Section 1

Introduction

This document represents the Water System Master Plan (WSMP) for Sacramento Suburban Water District (District). This section presents the WSMP objectives and approach, guidelines on the use of this document, a note regarding McClellan Business Park, as well as the report organization.

1.1 WSMP Objectives

The overall objective of this WSMP is to provide a roadmap of needed capital improvements to meet water demands for the District customers. The key objectives are as follows:

1. Update the water demand and supply analysis that was prepared for the 2009 WSMP.
2. Present the District's ultimate infrastructure vision and focus on what is critical to implement that vision.
3. Define a capital improvement program (CIP) to gain efficiencies in operations and maintenance (O&M) and sustainably maintain the water system.
4. Identify the reinvestment priority for the future and provide information to shape policy decisions related to infrastructure and supply.
5. Provide an implementable CIP.

1.2 Approach

The approach for developing the WSMP consists of first defining the District's water needs and the groundwater and surface water supplies. The current water supplies are defined in terms of the amounts available in wet, average, and dry climate years. This is followed by identifying and discussing conjunctive use strategies and water supply alternatives that both meet the District's current and expected needs and alternatives to possibly export water from the District. The new infrastructure and rehabilitation and replacement (R/R) activities are analyzed and prioritized in an overall 15-year prioritized project list. Figure 1-1 depicts a flowchart of the analysis approach.

1.3 Use of this Document

It is intended that District staff will use this WSMP to plan and budget for future facilities projects and capital improvements. In addition, this WSMP includes a water resources management component that provides analysis and information for the District to make informed decisions related to maximizing existing system capacity and exploring options to enhance reliable water supplies and conjunctive use operations for the benefit of the District rate payers.

It is intended that the District's Board use of this WSMP is to help make informed policy decisions. This WSMP is in alignment with the District's Strategic Plan. On the first page of Sections 2 through 12 of this WSMP the Strategic Plan component(s) relevant to the section content are identified as well as the potential policy implication(s) of each section.

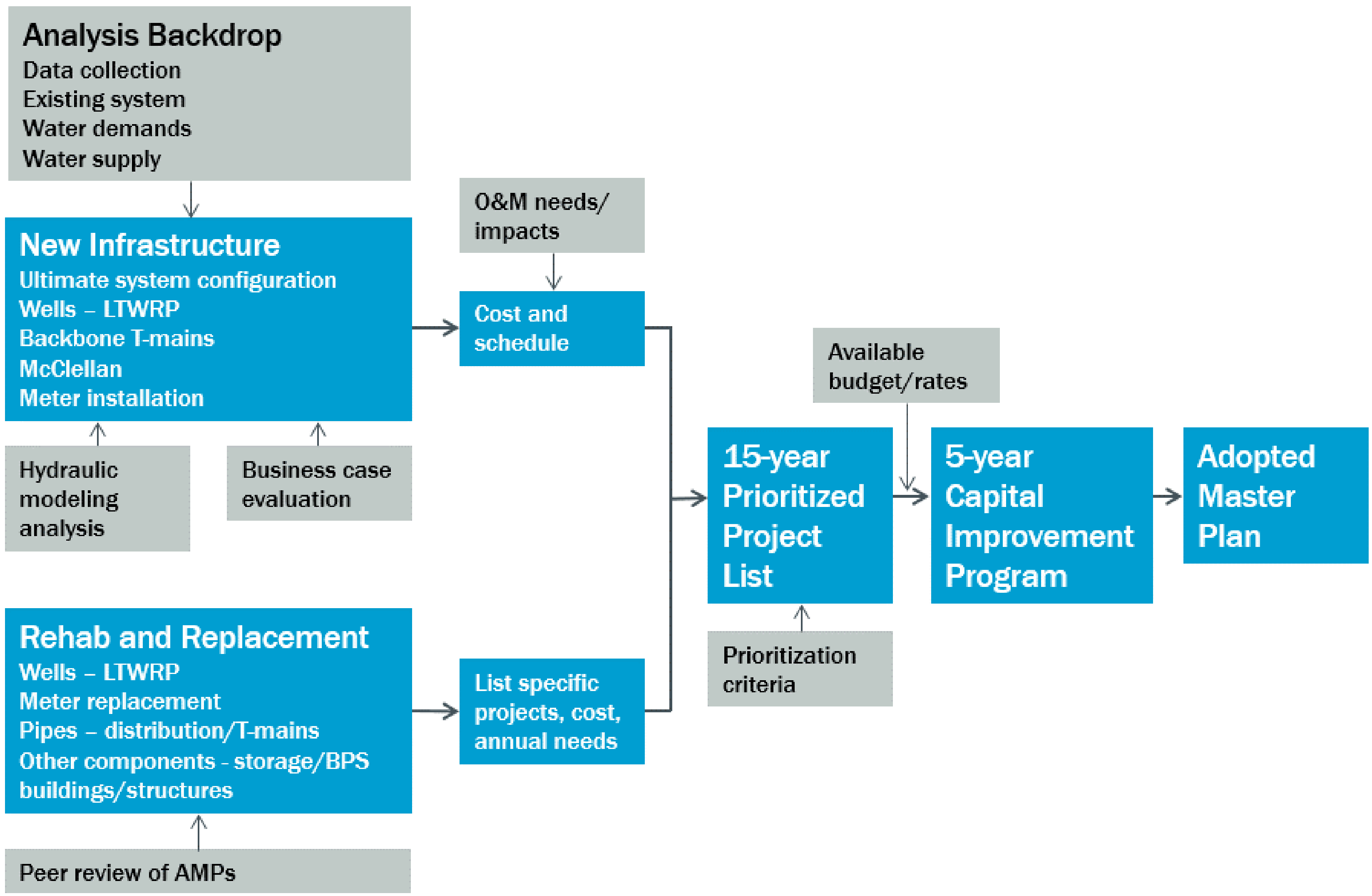

Figure 1-1. Water System Master Plan Approach

1.4 McClellan Business Park

The projected water demand for the McClellan Business Park Service area (MBPSA), of the District's water system is based on the current Sacramento County planning land use designations for this area. Currently the land use is zoned as industrial and commercial. Water system improvements presented in this WSMP for the McClellan Business Park are preliminary and would be refined based on future, more specific development plans.

1.5 Report Organization

The WSMP consists of 13 report sections and related appendices. The report sections are listed and summarized below.

- Section 1. Introduction – Explanation of WSMP objectives, approach, and report organization.
- Section 2. Description of Existing Water System – A summary of the District's service areas and existing facilities.
- Section 3. Water Requirements – An analysis of the District's projected water demands.
- Section 4. Water Supplies – A description of existing supplies, supply alternatives, and conjunctive use strategies.
- Section 5. Asset Management – An overview of asset management components and a review of the District's current asset management plans.
- Section 6. Supply Facilities Analysis – Assumptions and analysis related to the District's water supply facilities including a Long Term Well Plan, wellfield business case evaluation, and well investment decision tool.
- Section 7. Transmission Facilities Analysis – Assumptions and analysis of recommended transmission main improvements.
- Section 8. Distribution Facilities Analysis – Assumptions and analysis of the rate of replacement of the District's distribution pipelines.
- Section 9. Storage Facilities Analysis – Assumptions and analysis of storage and booster pump facilities within the District.
- Section 10. Special Project Analysis – Assumptions and analysis of the District's SCADA, water meters, and buildings and structures improvements.
- Section 11. Hydraulic Modeling – A summary of the results of the hydraulic modeling of the existing system and the system under buildout conditions.
- Section 12. Capital Improvement Plan – A presentation of the recommended projects for the next 15 years, summary of assumptions for each of the recommended projects, as well as recommended next steps to implement this WSMP and prepare for future updates of this WSMP.
- Section 13. A list of references.

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Section 2

Description of Existing Water System

This chapter describes the District's existing water system. It contains a description of the service area and its climate and the water supply facilities, including the groundwater wells, surface water supply facilities, booster pumping stations, reservoirs, and piping system.

Strategic Plan Alignment

Facilities and Operations – 2.A. - Monitor and improve the system efficiencies in operating and maintaining system infrastructure.

- **Documents existing system facilities.**

Facilities and Operations – 2.G. - Maintain up-to-date emergency response plans in conjunction with other public service organizations.

- **Inventory of existing interties in place for emergency response.**

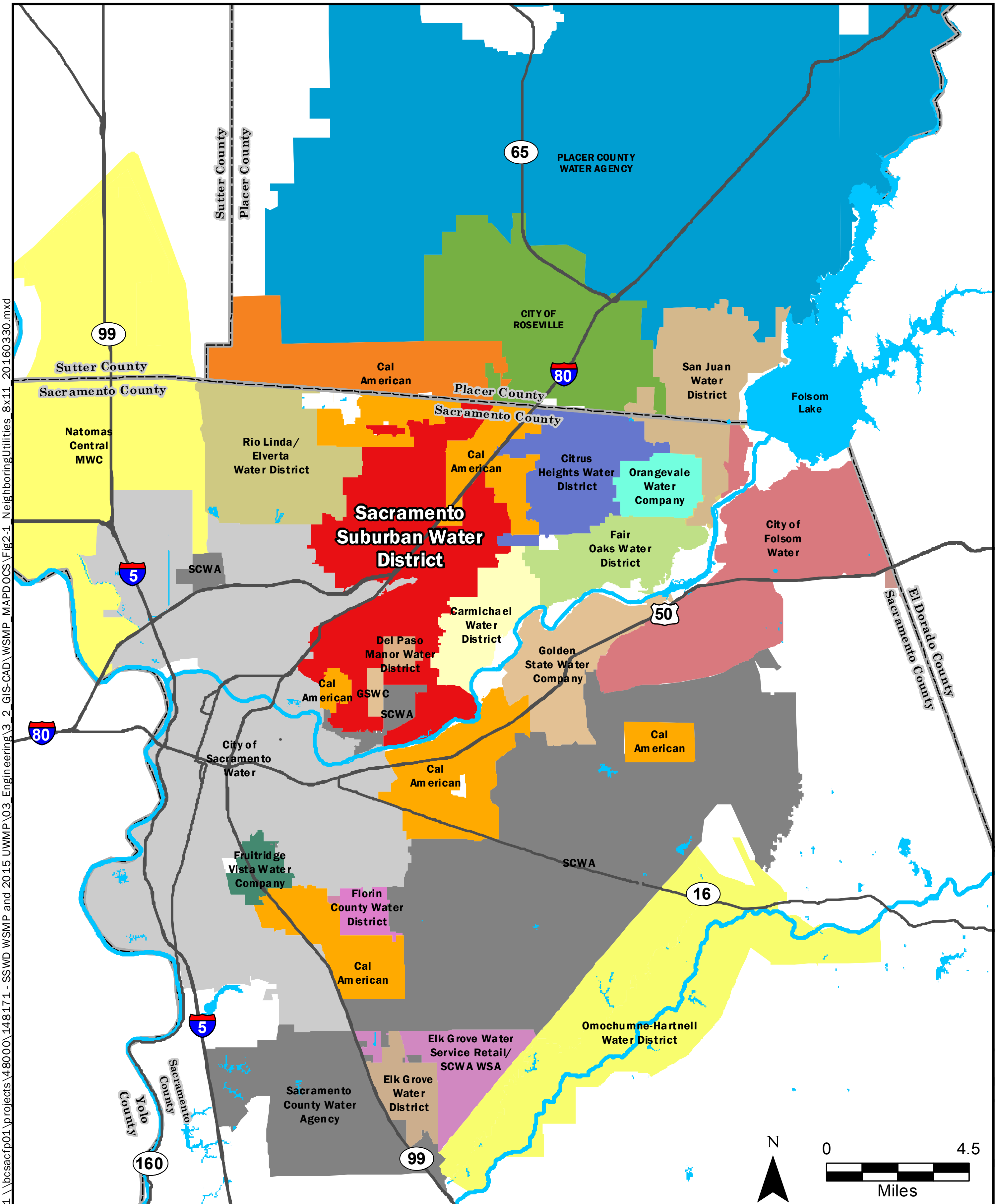
2.1 Description of Service Area

The District is located in Sacramento County, north of the American River and serves a large suburban area including portions of Citrus Heights, Carmichael, North Highlands, City of Sacramento (City), Foothill Farms, Arden Arcade, and Antelope, as well as. The District is a special district and is governed by a five-member Board of Directors. Within the District are four service areas: the North Service Area (NSA), the Arbors at Antelope Service Area (AASA), MBPSA, and the South Service Area (SSA). The term NSA is also used to describe a larger area consisting of the AASA, MBPSA, and the previously mentioned NSA. The SSA includes the Town and Country service area of the former Arcade Water District. Figure 2-1 illustrates the location of the District and the neighboring water agencies. The service areas within the District are shown on Figure 2-2.

For the analysis in this WSMP the District was further divided into subareas, as shown on Figure 2-2. The subareas are used to analyze the supply and demand for smaller areas within the District system that have limited water transmission capacity between areas due to geographical factors such as the railroad, highways, or hydraulic factors such as pressure zone separation. This is especially useful in the NSA where there is currently not a strong backbone water transmission system to move supplies from one area to meet demands in other areas.

2.2 Water Supply Facilities

Water supply for the District is currently derived from active groundwater wells and surface water from Placer County Water Agency (PCWA) via Folsom Reservoir and San Juan Water District's (SJWD) Peterson Water Treatment Plant (WTP) and from the American River via the City's Fairbairn WTP. This section describes the District's wells and surface water facilities. Figure 2-3 depicts the locations of the water system facilities.



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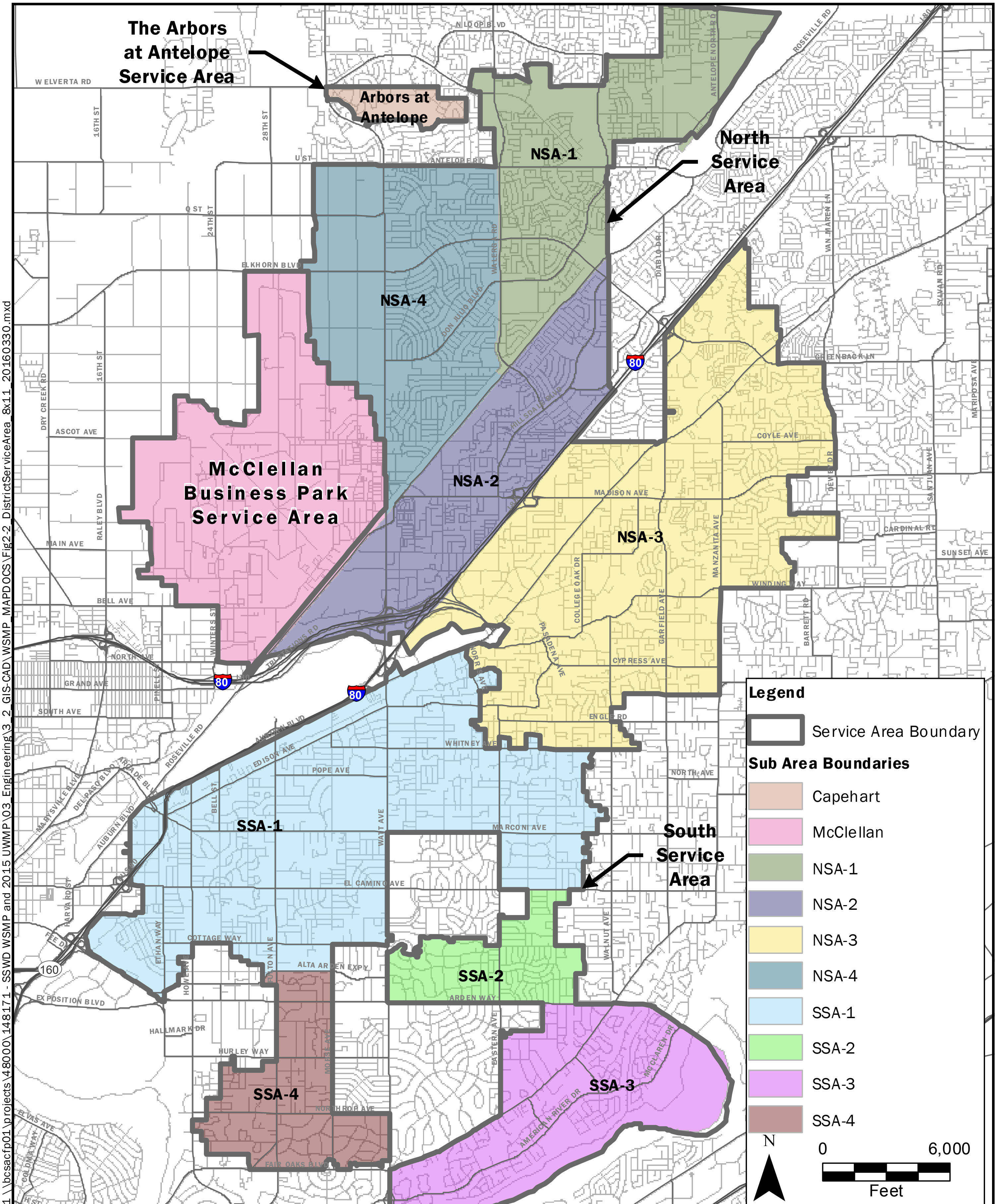
DATE	PROJECT	SITE	
11/9/16	148171	**Water System Master Plan** **Sacramento Suburban Water District**	**Figure 2-1**
Brown AND Caldwell		TITLE **District Vicinity Map**	



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Water System Master Plan
Sacramento Suburban Water District

