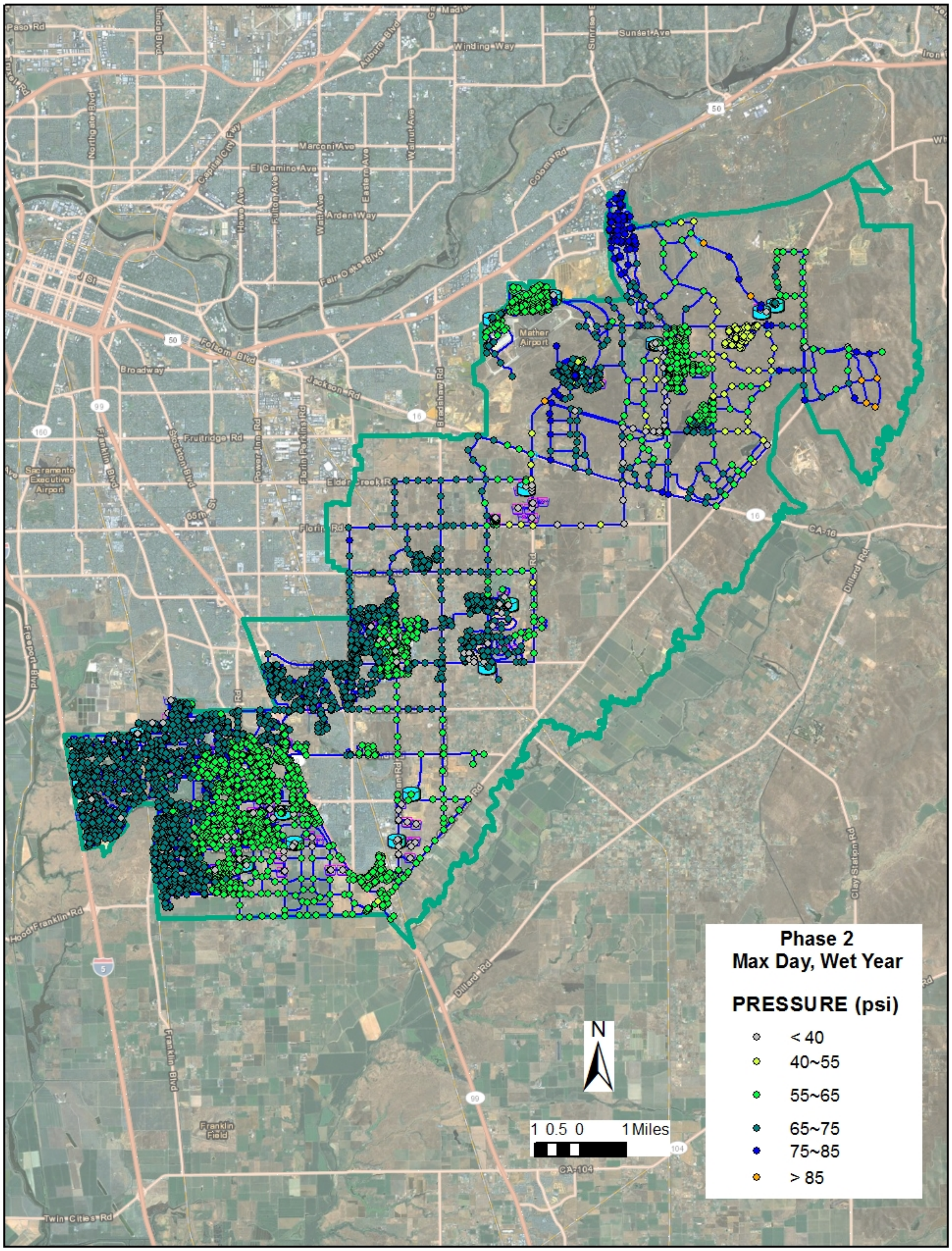


Figure H-25. System Pressures for Phase 2, Max Day, Wet Year Scenario

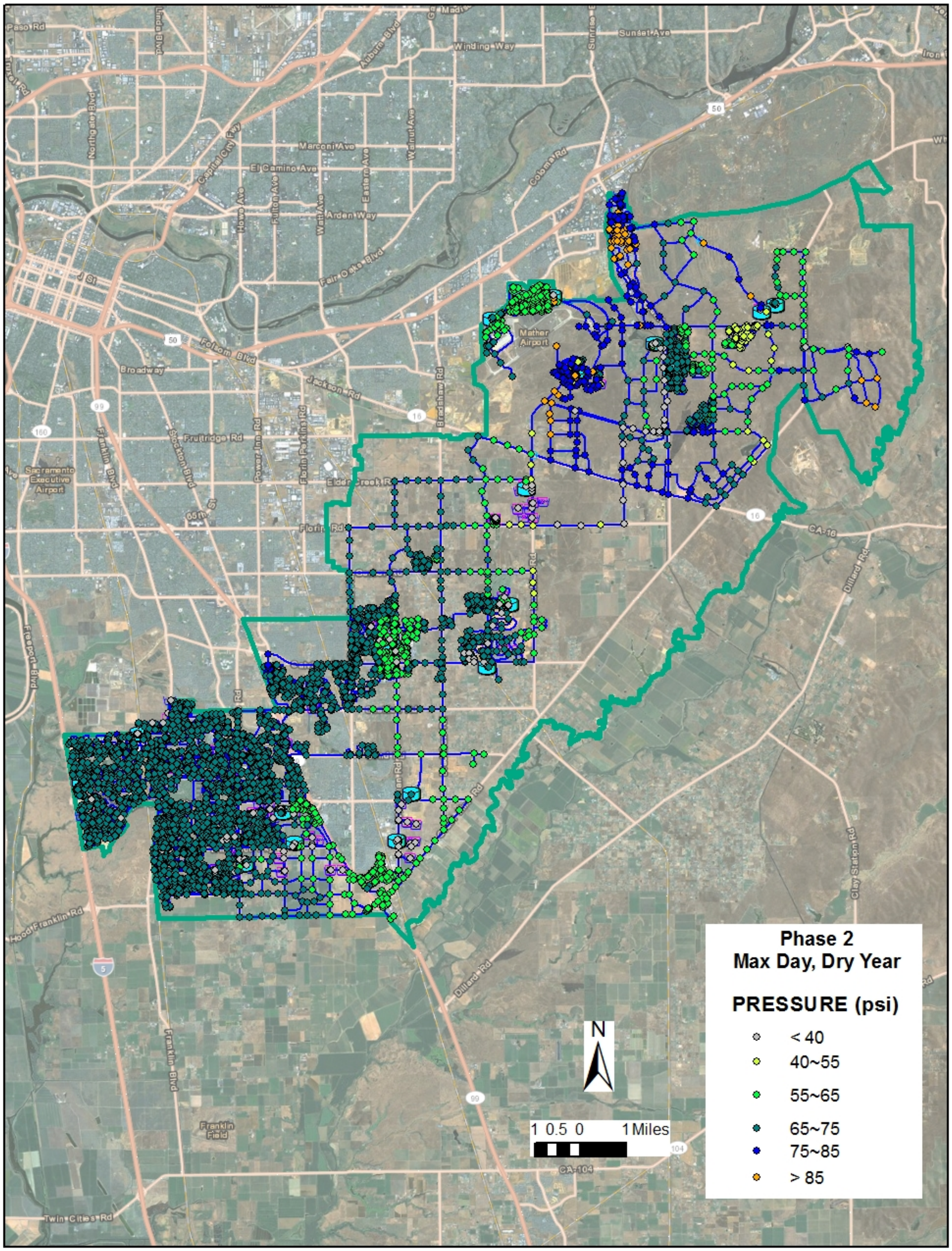


Figure H-26. System Pressures for Phase 2, Max Day, Dry Year Scenario

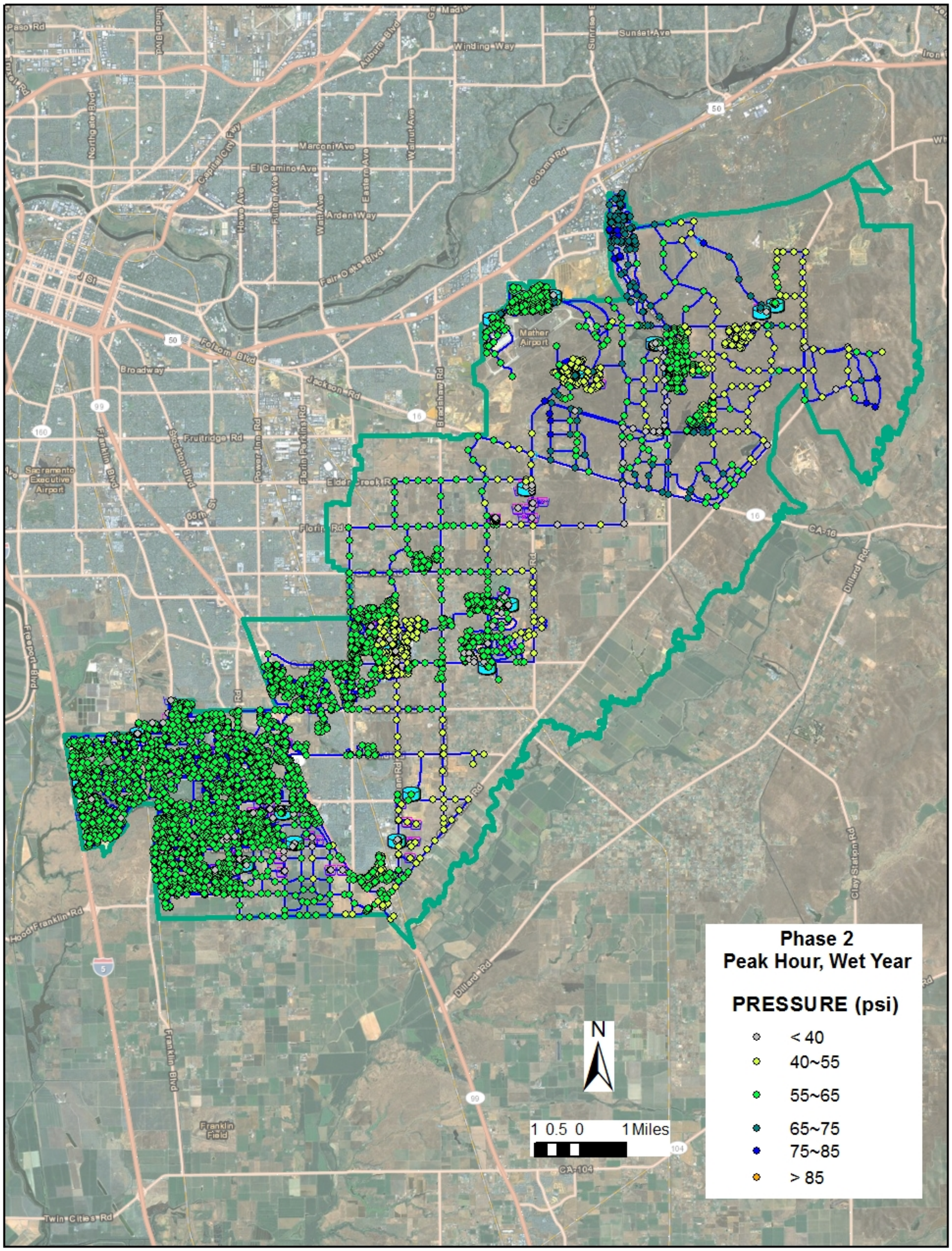


Figure H-27. System Pressures for Phase 2, Peak Hour, Wet Year Scenario

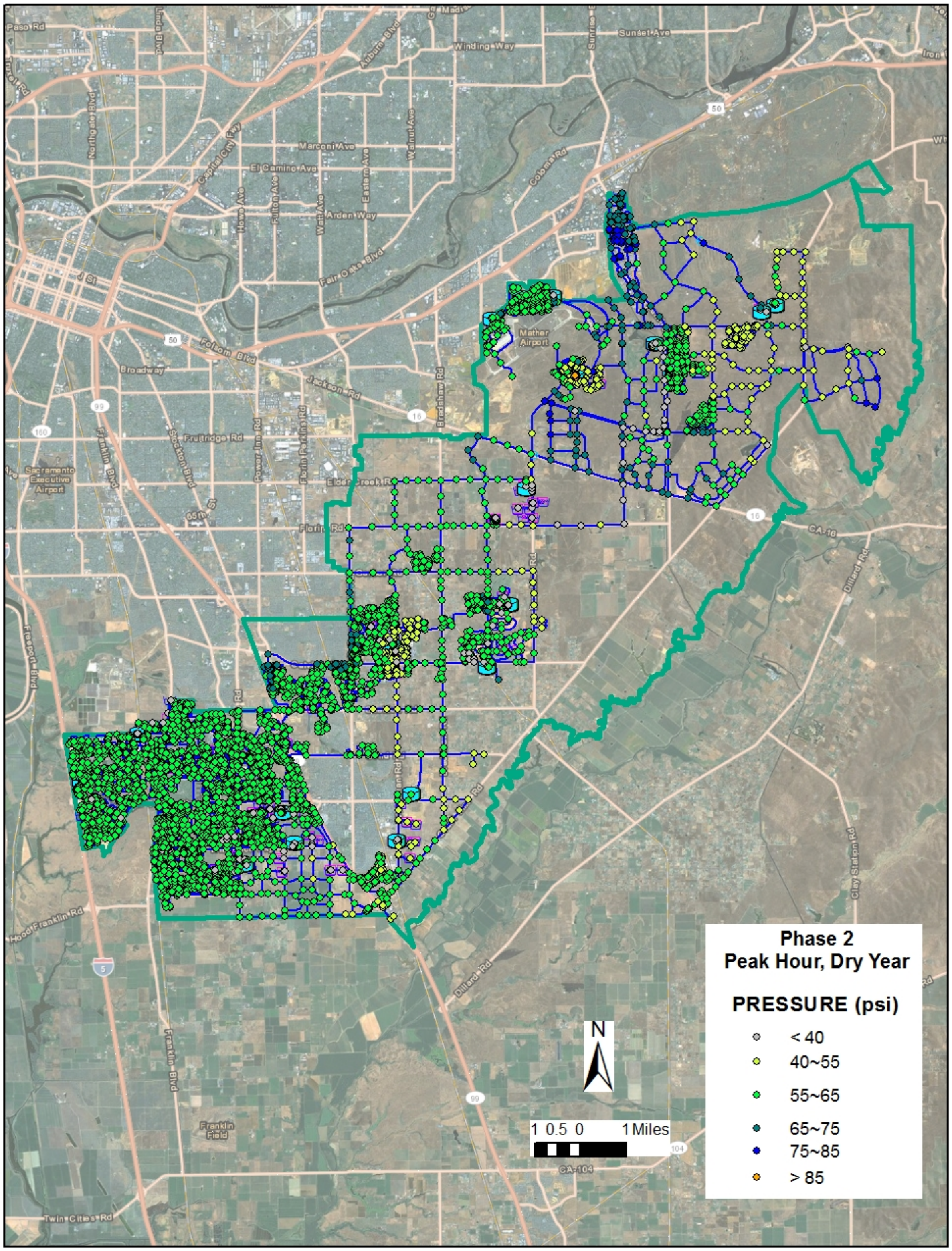


Figure H-28. System Pressures for Phase 2, Peak Hour, Dry Year Scenario

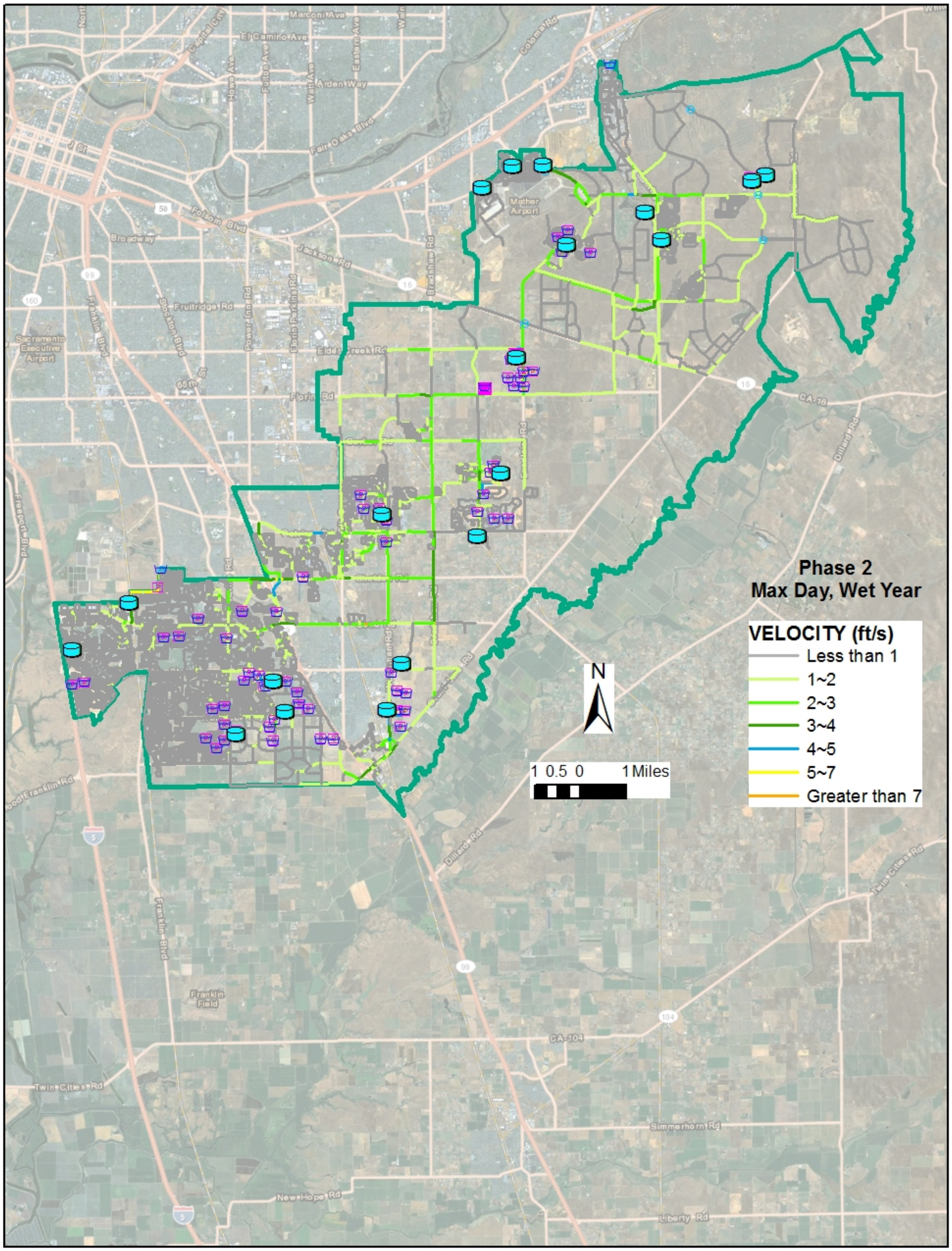


Figure H-29. Pipe Velocities for Phase 2, Max Day, Wet Year Scenario

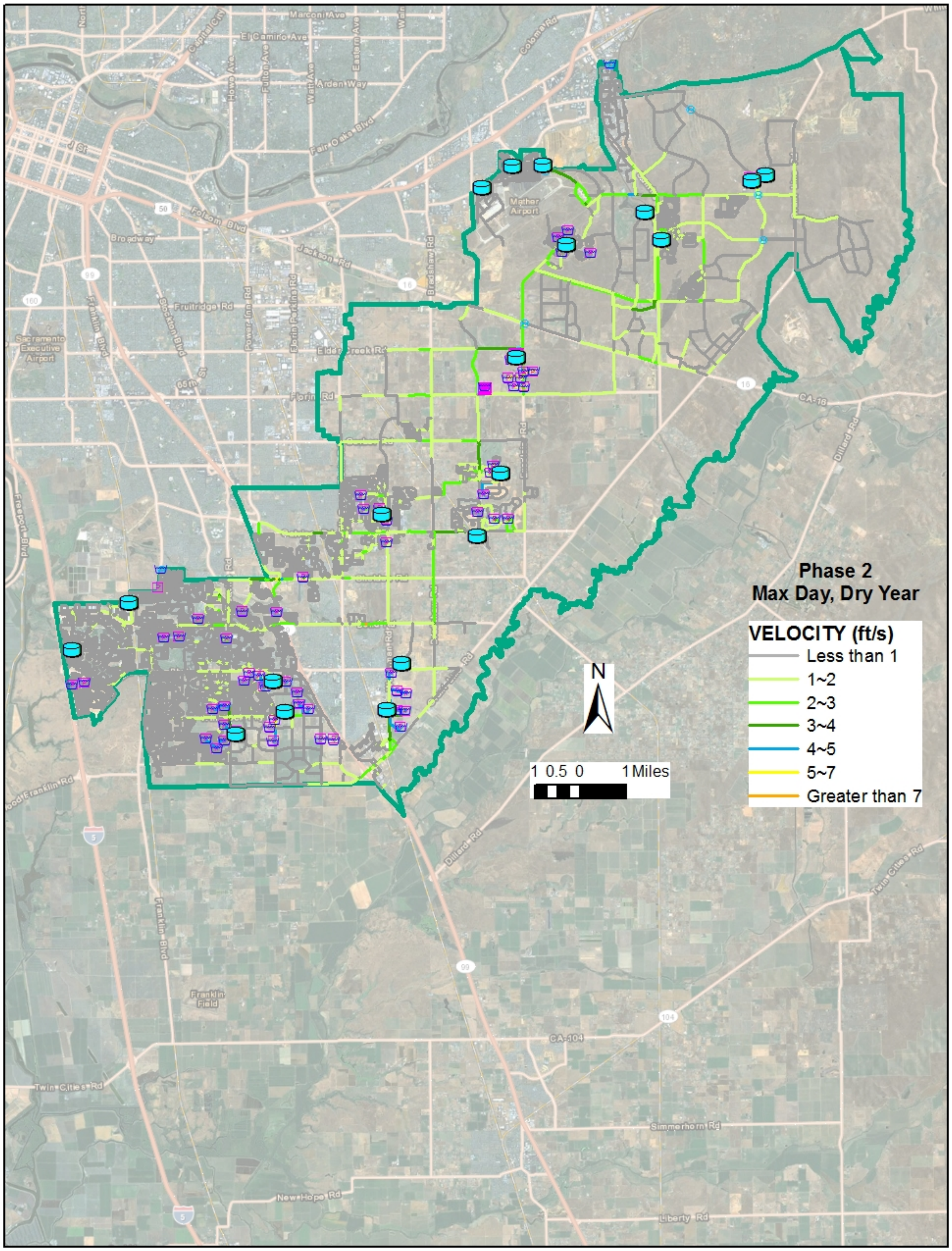


Figure H-30. Pipe Velocities for Phase 2, Max Day, Dry Year Scenario

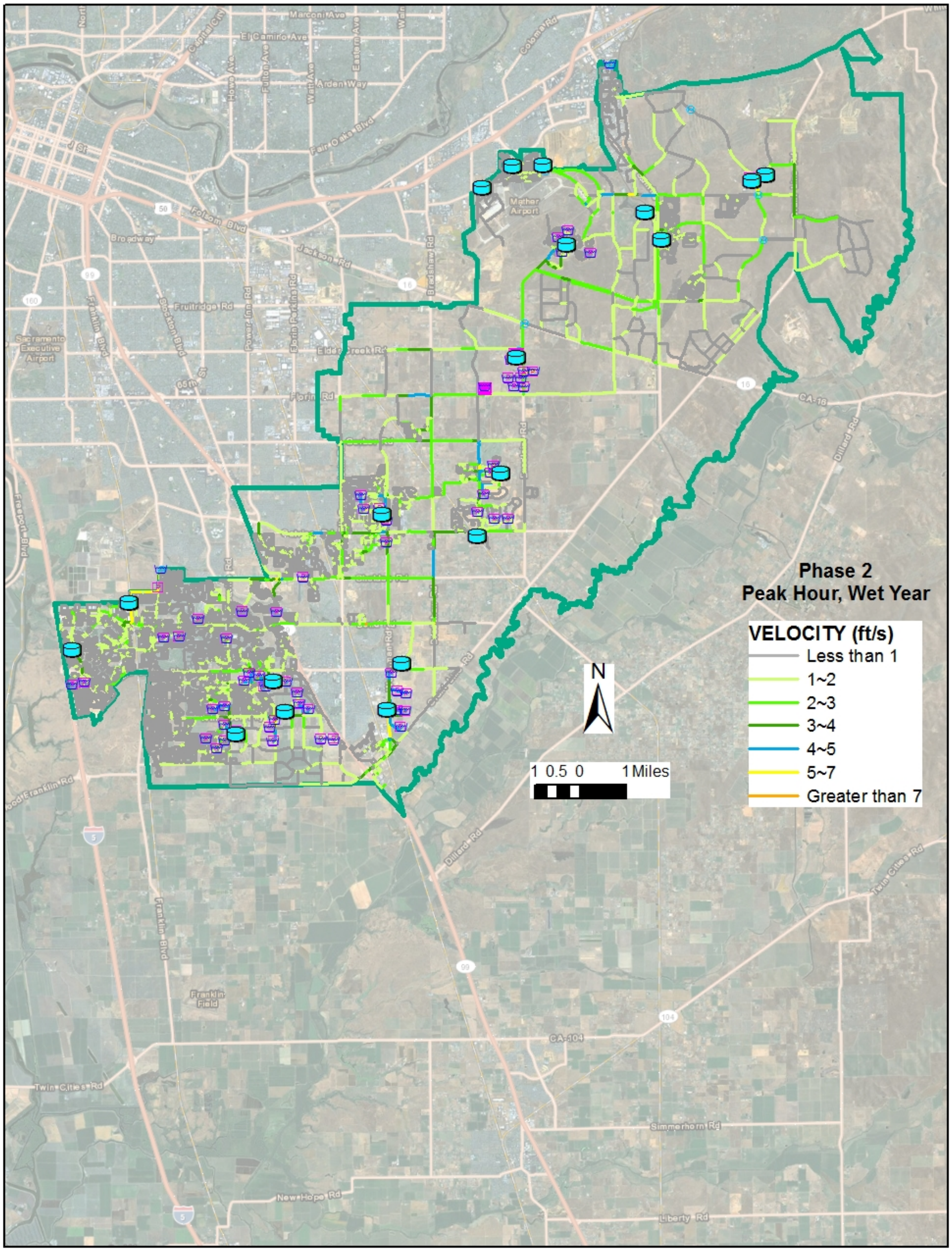


Figure H-31. Pipe Velocities for Phase 2, Peak Hour, Wet Year Scenario

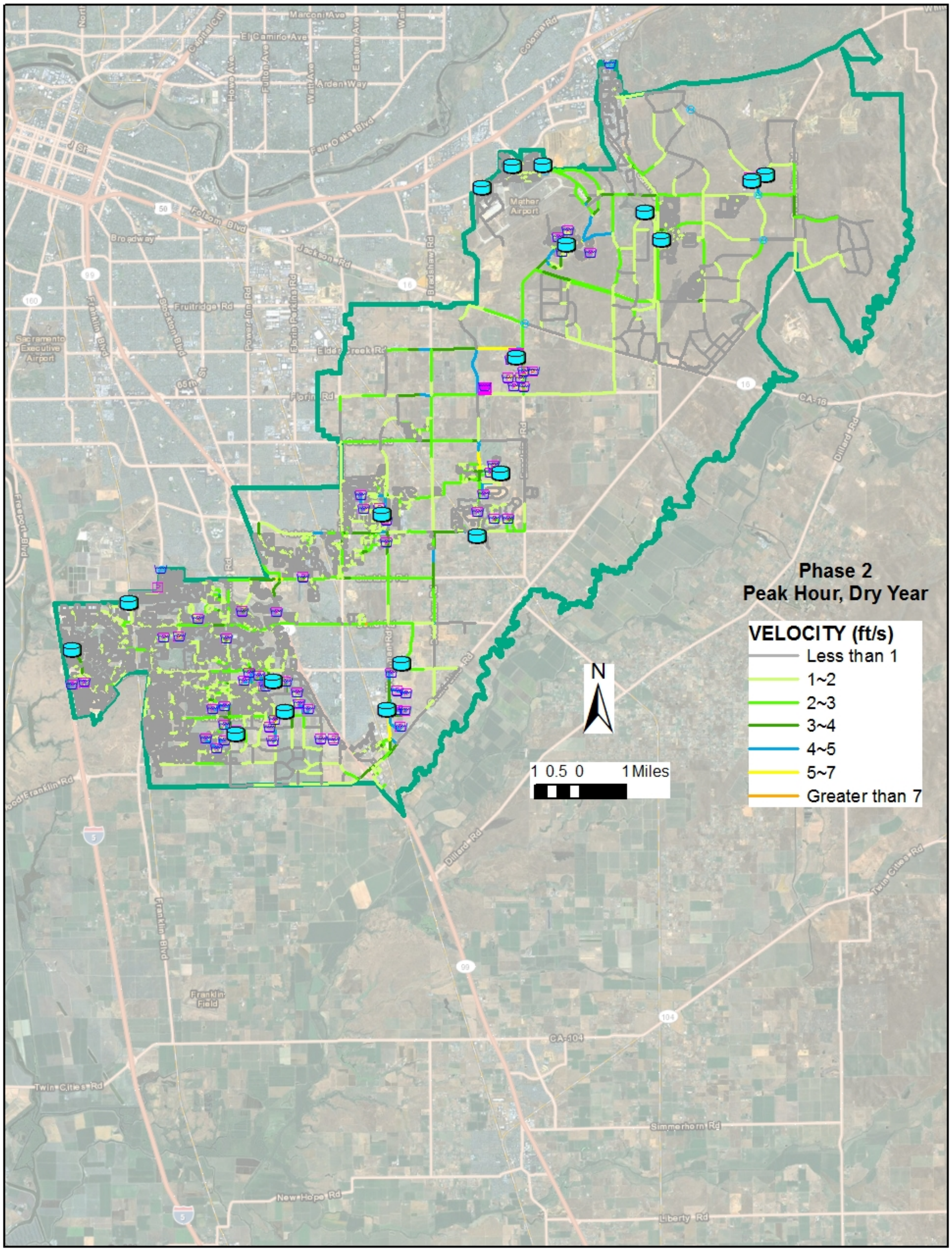


Figure H-32. Pipe Velocities for Phase 2, Peak Hour, Dry Year Scenario

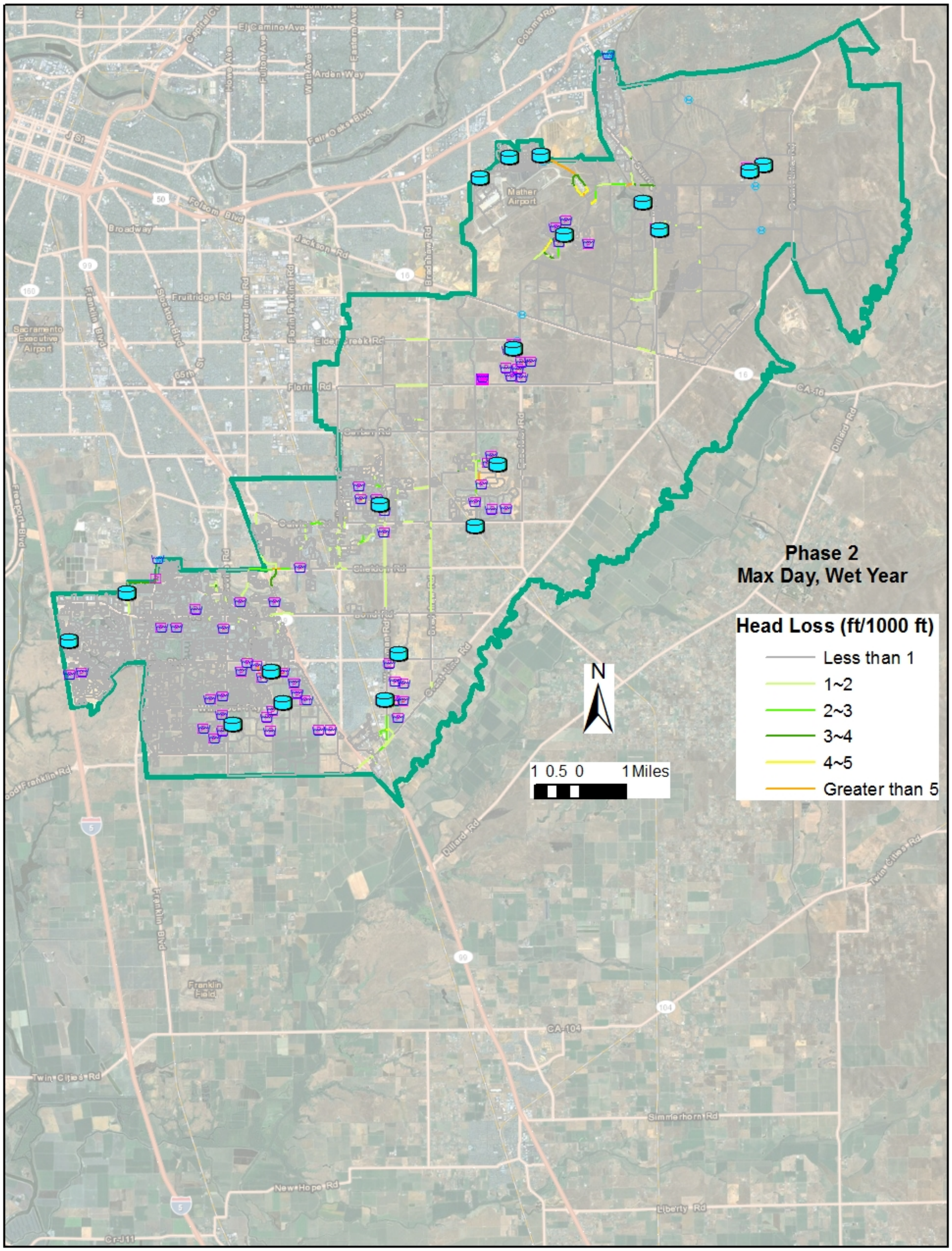


Figure H-33. Head Losses for Phase 2, Max Day, Wet Year Scenario

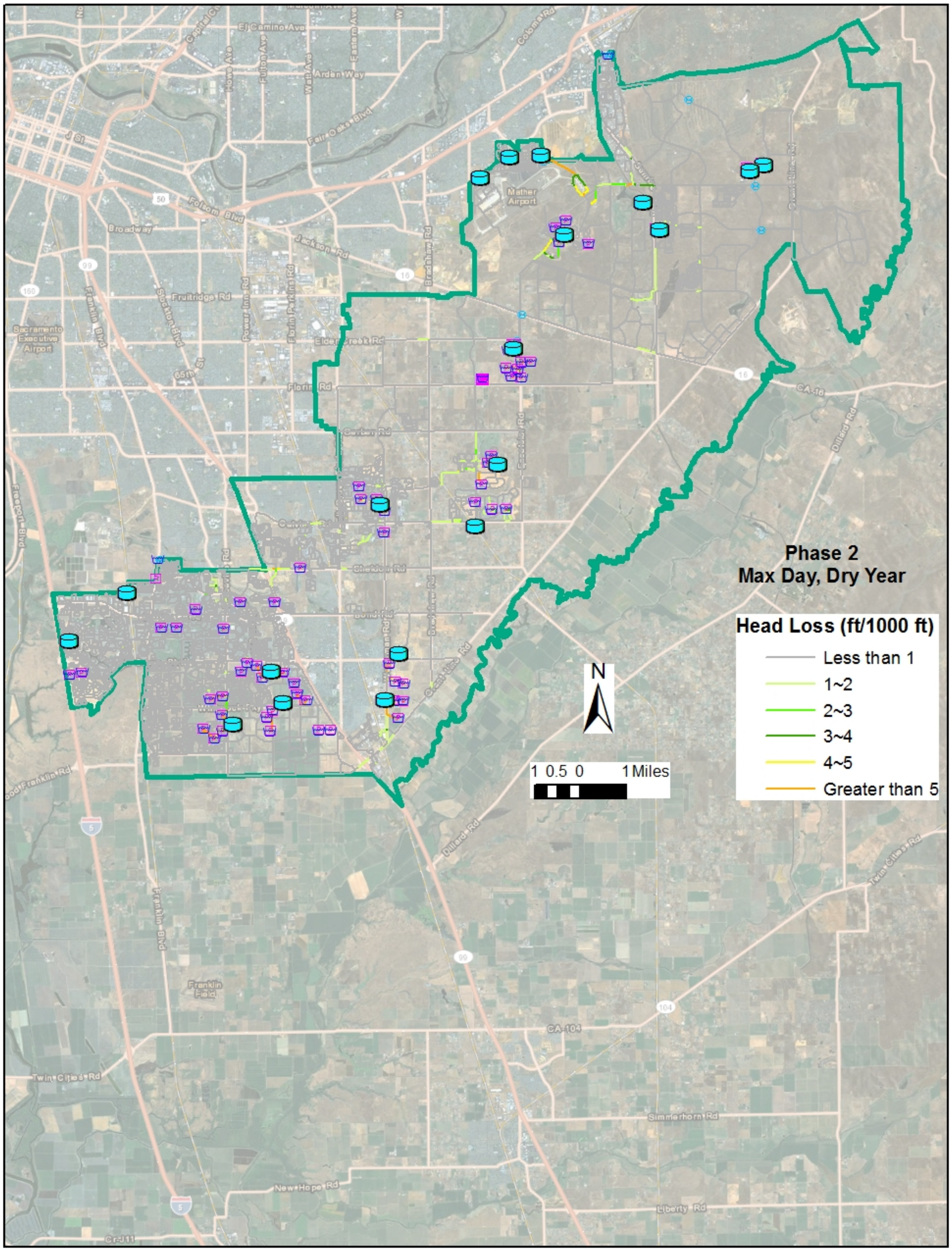


Figure H-34. Head Losses for Phase 2, Max Day, Dry Year Scenario

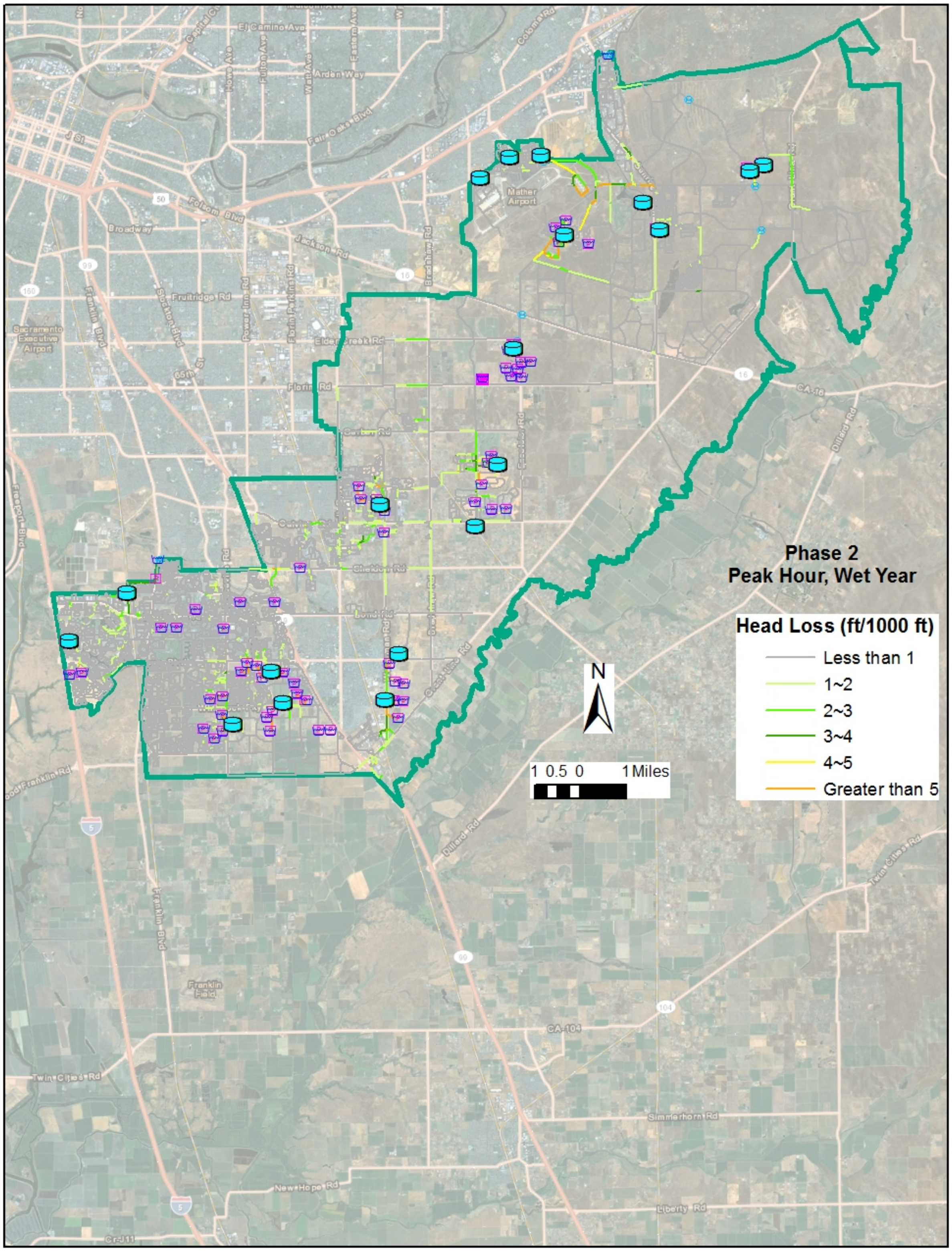


Figure H-35. Head Losses for Phase 2, Peak Hour, Wet Year Scenario

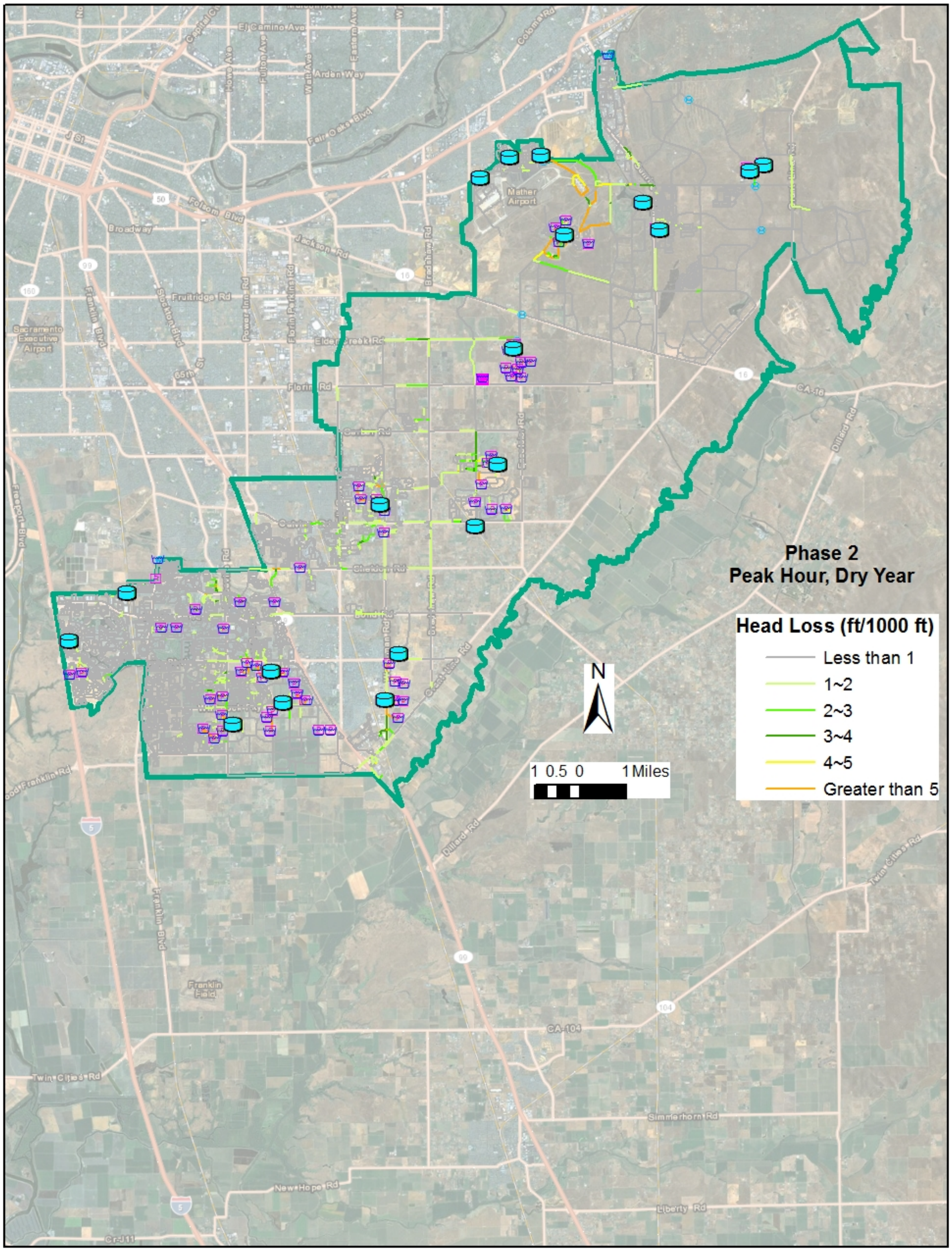


Figure H-36. Head Losses for Phase 2, Peak Hour, Dry Year Scenario

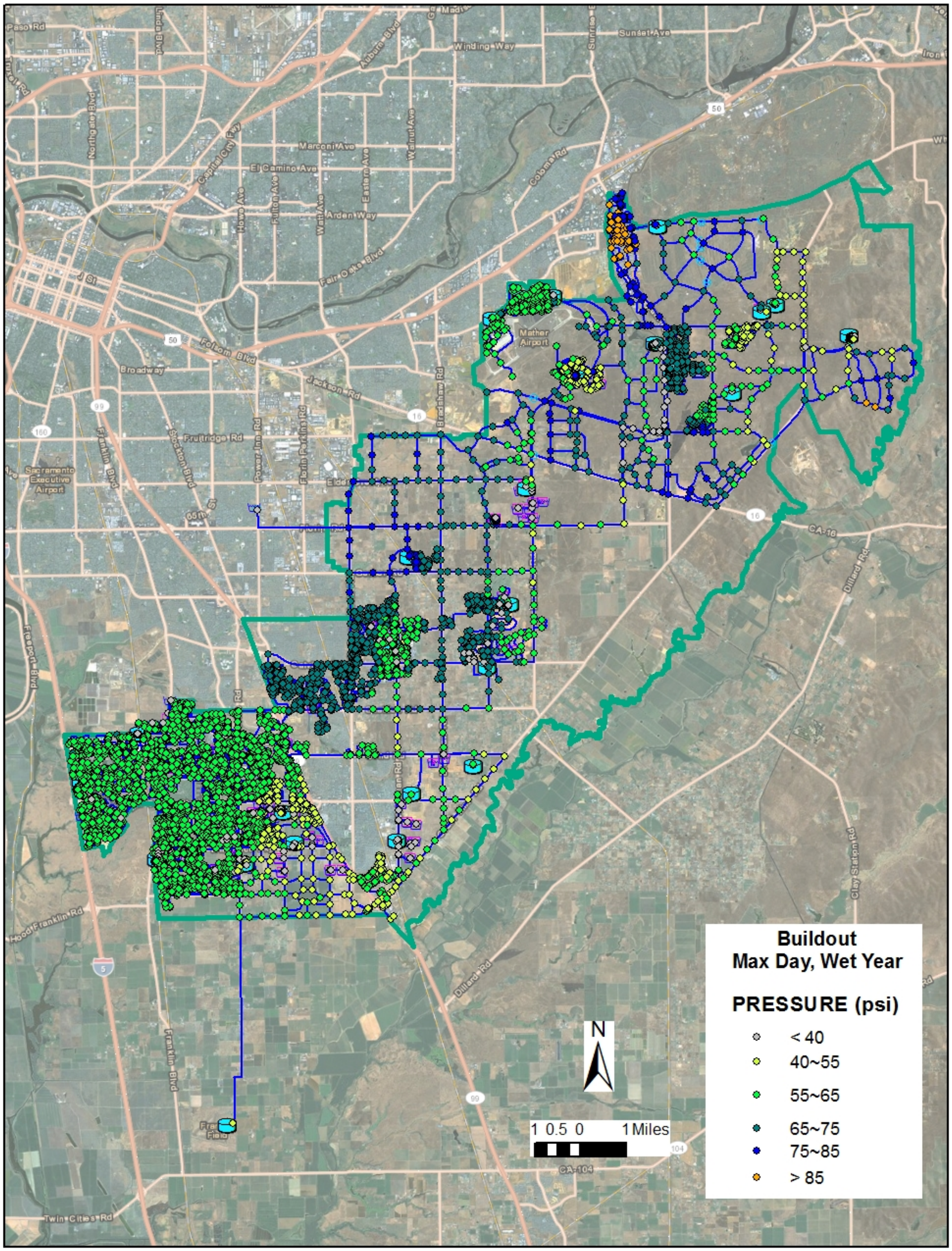


Figure H-37. System Pressures for Buildout, Max Day, Wet Year Scenario

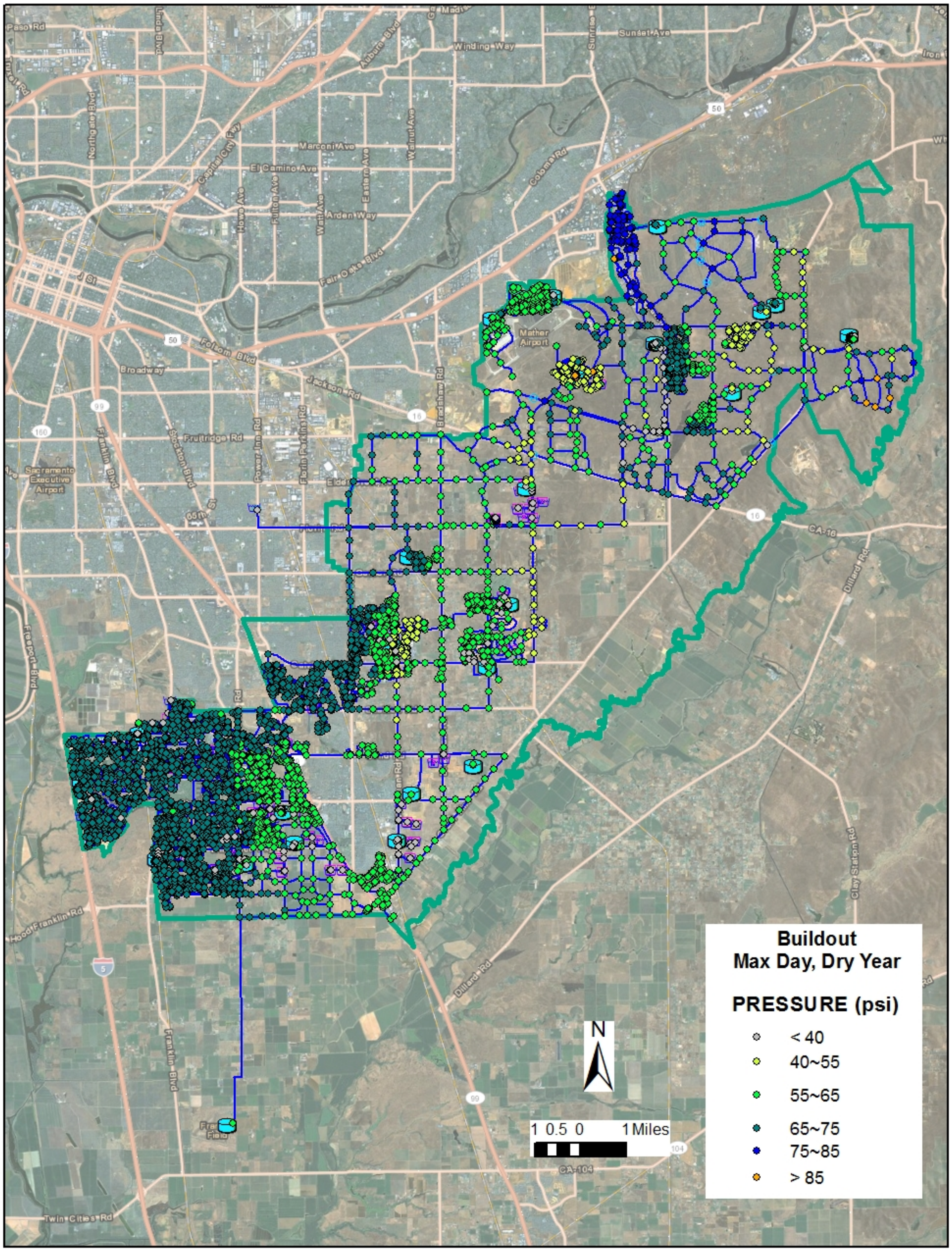


Figure H-38. System Pressures for Buildout, Max Day, Dry Year Scenario

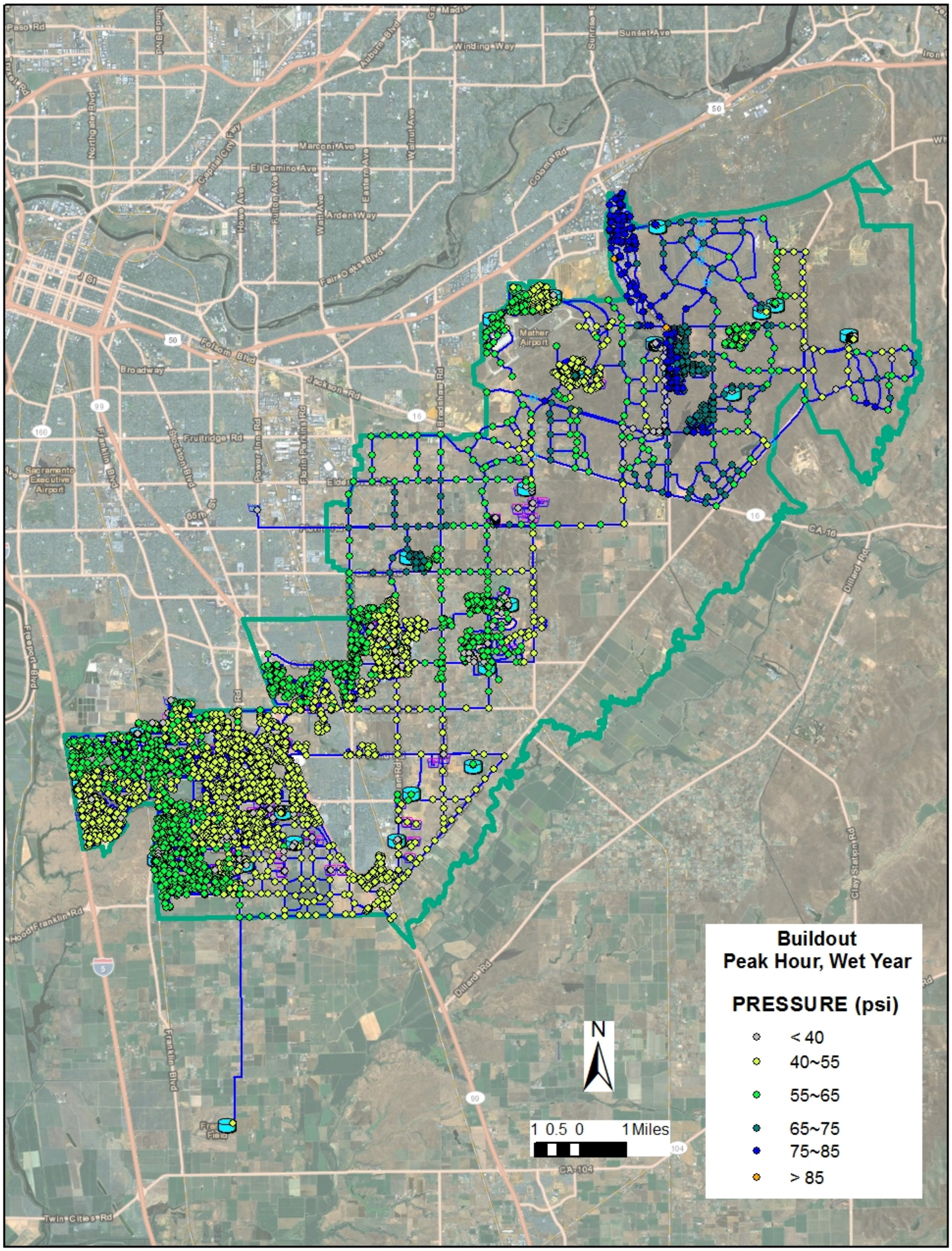


Figure H-39. System Pressures for Buildout, Peak Hour, Wet Year Scenario

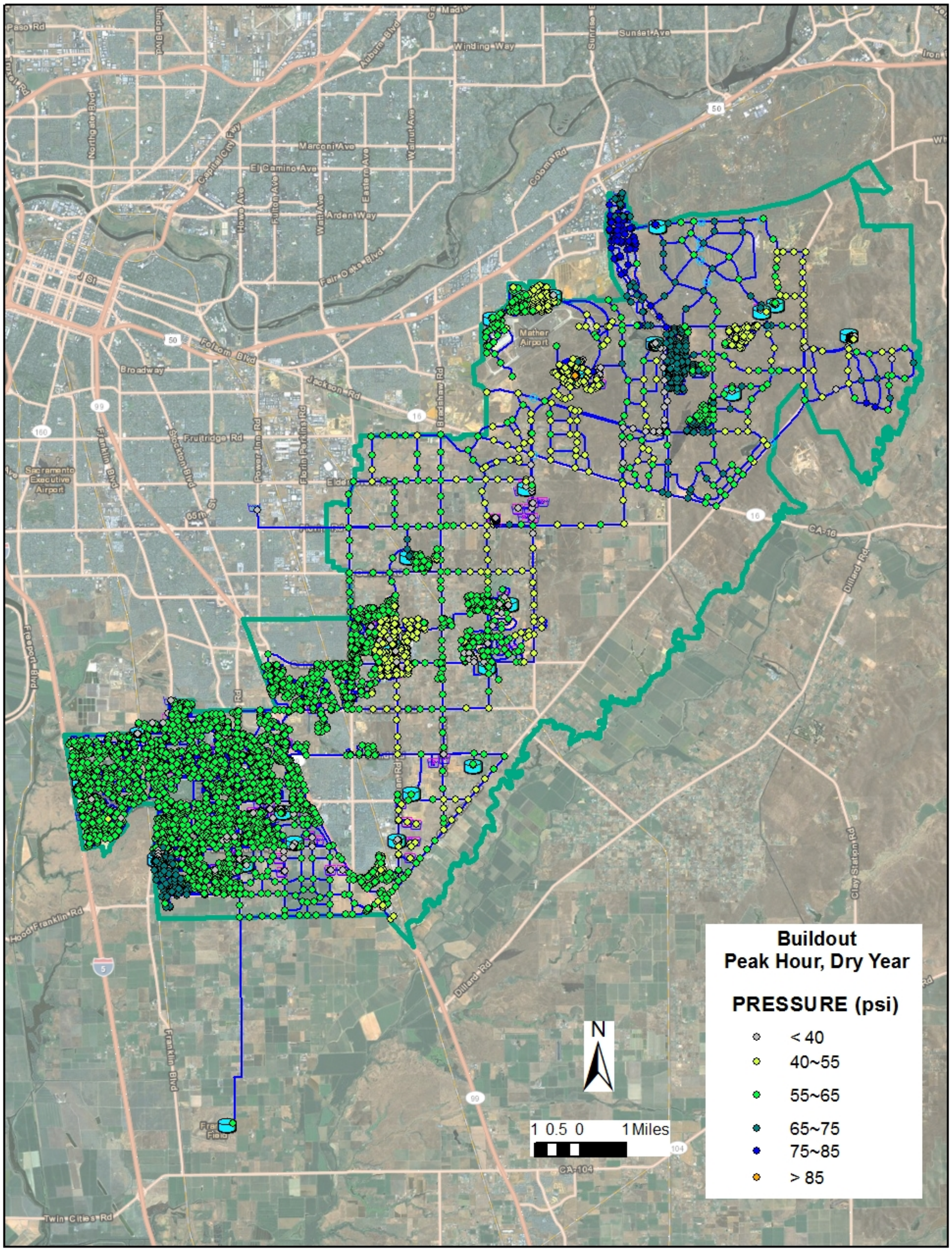


Figure H-40. System Pressures for Buildout, Peak Hour, Dry Year Scenario

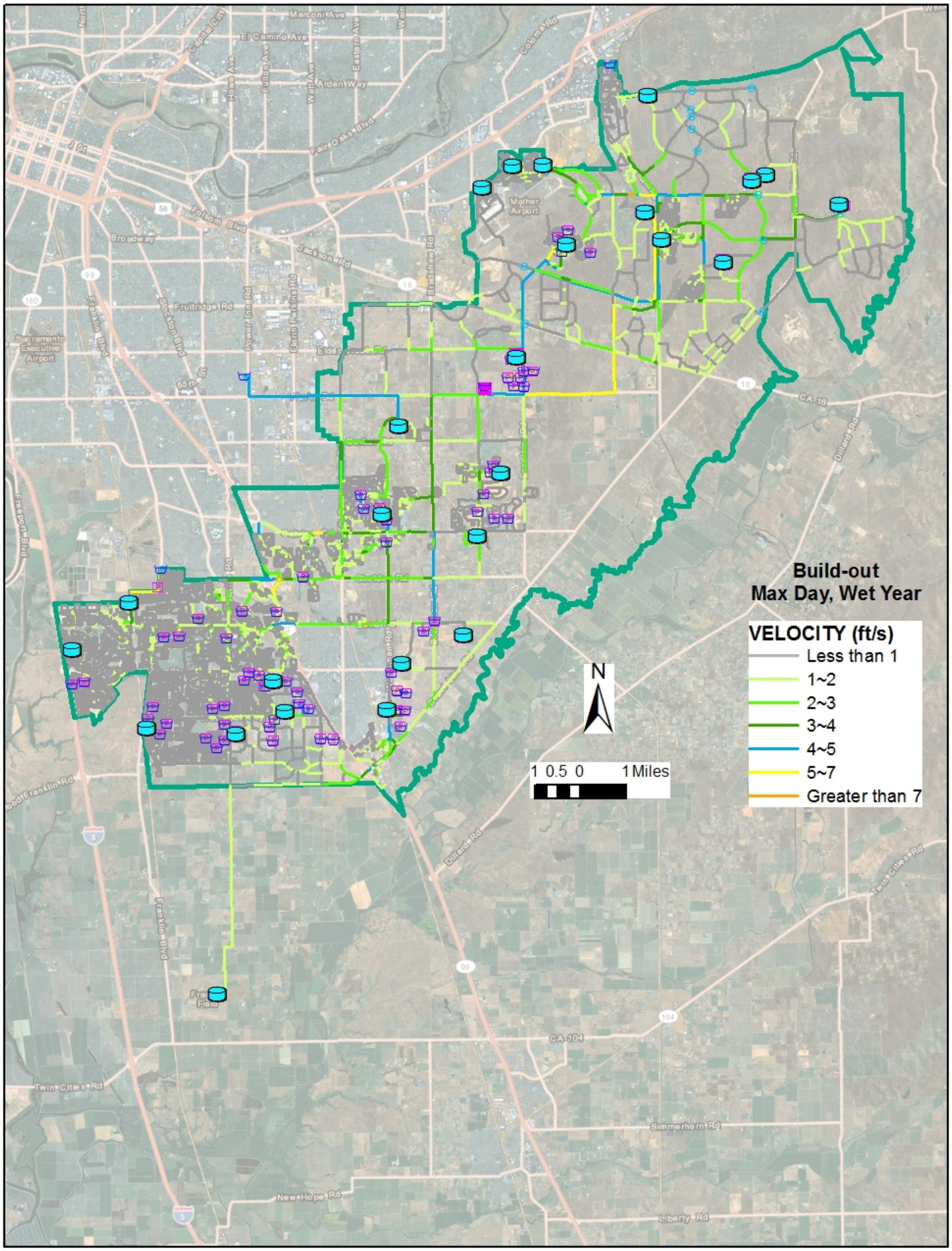


Figure H-41. Pipe Velocities for Buildout, Max Day, Wet Year Scenario

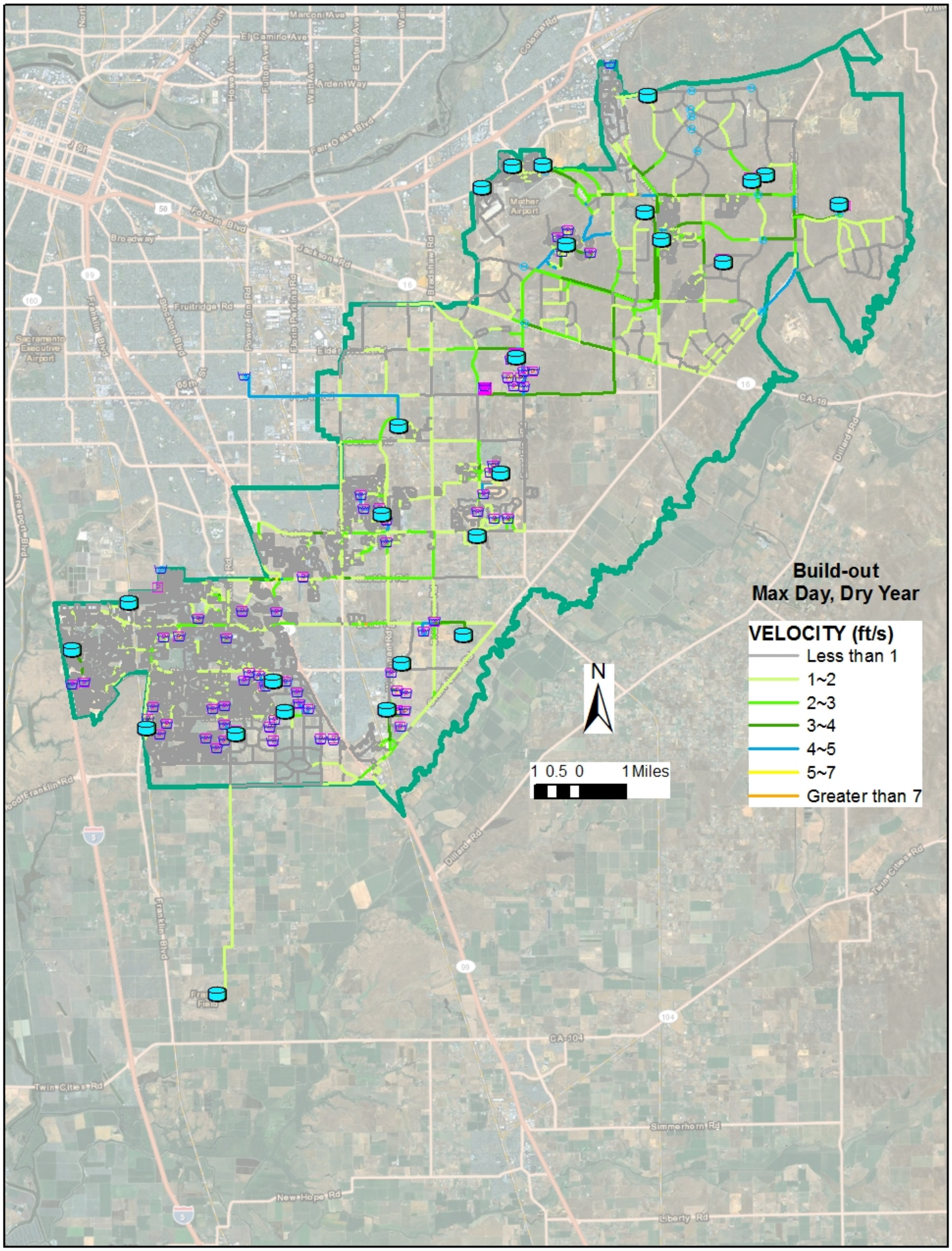


Figure H-42. Pipe Velocities for Buildout, Max Day, Dry Year Scenario

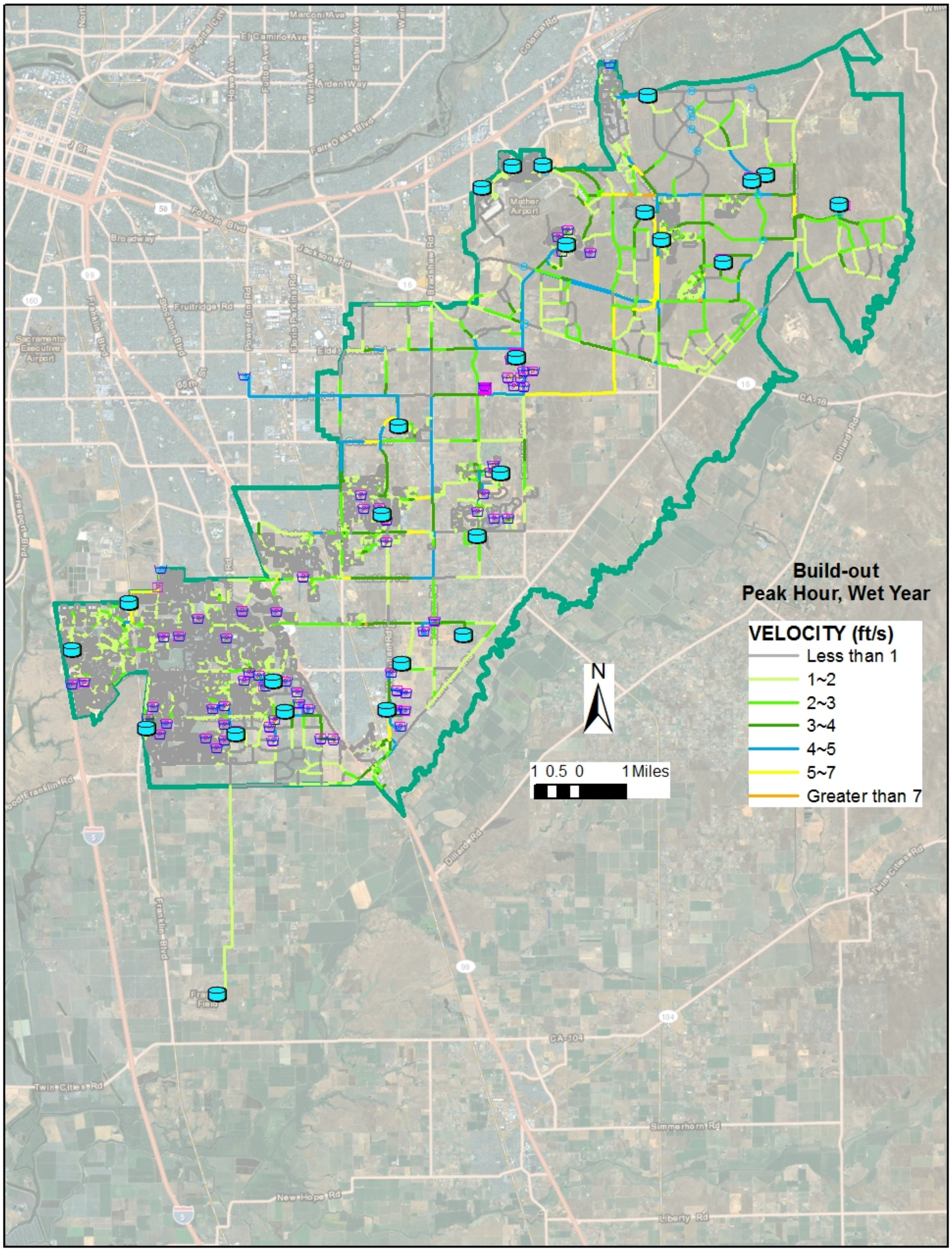


Figure H-43. Pipe Velocities for Buildout, Peak Hour, Wet Year Scenario

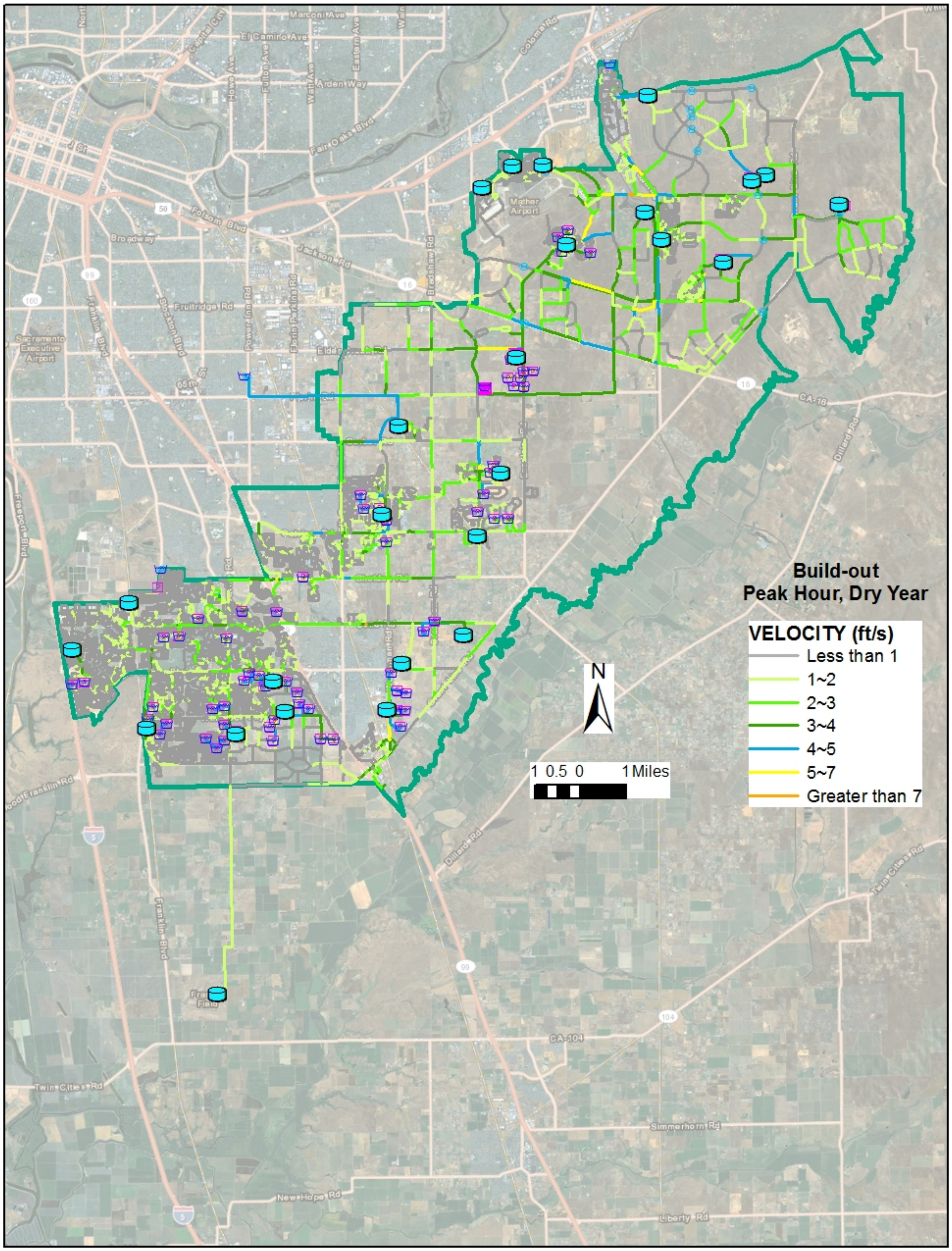


Figure H-44. Pipe Velocities for Buildout, Peak Hour, Dry Year Scenario

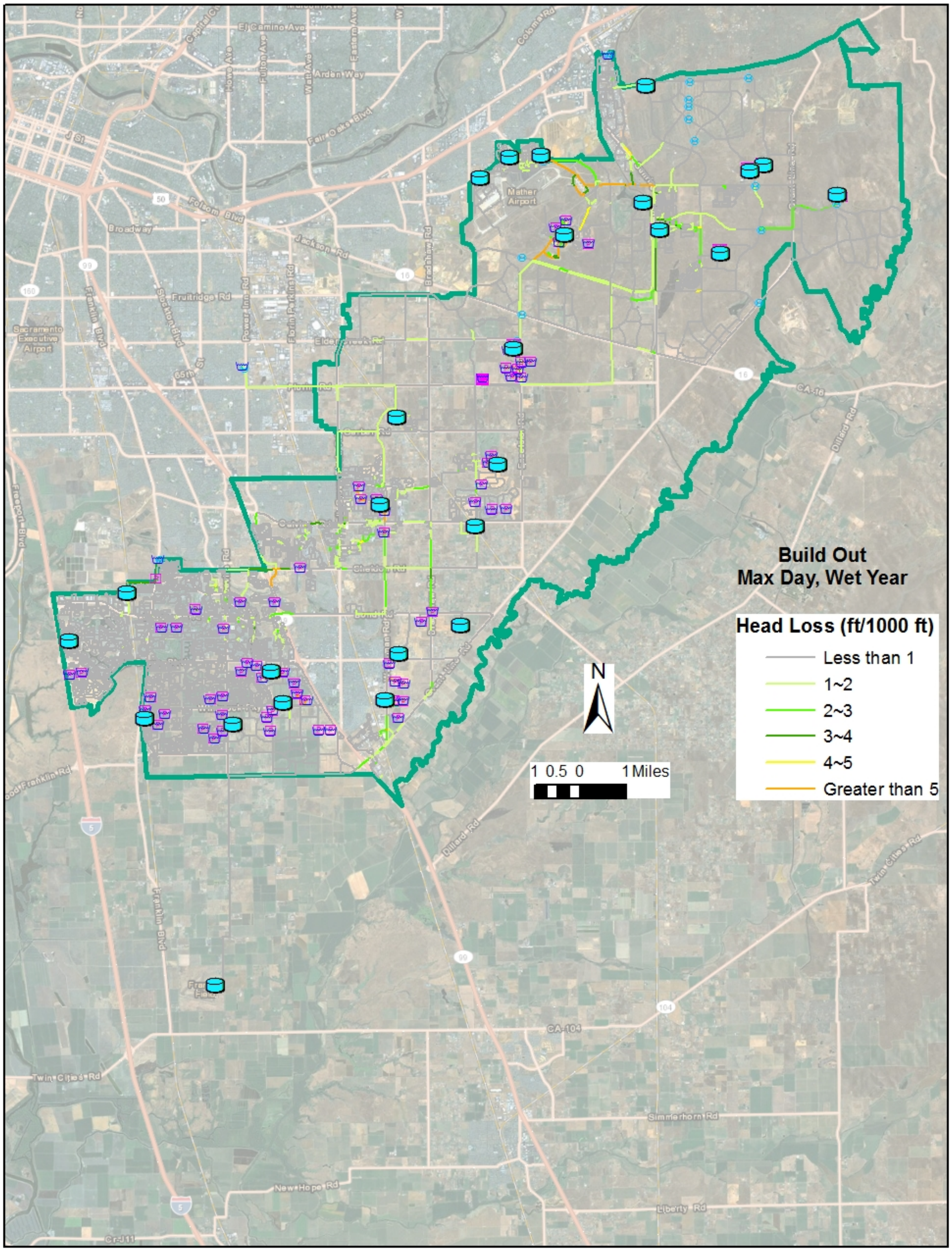


Figure H-45. Head Losses for Buildout, Max Day, Wet Year Scenario

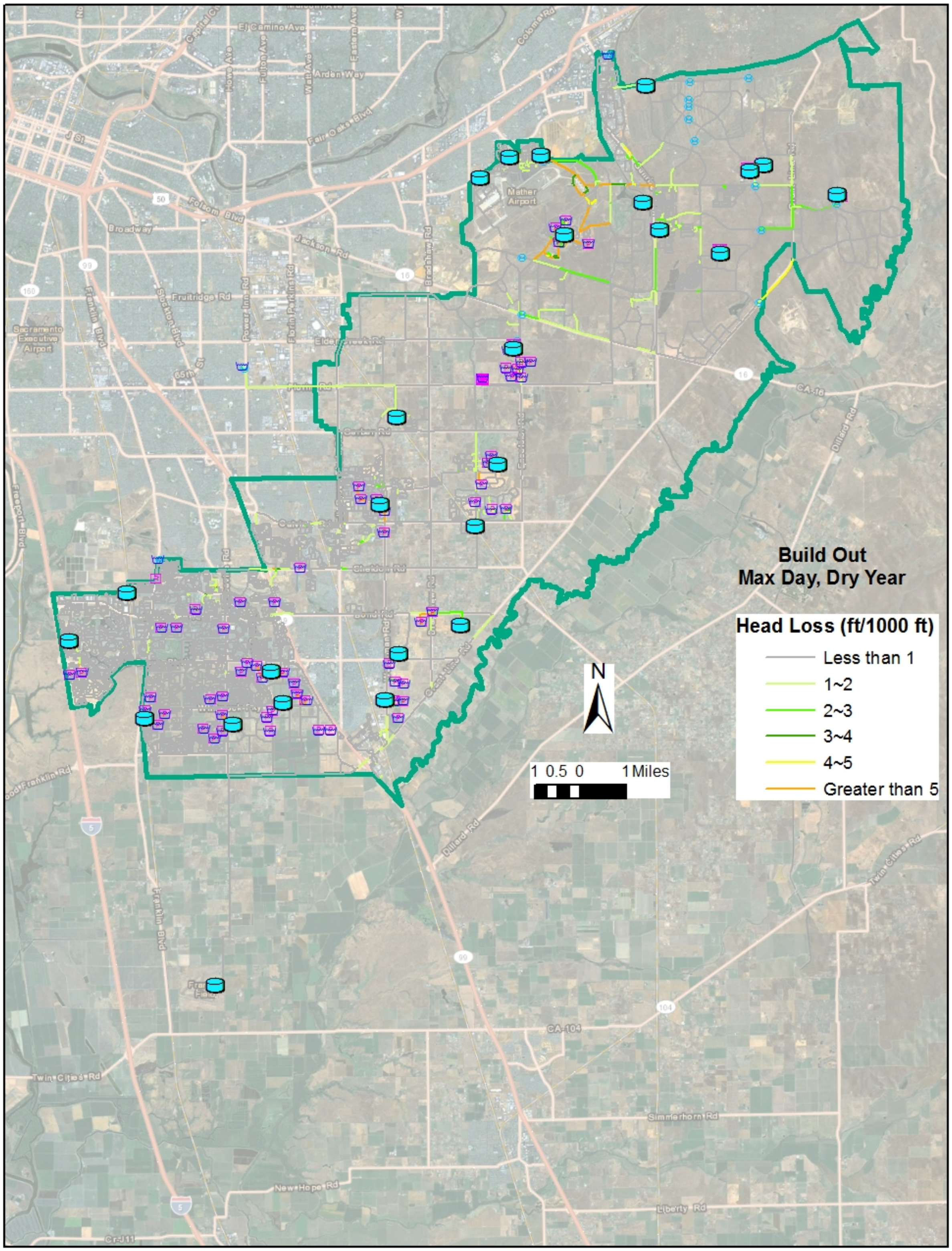


Figure H-46. Head Losses for Buildout, Max Day, Dry Year Scenario

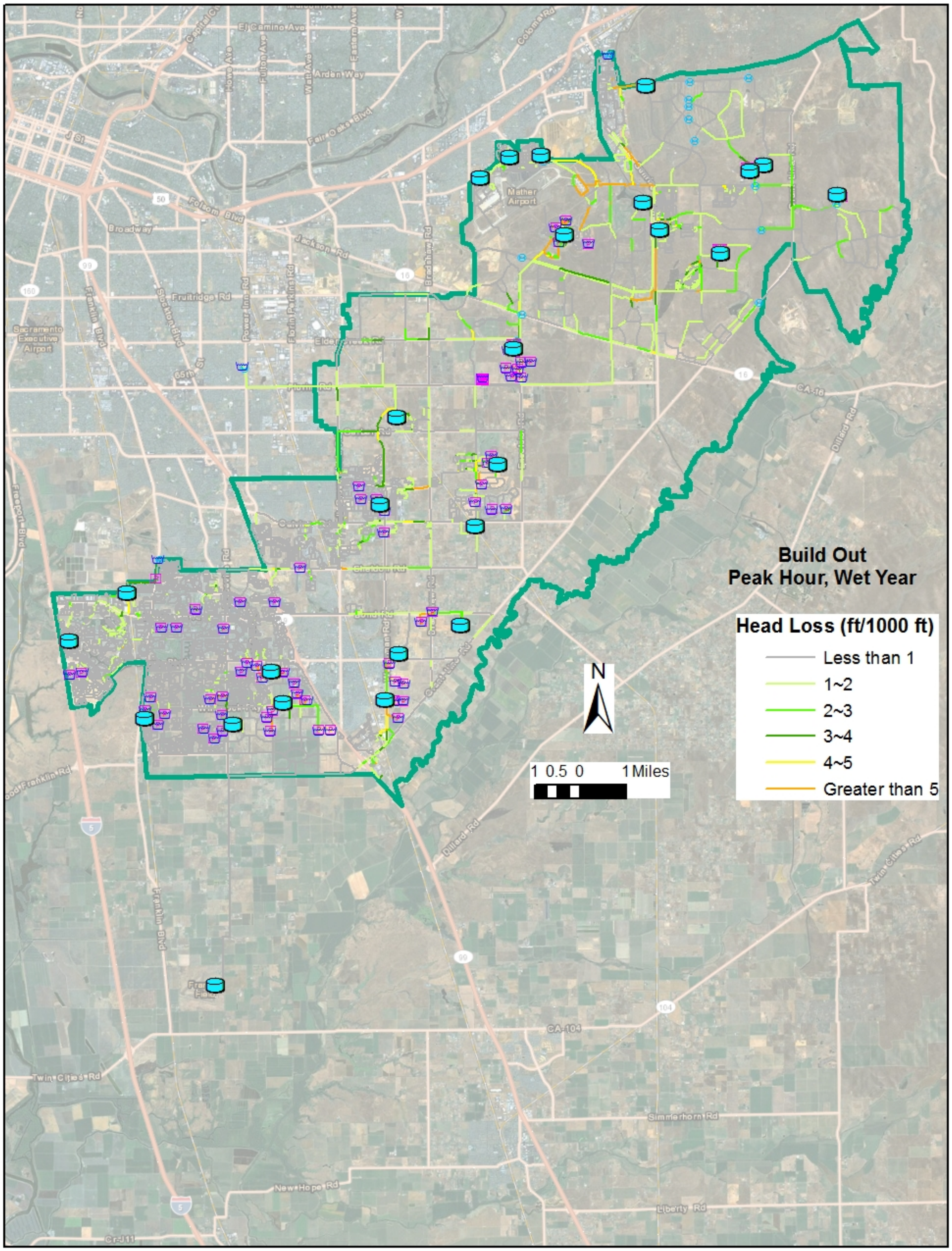


Figure H-47. Head Losses for Buildout, Peak Hour, Wet Year Scenario

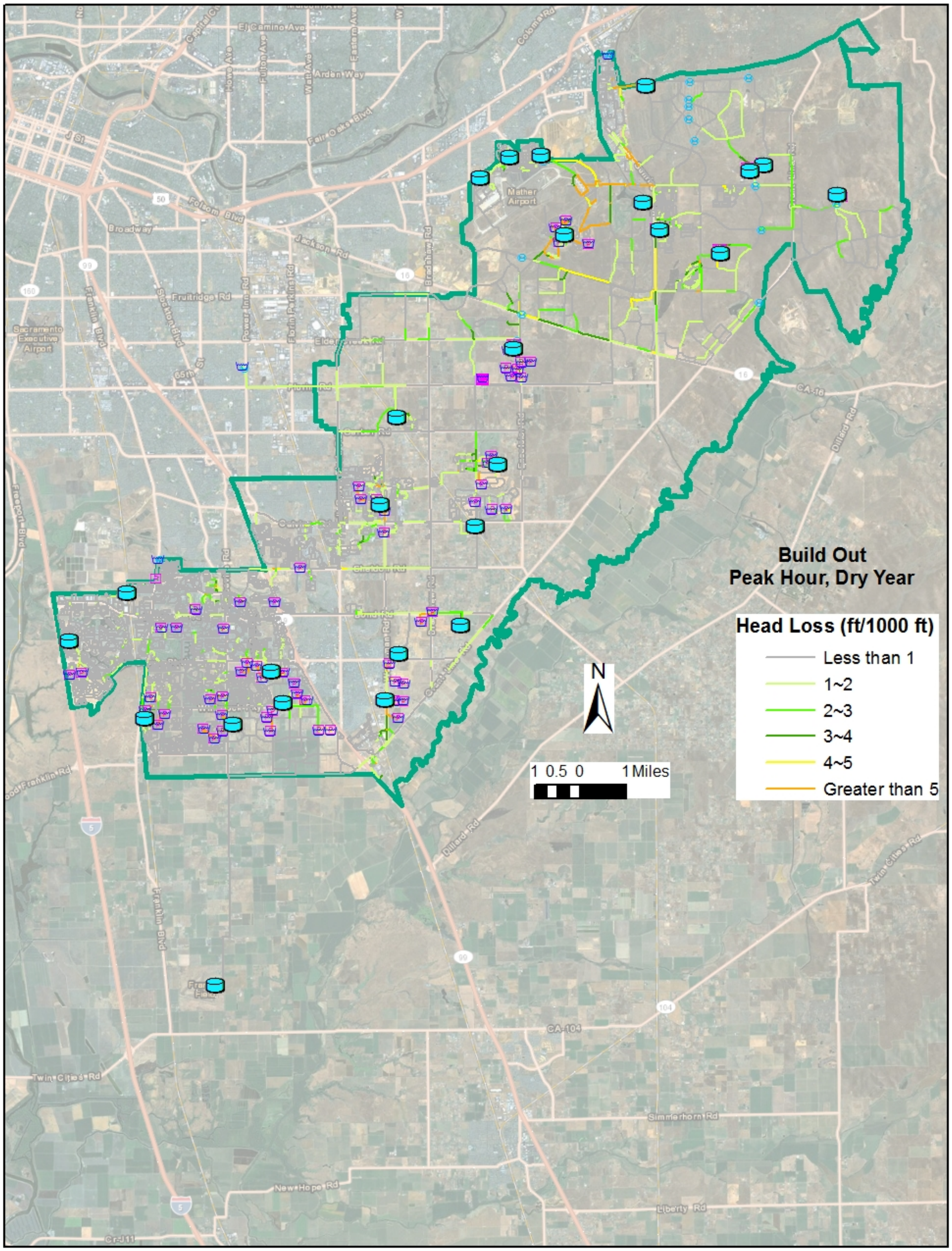


Figure H-48. Head Losses for Buildout, Peak Hour, Dry Year Scenario

Pump Station and Pump Specifications Used in the Model

ID	1		
Pump Station	Pump Station at Lakeside WTP	Service Area	SSA
Number of Pump Set #1	2	Number of Pump Set #2	
Design Flow (gpm)	2500	Design Flow (gpm)	
Design Head (feet)	110	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description: backup pump is not listed

Pump Station and Pump Specifications Used in the Model

ID	2		
Pump Station	Pump Station at Dwight Road Storage Tank	Service Area	SSA
Number of Pump Set #1	6	Number of Pump Set #2	
Design Flow (gpm)	3000	Design Flow (gpm)	
Design Head (feet)	155	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description

1. Pump water from the storage tank filled with surface water through Frankline intertie. 2. backup pump is not listed

Pump Station and Pump Specifications Used in the Model

ID	3		
Pump Station	Pump Station at Franklin WTP	Service Area	SSA
Number of Pump Set #1		Number of Pump Set #2	5
Design Flow (gpm)		Design Flow (gpm)	130
Design Head (feet)		Design Head (feet)	2500
Existing Pumps?	☐	Buildout Pumps?	☑

Description: backup pump is not listed

Pump Station and Pump Specifications Used in the Model

ID	4		
Pump Station	Pump Station at Poppy Ridge WTP	Service Area	SSA
Number of Pump Set #1	3	Number of Pump Set #2	3
Design Flow (gpm)	2400	Design Flow (gpm)	110
Design Head (feet)	110	Design Head (feet)	2400
Existing Pumps?	☑	Buildout Pumps?	☑

Description: backup pump is not listed

Pump Station and Pump Specifications Used in the Model

ID	5		
Pump Station	Pump Station at Big Horn WTP	Service Area	SSA
Number of Pump Set #1	3	Number of Pump Set #2	3
Design Flow (gpm)	2000	Design Flow (gpm)	120
Design Head (feet)	120	Design Head (feet)	2000
Existing Pumps?	☑	Buildout Pumps?	☑

Description: backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	6		
Pump Station	Pump Station at East Elk Grove WTP	Service Area	CSA
Number of Pump Set #1	3	Number of Pump Set #2	3
Design Flow (gpm)	3000	Design Flow (gpm)	107
Design Head (feet)	107	Design Head (feet)	3000
Existing Pumps?	☑	Buildout Pumps?	☑

Description: backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	7		
Pump Station	Pump Station at East Park WTP	Service Area	CSA