TITLE

District Service Areas

Figure 2-2

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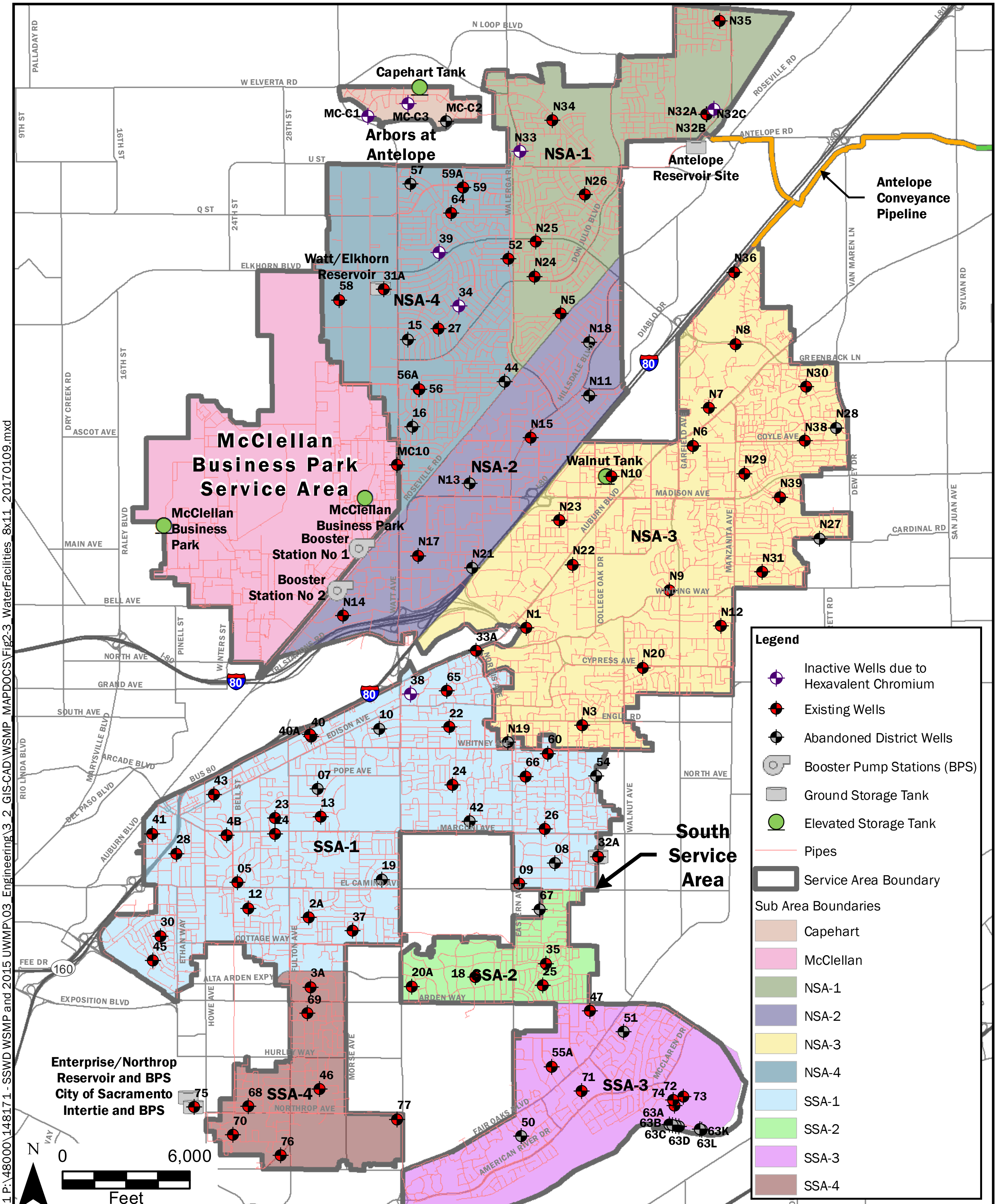

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3/20/17	148171	Water System Master Plan Sacramento Suburban Water District

Brown AND Caldwell

TITLE

Water System Facilities

Figure 2-3

2.2.1 Groundwater Facilities

Groundwater has been the primary source of water for both the NSA and SSA. The District's groundwater supply infrastructure has a total groundwater pumping capacity of approximately 84,000 gallons per minute (gpm). This includes all currently active and inactive wells. All of the wells pump directly into the distribution system.

Tables 2-1 and 2-2 summarize the capacity status of the District's groundwater wells. The term "active" is used to refer to wells that are fully operational and used for water supply within the District. Some wells are currently inactive due to water quality limits such as for Hexavalent Chromium (Cr+6).

Table 2-1. North Service Area Wells

Well Number	Well Name	Capacity[a], gpm	Status[b]
NSA 1			
N5	Hillsdale	775	Active
N24	Don Julio	1,130	Active
N25	Sutter	1,590	Active
N26	Monument	780	Active
N32-A	Poker 1	2,000	Active
N32-B	Poker 2	2,200	Active
N32-C	Poker 3	670	Inactive, Cr+6
N33	Walerga	1,260	Inactive, Cr+6
N34	Cottage	2,000	Active
N35	Antelope	2,570	Active
NSA 2			
N14	Orange Grove	1,300	Active
N15	Cabana	1,070	Active
N17	Oakdale	1,020	Active
NSA 3			
N1	Evergreen	800	Active
N3	Engle	900	Active
N6a	Palm	3,000	Under construction
N7	Rosebud	1,130	Active
N8	Field	950	Active
N9	Cameron	1,050	Active
N10	Walnut	1,300	Active

Table 2-1. North Service Area Wells			
Well Number	Well Name	Capacity[a], gpm	Status[b]
NSA 3 (continued)			
N12	St Johns	1,100	Active
N20	Cypress	1,100	Active
N22	River College	860	Active
N23a	Freeway	1,050	Active
N29	Merrihill	860	Active
N30	Park Oaks	1,000	Active
N31	Barrett Meadows	820	Inactive, needs water treatment
N36	Verner	1,500	Inactive, Addition of Mn treatment under construction
N39	Coyle	1,350	Active
N23a	Rutland	1,500	Active
AASA			
MC-1C	Capehart	550	Inactive, Cr+6
MC-3C	Capehart	725	Inactive, Cr+6
MBP			
MC10	McClellan Business Park	723	Active
NSA 4			
27	Melrose/Channing	875	Active
31A	Watt/Elkhorn	900	Active
34	La Cienege/Melrose	475	Inactive, Cr+6
39	Thomas/Elkhorn	530	Inactive, C+r6
52	Weddigen/Gothberg	900	Active
56A	Fairbairn/Karl	2,230	Active
58	Thirty Second/Elkhorn	920	Active
59A	Bainbridge/Holmes School	3,000	Active
64	Galbrath/Antelope Woods	1,200	Active
Total North Service Area well capacity (active and inactive)		**51,663**	--

[a] *Pumping capacity with current equipment under average operating pressure. The capacities are based on 2015 production capacity.*

[b] *Abandoned wells shown on Figure 2-3 but not listed in this table include 15,16, 44, 57, 59, MC-C2, N6, N11, N13, N18, N19, N21, N27, N28*

Table 2-2. South Service Area Wells			
Well Number	Well Name	Capacity[a], gpm	Status[b]
SSA 1			
5	Bell/El Camino	325	Active
9	Ravenwood/Eastern	500	Active
12	Hernando/Santa Anita Park	600	Active
13	Calderwood/Marconi	625	Active
14	Marconi South/Fulton	600	Active
22	West/Becerra	725	Active
23	Marconi North/Fulton	600	Active
24	Becerra/Woodcrest	600	Active
26	Greenwood/Marconi	700	Active
28	Red Robin/Darwin	700	Active
30	Rockbridge/Keith	600	Active
37	Morse/Cottage Park	80	Active
38	Watt/Auburn	450	Inactive, Cr+6
40	Auburn/Yard	700	Active
41	Albatross/Iris	500	Active
43	Edison/Traux	850	Active
45	Jamestown/Middleberry	750	Active
60	Whitney/Concetta	500	Active
65	Merrily/Annadale	1,100	Active
66	Eastern/Woodside Church	1,300	Active
2A	Watt/Arden	1,100	Active
32A	Eden/Root	1,650	Active
33A	Auburn/Norris	2,400	Active
40A	Auburn/Yard	2,300	Active
4B	Hernando/Santa Anita Park	600	Active
SSA 2			
18	Riding Club/Ladino	700	Active
25	Thor/Mercury	700	Active
35	Ulysses/Mercury	700	Active
75	Enterprise/Northrop	1,000	Active
20A	Watt/Arden	1,100	Active

Table 2-2. South Service Area Wells			
Well Number	Well Name	Capacity[a], gpm	Status[b]
SSA 3			
47	Copenhagen/Arden	950	Active
71	River Drive/Jacob	2,700	Active
72	River Walk/NETP	1,400	Active
73	River Walk/NETP East	3,400	Active
74	River Walk/NETP South	2,600	Active
55A	Stewart/Lynndale	2,100	Active
SSA 4			
46	Jonas/Sierra Mills	750	Active
70	Sierra/Blackmer	600	Active
76	Fulton/Fair Oaks	400	Active
77	Larch/Northrop	300	Active
3A	Auburn/Norris	2,400	Active
Total South Service Area well capacity (active and inactive)		**42,655**	--

[a] Pumping capacity with current equipment under average operating pressure. The capacities are higher under lower pressures.

[b] Abandoned wells shown on Figure 2-3 but not listed in this table include 7, 8, 19, 42, 50, 51, 54, 63A, 63B, 63C, 63D, 63K, 63L, and 67.

Wells throughout the District are generally between 200 and 1,300 feet deep and draw water primarily from the Mehrten formation. The older, shallower wells typically produce up to 1,000 gpm. Some of the newer wells produce over 2,500 gpm.

2.3 Distribution System

This section discusses the District's water distribution system, including storage, pump stations, and interconnections. This information is from the District's geographical information system (GIS). It is important to maintain the District's GIS database with current information on all facilities including information such as capacity, size, installation information, and materials.

Within the larger NSA there are two pressure zones: larger NSA (subareas NSA 1, 2, and 3), which includes also includes the MBPSA, AASA, and the North Highlands subzone. The North Highlands pressure zone (NSA 4) is hydraulically separated from the rest of the NSA by a pressure reducing valve (PRV) located at Bainbridge Drive and Walerga Road. While MBPSA and AASA are separate service areas, they are not hydraulically separated pressure zones. There is no PRV between AASA and the NSA. Water from the NSA to MBPSA flows directly into the MBPSA (boosters from the NSA to MBPSA are rarely used). Water is served to McClellan Business Park but prevented from flowing back into the NSA. Because of fluoridation and surface water place of use restrictions in the SSA, the SSA is hydraulically separated from the NSA (by closing main line valves) and is its own pressure zone.

A hydraulic schematic of the distribution system is shown on Figure 2-4.

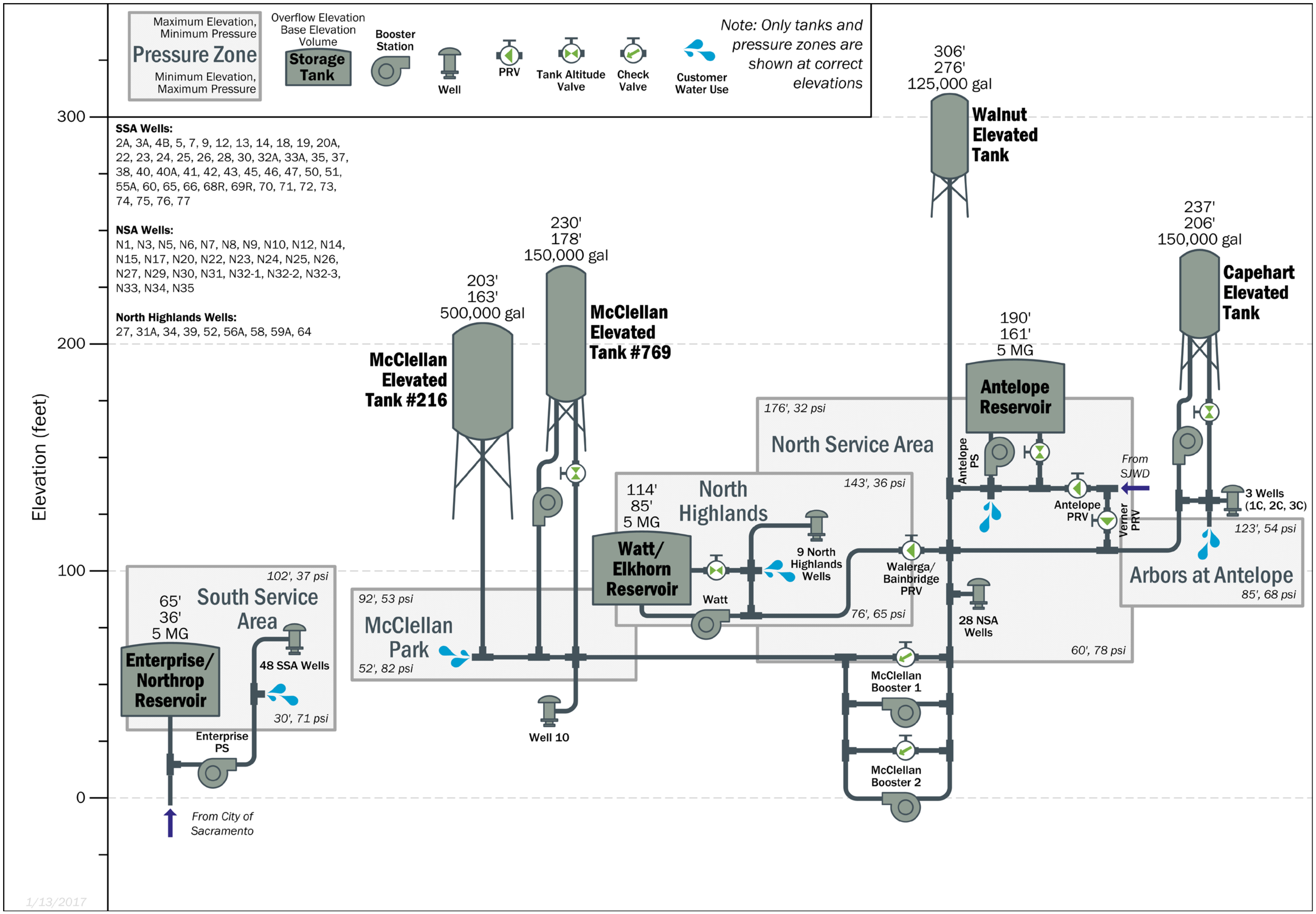


Figure 2-4. Existing System Hydraulic Schematic

2.3.1 Pipelines

The distribution system ranges in size from 48-inch mains down to 4-inch laterals. There are currently approximately 625 miles of distribution mains sized 4-inches through 14-inches in diameter and approximately 53 miles of transmission mains sized 16-inches in diameter and larger. Figure 2-5 provides a breakdown of the linear feet (LF) of each pipe diameter by material type in the system. Over 60 percent of the distribution system is 6-in to 8-in diameter pipe. Pipeline material consists predominantly of asbestos cement (48 percent) followed by polyvinyl chloride (PVC) (13 percent), ductile iron (21 percent), and mortar lined coated steel (11 percent).

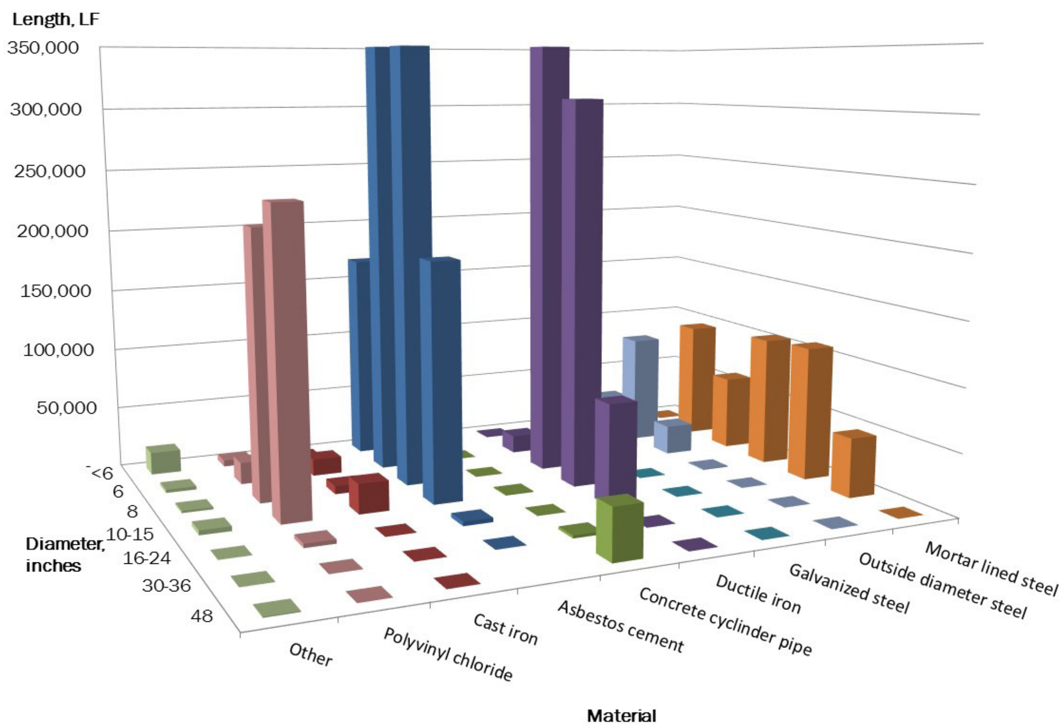


Figure 2-5. Pipe Material and Diameter Linear Feet

The District owns capacity in two transmission mains that are owned by the City and San Juan Water District. The District owns 32.26 percent of the capacity of approximately 2 miles of a 54-inch diameter transmission main owned by the City. This pipeline is located between the City's Fairbairn WTP and the SSA. The District also owns 59.2 million gallons per day (MGD) capacity in the San Juan Water District Cooperative Transmission Pipeline (CTP), which is approximately 50 percent of the capacity in the CTP. The CTP in combination with the District owned Antelope Transmission Pipeline (ACP) connect the NSA to San Juan Water District.