Number of Pump Set #1	1	Number of Pump Set #2	
Design Flow (gpm)	2400	Design Flow (gpm)	
Design Head (feet)	110	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description: backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	8		
Pump Station	Pump Station at Bond WTP	Service Area	CSA
Number of Pump Set #1		Number of Pump Set #2	3
Design Flow (gpm)		Design Flow (gpm)	145
Design Head (feet)		Design Head (feet)	2500
Existing Pumps?	☐	Buildout Pumps?	☑

Description: backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	9		
Pump Station	Pump Station at Calvine Meadows WTP	Service Area	CSA
Number of Pump Set #1	2	Number of Pump Set #2	2
Design Flow (gpm)	750	Design Flow (gpm)	120
Design Head (feet)	120	Design Head (feet)	2500
Existing Pumps?	☑	Buildout Pumps?	☑

Description: backkup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	10		
Pump Station	Pump Station at Wildhawk WTP	Service Area	CSA
Number of Pump Set #1	6	Number of Pump Set #2	
Design Flow (gpm)	2200	Design Flow (gpm)	
Design Head (feet)	162	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description: backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	11		
Pump Station	Pump Station at Waterman WTP	Service Area	CSA
Number of Pump Set #1	6	Number of Pump Set #2	
Design Flow (gpm)	3000	Design Flow (gpm)	
Design Head (feet)	150	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description: backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	12		
Pump Station	Pump Station at North Vineyard Station	Service Area	CSA
Number of Pump Set #1		Number of Pump Set #2	6
Design Flow (gpm)		Design Flow (gpm)	145
Design Head (feet)		Design Head (feet)	4500
Existing Pumps?	☐	Buildout Pumps?	☑

Description	backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	13		
Pump Station	Pump Station at West Jackson WTP	Service Area	CSA
Number of Pump Set #1		Number of Pump Set #2	6
Design Flow (gpm)		Design Flow (gpm)	165
Design Head (feet)		Design Head (feet)	4000
Existing Pumps?	☐	Buildout Pumps?	☑

Description

1. The pipe system is designed to allow the water pumped into the CSA distribution system, or pumped to fill the Anatolia storage tank through the converted Excelsior T-main; 2. backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	14		
Pump Station	Pump Station at Vineyard Surface WTP - CSA Pumps	Service Area	CSA
Number of Pump Set #1	5	Number of Pump Set #2	1
Design Flow (gpm)	10420	Design Flow (gpm)	175
Design Head (feet)	175	Design Head (feet)	5210
Existing Pumps?	☑	Buildout Pumps?	☐

Description: 1. The pump with a design flow of 5210 gpm is a jockey pump; 2. backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	15		
Pump Station	Pump Station at Vineyard Surface WTP -NSA	Service Area	NSA
Number of Pump Set #1		Number of Pump Set #2	6
Design Flow (gpm)		Design Flow (gpm)	200
Design Head (feet)		Design Head (feet)	9000
Existing Pumps?	☐	Buildout Pumps?	☑

Description

1. The pumps will convey water to fill the Anatolia Storage Tank when the 30-inch Excelsior raw water pipeline is converted to a treated water T-main, and to fill the NSA terminal tank; 2. backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	16		
Pump Station	Pump Station at NSA Terminal Tank - Serving Area West of FSC	Service Area	NSA
Number of Pump Set #1		Number of Pump Set #2	4
Design Flow (gpm)		Design Flow (gpm)	100
Design Head (feet)		Design Head (feet)	2600
Existing Pumps?	☐	Buildout Pumps?	☑

Description: 1. This set of pumps will serve the area west of Folsom South Canal; 2. backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	17		
Pump Station	Pump Station at NSA Terminal Tank - Serving Area East of FSC	Service Area	NSA
Number of Pump Set #1		Number of Pump Set #2	6
Design Flow (gpm)		Design Flow (gpm)	155
Design Head (feet)		Design Head (feet)	5000
Existing Pumps?	☐	Buildout Pumps?	☑

Description: 1. This set of pumps will serve the area east of Folsom South Canal; 2. backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	18		
Pump Station	Pump Station at Anatolia Storage Tank	Service Area	NSA
Number of Pump Set #1	6	Number of Pump Set #2	
Design Flow (gpm)	2600	Design Flow (gpm)	
Design Head (feet)	162	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description

backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	19		
Pump Station	Pump Station at North Douglas Storage Tank	Service Area	NSA
Number of Pump Set #1	6	Number of Pump Set #2	
Design Flow (gpm)	2250	Design Flow (gpm)	
Design Head (feet)	120	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description: Serve upper pressure zone; backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	20		
Pump Station	Pump Station at Suncreek Storage Tank	Service Area	NSA
Number of Pump Set #1		Number of Pump Set #2	5
Design Flow (gpm)		Design Flow (gpm)	150
Design Head (feet)		Design Head (feet)	2500
Existing Pumps?	☐	Buildout Pumps?	☑