The District's standards include the requirement for gridding cross connecting mains at intervals of approximately 1,300 feet with a minimum size of 12-inch. Exceptions have been made where 10-inch mains and larger exist in the grid pattern.

2.3.2 Storage Facilities

The NSA has five active storage tanks. The reservoir storage and pump station capacities are summarized in Table 2-3 and depicted on Figure 2-4. Detailed descriptions of each storage and pump station facility are provided below.

Table 2-3. Storage and Pump Stations				
Name	Volume, MG	Pump Station Capacity, gpm	Location	Status
NSA				
Antelope Reservoir	5.000	10,000 (8,000 gpm reliable capacity[b])	Antelope North Rd	Active
Capehart Elevated Tank	0.150	400 gpm	Arbors at Antelope service area	Active
Watt/Elkhorn Reservoir	5.000	10,000 (8,000 gpm reliable capacity[b])	Watt Ave and Elkhorn Blvd	Active
McClellan Business Park Elevated Tank #769	0.150	200 gpm	West side of McClellan Business Park Lang Avenue	Tied to system, backup on low pressure situation-fire backup/emergency
McClellan Elevated Tank #216	0.500	350 gpm	At Peacekeeper Way and Dudley Blvd	Tied to system, backup on low pressure situation-fire backup/emergency
Walnut Yard Elevated Tank	0.125	--[a]	Walnut Yard, 5331 Walnut Ave	Active
NSA Total	10.925	20,950 (16,950 gpm reliable capacity)	--	--
SSA				
Enterprise/Northrop Reservoir	5.000	From storage tank to District: 2 pumps: 60 hp and capacity of 1,000 gpm/each 2 pumps: 150 hp and capacity of 2,500 gpm/each Total capacity: 7,000 gpm (4,500 gpm reliable pumping capacity)	Enterprise Dr. (near Northrop Ave.)	Active
SSA Total	5.000	7,000 (4,500 gpm reliable capacity)	--	--

[a] *Not applicable.*

[b] *Reliable capacity based on largest booster pump out of service.*

Antelope Reservoir and Boster Pump Station (BPS) – The Antelope ground level reservoir was constructed in 1997 and is located in the northeast corner of the NSA (NSA 1 subarea). The NSA surface water supply from the Peterson WTP is delivered via the CTP and the ACP to the Antelope facility.

Capehart Elevated Tank – The Capehart elevated reservoir is located in the AASA, previously owned by the federal government. This tank was constructed in the 1950's. The District has operational issues with utilizing this storage tank because the height of the tank is lower than the hydraulic grade line (HGL) of the service area. A booster pump was added in 2016 to pump water out of this tank into the distribution system.

Watt/Elkhorn Reservoir and BPS – The Watt/Elkhorn ground level reservoir and BPS is located in the North Highlands sub zone of the NSA. It was constructed in 2001. During peak demand periods the District has difficulties filling this tank and providing supply to meet demands. Well 31A is located near the reservoir and is plumbed to pump to the distribution system or the reservoir.

McClellan Business Park Elevated Tank #769 – The McClellan Business Park elevated tank #769 is located on the west side of the MBPSA. It was constructed in 1952. The elevation of this tank is lower than the current HGL of the service area and the District has difficulty emptying this tank. A booster pump was added in 2016 to pump water out of this tank into the distribution system.

McClellan Business Park Elevated Tank #216 – The McClellan Business Park elevated tank #216 is located at Peacekeeper Way and Dudley Blvd. It was constructed in 1953. The elevation of this tank is lower than the current HGL of the service area and the District has difficulty emptying this tank. A booster pump was added in 2016 to pump water out of this tank into the distribution system.

Walnut Yard Elevated Tank – The Walnut Yard elevated tank is located in the NSA (NSA 3 subarea) near Walnut Avenue and Auburn Blvd. It was constructed in 1958. Because the elevation of this tank is higher than the HGL of the NSA, the District utilizes a booster pump to boost water back into the tank from the system. As pressure drops in the system, an operational control valve slowly opens to allow the tank to provide supply to the system.

Enterprise/Northrop Reservoir and BPS – The Enterprise/Northrop ground level reservoir and BPS was constructed in 2006 and is located in the southwest corner of the SSA on Enterprise Drive (near the intersection with Northrop Avenue) at the City intertie.

2.3.3 Booster Pump Stations

There are two booster pump stations that are designed to boost water from the District's NSA into the MBPSA. These booster pump stations are identical in configuration. These BPSs were constructed in 1988. Backflow prevention valves are located at both BPSs to prevent flow within the MBPSA from re-entering the NSA. As demand increases and the pressure decreases, the booster pumps start and maintain the elevation at the set point. Because the pressure gradient for the MBPSA does not differ significantly from the NSA, the booster pump stations rarely are required to operate, and sufficient flow is usually delivered by gravity.

The Antelope Pump-Around BPS facility is intended to address drought or emergency conditions by neighboring water agencies as well as increased operational flexibility in the NSA by providing the capability to pump water from the NSA-1 subarea to the northern part of the NSA-3, also known as the Arvin Area.

The design flows for each booster pump station is shown in Table 2-4. The location of these booster pump stations are shown on Figure 2-3.

Table 2-4. Booster Pump Stations

Name	Design Flow, gpm
McClellan Booster Station 1	
Booster 1A	2,000
Booster 1B	2,000
McClellan Booster Station 2	
Booster 2	2,000
Antelope Pump-Around Facility	
Booster 1	5,000
Booster 2	5,000
Booster 3 (low head pump-around)	2,000

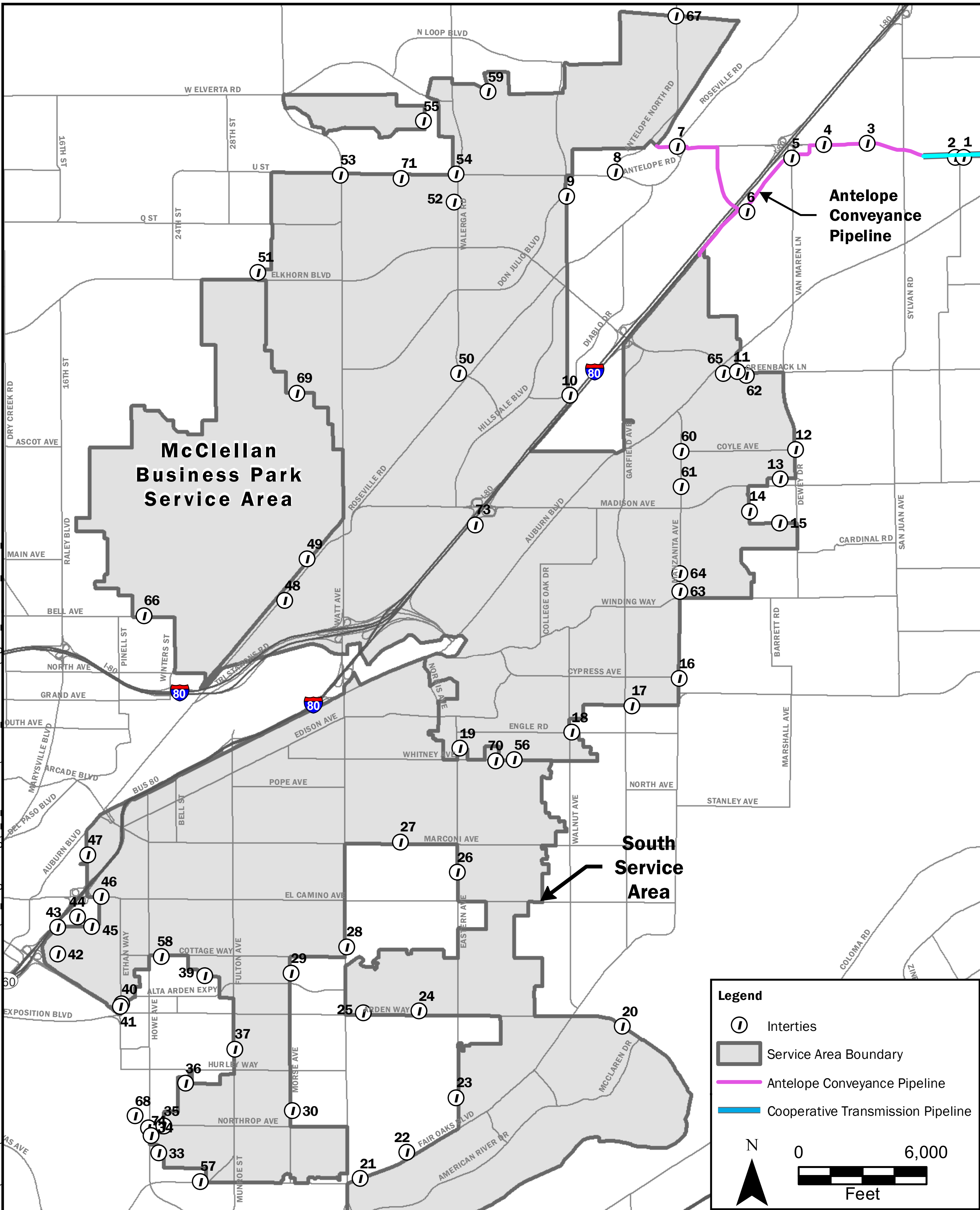
2.3.4 Interties

The District has emergency interties with neighboring agencies along the District boundary. The District has mutual assistance agreements in place with each of the interconnected agencies. The District's interties are listed in Table 2-5 and depicted on Figure 2-6. Also listed are the ACP turnouts with California American Water Company (Cal Am) and Citrus Heights Water District (CHWD).

Table 2-5. District Interties				
District ID No.	Size, in	Interconnected Agency	Type	Location
1	18	CHWD	Intertie	7722 Antelope Rd
2	30	CWD	Intertie	7690 Antelope Rd
3	24	CHWD	ACP[a] outlet	Antelope Rd/Lauppe Ln
4	12	Cal Am	ACP[a] outlet	Antelope Rd/Rollingwood Bl
5	12	CHWD	Intertie	Van Maren Ln/Navion Dr
6	16	Cal Am	ACP[a] outlet	6408 Silk Oak Ct/Navion Dr
7	20 PIV	Cal Am	Intertie	Roseville Rd/Antelope Rd
8	18	Cal Am	ACP[a] outlet	Antelope Rd/Antelope North Rd
9	10	Cal Am	Intertie	5109 Cherbourg Dr
10	6	Cal Am	Intertie	6029 Jeanine Dr
11	6	Cal Am	Intertie	6201 Greenback Ln
12	8	Cal Am	Intertie	Coyle Av/Dewey Dr
13	6	CHWD	Intertie	6613 Markley Wy
14	12	CHWD	Intertie	6331 Rutland Dr
15	6	CHWD	Intertie	6601 Oakcrest Av
16	18	CWD	Intertie	Cypress Av/Manzanita Av
17	12	CWD	Intertie	5507 Gibbons Dr
18	8	CWD	Intertie	Engle Rd/Walnut Av
19	6	NSA/ SSA	Intratie	Landolt Av/ Eastern Av
20	6	CWD	Intertie	1548 Gregory Wy
21	8	SCWA	Intertie	3604 Fair Oaks Bl
22	10	SCWA	Intertie	Wilhaggin Dr/San Ramon Wy
23	4	SCWA	Intertie	1151 Eastern Av
24	10	SCWA	Intertie	1701 Ladino Rd/Arden Wy
25	10	SCWA	Intertie	1700 Devonshire Rd/Arden Wy
26	6	DPMWD	Intertie	4251 Annette St
27	10-PIV	DPMWD	Intertie	Nw Corn. Marconi Av/Becerra Wy
28	8	DPMWD	Intertie	2114 Watt Av
29	8-PIV	ACWS	Intertie	2025 Morse Av
30	6-PIV	ACWS	Intertie	1001 Morse Av
33	8	SCWA	Intertie	701 Blackmer Cr
34	6	SCWA	Intertie	Howe Av S/O Northrop Av (Woodside)
35	8	SCWA	Intertie	2240 Northrop Av
36	6-PIV	Cal Am	Intertie	1150 Dealynn St
37	8	Cal Am	Intertie	1530 Fulton Av
39	8-PIV	Cal Am	Intertie	1935 Wright St
40	8-PIV	Cal Am	Intertie	SE Corner of Ethan Wy/Alta Arden Exp Wy
41	8	City of Sacramento	Intertie	SW Corner of Ethan Wy/Alta Arden Exp Wy

Table 2-5. District Interties				
District ID No.	Size, in	Interconnected Agency	Type	Location
42	8	City of Sacramento	Intertie	Royale Rd-Sears Parking Lot
43	6	City of Sacramento	Intertie	1600 Cormorant Wy
44	8	City of Sacramento	Intertie	Cormorant Wy/Silica Wy
45	6	City of Sacramento	Intertie	2255 Ray St
46	6	City of Sacramento	Intertie	NE Corner Albatross Wy/El Camino Av
47	6	City of Sacramento	Intertie	1800 Helena Wy
48	8	NSA/ MBP	Intratie	Sac County Transfer Station
49	20	NSA/ MBP	Intratie	4700-08 Roseville Rd
50	8	Conveyance Line/ NSA	Intratie	4195-97 Cornelia Way
51	8	RLECWD	Intertie	6836 30th St
52	24	Conveyance Line/ NSA	Intratie	Bainbridge Dr/ Walerga
53	8-PIV	Cal Am	Intertie	7547 Watt Av
54	12	Cal Am	Intertie	Old Walerga Rd/Antelope Rd
55	16	Capehart	Intratie	Ottaway Way
56	30	NSA/ SSA	Intratie	Whitney Av/ Mission Av
57	8	SCWA	Intertie	2831 Fair Oaks Blvd
58	10	Cal Am	Intertie	Cottage Way (Home Depot)
59	12	Cal Am	Intertie	Palmerson Drive
60	16	NSA/ Arvin Area[b]	Intratie	Coyle Av/ Manzanita Av
61	12	NSA/ Arvin Area[b]	Intratie	5318 Manzanita Av
62	16	NSA/ Arvin Area[b]	Intratie	6159-61 Parkoaks Dr
63	12	NSA/ Arvin Area[b]	Intratie	4705 Manzanita Av
64	12	NSA/ Arvin Area[b]	Intratie	4789 Manzanita Av
65	12	NSA/ Arvin Area[b]	Intratie	Autumn Ridge Apartments – Desimone Lane
66	10	City of Sacramento	Intertie	Astoria Dt/ Bell Av
67	36	Roseville	Intertie	Antelope North Rd/ Placer County Line
68	36	City of Sacramento	Intertie	Enterprise/ Northrop Reservoir
69	8	SSWD/MBP	Intratie	3200 Freedom Park Dr
70	6	NSA/SSA	Intratie	4540 Whitney Av
71	8	NSA/North Highlands (NSA 4)	Intratie	Wendell C Brock Park – Antelope Rd
72	48	SJWD	Intertie	C-Bar-C Park
73	24	SCWA	Intertie	5110 Tyler St
74	6	SCWA	Intertie	760 Howe Av

[a] Antelope Conveyance Pipeline (ACP)
CWD – Carmichael Water District
CHWD – Citrus Heights Water District
Cal Am – California American Water Company
RLECWD – Rio Linda/Elverta Community Water District
SCWA – Sacramento County Water Agency
SJWD- San Juan Water District
[b] The Arvin Area is the area on the west side of the NSA, located within Subarea NSA 3.



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DATE	PROJECT	SITE	
3/20/17	148171	Water System Master Plan Sacramento Suburban Water District	2-6
Brown AND Caldwell		TITLE District Interties	

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Section 3

Water Requirements

This section describes the historical and buildout land use, demographics, demand factors, and demand projections for the District.

Strategic Plan Alignment

Water Supply – 1.B. - Provide for the long-term water supply needs of the customers through prudent planning that will ensure capacity to serve system demands.

- **Projected water demands.**

Water Supply - 1.C. – Continue to implement and support demand management strategies and water conservation that comply with federal, state and regional programs; support Water Forum Agreement goals and efficiently meet the water supply needs of the customers.

- **Analysis of per capita water demands.**
- **Estimated future water savings.**

Policy Implications

- **Parcels currently supplied by private wells will remain to be supplied by private wells at buildout.**
- **Demand projection through buildout is reduced from prior projections.**

3.1 Description of Methodology

The District's demographics and water demands through buildout are estimated based on the analysis progression shown on Figure 3-1. The first part of the process is focused on examining historical demographics and connections within the District. Also, the current land area served by the District and land area within the District that will be served at buildout are analyzed. Historical demographics, historical connection data by customer sector, and the 2015 served land area are used in conjunction with buildout developed land acreage to estimate buildout demographics and connections. Once the buildout demographics are estimated, the rate of annual connection growth for each customer sector is estimated.

The second part of the process mimics the first part described above, but is focused on water use. Water demand factors are developed and used together with the buildout land use and demographics to estimate the buildout water use.

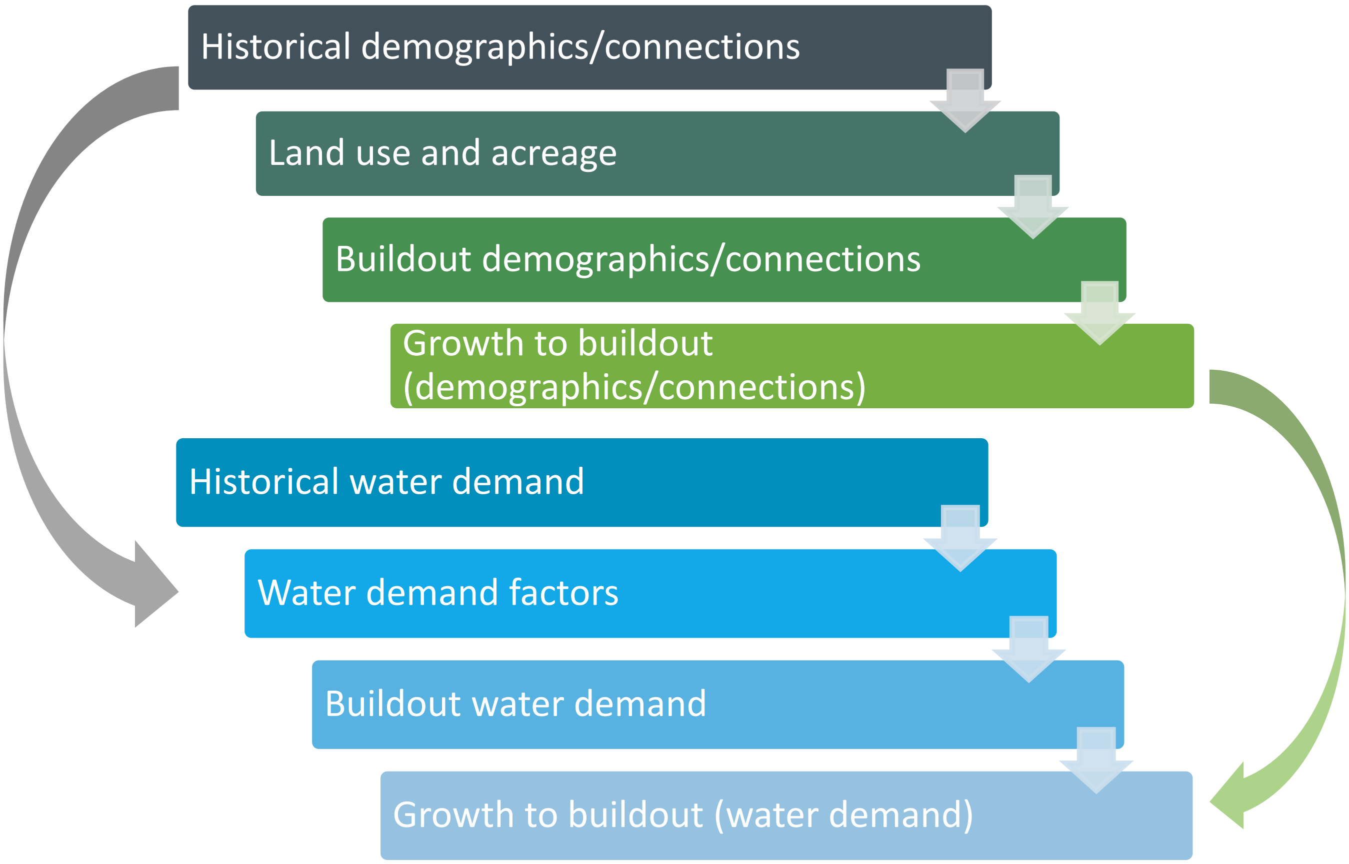


Figure 3-1. Water Demand Estimate Analysis Progression

3.2 Historical Population and Connections

This section presents the District's estimated historical population and connections. Historical population is estimated using the US Census combined with records of historical District residential connections.

3.2.1 Historical Population Estimate

The historical population in the District is based on the 1990, 2000, and 2010 Census for the Census blocks within the District's service area using the California Department of Water Resources (DWR) population tool (DWR, 2016a) and the District's 1990, 2000, and 2010 boundaries. There are some areas within the District's service area that are not served by the District but by private wells instead. There is a significant residential area within the southern portion of the SSA that is served by private wells. It is estimated that this private well area consists of approximately 730 people in 2015. This area and the associated population served by private wells are not included in the Census analysis.

The DWR population tool utilizes the US Census data and electronic maps of the District's service area to obtain historical population for the Census years. Using the District's number of residential service connections, the tool calculates the population for the non-Census years.

Because the estimated historical population is based on the District's historical connections, any fluctuations occurring in the District's records for number of connections for single family or multi-family result in fluctuations of estimated population. Fluctuations in District records for number of single family and multi family connections by customer sector have occurred due in large part as a result of inconsistent categorizing of residential connections. It is most likely that the fluctuations in the historical number of multi-family connections are due primarily to revised District accounting of the multi-family connection sector, assuming that historically some multi-family connections were accounted-for in the commercial sector or single family sector. The District's accounting (and the variation in accounting from Arcade and Northridge Districts) of single-family connections was adjusted in past years. The District has worked to eliminate these inconsistencies in recent years. For the purposes of the population analysis, the historical multi-family connections are adjusted to eliminate extremely low multi-family connection values.

The historical residential connections and population are presented in Table 3-1 and shown on Figure 3-2.

Table 3-1. Current and Historical Residential Connections, Population, and Dwelling Units Served by the District

Year	Residential Connections			People per Connection		Estimated Population
	Single Family	Multi-Family Raw Data	Multi-Family Adjusted	Single Family	Multi-Family	
1995	38,232	571	2,150	2.62	22.83	149,375
1996	38,275	433	2,200	2.65	22.28	150,522
1997	39,924	443	2,250	2.68	21.73	155,923
1998	39,589	445	2,300	2.71	21.18	155,988
1999	39,762	2,318	2,318	2.74	20.63	156,709
2000	38,035	3,075	3,075	2.77	20.08	167,003
2001	41,054	1,143	2,500	2.80	19.53	163,738
2002	41,603	2,000	2,000	2.83	18.98	155,617
2003	40,290	190	2,500	2.86	18.43	161,191
2004	35,589	3,268	3,268	2.89	17.88	161,155
2005	37,164	3,803	3,803	2.92	17.34	174,258
2006	37,121	3,801	3,801	2.94	16.79	173,088
2007	37,276	3,812	3,812	2.97	16.24	172,717
2008	37,095	4,038	4,038	3.00	15.69	174,641
2009	37,331	3,835	3,835	3.03	15.14	171,175
2010	37,366	3,831	3,831	3.06	14.59	170,050
2011	37,034	3,750	3,750	3.09	14.04	167,018
2012	36,762	3,811	3,811	3.12	13.49	165,976
2013	38,040	3,899	3,899	3.14	12.95	170,074
2014	38,447	4,025	4,025	3.17	12.40	171,856
2015	38,634	4,216	4,216	3.20	11.85	173,380

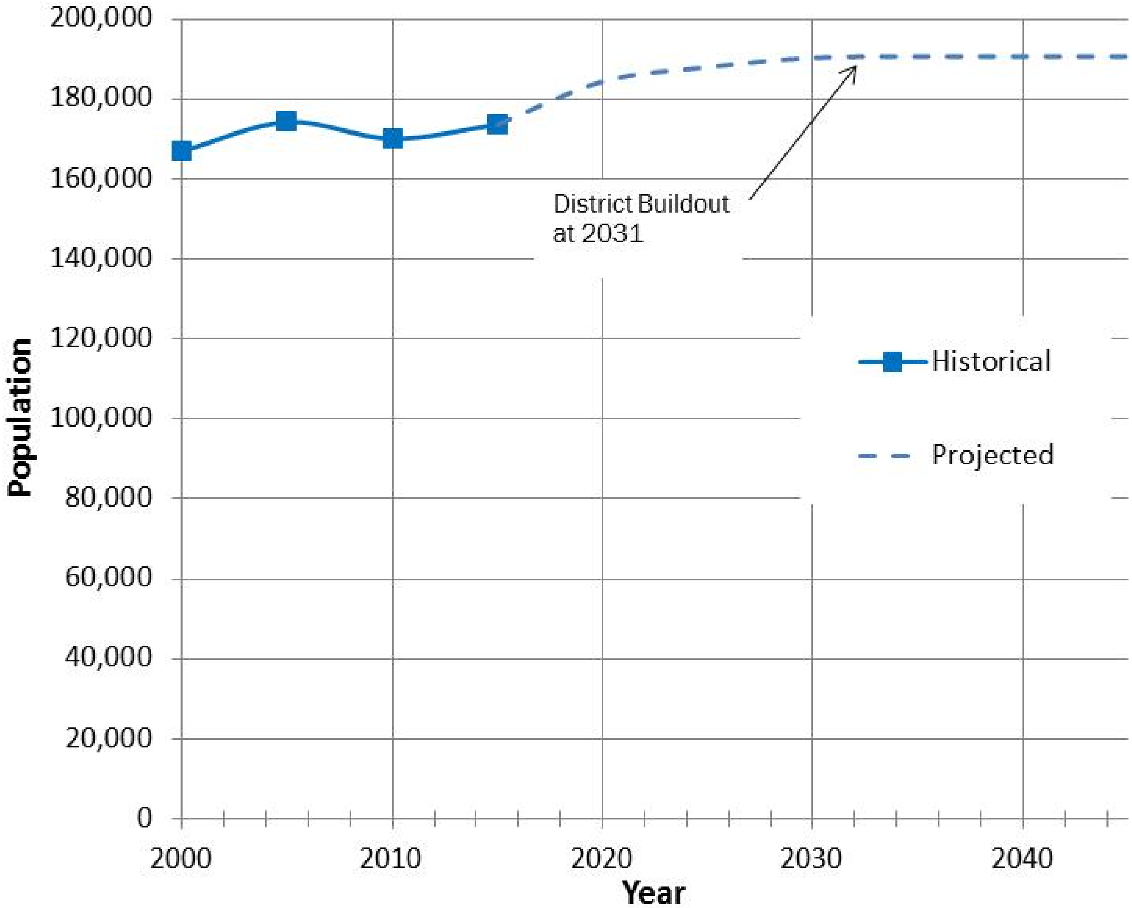


Figure 3-2. Historical and Projected Population

3.2.2 Historical Connections

The District's historical number of customer connections by customer sector is presented in Table 3-2. Note that multi-family customers include mobile home parks, duplexes, condominiums, and apartment complexes. Some of the District's residential customers are not currently metered. The District's current metering schedule projects the District being completely metered by the year 2022. The historical number of connections by customer sector within the District is shown on Figure 3-3.

Table 3-2. Historical Connections by Customer Classification								
	Historical Connections							
Customer Sector	2000	2005[a)]	2010	2011	2012	2013[(c)]	2014[(d)]	2015
Single-family								
Unmetered	36,530	26,265	17,636	15,896	14,065	12,132	10,876	9,669
Metered	1,505	10,899	19,730	21,138	22,697	25,908	27,571	28,965
Single-family total	38,035	37,164	37,366	37,034	36,762	38,040	38,447	38,634
Multi-family								
Unmetered	-- [(e)]	2,106	1,528	1,057	921	879	542	319
Metered	-- [(e)]	1,697	2,303	2,693	2,890	3,020	3,483	3,897
Multi-family total	3,075	3,803	3,831	3,750	3,811	3,899	4,025	4,216
Commercial								
Unmetered	-- [(e)]	-- [(e)]	28	23	19	17	16	7
Metered	-- [(e)]	-- [(e)]	2,099	2,216	2,379	2,752	2,789	2,636
Commercial total	2,843	2,230	2,127	2,239	2,398	2,769	2,805	2,643
Industrial [(b)]	57	1	13	17	17	17	17	20
Institutional [(b)]	0	450	471	518	531	537	542	543
Landscape irrigation [(b)]	24	168	376	396	453	549	574	594
Total	**44,034**	**43,816**	**44,184**	**43,954**	**43,972**	**45,811**	**46,410**	**46,650**

[(a)] *In 2005 the District reclassified customer account categories. This results in varying customer account data from 2000 to 2005.*

[(b)] *Metered connections.*

[(c)] *2013 single family connections increase due to metering of AASA and Oak Knoll.*

[(d)] *2014 conversion to TrueBill.*

[(e)] *Unmetered vs. metered connection breakdown in year 2000 is not known.*

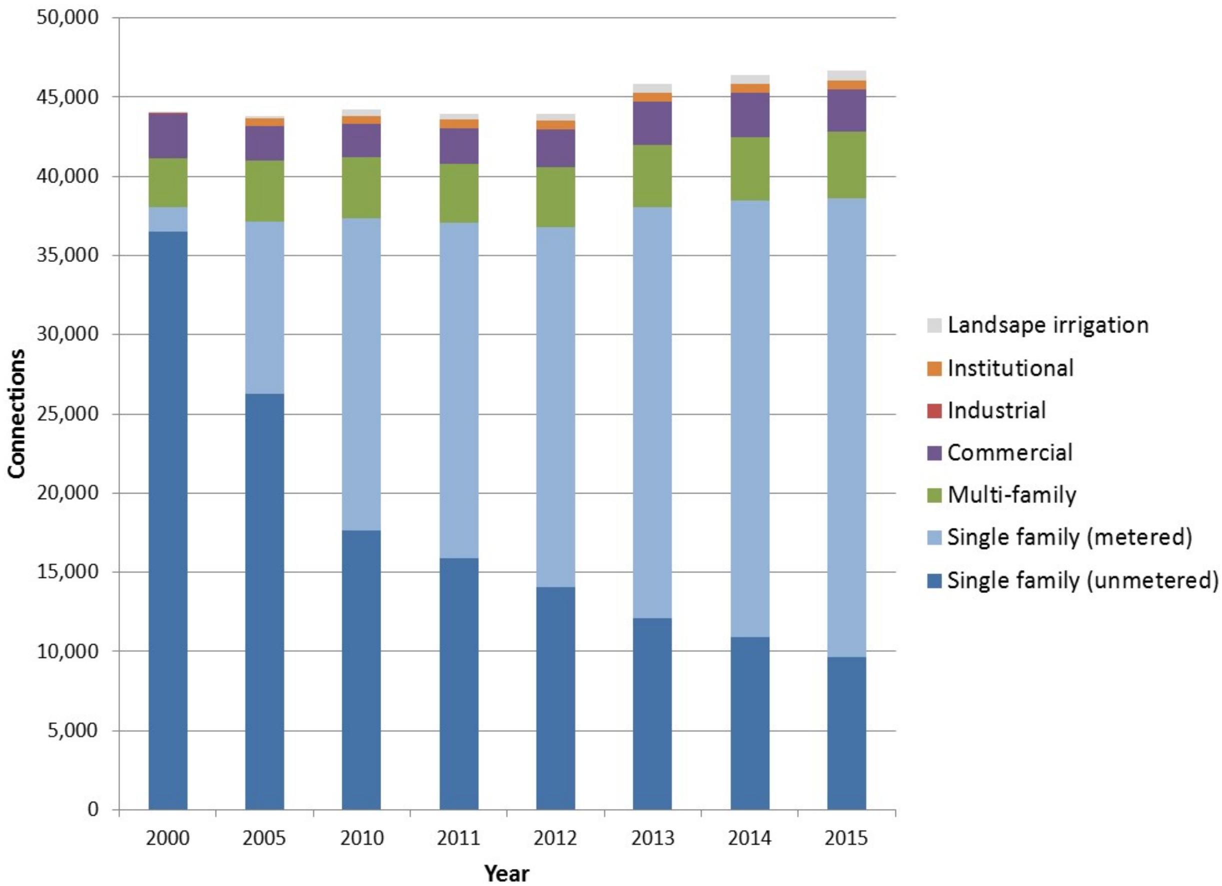
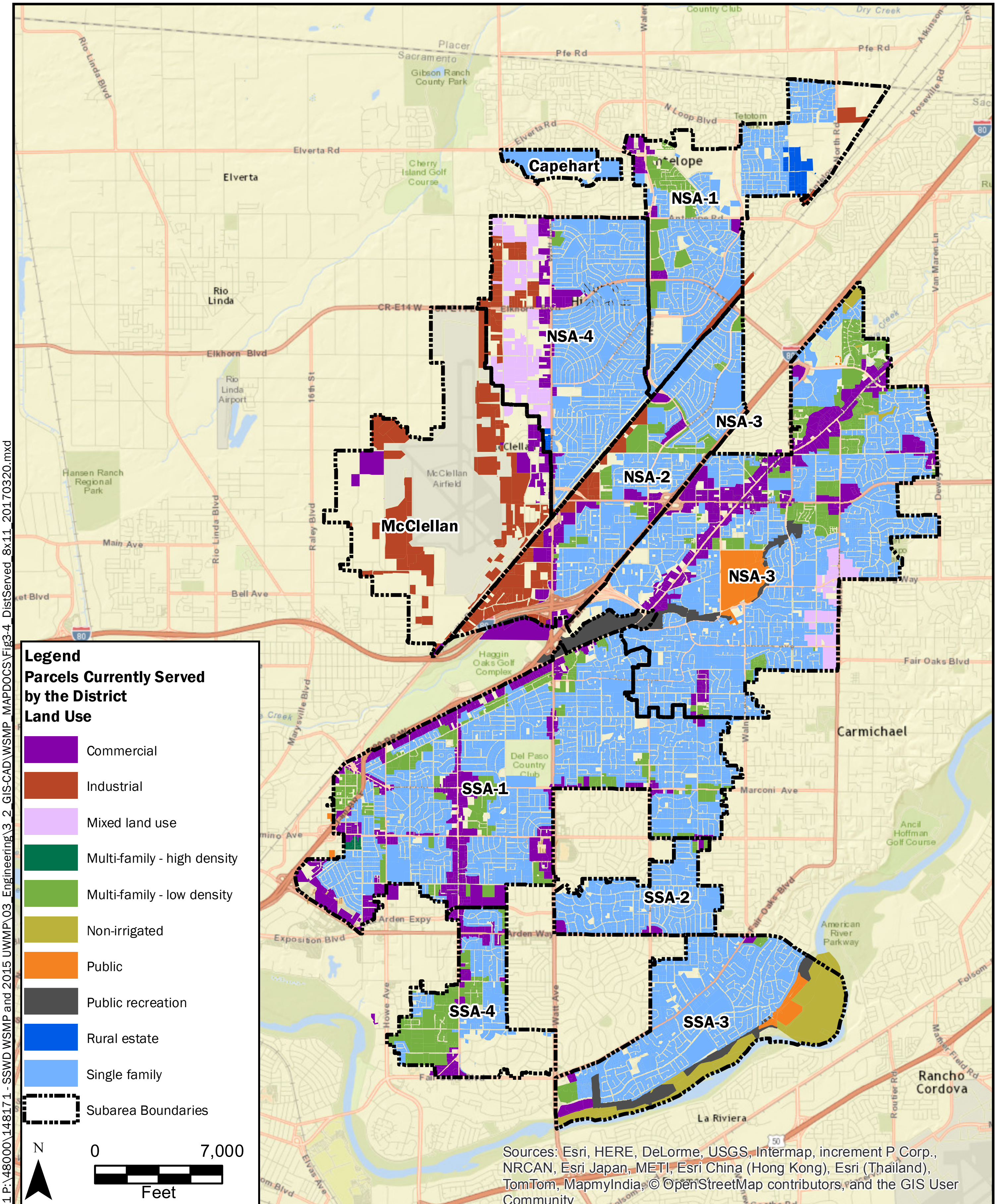


Figure 3-3. Historical Number of Connections

3.3 Land Area Served within the District

The land use designations in the District are based on the Sacramento County General Plan (Sacramento County, 2011), City of Sacramento General Plan (City of Sacramento, 2015), and City of Citrus Heights General Plan (City of Citrus Heights, 2011). A list of the land use categories from each of these general plans and the correlating customer sector assumed for this analysis is provided in Appendix A. The parcels served in 2015 by the District are shown on Figure 3-4. The parcels served in 2015 by the District are identified based on a list of customers with corresponding assessor parcel numbers (APNs) provided by the District. Table 3-3 presents the number of customers that were located using Sacramento County parcels GIS based on the parcel APN information provided by the District. As shown in this table, 97 percent of the District's customers were located using GIS.