Description: provide peaking and fireflow for SunCreek, Arboretum, and the Ranch at Sunridge; backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	21		
Pump Station	Pump Station at Cordova Hills Storage Tank	Service Area	NSA
Number of Pump Set #1		Number of Pump Set #2	5
Design Flow (gpm)		Design Flow (gpm)	105
Design Head (feet)		Design Head (feet)	2100
Existing Pumps?	☐	Buildout Pumps?	☑

Description: Serve predominantly Cordova Hills and upper pressure zone along with North Douglas pump station; back up pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	22		
Pump Station	Pump Station at White Rock Road Storage Tank	Service Area	NSA
Number of Pump Set #1		Number of Pump Set #2	4
Design Flow (gpm)		Design Flow (gpm)	180
Design Head (feet)		Design Head (feet)	1500
Existing Pumps?	☐	Buildout Pumps?	☑

Description: provide peaking and fireflow for Rio del Oro; backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	23		
Pump Station	Pump Station at Mather Housing WTP	Service Area	
Number of Pump Set #1	3	Number of Pump Set #2	
Design Flow (gpm)	1200	Design Flow (gpm)	
Design Head (feet)	130	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description: backup pump is not listed.

Pump Station and Pump Specifications Used in the Model

ID	24		
Pump Station	Pump Station at Mather Base Storage Tank	Service Area	
Number of Pump Set #1	3	Number of Pump Set #2	
Design Flow (gpm)	1200	Design Flow (gpm)	
Design Head (feet)	192	Design Head (feet)	
Existing Pumps?	☑	Buildout Pumps?	☐

Description

backup pump is not listed.

Appendix I: Cumulative Supply and Demand Comparison Tables

Table I-1. Maximum Day Demand to Supply Comparison for NSA, mgd

NSA			Phase 1			Phase 2		Phase 3			
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Demand											
	Maximum day	7.4	9.5	13.1	18.1	23.5	31.3	39.9	49.0	58.6	62.4
Existing supply capacity											
	Mather Housing GWTP	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	Anatolia GWTP	6.5	6.5								
	total groundwater	12.5	12.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	Vineyard SWTP										
	Total	12.5	12.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Planned future supply capacity											
	surface water, Vineyard SWTP			16.0	32.5	32.5	32.5	32.5	32.5	65.0	65.0
Total supply capacity											
	groundwater	12.5	12.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	surface water	0.0	0.0	16.0	32.5	32.5	32.5	32.5	32.5	65.0	65.0