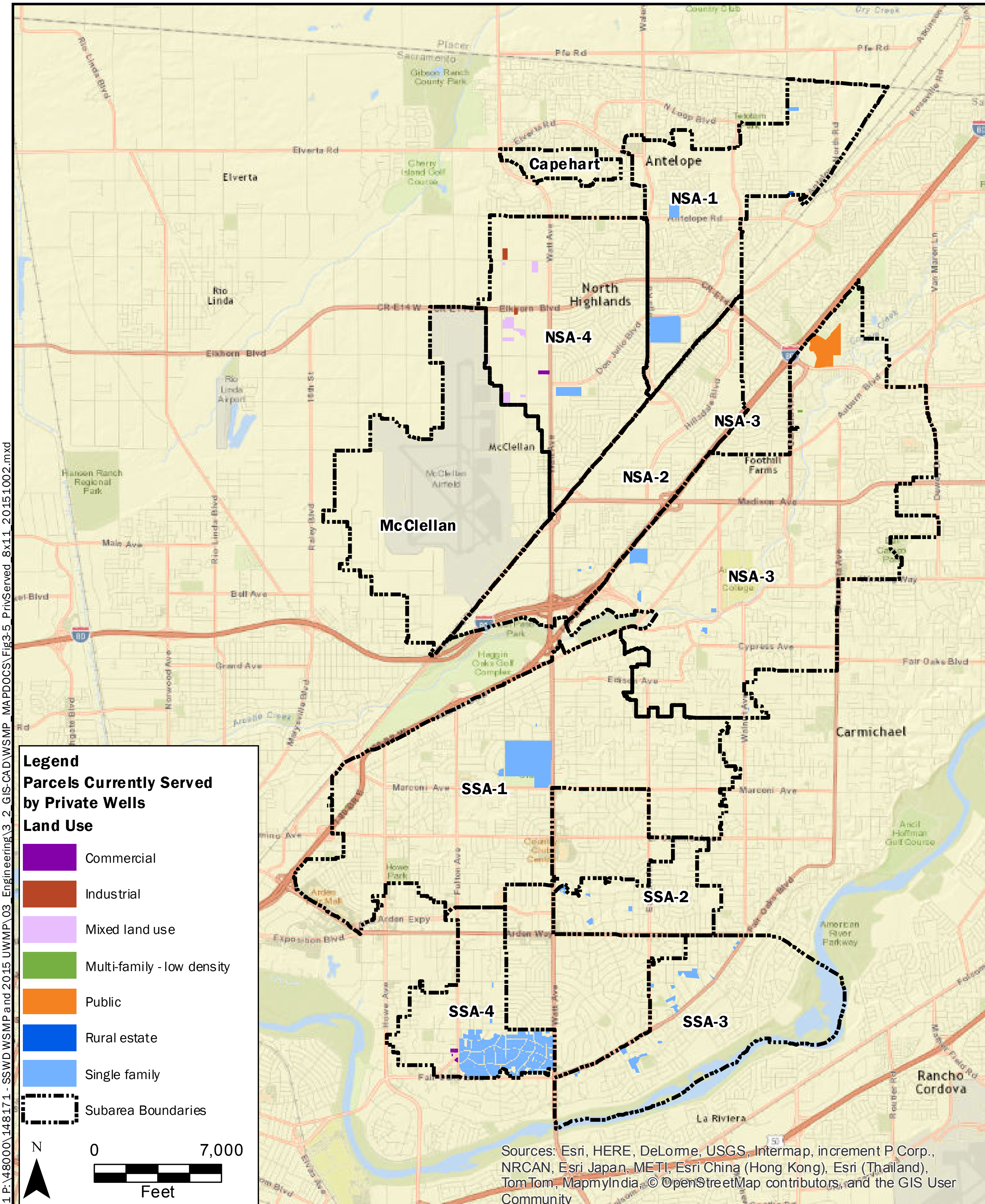


DATE	PROJECT	SITE	
3/20/17	148171	Sacramento Suburban Water District	Figure 3-4
Brown AND Caldwell		TITLE: Parcels Currently Served by the District	

Table 3-3. District Customer Data Correlation with Sacramento County Parcel Data		
	Customers	Percent of Total
Customers' APN match County parcel APN	43,534	97%
No parcel APN provided by District	92	0%
Customer APN data does not match County parcel APN	1,175	3%
Total customers provided (2014)	**44,801**	--

There are currently some parcels in the District's service area served by private wells. It is assumed that these parcels will remain supplied by private wells and this land area will not be served by the District at buildout. The parcels currently served by private wells are shown on Figure 3-5. A significant area of parcels served by private wells is located in the southern portion of the SSA. This area is not included in the historical population analysis described in Section 3.2.

It is assumed that the remaining land area within the District that is not served in 2015 and not served by private wells will eventually be developed and served by the District. The parcels remaining to be served by the District are shown on Figure 3-6. A comparison of the currently developed area and area remaining to be served is shown on Figure 3-7. The acreage of the current parcels served by the District (developed area), area remaining to be served, and area served by private wells is categorized by customer sector and summarized in Table 3-4. The current and buildout land use by generalized land use category and by service area is presented in Table 3-5.



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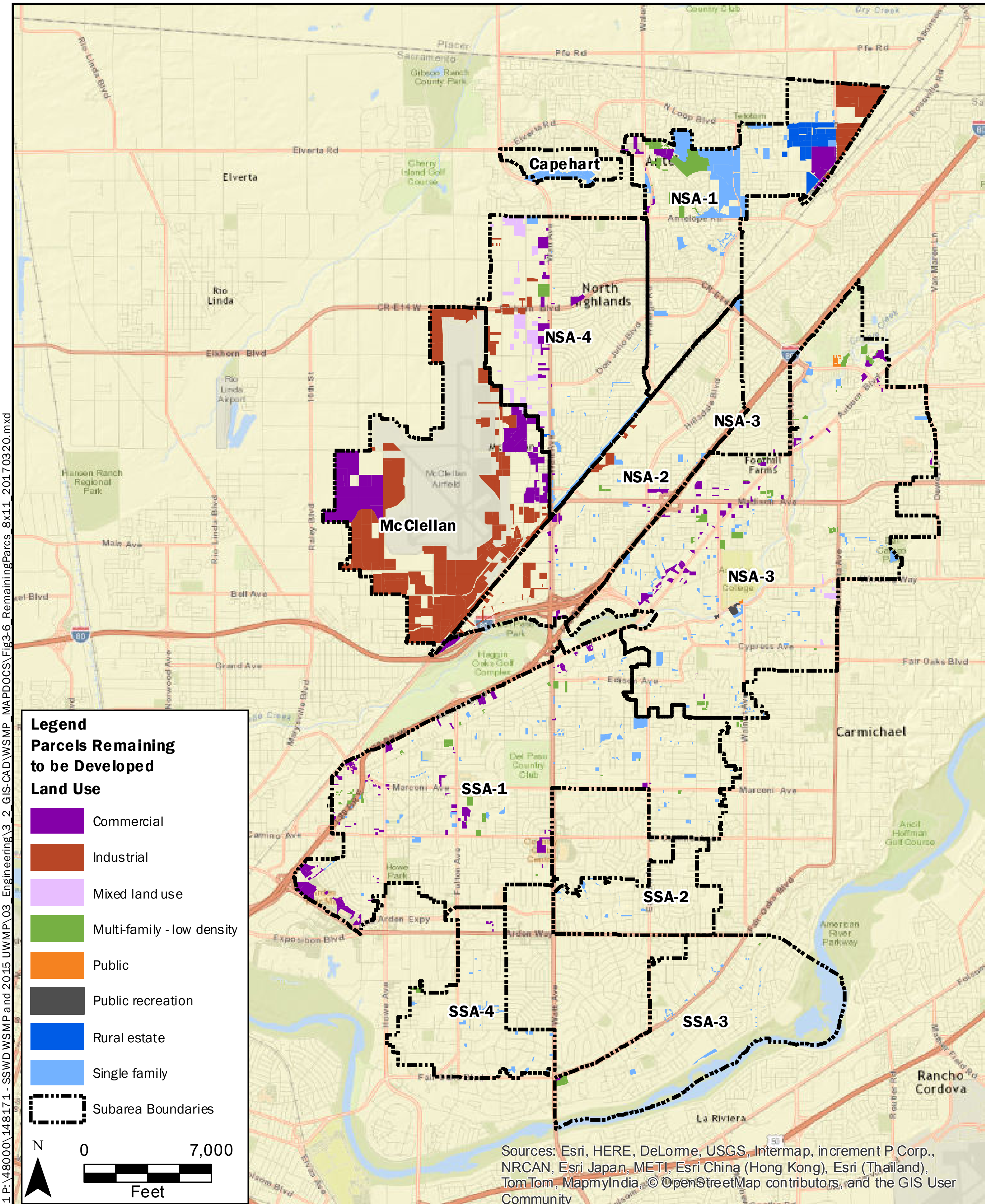
DATE	PROJECT	SITE
3/20/17	148171	Sacramento Suburban Water District

Brown AND Caldwell

TITLE

Parcels Currently Served by Private Wells

Figure 3-5



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DATE	PROJECT	SITE / TITLE	
3/20/17	148171	**Sacramento Suburban Water District**	**Figure 3-6**
Brown AND Caldwell		**Parcels Remaining to be Developed**	

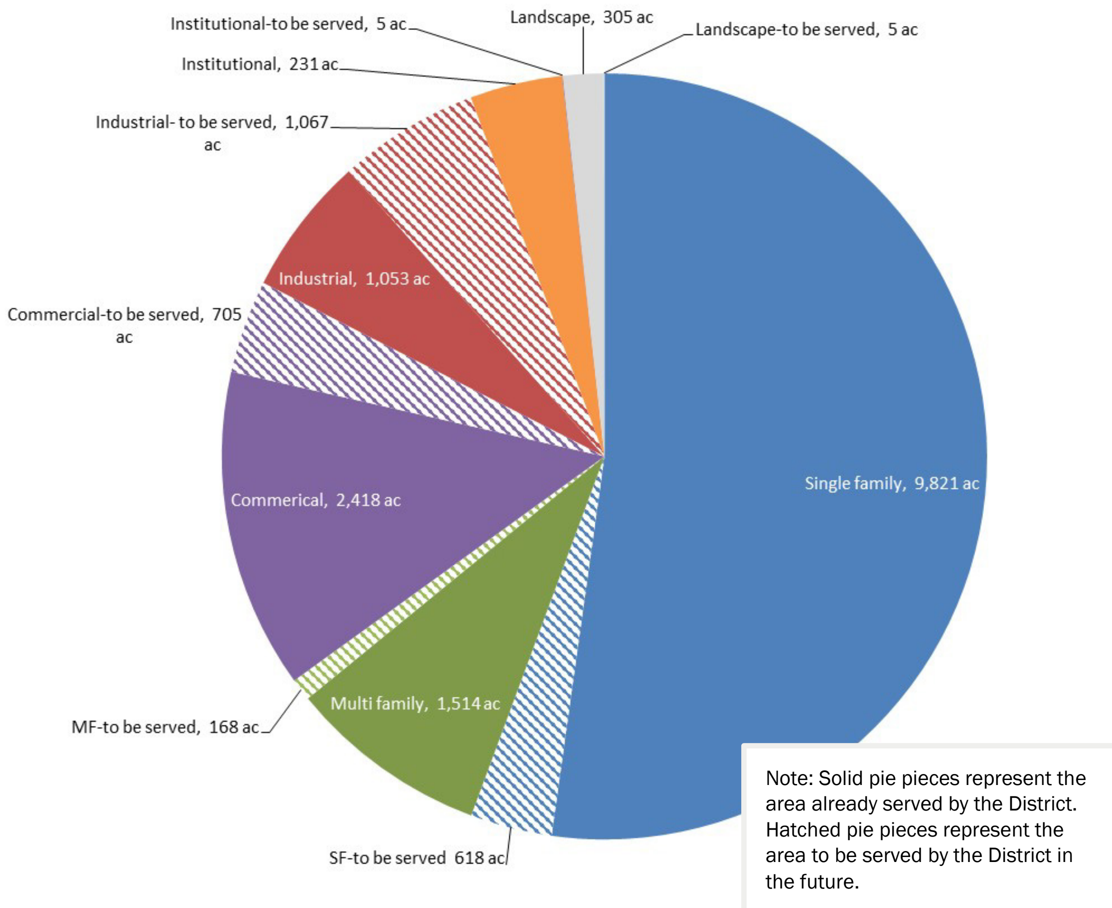

Figure 3-7. Acreage to be Served Compared to Acreage Served Currently by the District

Table 3-4. Current and Buildout Area by Customer Sector

Customer sector	2015 Developed Area[(a)], acres	2015 Area Not Currently Served by the District[(b)], acres	Total Buildout Area[(c)], acres	Area Served by Private Wells, acres
Single family	9,350	618	9,969	507
Multi family	1,514	168	1,682	1
Commercial	2,418	705	3,123	35
Industrial	1,053	1,067	2,119	6
Institutional	701	5	706	60
Landscape irrigation	305	5	311	-
Total	**15,342**	**2,568**	**17,910**	**610**

Note: This table does not include the acres within the District with natural preserve and open space land use zoning that are not served by the District.

(a) *2015 developed area only includes the area served by the District and does not include areas not currently served by the District or served by private wells. 2015 developed acres do not include the 439 acres classified as non-irrigation acreage for natural preserve and open space land use.*

(b) *2015 area not currently served by the District does not include areas served by private wells.*

(c) *Total buildout area does not include area served by private wells.*

Table 3-5. Current and Buildout Land Use by Service Area				
Service area	2015 Developed Area [a], acres	2015 Area not Currently Served by the District [b], acres	Total Buildout Area [c], acres	Area Served by Private Wells, acres
AASA				
Single family	151	53	203	-
Public	6		6	
Total	**157**	**53**	**210**	
McClellan			-	-
Commercial	127	294	422	-
Industrial	587	857	1,444	-
Mixed land use	7	4	10	-
Total	**721**	**1,155**	**1,875**	
NSA			-	
Rural estate	75	99	174	2
Single family	5,153	361	5,514	110
Multi-family - low density	772	130	901	1
Multi-family - high density	-	-	-	-
Mixed land use	471	96	568	29
Commercial	970	205	1,175	3
Industrial	466	210	676	6
Public recreation	130	5	136	-
Public	403	5	408	60
Non-irrigated	28	-	28	-
Total	**8,467**	**1,112**	**9,579**	**212**
SSA			-	
Single family	3,972	105	4,077	395
Multi-family - high density	11	-	11	-
Multi-family - low density	731	38	769	0
Commercial	843	105	948	3
Public	292	-	292	-
Public recreation	175	-	175	-
Non-irrigated	411	-	411	-
Total	**6,436**	**249**	**6,585**	**398**
District total [d]	**15,781**	**2,568**	**18,349**	**610**

(a) *2015 developed area only includes the area served by the District and does not include areas not currently served by the District or served by private wells.*

(b) *2015 area not currently served by the District does not include areas served by private wells.*

(c) *Total buildout area does not include area served by private wells.*

(d) *District total acreage includes 429 acres classified as non-irrigation acreage for natural preserve and open space land use. Table 3-4 does not include this acreage.*

3.4 Buildout Analysis of Connections, Population, and Dwelling Units

The number of dwelling units (DUs), population, and connections at buildout is based on the estimate of the buildout area by land use type presented in Section 3.3. Buildout connections are estimated directly based on the buildout land area followed by buildout population and buildout dwelling units that are estimated based on the buildout number of connections.

Buildout connections - The number of connections at buildout is based on the 2015 connections per acre ratio by customer sector. 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 residential connections at buildout may be overestimated due to land use zoning in the District's service area that may not represent the actual land use. For example, there are parks within the District's service area that are currently zoned as single family residential. An analysis to identify the area in the District that is used as parks but that is currently zoned as single family identified 470 acres. The land use of these 470 acres are reclassified from single family to irrigation acres for the purpose of this buildout land use analysis.

Buildout population - The buildout population for the District is estimated using the projected number of single family and multi family connections combined with the number of people per single family connection (3.06) and the number of people per multi-family connection (14.6), respectively from the 2010 Census as determined using the DWR population tool. This results in an overall 4.12 people per residential connection. Because the District is close to buildout it is assumed the people per residential connection will not significantly change from 2010 through buildout.

Buildout DUs - The total number of DUs at buildout is based on the overall total number of people per dwelling unit (2.32) from the 2010 Census. The number of single family dwelling units is based the assumed one single family dwelling unit per single family connection. The number of multi family dwelling units is the total dwelling units minus the single-family dwelling units. This results in 1.56 people per multi family dwelling unit, and 9.2 multi family dwelling units per multi family connection.

The projected DUs, population, and connections at buildout by land use category are shown in Table 3-6. Population per DU and per connection, DUs per connection, and connections per acre by land use category are also shown in this table.

Table 3-6. Buildout Connections, Population, and Dwelling Units by Customer Sector

Customer Sector	Connections	Population	Dwelling Units	Population/ Dwelling Unit	Population/ Connection	Dwelling Units/ Connection	Connections/ acre
Single family	40,989	125,427	40,989	3.06	3.06	1.0	4.1
Multi family	4,471	65,232	41,040	14.6	1.59	9.2	2.7
Commercial	3,602	--	--	--	--	--	1.2
Industrial	34	--	--	--	--	--	0.02
Institutional	546	--	--	--	--	--	0.8
Landscape irrigation	604	--	--	--	--	--	1.9
Total	**50,247**	**190,659**	**82,029**	**3.8**	**2.32**	**1.6**	**2.8**

A comparison of the 2010 and buildout demographic factors for the District to 2010 data from the City of Sacramento, Sacramento County Water Agency Zone 40, and the City of Roseville is summarized in Table 3-7.

Table 3-7. Comparison of District 2014 and Buildout Demographic Factors with Nearby Water Agencies

Category	City of Sacramento, 2010 [a]	SCWA Zone 40, 2010 [b]	City of Roseville, 2010 [c]	District	
				2010	Buildout
Population	466,488	148,992	114,078	170,050	190,659
Connections					
SFR conn	113,375	43,659	34,801	37,366	40,989
MFR conn	19,143	212	1,650	3,831	4,471
Non-res conn	10,456	1,729	3,001	2,987	4,786
Total connections	133,696	45,600	39,452	44,184	50,247
Dwelling units					
SF DU	119,000	43,659	--	37,366	40,989
MF DU	60,000	4,888	--	35,729	41,040
Per connection factors					
Population/connection	3.49	3.27	2.89	3.85	3.79
Population/residential connection	3.52	3.4	3.13	4.13	4.19
MF DU/MF connection	3.13	23.1	--	9.33	9.18
Population/dwelling unit	2.61	3.07	--	2.33	2.32

[a] *Source: City of Sacramento 2010 Urban Water Management Plan*

[b] *Source: SCWA 2015 Water System Master Plan*

[c] *Source: City of Roseville 2010 Urban Water Management Plan*

3.5 Connections, Population, and Dwelling Units Growth Projection

The future growth rate of the District is expressed as the growth in the number of water system connections, population, and dwelling units. The future growth in water system connections is projected based on the growth in connections for each customer sector occurring over the past ten to twenty years. The District's overall connection average annual growth rate occurring from 1995 to 2014 is 0.44 percent. Based on this 20-year historical annual average growth rate, the District is projected to reach buildout by 2031. The connection growth assumptions by customer sector are described below:

Single family - It is assumed that the 10-year historical annual average growth rate for this sector is more accurate than the 20-year growth rate for this sector due to fluctuations in single family connections prior to 2005. Projected growth in single family customers is based on the 10-year historical annual average growth rate for single family connections occurring from 2005 through 2014 (0.44 percent).

Multi-family – Because the multi-family number of connections has fluctuated dramatically historically, it is difficult to base future growth on any historical trend. The projected growth within the

District's multi-family sector is based on 30 to 35 new connections per year from 2015 through 2023.

Non-residential sectors – The projected growth in the commercial, industrial, institutional, and landscape irrigation sectors is based on a constant number of connections added annually from 2014 until buildout.

The number of new connections estimated to occur each year for each customer sector is presented in Table 3-8. The projected number of connections in 5-year increments by customer sector is summarized in Table 3-9. The projected number of connections through buildout is illustrated on Figure 3-8.

Table 3-8. Projected New Connections by Customer Sector

Year	Single Family	Multi Family	Commercial	Industrial	Institutional	Landscape Irrigation	Total
2016	146	35	75	1	0	1	258
2017	146	35	75	1	0	0	257
2018	147	35	75	1	1	1	260
2019	147	30	75	1	0	0	253
2020	148	30	75	1	0	1	255
2021	148	30	75	1	0	0	254
2022	149	30	75	1	1	1	257
2023	150	30	75	1	0	0	256
2024	150	0	75	1	0	1	227
2025	151	0	75	1	0	1	228
2026	151	0	75	1	1	1	229
2027	152	0	75	1	0	1	229
2028	152	0	59	1	0	1	213
2029	153	0	0	1	0	1	155
2030	154	0	0	0	0	0	154
2031	111	0	0	0	0	0	111
Total	**2,355**	**255**	**959**	**14**	**3**	**10**	**3,596**

Table 3-9. Projected Connections in 5-Year Increments								
Customer Sector	2010	2015	2020	2025	2030	2035	2040	Buildout (2031)
Single family	37,366	38,634	39,368	40,116	40,878	40,989	40,989	40,989
Multi family	3,831	4,216	4,381	4,471	4,471	4,471	4,471	4,471
Commercial	2,127	2,643	3,018	3,393	3,602	3,602	3,602	3,602
Industrial	13	20	25	30	34	34	34	34
Institutional	471	543	544	545	546	546	546	546
Landscape	376	594	597	600	604	604	604	604
Total	**44,184**	**46,650**	**47,933**	**49,155**	**50,135**	**50,246**	**50,246**	**50,246**

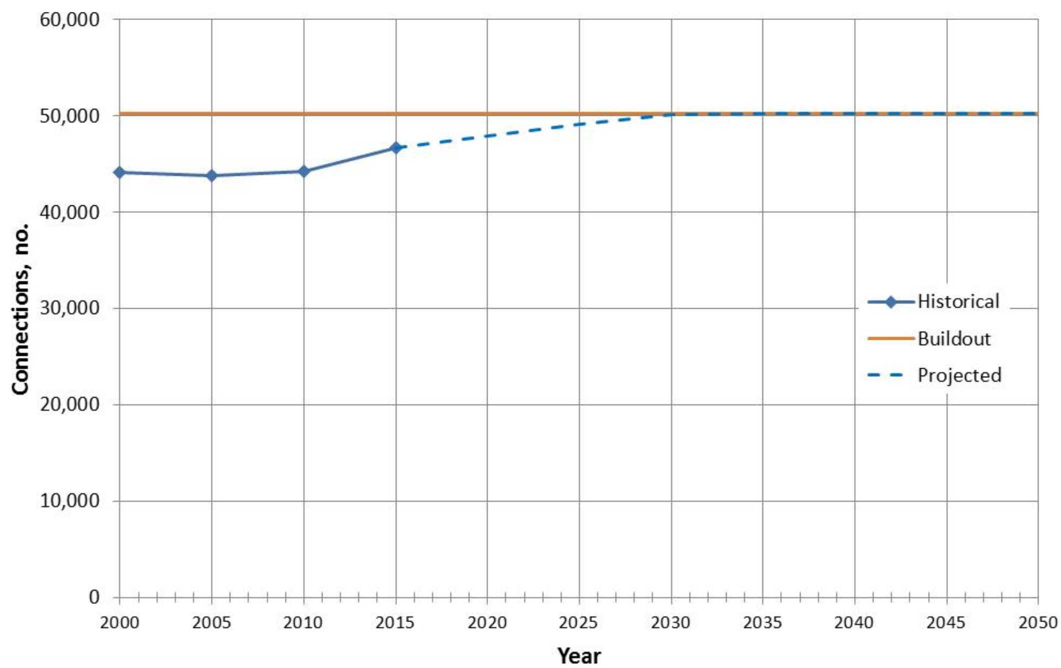

Figure 3-8. Historical and Projected District Connections

The projected population and dwelling units in five year increments is shown in Table 3-10.

Table 3-10. Projected Population and Dwelling Units in 5-Year Increments							
	2015	2020	2025	2030	2035	2040	Buildout (2031)
Population	173,588	184,385	187,987	190,319	190,659	190,659	190,659
Dwelling Units							
Single family	38,634	39,368	40,116	40,878	40,989	40,989	40,989
Multi-family	36,050	39,962	40,763	41,004	41,040	41,040	41,040
Total	**74,684**	**79,330**	**80,879**	**81,883**	**82,029**	**82,029**	**82,029**

3.6 Historical Water Production and Use

The District's historical water production for surface water and groundwater in the NSA and SSA is shown in Table 3-11 and illustrated on Figure 3-9. The District's surface water source from 1997 through 1999 was United States Bureau of Reclamation (USBR) 215 water. Surface water used in the NSA from 2000 through 2010 was supplied by PCWA. The City water supply began being used in 2007 in the SSA.

Table 3-11. Historical Water Production

	Surface water, ac-ft/yr			Groundwater, ac-ft/yr			Surface Water/Total Supply, %	Total Supply			Average Annual, MGD
Year	NSA	SSA	Total	NSA	SSA	Total		NSA	SSA	Total	Total
1995	1,914	501	2,416	20,493	18,624	39,117	6%	22,408	19,125	41,533	37.1
1996	1,502	715	2,217	21,847	19,029	40,876	5%	23,350	19,743	43,093	38.5
1997	932	336	1,268	22,297	19,968	42,265	3%	23,229	20,304	43,533	38.9
1998	12,361	-	12,361	9,805	18,294	28,099	31%	22,167	18,294	40,460	36.1
1999	8,574	-	8,574	16,378	20,572	36,950	19%	24,952	20,572	45,524	40.6
2000	14,988	-	14,988	12,206	19,870	32,075	32%	27,194	19,870	47,064	42.0
2001	15,483	-	15,483	12,182	21,610	33,792	31%	27,666	21,610	49,276	44.0
2002	16,929	803	17,732	9,077	21,794	30,870	36%	26,005	22,597	48,602	43.4
2003	13,140	3,860	17,000	10,265	20,049	30,314	36%	23,405	23,909	47,313	42.2
2004	15,337	-	15,337	10,725	22,535	33,260	32%	26,062	22,535	48,597	43.4
2005	14,363	-	14,363	5,681	21,147	26,827	35%	20,043	21,147	41,190	36.8
2006	13,073	-	13,073	5,712	20,917	26,630	33%	18,785	20,917	39,703	35.4
2007	3,842	3,701	7,543	21,838	16,091	37,930	17%	25,680	19,792	45,473	40.6
2008	12,238	2,743	14,981	6,984	16,530	23,514	39%	19,222	19,273	38,495	34.4
2009	8,211	3,872	12,083	10,203	12,817	23,020	34%	18,413	16,689	35,103	31.3
2010	15,518	2,289	17,807	6,522	13,654	20,176	47%	22,040	15,943	37,983	33.9
2011	12,626	4,084	16,710	7,738	11,381	19,119	47%	20,364	15,465	35,829	32.0
2012	4,096	6,463	10,559	17,697	9,833	27,530	28%	21,793	16,296	38,089	34.0
2013	409	-	409	21,869	16,276	38,145	1%	22,278	16,276	38,554	34.4
2014	-	-	-	18,790	13,771	32,561	0%	18,790	13,771	32,561	29.1
2015	80	-	80	15,702	11,719	27,422	0%	15,782	11,719	27,502	24.6
1995 - 2015 average	8,839	1,398	10,237	13,524	17,452	30,976	24%	22,363	18,850	41,213	37
2010 - 2015 average	5,455	2,139	7,594	14,720	12,772	27,492	20%	20,174	14,912	35,086	31

NSA surface water source in 1997 through 1999 was USBR 215 water. NSA surface water 2000 through 2010 surface water source was PCWA.

SSA surface water prior to 2007 is from American River wells. SSA surface water beginning in 2007 is from City of Sacramento.

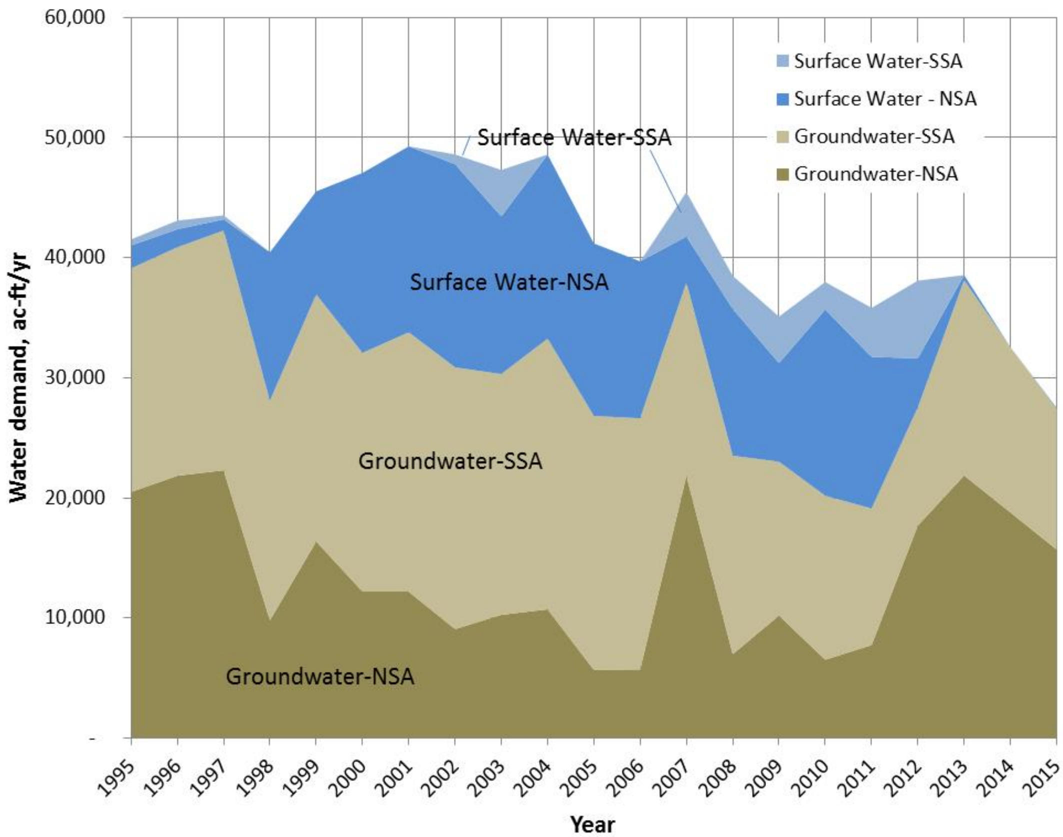

Figure 3-9. Historical Annual Water Production by Source and Service Area

The District's historical water use by customer category from 2010 through 2015 is shown in Table 3-12 and illustrated on Figure 3-10. The District's historical metered water use by customer category is based on metered demand data. The water use for the unmetered single family, multi-family, and commercial customers is estimated by subtracting all metered uses plus the assumed unaccounted-for water (UAW). UAW is assumed to be 8 percent of production with the exception of 4 percent assumed for 2015 due to the drought water use restrictions.

Table 3-12. Historical Demands, ac-ft/yr

Use Type	2010	2011	2012	2013	2014	2015
Single family	15,762	15,383	18,304	16,943	14,244	12,972
Multi-family	11,264	8,409	8,337	8,726	7,142	6,580
Commercial	3,325	3,571	3,950	4,854	4,085	3,614
Industrial	10	22	34	37	31	32
Institutional/governmental	2,062	2,550	2,853	3,056	2,656	2,020
Landscape irrigation	1,019	1,091	969	1,535	1,693	1,135
Sales/transfers/exchanges to other agencies	1,632	2,106	647	347	115	51
Losses	2,908	2,698	2,995	3,057	2,596	1,098
Total	**37,983**	**35,829**	**38,088**	**38,554**	**32,561**	**27,502**

Historical water sales to other water agencies are summarized in Table 3-13.

Table 3-13. Water Sales Outside the District, ac-ft/yr						
Receiving Agency	2010	2011	2012	2013	2014	2015
Arden Park Vista	-	-	5	-	-	0.01
Del Paso Manor	-	-	5	-	-	-
Citrus Heights Water District	1	1	-	17	-	-
San Juan Water District	-	-	-	-	-	51
City of Sacramento	-	-	28	331	104	-
Rio Linda/Elverta Water District	3	2	25	0.08	11	-
California American Water Company	1,628	2,102	584	-	-	-
Total	**1,632**	**2,106**	**647**	**347**	**115**	**51**

Figure 3-10. Historical Water Use

3.7 Unit Water Demand Factors

Buildout unit water demand factors (UWDFs) are developed by reviewing the District's historical water demand by customer category in comparison to the land area served and the number of connections by category. It is recognized that unit water use on a per capita basis has been trending downward for several years. As the District becomes fully metered, active and passive water savings occur, and the use of more water efficient structures and landscape are implemented, it can be concluded that the UWDFs for buildout should be lower than those previously established.