	Total	12.5	12.5	22.0	38.5	38.5	38.5	38.5	38.5	71.0	71.0
Use of supply: average/wet years											
	groundwater	7.4	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	surface water	0.0	0.0	13.1	18.1	23.5	31.3	39.9	49.0	58.6	62.4
	Total	7.4	9.5	13.1	18.1	23.5	31.3	39.9	49.0	58.6	62.4
Use of supply: dry years											
	groundwater	7.4	9.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	surface water	0.0	0.0	11.1	16.1	21.5	29.3	37.9	47.0	56.6	60.4
	Total	7.4	9.5	13.1	18.1	23.5	31.3	39.9	49.0	58.6	62.4

Table I-2. Maximum Day Demand to Supply Comparison for CSA, mgd

CSA			Phase 1			Phase 2		Phase 3			
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Demand											
	Maximum day	27.0	29.2	32.9	37.9	43.0	50.2	57.9	65.7	73.8	74.0
Existing supply capacity											
	Calvine Meadows GWTP	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	East Elk Grove GWTP	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	East Park GWTP	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
	Waterman GWTP	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
	Wildhawk GWTP	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
	CSA DirectFeed	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
	total groundwater	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4
	Vineyard SWTP	50.0	50.0	34.0	17.5	17.5	17.5	17.5	17.5	17.5	17.5
	Total	84.4	84.4	68.4	51.9	51.9	51.9	51.9	51.9	51.9	51.9
Planned future supply capacity											
	West Jackson GWTP					9.0	18.0	18.0	18.0	18.0	18.0
	Bond GWTP									6.5	6.5
	East Elk Grove GWTP expansion									6.5	6.5
	total groundwater					9.0	18.0	18.0	18.0	31.0	31.0
	Vineyard SWTP expansion									17.5	17.5
	City POU supply										19.1
	total surface water									17.5	36.6
Total supply capacity											
	groundwater	34.4	34.4	34.4	34.4	43.4	52.4	52.4	52.4	65.4	65.4
	surface water	50.0	50.0	34.0	17.5	17.5	17.5	17.5	17.5	35.0	54.1
	Total	84.4	84.4	68.4	51.9	60.9	69.9	69.9	69.9	100.4	119.5
Use of supply: average/wet years											
	groundwater	0.0	0.0	0.0	20.4	25.5	32.7	40.4	48.2	38.8	19.9
	surface water	27.0	29.2	32.9	17.5	17.5	17.5	17.5	17.5	35.0	54.1
	Total	27.0	29.2	32.9	37.9	43.0	50.2	57.9	65.7	73.8	74.0
Use of supply: dry years											
	groundwater	27.0	29.2	32.9	34.4	43.0	50.2	57.9	65.7	65.4	65.4
	surface water	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	8.4	8.6
	Total	27.0	29.2	32.9	37.9	43.0	50.2	57.9	65.7	73.8	74.0