The current and buildout UWDFs by customer category expressed as ac-ft/acre/yr, gpd/acre, and gpd/connection are shown in Table 3-14. Current UWDFs are based on the year 2012 water use because 2012 is assumed to be a year closer to normal demand than 2015 due to the recent drought and resulting reduced water demands in 2015. It is assumed that the 2012 land area is similar to the land areas calculated in this analysis based on 2015 parcels. UWDFs categories are shown for buildout in Table 3-14 to reflect the estimate of water use differences between existing non-metered, existing metered, and new connections. Future water savings from the District's conservation program and passive savings as a result of changes in codes and regulations related to devices are incorporated into the buildout UWDFs. See Section 3.9 for a discussion of the expected future passive water savings in the District. The subject of additional water conservation effects on unit water use should be revisited by the District 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. 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 UWDFs in Table 3-14 exclude water losses.

Table 3-14. Unit Water Demand Factors

Customer Category	Current			Buildout		
	By Land Area		By Connection	By Land Area		By Connection
	ac-ft/acre/yr	gpd/acre	gpd/connection	ac-ft/acre/yr	gpd/acre	gpd/connection
Single family						
Existing connections- original devices	--	--	--	--	--	380
Existing connections - retrofitted/updated devices	--	--	--	--	--	373
Future connections	--	--	--	--	--	299
Total single family	**1.96**	**1,828**	**445**	**1.71**	**1,525**	**371**
Multi-family						
Existing connections- original devices	--	--	--	--	--	1,945
Existing connections - retrofitted/updated devices	--	--	--	--	--	1,892
Future connections	--	--	--	--	--	1,826
Total multi-family	**4.38**	**5,443**	**2,047**	**5.70**	**5,088**	**1,914**
Commercial						
Existing connections	--	--	--	--	--	1,471
Future connections	--	--	--	--	--	1,071
Total commercial	**1.62**	**1,707**	**1,471**	**1.77**	**1,583**	**1,365**

Table 3-14. Unit Water Demand Factors						
	Current			Buildout		
	By Land Area		By Connection	By Land Area		By Connection
Customer Category	ac-ft/acre/yr	gpd/acre	gpd/connection	ac-ft/acre/yr	gpd/acre	gpd/connection
Industrial						
Existing connections	--	--	--	--	--	1,763
Future connections	--	--	--	--	--	1,520
Total industrial	**0.03**	**28**	**1,763**	**0.03**	**27**	**1,663**
Institutional						
Existing connections	--	--	--	--	--	4,797
Future connections	--	--	--	--	--	4,528
Total institutional	**4.07**	**3,708**	**4,797**	**4.15**	**3,707**	**4,796**
Landscape irrigation						
Existing connections	--	--	--	--	--	1,909
Future connections	--	--	--	--	--	1,909
Total irrigation	**3.17**	**3,591**	**1,909**	**4.16**	**3,712**	**1,909**

3.8 Gallons Per Capita per Day

The assumed buildout UWDFs described in Section 3.7 result in an overall buildout per capita demand that is slightly greater than the 2012 GPCD value and slightly less than the GPCD target. Water use declined in 2014, 2015, and 2016 because of the Governor's drought declaration. It is assumed that the current decline in per capita water use due to the drought is temporary and will increase partially back to pre-drought levels.

New demand requirements are being developed by DWR as part of a draft plan (released for public review in December 2016) for achieving long-term efficient water use and meeting drought preparedness goals that reflect California's diverse climate, landscape, and demographic conditions. This draft plan builds on the mandatory water restrictions enacted during the recent drought and develops long-term water conservation measures. These requirements may result in a change in the demand projection for the District.

In the 2010 UWMP the District selected Method 1, eighty percent of the District's baseline per capital daily water use, to determine their urban per capita water use target. Based on Method 1 in the 2010 UWMP, the District's 2020 target was 193 GPCD with an interim 2015 target of 218 GPCD. With the updated historical population analysis incorporating the1990, 2000, and 2010 Census data described in Section 2, the District's baseline per capita water use, gross water use divided by service area population for each year for a selected 10-year period between 1995 and 2010. The District's 10-year baseline period is 1995 – 2004 and results in a baseline GPCD of 257, which is 6 percent higher than the baseline GPCD calculated in the 2010 UWMP, 242 GPCD. The District has selected to remain with Method 1, to determine its GPCD target, which results in an updated 2020 target of 205 GPCD, with an interim 2015 target of 239 GPCD. The estimated 2016 GPCD was 151 GPCD. Figure 3-11 illustrates the historical, projected, and target GPCDs for the District.

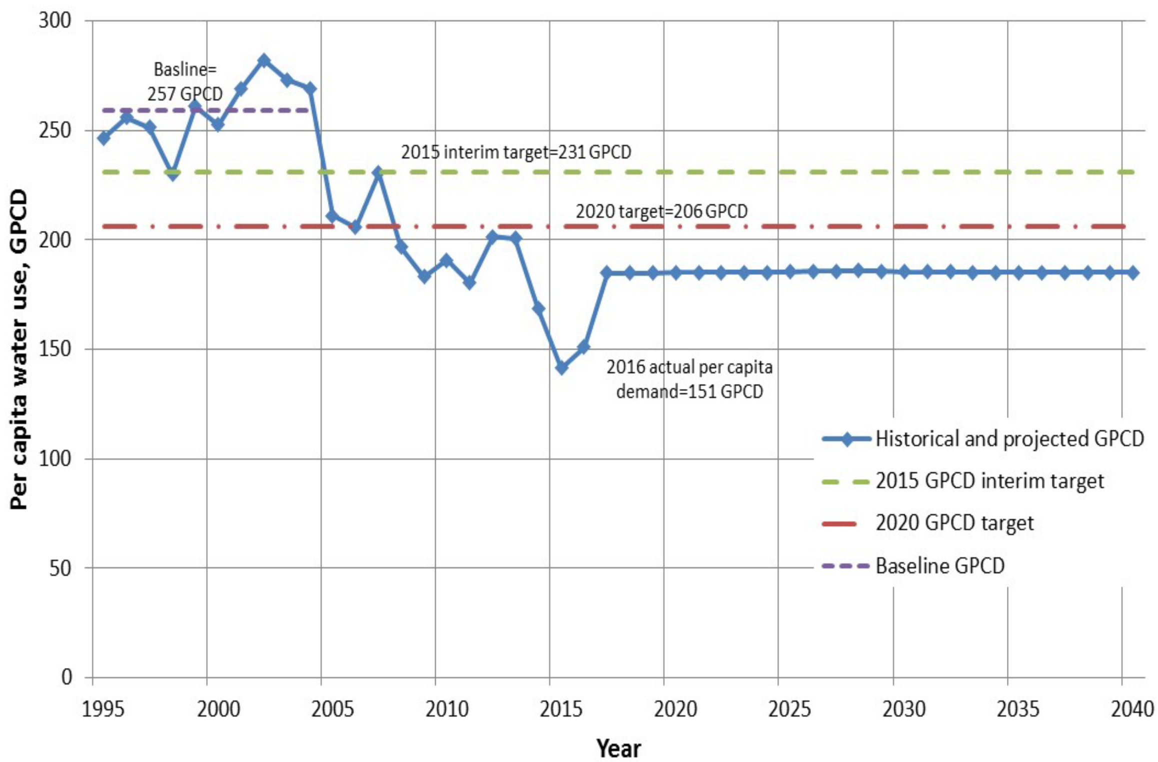

Figure 3-11. Historical and Projected GPCD vs Target GPCD

3.9 Estimated Future Water Savings

Water savings from codes, standards, ordinances, or transportation and land use plans are also known as "passive savings". These various factors generally decrease the water use for future customers, compared to existing non-retrofitted customers. Existing customers will decrease their demand through device retrofits. Below is a summary of the applicable state codes and ordinances that could reduce the District's water demand in the future based on information provided in the DWR 2015 UWMP Guidebook (DWR, 2016b).

Model Water Efficient Landscape Ordinance – Effective on December 1, 2015, this new ordinance is projected to reduce the typical residential outdoor landscape demands for new construction by up to 20 percent from the estimated demand using the prior ordinance provisions. Commercial landscape for new construction may reduce outdoor water demand by up to 35 percent over the prior ordinance.

California Energy Commission Title 20 appliance standards for toilets, urinals, faucets, and showerheads – This standard will impact both new construction and replacement fixtures in existing homes. This is included in the CALGreen assumption for new construction described below. Assume up to 5 percent reduction in indoor water use of existing homes.

CALGreen Building Code – Requires residential and non-residential water efficiency and conservation measures for new buildings and structures. It is assumed that this code will reduce residential and non-residential indoor water use on new construction by up to 20 percent.

A summary of the estimated future passive water savings for the District's service area is provided in Table 3-15.

Table 3-15. Estimated Future Passive Water Savings from Projected Water Demands					
	2020	2025	2030	2035	2040
Single family, ac-ft/yr	180	316	413	453	476
Multi-family, ac-ft/yr	112	137	149	162	172
Commercial, ac-ft/yr	168	336	430	430	430
Total, ac-ft/yr	461	789	992	1,044	1,078
Total, GPCD	**2**	**4**	**5**	**5**	**5**

Based on these assumed reductions in water use by customer sector, it is estimated that the District could realize approximately 1,100 ac-ft/yr of passive water savings by 2040. In terms of GPCD this is approximately 5 GPCD in passive water savings by 2040 from these codes and ordinances. The water use projections in this analysis do account for these passive water savings that may be realized from these codes and ordinances.

It is estimated that the District's water conservation program will result in water savings for the single family, multi-family, and commercial customer sectors. The estimated water savings from the District's current water conservation program is expected to be up to 2,200 ac-ft/yr.

3.10 Water Demand Projections

This section describes the estimated buildout demands and projected growth to reach buildout.

3.10.1Buildout Water Demands

The buildout water demands are estimated by combining the estimate of the number of buildout connections for each customer category with the buildout water use per connection UWDF for each customer category. Table 3-16 summarizes the buildout water demand within the District.

Table 3-16. Buildout Water Demand by Customer Sector	
Customer Sector	Water Demand, ac-ft/yr
Single family	17,030
Multi-family	9,587
Commercial	5,505
Industrial	63
Institutional	2,933
Landscape	1,292
Water system losses (8% of water production)	3,166
Total production	**39,577**

Note: Does not include water sales to others.

Water loss includes water loss due to leaks, breaks, storage overflows, water use for firefighting, line flushing, and other authorized, but unbilled uses. Since the District is not completely metered, data are unavailable for determining the current percent of water loss. Water loss is assumed to be 8 percent of water production.

The increase in demand to buildout for each service area is based on the projected increase in served land for each service area from 2015 to buildout. Table 3-17 summarizes the estimated water demand within each service area in 2013 (considered a normal climate year) and at buildout.

Table 3-17. Projected Water Demand by Service Area, ac-ft/yr

Service Area	2013	Buildout (2031)
NSA	18,765	20,888
SSA	17,437	16,368
AASA	1,155	449
McClellan	850	1,871
Total	**38,207**	**39,577**

Note: Does not include water sales to others.

Table 3-18 compares historical and projected buildout metrics including demand per capita, per dwelling unit, per connection, and per acre for the District. Below are some observations regarding some of the factors with the larger change ratios between 2012 and buildout.

- GPCD decreases by eight percent from 2012 to buildout. It is assumed that reduced demands because of the drought will not increase back completely to 2012 conditions.
- Non-residential water use/DU factor increases from 2012 to buildout by 10 percent. This reflects the increase in the amount of non-residential land area.

Table 3-18. Comparison of 2012 to Buildout Metrics

	2012	Buildout	Change Ratio
Gallons per capita per day (gpcd)	201	185	0.92
Total use/total DU, gpd/DU	468	431	0.92
SFR use/ SFR DU, gpd/DU	445	371	0.83
MFR use/MFR DU, gpd/DU	215	209	0.97
MFR DU/MFR con	9.1	9.2	1.01
Non-res use/DU, gpd/DU	97	107	1.10
Total use/total con, gpd/connection	760	703	0.92
SFR use/SFR con, gpd/connection	445	371	0.83
MFR use/MFR con, gpd/connection	1,953	1,914	0.98
Non-res use/non res con, gpd/connection	2,054	1,827	0.89
Total demand per developed acre, ac-ft/ac	**2.44**	**2.21**	**0.91**

SFR=single family residential

MFR=multi-family residential

3.10.2 Water Demand Projection

Water demand projections for the years prior to buildout are determined based on the projected connection growth described previously. The projected water demands by use type are shown in Table 3-19 and illustrated on Figure 3-12.

Table 3-19. Projected Demands, ac-ft/yr							
Use Type	2015	2020	2025	2030	2035	2040	Buildout (2031)
Single family (unmetered)	1,593	2,090	-	-	-	-	-
Single family (metered)	11,379	14,576	16,864	16,999	17,007	16,983	17,030
Total single family	12,972	16,665	16,864	16,999	17,007	16,983	17,030
Multi-family	6,580	9,431	9,602	9,589	9,577	9,567	9,587
Commercial	3,614	4,805	5,255	5,505	5,505	5,505	5,505
Industrial	32	48	57	63	63	63	63
Institutional/governmental	2,020	2,923	2,928	2,933	2,933	2,933	2,933
Landscape	1,135	1,277	1,283	1,292	1,292	1,292	1,292
Sales/transfers/exchanges to other agencies	51	1,800	1,800	1,800	1,800	1,800	1,800
Losses	1,098	3,056	3,121	3,164	3,163	3,160	3,166
Total	**27,502**	**40,004**	**40,910**	**41,345**	**41,340**	**41,304**	**41,377**

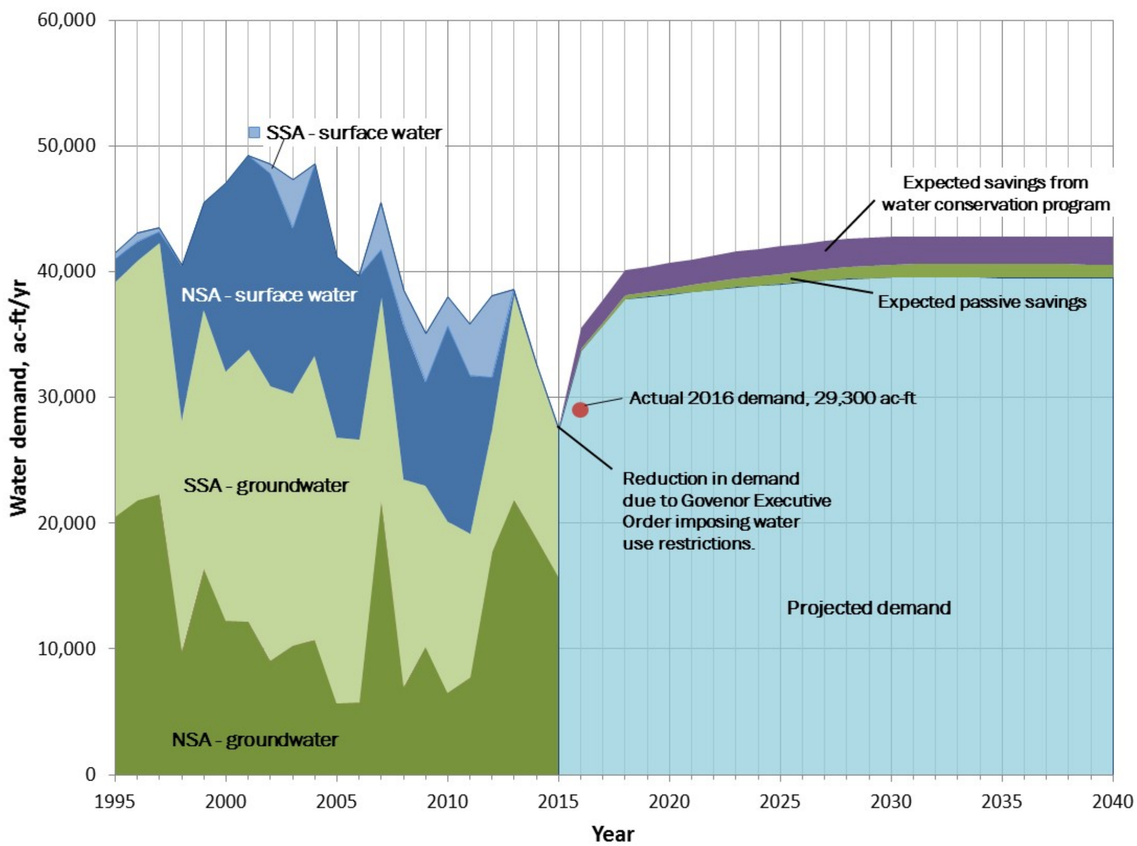

Figure 3-12. Water System Historical and Projected Water Demand

Notes: Sales to other agencies not shown. 2016 actual demand is 29,300.

The water sales to other agencies are projected to be up to 1,800 ac-ft/yr. In 2001 the District participated in a pilot groundwater banking and exchange program in conjunction with the Regional Water Authority (RWA). This pilot program transferred water to the DWR environmental water account on a short-term basis. It is anticipated that similar transfer opportunities will occur in the future. The District intends to work with the RWA to identify both short-term and long-term water sales opportunities with other RWA members.

3.11 Water Demand Peaking Factors

Water use varies continuously throughout a given day, as well as seasonally. These variations must be taken into account when developing projected water needs and defining needed facility improvements.