Table I-3. Maximum Day Demand to Supply Comparison for SSA, mgd

SSA			Phase 1			Phase 2		Phase 3		
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Demand											
	Maximum day	27.1	30.5	35.2	40.3	45.7	46.6	46.6	46.6	46.6	46.6
Existing supply capacity											
	Big Horn GWTP	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
	Dwight Road GWTP	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Lakeside GWTP	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	Poppy Ridge GWTP	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	SSA Direct Feed	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	total groundwater	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
	Franklin Intertie to City	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
	SSA Recycled Water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	Total	65.3	65.3	65.3	65.3	65.3	65.3	65.3	65.3	65.3	65.3
Planned future supply capacity											
	Poppy Ridge GWTP expansion				6.5	6.5	6.5	6.5	6.5	6.5	6.5
	Big Horn GWTP expansion						8.5	8.5	8.5	8.5	8.5
	Franklin GWTP									7.0	7.0
	Whitelock GWTP										13.0
	total groundwater			0.0	6.5	6.5	15.0	15.0	15.0	22.0	35.0
	recycled water									2.9	2.9
Total supply capacity											
	groundwater	25.6	25.6	25.6	32.1	32.1	40.6	40.6	40.6	47.6	60.6
	surface water	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
	recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	39.7	39.7	39.7	46.2	46.2	54.7	54.7	54.7	64.6	64.6
Use of supply: average/wet years											
	groundwater	13.0	16.4	21.1	26.2	31.6	32.5	32.5	32.5	29.7	29.7
	surface water	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
	recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	27.1	30.5	35.2	40.3	45.7	46.6	46.6	46.6	46.6	46.6
Use of supply: dry years											
	groundwater	24.1	25.6	25.6	32.1	32.1	40.6	40.6	40.6	40.8	40.8
	surface water	0.0	1.9	6.6	5.2	10.6	3.0	3.0	3.0	0.0	0.0
	recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	27.1	30.5	35.2	40.3	45.7	46.6	46.6	46.6	46.6	46.6

Table I-4. Maximum Day Demand to Supply Comparison for Zone 40, mgd

Zone 40				Phase 1		Phase 2			Phase 3		
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Maximum day demand											
	Zone 40 total	61.5	69.2	81.2	96.3	112.2	128.1	144.4	161.4	179.0	183.0
Existing supply capacity											
	groundwater	72.5	72.5	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
	surface water	61.1	61.1	45.1	28.6	28.6	28.6	28.6	28.6	28.6	28.6
	recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	Total	136.6	136.6	114.1	97.6	97.6	97.6	97.6	97.6	97.6	97.6
Planned future supply capacity											
	groundwater	0.0	0.0	0.0	6.5	15.5	33.0	33.0	33.0	53.0	66.0
	surface water	0.0	0.0	16.0	32.5	32.5	32.5	32.5	32.5	82.5	101.6
	recycled water									2.9	2.9
Total supply capacity											
	groundwater	72.5	72.5	66.0	72.5	81.5	99.0	99.0	99.0	119.0	132.0
	surface water	61.1	61.1	61.1	61.1	61.1	61.1	61.1	61.1	111.1	130.2
	recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	136.6	136.6	130.1	136.6	145.6	163.1	163.1	163.1	236.0	268.1
Use of supply: average/wet years											
	groundwater	20.4	25.8	21.1	46.6	57.1	65.2	72.9	80.7	68.4	49.5
	surface water	38.1	40.3	57.1	46.7	52.1	59.9	68.5	77.6	104.7	127.6
	recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	61.5	69.2	81.2	96.3	112.2	128.1	144.4	161.4	179.0	183.0
Use of supply: dry years											
	groundwater	58.5	64.3	60.5	68.5	77.1	92.8	100.5	108.3	108.2	108.2
	surface water	0.0	1.9	17.7	24.8	32.1	32.3	40.9	50.0	65.0	69.0
	recycled water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.9	5.9
	Total	61.5	69.2	81.2	96.3	112.2	128.1	144.4	161.4	179.0	183.0

Table I-5. Conjunctive Use Metrics

			Phase 1			Phase 2			Phase 3		
Parameter		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Provided Capacity											
	surface water, % of demand	99.3%	88.3%	75.2%	63.4%	54.5%	47.7%			62.1%	71.2%
	groundwater, % of demand	117.8%	104.8%	81.3%	75.3%	72.7%	77.3%			66.5%	72.1%
	Total	217.2%	193.1%	156.5%	138.7%	127.1%	125.0%			128.6%	143.3%
Use in wet/average years											
	surface water, % of demand	62.0%	58.3%	70.3%	48.5%	46.4%	46.8%			58.5%	69.7%
	groundwater, % of demand	33.1%	37.3%	26.0%	48.4%	50.9%	50.9%			38.2%	27.1%
	surface water, % of surface water capacity	62.4%	66.0%	93.5%	76.4%	85.2%	98.0%			94.3%	98.0%
	groundwater, % of groundwater capacity	28.1%	35.6%	32.0%	64.3%	70.1%	65.9%			57.5%	37.5%
Use in dry years											
	surface water, % of demand	0.0%	2.7%	21.8%	25.8%	28.6%	25.2%			36.3%	37.7%
	groundwater, % of demand	95.1%	93.0%	74.5%	71.1%	68.7%	72.4%			60.4%	59.1%
	surface water, % of wet/average year use	0.0%	4.6%	31.0%	53.1%	61.6%	53.9%			62.0%	54.0%
	groundwater, % of groundwater capacity	80.7%	88.7%	91.7%	94.5%	94.6%	93.7%			90.9%	81.9%

Table I-6. Annual Capacity and Use - NSA

NSA				Phase 1		Phase 2			Phase 3		
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Demand											
	Annual, ac-ft/yr	4,200	5,300	7,300	10,100	13,100	17,500	22,400	27,500	32,800	35,000
Supply capacity, ac-ft/yr											
	groundwater	7,000	7,000	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400
	surface water	-	-	9,000	18,200	18,200	18,200	18,200	18,200	36,400	36,400
	Total	7,000	7,000	12,300	21,600	21,600	21,600	21,600	21,600	39,800	39,800
Use of supply: average/wet years											
	groundwater	4,100	5,300	-	-	-	-	-	-	-	-
	surface water	-	-	7,300	10,100	13,100	17,500	22,300	27,400	32,800	34,900
	Total	4,100	5,300	7,300	10,100	13,100	17,500	22,300	27,400	32,800	34,900
Use of supply: dry years											
	groundwater	4,100	5,300	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
	surface water	-	-	6,200	9,000	12,000	16,400	21,200	26,300	31,700	33,800
	Total	4,100	5,300	7,300	10,100	13,100	17,500	22,300	27,400	32,800	34,900

Table I-7. Annual Capacity and Use - CSA											
CSA			Phase 1			Phase 2		Phase 3			
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Demand											
	Annual, ac-ft/yr	15,100	16,400	18,400	21,200	24,100	28,100	32,400	36,800	41,300	41,400
Supply capacity, ac-ft/yr											
	groundwater	19,300	19,300	19,300	19,300	24,300	29,300	29,300	29,300	36,600	36,600
	surface water	28,000	28,000	19,000	9,800	9,800	9,800	9,800	9,800	19,600	30,300
	Total	47,300	47,300	38,300	29,100	34,100	39,100	39,100	39,100	56,200	66,900
Use of supply: average/wet years											
	groundwater	-	-	-	11,400	14,300	18,300	22,600	27,000	21,700	11,100
	surface water	15,100	16,400	18,400	9,800	9,800	9,800	9,800	9,800	19,600	30,300
	Total	15,100	16,400	18,400	21,200	24,100	28,100	32,400	36,800	41,300	41,400
Use of supply: dry years											
	groundwater	15,100	16,400	18,400	19,300	24,100	28,100	32,400	36,800	36,600	36,600
	surface water	-	-	-	2,000	-	-	-	-	4,700	4,800
	Total	15,100	16,400	18,400	21,200	24,100	28,100	32,400	36,800	41,300	41,400

Table I-8. Annual Capacity and Use - SSA											
SSA			Phase 1			Phase 2		Phase 3			
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Demand											
	Annual, ac-ft/yr	15,200	17,100	19,700	22,600	25,600	26,100	26,100	26,100	26,100	26,100
Supply capacity, ac-ft/yr											
	groundwater	14,300	14,300	14,300	18,000	18,000	22,700	22,700	22,700	26,700	33,900
	surface water	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200
	recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Total	22,200	22,200	22,200	25,900	25,900	30,600	30,600	30,600	36,200	43,400
Use of supply: average/wet years											
	groundwater	7,300	9,200	11,800	14,700	17,700	18,200	18,200	18,200	16,600	16,600
	surface water	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200
	recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Total	15,200	17,100	19,700	22,600	25,600	26,100	26,100	26,100	26,100	26,100
Use of supply: dry years											
	groundwater	13,500	14,300	14,300	18,000	18,000	22,700	22,700	22,700	22,800	22,800
	surface water	-	1,000	3,700	2,900	6,000	1,700	1,700	1,700	-	-
	recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Total	15,200	17,100	19,700	22,600	25,600	26,100	26,100	26,100	26,100	26,100

Table I-9. Annual Capacity and Use - Total											
Total Zone 40			Phase 1			Phase 2		Phase 3			
		2013	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Demand											
	Annual, ac-ft/yr	34,500	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
Supply capacity, ac-ft/yr											
	groundwater	40,600	40,600	37,000	40,600	45,600	55,400	55,400	55,400	66,600	73,900
	surface water	34,200	34,200	34,200	34,200	34,200	34,200	34,200	34,200	62,200	72,900
	recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Total	76,500	76,500	72,900	76,500	81,600	91,400	91,400	91,400	132,200	150,100
Use of supply: average/wet years											
	groundwater	11,400	14,500	11,800	26,100	32,000	36,500	40,800	45,200	38,300	27,700
	surface water	21,400	22,600	32,000	26,200	29,200	33,500	38,400	43,500	58,600	71,500
	recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Total	34,500	38,700	45,500	53,900	62,800	71,700	80,900	90,400	100,200	102,500
Use of supply: dry years											
	groundwater	32,800	36,000	33,900	38,400	43,200	52,000	56,300	60,700	60,600	60,600
	surface water	-	1,000	9,900	13,900	18,000	18,100	22,900	28,000	36,400	38,600
	recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
	Total	34,500	38,700	45,500	53,900	62,800	71,700	80,900	90,400	100,200	102,500

Table I-10. Supply and Demand Comparison-Normal Year, ac-ft/yr

	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Supplies, no facility constraints									
US Bureau of Reclamation-CVP supply	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
Appropriative water	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000
City of Sacramento American River POU water rights	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300
Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
Groundwater	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
Supply total	185,500	185,500	185,500	185,500	185,500	185,500	185,500	187,100	187,100
Demand	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
Difference	146,800	140,000	131,600	122,700	113,700	104,600	95,100	86,800	84,600

Table I-11. Use of Supply-Normal Year, ac-ft/yr

	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Use of supplies									
Surface water	22,600	32,000	26,200	29,200	33,500	38,400	43,500	58,600	71,500
Remediated groundwater									
Groundwater	14,500	11,800	26,100	32,000	36,500	40,800	45,200	38,300	27,700
Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
Total	38,800	45,500	54,000	62,900	71,700	80,900	90,400	100,200	102,500
Surface water use breakdown									
US Bureau of Reclamation-CVP supply	22,600	32,000	26,200	29,200	33,500	38,400	43,500	45,000	45,000
Appropriative water	-	-	-	-	-	-	-	13,600	26,500
City of Sacramento American River POU water rights									
Other surface water supplies									
Surface water plus remediated groundwater	22,600	32,000	26,200	29,200	33,500	38,400	43,500	58,600	71,500

Table I-12. Supply and Demand Comparison-Single Dry Year, ac-ft/yr

	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Supplies, no facility constraints									
US Bureau of Reclamation-CVP supply allocation	11,300	16,000	13,100	14,600	16,800	19,200	21,800	22,500	22,500
Appropriative water									
City of Sacramento American River POU water rights									
Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
Groundwater	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
Supply total	101,500	106,200	103,300	104,800	107,000	109,400	112,000	114,300	114,300
Demand	38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
Difference	62,800	60,700	49,400	42,000	35,200	28,500	21,600	14,000	11,800

Table I-13. Use of Supply-Single Dry Year, ac-ft/yr

	2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
Use of supplies									
Surface water	1,000	1,000	5,000	9,100	9,200	14,000	19,100	27,500	29,700
Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
Groundwater	27,100	33,900	38,400	43,200	52,000	56,300	60,700	60,600	60,600
Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
Total	38,700	45,500	54,000	62,900	71,800	80,900	90,400	100,300	102,500
Surface water use breakdown									
US Bureau of Reclamation-CVP supply	1,000	1,000	5,000	9,100	9,200	14,000	19,100	22,500	22,500
Appropriative water									
City of Sacramento American River POU water rights									
Other surface water supplies	-	-	-	-	-	-	-	5,000	7,200
Surface water plus remediated groundwater	1,000	9,900	13,900	18,000	18,100	22,900	28,000	36,400	38,600

Table I-14. Supply and Demand Comparison-Multiple Dry Years

Year			2015	2020	2025	2030	2035	2040	2045	2050	Buildout (2052)
First year	Supplies										
Table I-3. Maximum		US Bureau of Reclamation-CVP supply	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
		Appropriative water	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000	71,000
		City of Sacramento American River POU water rights	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300	9,300
		Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
		Groundwater	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
		Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
		Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
		Supply totals	185,500	185,500	185,500	185,500	185,500	185,500	185,500	187,100	187,100
	Demand		38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
	Difference		146,800	140,000	131,600	122,700	113,700	104,600	95,100	86,800	84,600
Second year	Supplies										
		US Bureau of Reclamation-CVP supply	17,000	24,000	19,700	21,900	25,100	28,800	32,600	33,800	33,800
		Appropriative water	-	-	-	-	-	-	-	-	-
		City of Sacramento American River POU water rights	-	-	-	-	-	-	-	-	-
		Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
		Groundwater	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
		Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
		Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
		Supply totals	107,200	114,200	109,900	112,100	115,300	119,000	122,800	125,600	125,600
	Demand		38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
	Difference		68,500	68,700	56,000	49,300	43,500	38,100	32,400	25,300	23,100
Third year	Supplies										
		US Bureau of Reclamation-CVP supply	11,300	16,000	13,100	14,600	16,800	19,200	21,800	22,500	22,500
		Appropriative water	-	-	-	-	-	-	-	-	-
		City of Sacramento American River POU water rights	-	-	-	-	-	-	-	-	-
		Other surface water supplies	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
		Groundwater	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
		Remediated groundwater	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900	8,900
		Recycled water	1,700	1,700	1,700	1,700	1,700	1,700	1,700	3,300	3,300
		Supply totals	101,500	106,200	103,300	104,800	107,000	109,400	112,000	114,300	114,300
	Demand		38,700	45,500	53,900	62,800	71,800	80,900	90,400	100,300	102,500
	Difference		62,800	60,700	49,400	42,000	35,200	28,500	21,600	14,000	11,800

Table I-15. NSA Upper Zone Storage Capacity Evaluation					
	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2052)	Notes
Maximum day demand, mgd	0.0	2.5	5.0	7.9	Cordova Hills (4,451 ac-ft/yr)
Peak hour demand, mgd	0.0	5.0	10.0	15.8	
Provided storage volume, MG					
Existing					
North Douglas	3.0	3.0	3.0	3.0	
Future					
Cordova Hills				3.0	
Total	3.0	3.0	3.0	6.0	
Required storage volume, MG					
Equalization	0.0	0.5	1.0	1.6	Assume 20% MDD.
Fire	0.5	0.5	0.5	0.5	Assume volume for one fire at 3,000 gpm for 3 hours.
Emergency	0.0	0.4	0.8	1.3	Assume 1/3 average day.
Total	0.5	1.4	2.3	3.4	
Difference (provided minus required)	2.5	1.6	0.7	2.6	Could downsize Cordova Hills tank.

Table I-16. NSA Upper Zone Pump Station Capacity Evaluation					
	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2052)	Notes
Provided pumping capacity, mgd					
Existing					
North Douglas	19.4	19.4	19.4	19.4	Very large capacity for such a small demand.
Upper zone max day supply	0.0	2.5	5.0	7.9	
from storage	19.4	16.9	14.4	11.5	
Future					
Cordova Hills				21.6	
Total from storage	19.4	16.9	14.4	33.1	
Required peak hour capacity from storage, mgd	0.0	2.5	5.0	7.9	Capacity increment above maximum day demand capacity.
Required fire flow from storage, mgd	4.3	4.3	4.3	4.3	4.3 mgd for one fire, max day supply accounted for above.
Required capacity from storage	4.3	4.3	5.0	7.9	Greater of pk hr or fire.
Difference (provided minus required)	15.1	12.6	9.4	25.2	Substantial surplus capacity.
Summary					
Total provided pump station capacity, mgd	38.8	36.3	33.8	52.5	
Total required pump station capcity					
from storage, mgd	4.3	4.3	5.0	7.9	
for max day supply capacity, mgd	0.0	2.5	5.0	7.9	
Total	4.3	6.8	10.0	15.8	

Table I-17. NSA Main Zone Storage Capacity Evaluation					
	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2052)	Notes
Maximum day demand, mgd	7.4	14.1	24.4	48.6	NSA 62.4 mgd minus Cordova Hills (7.9 mgd) and half of Rio del Oro (5.9 mgd).
Peak hour demand, mgd	14.8	28.2	48.8	97.2	
Provided storage volume, MG					
Existing					
Mather Housing GWTP	0.5	0.5	0.5	0.5	
Anatolia GWTP	4.0	4.0	4.0	4.0	
Mather 1 Main Base	1.0	1.0	1.0	1.0	
Mather 2	0.3	0.3	0.3	0.3	
subtotal	5.8	5.8	5.8	5.8	
Future					
Phase B NSA Project		10.0	10.0	10.0	
White Rock				3.0	
Suncreek				3.0	
subtotal	0.0	10.0	10.0	16.0	
Total	5.8	15.8	15.8	21.8	
Required storage volume, MG					
Equalization	1.5	2.8	4.9	9.7	Assume 20% MDD.
Fire	1.1	1.1	1.1	1.1	Assume volume for two fires at 3,000 gpm for 3 hours.
Emergency	1.2	2.4	4.1	8.1	Assume 1/3 average day.
Total	3.8	6.3	10.0	18.9	Could phase in the Phase B NSA Project storage.
Difference (provided minus required)	2.0	9.5	5.8	2.9	

Table I-18. NSA Main Zone Pump Station Capacity Evaluation					
	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2052)	Notes
Provided pumping capacity, mgd					
Existing					
Mather Housing GWTP	5.2	5.2	5.2	5.2	
GWTP	3.0	3.0	3.0	3.0	Assume half of GWTP supplies pump station.
from storage	2.2	2.2	2.2	2.2	
Anatolia GWTP/Storage (a)	11.2	22.5	22.5	22.5	
GWTP/part of MD supply from Vineyard SWTP	6.5	4.7	8.1	16.2	Assume 2/3 of main zone MD demand through NSA terminal and 1/3 through Anatolia tanks.
from storage	4.7	17.8	14.4	6.3	
Mather 1 Main Base	5.2	5.2	5.2	5.2	
Mather 2	2.0	2.0	2.0	2.0	Elevated tank, assumed flow.
subtotal from storage	14.1	27.2	23.8	15.7	
Future					
White Rock				14.4	
Suncreek				18.0	
Phase B NSA-total capacity (b)		64.0	64.0	64.0	Total pump station capacity.
max day supply for Cal Am Rio del Oro		1.0	3.0	5.9	Max day supply for Cal Am tank. Not from storage.
max day supply for upper zone		2.5	5.0	7.9	Supply to North Douglas and Cordova Hills tanks. Not from storage.
part of max day supply from Vineyard SWTP for main zone		9.4	16.3	32.4	Assume 2/3 through NSA terminal and 1/3 through Anatolia tanks.
subtotal, pumping not from Phase B NSA storage		12.9	24.3	46.2	
subtotal, capacity available to pump from Phase B NSA Project storage		51.1	39.7	17.8	
subtotal from storage		51.1	39.7	50.2	
Total from storage	14.1	78.3	63.5	65.9	
Required peak hour capacity from storage, mgd	7.4	14.1	24.4	48.6	
Difference (provided minus required)	6.7	64.2	39.1	17.3	Could phase in the NSA terminal storage pump station capacity.
Summary					
Total provided pump station capacity, mgd	23.6	98.9	98.9	131.3	
Total required pump station capacity					
from storage, mgd	7.4	14.1	24.4	48.6	
for max day supply capacity, mgd	9.5	20.6	35.4	65.4	
Total	16.9	34.7	59.8	114.0	

(a) When Phase A NSA is completed, Anatolia will pump through supply from Vineyard SWTP.

(b) Calculation of Phase B NSA pump station capacity available to supply from storage the main zone's pk hr increment.

Table I-19. CSA Storage Capacity Evaluation					
	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2051)	Notes
Maximum day demand, mgd	27.0	37.9	50.2	61.5	
Peak hour demand, mgd	54.0	75.8	100.4	123.0	
Provided storage volume, MG					
Existing					
Calvine Meadows GWTP	0.35	0.35	0.35	0.35	
East Elk Grove GWTP	3.5	3.5	3.5	3.5	
East Park GWTP	0.5	0.5	0.5	0.5	
Waterman GWTP	7.0	7.0	7.0	7.0	
Wildhawk GWTP	3.0	3.0	3.0	3.0	
Vineyard SWTP clearwell	6.0	6.0	6.0	6.0	Assumed equalization storage available from 20 mgd clear well.
subtotal	20.4	20.4	20.4	20.4	
Future					
West Jackson GWTP			4.0	4.0	
East Elk Grove GWTP expansion				0.0	
Bond GWTP				0.5	
North Vineyard Station				4.0	
Calvine Meadows GWTP expansion				0.0	
subtotal			4.0	8.5	
Total	20.4	20.4	24.4	28.9	Planned storage volume.
Required storage volume, MG					
Equalization	5.4	7.6	10.0	12.3	Assume 20% MDD.
Fire	1.1	1.1	1.1	1.1	Assume volume for two fires at 3,000 gpm for 3 hours.
Emergency	4.5	6.3	8.4	10.3	Assume 1/3 average day.
Total	11.0	15.0	19.5	23.7	
Difference (provided minus required)	9.4	5.4	4.8	5.2	

Table I-20. CSA Pump Station Capacity Evaluation					
	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2051)	Notes
Provided pumping capacity, mgd					
Existing					
Calvine Meadows GWTP, total	8.8	8.8	8.8	8.8	
GWTP	5.0	5.0	5.0	5.0	
from storage	3.8	3.8	3.8	3.8	
East Elk Grove GWTP, total	13.0	13.0	13.0	13.0	
GWTP	6.5	6.5	6.5	6.5	
from storage	6.5	6.5	6.5	6.5	
East Park GWTP, total	3.5	3.5	3.5	3.5	
GWTP	2.9	2.9	2.9	2.9	
from storage	0.6	0.6	0.6	0.6	
Waterman GWTP, total	25.9	25.9	25.9	25.9	
GWTP	8.6	8.6	8.6	8.6	
from storage	17.3	17.3	17.3	17.3	
Wildhawk GWTP, total	19.0	19.0	19.0	19.0	
GWTP	7.5	7.5	7.5	7.5	
from storage	11.5	11.5	11.5	11.5	
Vineyard SWTP pump station	13.0	13.0	13.0	13.0	Assume capacity provided from clear well.
subtotal from storage	52.7	52.7	52.7	52.7	
Future					
West Jackson GWTP			21.6	21.6	
GWTP			18.0	18.0	
from storage			3.6	3.6	
East Elk Grove GWTP expansion, total				13.0	
GWTP				6.5	
from storage				6.5	
Bond GWTP, total				10.8	
GWTP				6.5	
from storage				4.3	
North Vineyard Station, total				21.6	Pumps through City POU supply.
City POU supply				19.1	
from storage				2.5	
Calvine Meadows GWTP expansion				7.2	Pump all from storage.
Vineyard SWTP pump station expansion				10.0	Assume future capacity from clear well.
subtotal from storage			3.6	34.1	
Total from storage	52.7	52.7	56.3	86.8	
Required peak hour capacity from storage, mgd	27.0	37.9	50.2	61.5	
Difference (provided minus required) (a)	25.7	14.8	6.1	25.3	Pumping capacity could be reduced in Phase 3.
Summary					
Total provided pump station capacity, mgd	83.2	83.2	104.8	167.4	
Total required pump station capacity					
from storage, mgd	27.0	37.9	50.2	61.5	
for max day supply capacity, mgd	30.5	30.5	48.5	61.5	
Total	57.5	68.4	98.7	123.0	
(a) Peak hour pumping surplus used to supply the SSA.					

Table I-21. SSA Storage Capacity Evaluation

	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2051)	Notes
Maximum day demand, mgd	27.1	40.3	46.6	46.6	
Peak hour demand, mgd	54.2	80.6	93.2	93.2	
Provided storage volume, MG					
Existing					
Big Horn GWTP	2.0	2.0	2.0	2.0	
Dwight Road GWTP	7.0	7.0	7.0	7.0	
Lakeside GWTP	0.5	0.5	0.5	0.5	
Poppy Ridge GWTP	3.5	3.5	3.5	3.5	
subtotal	13.0	13.0	13.0	13.0	
Future					
Poppy Ridge GWTP expansion		3.5	3.5	3.5	
Big Horn GWTP expansion					
Franklin GWTP				2.0	
Whitelock GWTP				3.0	
subtotal	0.0	3.5	3.5	8.5	
Total	13.0	16.5	16.5	21.5	Planned storage volume.
Required storage volume, MG					
Equalization	5.4	8.1	9.3	9.3	Assume 20% MDD.
Fire	1.1	1.1	1.1	1.1	Assume volume for two fires at 3,000 gpm for 3 hours.
Emergency	4.5	6.7	7.8	7.8	Assume 1/3 average day.
Total	11.0	15.9	18.2	18.2	
Difference (provided minus required)	2.0	0.6	-1.7	3.3	Phase 2 deficit supplied by CSA storage surplus.

Table I-22. SSA Pump Station Capacity Evaluation

	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2050)	Notes
Provided pumping capacity, mgd					
Existing					
Big Horn GWTP, total	8.6	8.6	8.6	8.6	
GWTP	4.5	4.5	4.5	4.5	
from storage	4.1	4.1	4.1	4.1	
Dwight Road GWTP, total	25.9	25.9	25.9	25.9	
GWTP and Franklin Intertie	13.2	13.2	13.2	13.2	
from storage	12.7	12.7	12.7	12.7	
Lakeside GWTP, total	7.2	7.2	7.2	7.2	
GWTP	6.5	6.5	6.5	6.5	
from storage	0.7	0.7	0.7	0.7	
Poppy Ridge GWTP, total	10.4	10.4	10.4	10.4	
GWTP	6.5	6.5	6.5	6.5	
from storage	3.9	3.9	3.9	3.9	
subtotal from storage	21.4	21.4	21.4	21.4	
Future					
Poppy Ridge GWTP expansion, total		17.0	17.0	17.0	
GWTP		6.5	6.5	6.5	
from storage		10.5	10.5	10.5	
Big Horn GWTP expansion, total			17.0	17.0	
GWTP			8.5	8.5	
from storage			8.5	8.5	
Franklin GWTP, total				21.6	
GWTP				7.0	
from storage				14.6	
Whitelock GWTP, total				14.4	
GWTP				13.0	
from storage				1.4	
subtotal from storage	0.0	10.5	19.0	35.0	
Total from storage	21.4	31.9	40.4	56.4	
Required peak hour capacity from storage, mgd	27.1	40.3	46.6	46.6	
Difference (provided minus required) (a)	-5.7	-8.4	-6.2	9.8	Phase 1 and 2 deficit supplied by CSA.
Summary					
Total provided pump station capacity, mgd	52.1	69.1	86.1	122.1	
Total required pump station capacity					
from storage, mgd	27.1	40.3	46.6	46.6	
for max day supply capacity, mgd	30.7	37.2	45.7	65.7	
Total	57.8	77.5	92.3	112.3	

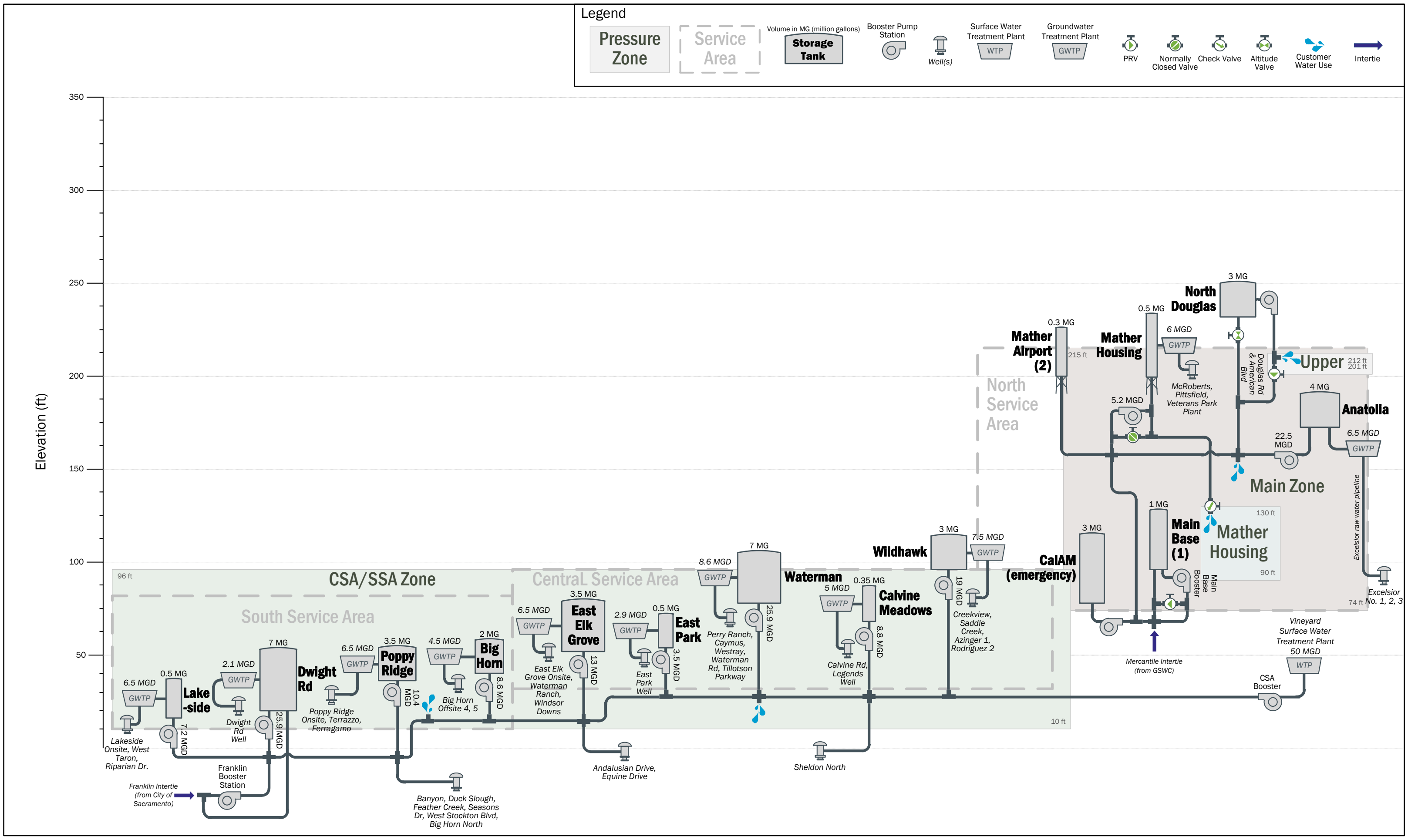
(a) Peak hour pumping deficit to be supplied by surplus in CSA.

Table I-23. Zone 40 Storage Capacity Evaluation Summary

	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2051)
Provided storage volume, MG				
Existing	42.2	42.2	42.2	42.2
Future	0.0	13.5	17.5	36.0
Total	42.2	55.7	59.7	78.2
Required storage volume, MG				
Equalization	12.3	19.0	25.2	32.9
Fire	3.8	3.8	3.8	3.8
Emergency	10.3	15.8	21.0	27.4
Total	26.4	38.6	50.1	64.2
Difference (provided minus required)	15.8	17.1	9.6	14.0

Table I-24. Zone 40 Pump Station Capacity Evaluation Summary

	2013	Phase 1 (2015-2025)	Phase 2 (2026-2035)	Phase 3 (2036-2050)
Provided pump station capacity from storage, mgd				
Existing	107.6	118.2	112.3	101.3
Future	0.0	20.5	32.6	88.1
Total	107.6	138.7	144.9	189.4
Required pump station capacity from storage, mgd	65.8	96.6	126.2	164.6
Difference (provided minus required)	41.8	42.1	18.7	24.8



Sacramento County Water Zone 40

Figure 2-4. Existing System Hydraulic Schematic

Brown AND Caldwell

10540 White Rock Road, Suite 180
Rancho Cordova, CA 95670
T | 916.444.0123