Maximum water demands normally occur in June, July, August, and September. Increased landscape irrigation during the hot, dry weather is largely responsible for these higher demands. The ratio between maximum and average day demands provides a maximum day demand (MDD) peaking factor (PF) that can be used to scale future demand projections. The ratio of peak hour and maximum day demand provides a peak hour demand factor (PHD) PF.

The historical maximum day peaking factor for the District since 2008 is shown in Table 3-20. The MDD PF has fluctuated from year to year. In previous planning exercises the District has used a MDD PF of 2.0. For this analysis a MDD PF of 1.9 is used for estimating future maximum day demands for the NSA and SSA. This is based on the assumption that peak demands will decrease into the future due in part to the District's conservation efforts that result in reduced summer peak demands. An analysis of the District's summer diurnal SCADA production data in the previous WSMP (Brown and Caldwell, 2009) identified a peak hour demand (PHD) to MDD peaking factor of 1.5 in the SSA and 1.7 in the NSA. An update of the analysis of diurnal demands was not conducted for this analysis because the data utilized to estimate the peak hour peaking factors was based on normal year conditions.

Table 3-20. Maximum Day Demand Peaking Factors Analysis

Year	Average Day Demand (ADD), ac-ft/yr		Maximum Day Demand (MDD), MGD	MDD/ADD Peaking Factor
	ac-ft/yr	MGD		
2008	38,498	34.37	72.91	2.1
2009	35,105	31.34	56.68	1.8
2010	36,351	32.45	61.64	1.9
2012	37,442	33.43	77.70	2.3
2013	38,207	34.11	60.29	1.8
Average	**34,903**	**31.16**	**64.09**	**2.0**

Table 3-21 provides the summary of the buildout maximum day and peak hour demand demands estimated for the pressures zones in the NSA (North Highlands (NSA 4), MBPSA, and NSA 1, 2, and 3) and the SSA, based on the buildout demands and peaking factors established in this section.

Table 3-21. Buildout Water Demands by Service Area							
	NSA					Total SSA (SSA subareas 1,2,3,4)	Total System
	NSA Subareas 1,2,3	NSA Subarea 4 (North Highlands)	AASA	McClellan	Total NSA		
Average annual, ac-ft/yr	16,364	4,312	1,156	1,561	23,393	16,183	39,576
Average day, MGD	14.6	3.8	1.0	1.4	20,9	14.4	35.3
ADD/MDD peaking factor	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Maximum day, MGD	27.8	7.3	2.0	2.6	39.7	27.5	67.2
gpm	19,277	5,079	1,362	1,839	27,557	19,064	46,621
PHD/MDD peaking factor	1.7	1.7	1.7	1.7	1.7	1.5	1.62
Peak-hour, gpm	32,770	8,635	2,316	3,126	46,847	28,596	75,443

Note: Does not include water sales to others.

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Section 4

Water Supplies

Since the previous water master plan was prepared several changes have occurred in the availability of water supplies. Several consecutive dry years have occurred that resulted in mandated demand reductions and reductions in available surface water supplies. Projected buildout water demands have been reduced as presented in Section 3. Folsom Reservoir reached a record low level of 160,000 acre feet (ac-ft) in February 2014. The District has an aging groundwater well field as noted in Section 7. The encouragement of conjunctive use and groundwater banking has occurred at the state levels. RWA has initiated a regional water supply reliability study and the RiverArc project has seen some initial progress. This section describes the current situation with the District's water supplies and evaluates water supply alternatives to meet the District's needs and opportunities to maximize facility value.

Strategic Plan Alignment

Water Supply – 1.B. - Provide for the long-term water supply needs of the customers through prudent planning that will ensure capacity to serve system demands.

- **Projected water supplies in varying climate year types.**

Water Supply – 1.D. – Manage the District's water supplies to ensure their quality and quantity

- **Evaluation of conjunctive use of water supplies.**

Finance – 4.I. - Pursue opportunities for grant funding and cost savings activities with collaborative entities.

- **Description of alternatives to partner with other water agencies that would provide cost savings.**

Leadership – 5.C. - Participate in regional, statewide and national water management partnerships.

- **Description of partnerships with Water Forum, Sacramento Groundwater Authority, and other water agencies.**

Leadership – 5.D. - Provide leadership within the community in a positive manner for the mutual benefit of the area (service groups, adjacent water purveyors, county/city/local government).

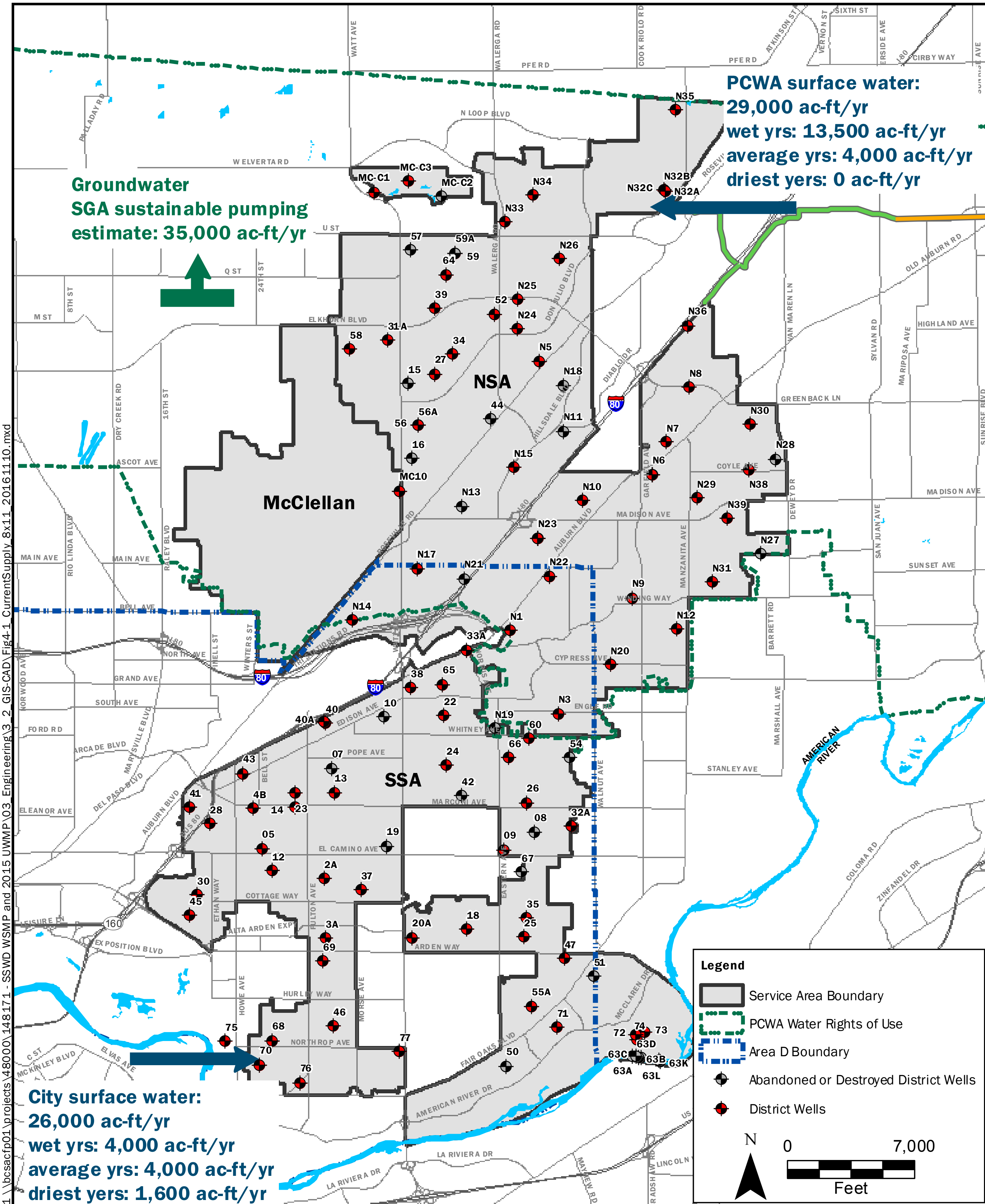
- **Description of alternatives to partner with other agencies to sell water provides the Board information to help decide on policy direction to provide leadership.**

Policy Implications

- **The assumed amounts of surface water available from PCWA and the City are reduced.**
- **The higher costs of purchased surface water supplies are considered.**
- **The occurrence of Water Forum drier and driest years has increased in recent years.**
- **The costs and revenue potential of partnering with other water agencies to supply water to others is evaluated, including groundwater banking.**

4.1 Existing Water Supplies

Water for the District is supplied from currently reliable active groundwater wells and intermittently purchased surface water as summarized in Figure 4-1. This section describes the District's existing water supplies.



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DATE	PROJECT	SITE
11/9/16	148171	**Water System Master Plan** **Sacramento Suburban Water District**

Brown AND Caldwell

TITLE

Current Water Supplies

Figure 4-1

4.1.1 Groundwater

Historically, groundwater has been the primary source of water for both the NSA and SSA. A list of the District's wells and their capacities is provided in Section 2.2.1. This section presents a description of the groundwater basin, banking, pumping targets, and contamination.

4.1.1.1 Groundwater Basin Description

The groundwater basin underlying the District is located in the North American Subbasin (DWR number 5-021.64), which is part of the larger Sacramento Valley Groundwater Basin. The water-bearing deposits underlying the District include the Miocene/Pliocene volcanic Mehrten Formation. Overlying units known collectively as "older-alluvium" include the Pliocene and Pleistocene, Modesto, Riverbank, and Turlock Lake formations (DWR, 2006). The Mehrten Formation is the most productive fresh water-bearing unit in the eastern Sacramento Valley, though some of the permeable layers of the overlying older alluvium produce moderate amounts of water. Groundwater is generally recharged along the east side of the subbasin and through the younger alluvium of streams and rivers, and flows west/southwest through the subbasin.

The historical use of groundwater in the North American Subbasin (5-21.64) through the mid-1990s resulted in a general lowering of groundwater levels that have stabilized in recent years. These depressions have grown and coalesced into a single cone of depression in the central area of the subbasin centered in the area of the prior McClellan Air Force Base. Groundwater elevations in the eastern and western areas of the North American Subbasin (5-21.64) have been fairly stable. The groundwater level stabilization in the cone of depression was due, at least in part, to expanded conjunctive use operations by water agencies including the District in this area.

4.1.1.2 Groundwater Quality

The groundwater quality in the North American Subbasin (5-21.64) is generally excellent. The total dissolved solids varied from 120 to 410 parts per million and hardness varied from 51 to 220 parts per million according to the 2015 Consumer Confidence Report. Most municipal wells do not currently need any treatment to meet drinking water standards other than disinfection. However, there are some wells that have iron and manganese treatment, as well as locations with elevated levels of arsenic and hexavalent chromium. Several wells have been closed due to the presence of hexavalent chromium.

There are several groundwater contaminant plumes and some point sources of contamination (e.g., leaking underground storage tanks). The three largest groundwater contaminant plumes emanate from source areas at the prior McClellan Air Force Base, the Roseville railroad yard, and the Aerojet facility in Rancho Cordova. The presence of these contaminant plumes has resulted in the closure of some municipal wells owned by other water suppliers and limits the construction of new municipal wells in the vicinity of the contaminant plumes. Significant remediation efforts/programs by federal, state, and local government agencies are in progress to confine and clean up the contaminated groundwater. However, there is no assurance that these groundwater contaminant plumes have been completely contained.

The trend to more stringent drinking water standards and the presence of contaminants within the groundwater basin are a potential threat to the District's groundwater supply. There is a possibility that all the District's groundwater wells may someday need to have treatment facilities.

4.1.1.3 Groundwater Management

The groundwater in the southern portion of the North American Subbasin (DWR number 5-021.64), the portion in Sacramento County, is currently managed by the Sacramento Groundwater Authority (SGA). SGA draws its authority from a joint powers agreement signed by the cities of Citrus Heights, Folsom, and Sacramento and the County of Sacramento to exercise their common police powers to manage the underlying groundwater basin. The District is a participating agency in SGA. The goal of the SGA is to ensure a viable groundwater resource for beneficial uses including agricultural, industrial, and municipal supplies that support the Water Forum Agreement's co-equal objectives of providing a reliable and safe water supply and preserving the fishery, wildlife, recreational, and aesthetic values of the lower American River.

The SGA Groundwater Management Plan was first completed in December 2003 and subsequently updated several times. The SGA prepares a biannual report to evaluate progress on Groundwater Management Plan implementation and to report on basin conditions.

The Sustainable Groundwater Management Act (SGMA) was enacted by the legislature in 2014, with subsequent amendments in 2015. SGMA requires groundwater management in priority groundwater basins, which includes the formation of Groundwater Sustainability Agencies (GSAs) and the development of Groundwater Sustainability Plans (GSPs) for groundwater basins or subbasins that are designated by DWR as medium or high priority.

The designation of the priority of groundwater basins was done as part of the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. CASGEM was developed in response to legislation enacted in California's 2009 Comprehensive Water package. The CASGEM Groundwater Basin Prioritization is a statewide ranking of groundwater basin importance that incorporates groundwater reliance and focuses on basins producing greater than 90 percent of California's annual groundwater. The CASGEM Program has ranked the North American Subbasin (5-21.64) as high priority.

SGMA directs DWR to identify groundwater basins and subbasins in conditions of critical overdraft. DWR identified such basins in Bulletin 118, 1980 and Bulletin 118, Update 2003. DWR issued an updated draft list of critically overdrafted basins in July 2015. The North American Subbasin (5-21.64) that supplies the District is not on the list.

Groundwater basins designated as high or medium priority and critically overdrafted must be managed under a GSP by January 31, 2020. All other high and medium priority basins must be managed under a GSP by January 31, 2022. The North American Subbasin (5-21.64) is covered by the latter deadline.

A GSA must be formally established by June 30, 2017. The GSA will have enforcement authority over their designated portion of the basin. There are three options for preparing a GSP and forming a GSA, as follows:

- A single GSP covering the entire basin developed and implemented by one GSA.
- A single GSP covering the entire basin developed and implemented by multiple GSAs.
- Multiple GSPs implemented by multiple GSAs and coordinated pursuant to a single coordination agreement that covers the entire basin.

The various agencies that are located in the North American Subbasin (5-21.64) have been in discussions to explore options for the organization of one or more GSA's. It is likely that the North American Subbasin (5-21.64) will have several GSAs and possibly several GSPs. SGA filed a notice with DWR on October, 20, 2015 that it intends to be the GSA for a portion of the North American Subbasin (5-21.64).

The previous water master plan developed a groundwater pumping target for the District using three approaches. The results of the analysis provide a range of 24,000 ac-ft/yr to 41,000 ac-ft/yr for a possible groundwater pumping target. A long-term groundwater pumping target of 35,000 ac-ft/yr was selected. In June 2010, the SGA developed Phase III of the Water Accounting Framework which established a combined sustainable pumping estimate of 35,000 ac-ft/yr for the District (SGA, 2010). It is expected that the GSP that will be developed for the North American Subbasin (5-21.64) will establish a basin safe yield that may change this amount.

4.1.1.4 Groundwater Banking

The District has an in-lieu groundwater recharge program in place that involves the importation of surface water to partially offset groundwater usage, which has resulted in the local recovery of groundwater levels in the NSA. Since 1998, the District has recorded with the State Water Resources Control Board (SWRCB) the volume of water that has been banked via in-lieu groundwater recharge. Table 4-1 provides the volume that was banked annually from 1998 through 2015. The District has banked a total of 201,759 ac-ft since 1998.

Table 4-1. District Groundwater Banking Program Annual Volumes

Time Period	Volume Banked, ac-ft
1998 - 2001	47,307
10/01/02 – 09/30/03	17,113
10/01/03 – 09/30/04	15,902
11/01/04 – 10/31/05	13,685
11/01/05 – 10/31/06	14,869
10/01/06 – 10/01/07	10,836
11/01/07 – 10/30/08	13,590
2009	10,044
2010	16,932
2011	18,421
2012	10,559
2013	973
2014	0
2015	80
2016	11,448
Total	201,759

Source: First Statement and Annual Statements of Cessation or Reduction in Groundwater Extractions as submitted to the State of California State Water Resources Control Board, Division of Water Rights.

4.1.2 Surface Water

The District purchases surface water from PCWA, USBR, and the City. The District uses available surface water typically in wet years to meet a substantial portion of its overall water demand.

Beginning in the 1960s, the District began using surface water in limited quantities within the SSA. This surface water was pumped through several shallow infiltration wells (known as the American River Well Field) along the north bank of the American River. These wells were abandoned in 1997 as the result of a compliance order to install surface water treatment. Starting in 1991, surface water in limited quantities began to be used within the NSA. The use of surface water from PCWA within the NSA significantly expanded in 1998 with the completion of the CTP. Surface water use in the SSA began again in 2006 after the District purchased capacity in the City's E.A. Fairbairn WTP and complete construction of the Enterprise/Northrup reservoir and booster pump station project.

4.1.2.1 Water Forum Agreement

The District's use of surface water is controlled to some extent by the terms of the Water Forum Agreement. The District is a stakeholder in the Water Forum, a Sacramento regional water management initiative. The Water Forum Agreement was the result of the efforts of a diverse group of community organizations formed in 1994 to formulate principles for a regional solution to protecting the lower American River and providing for future water supply. The Water Forum Agreement 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 Water Forum Agreement identifies four water supply conditions based on the March to November unimpaired inflow into Folsom Reservoir (UIFR). Table 4-2 presents the water supply conditions with the exceedance probability based on the historical written flow record. As shown in Table 4-2, wet years as defined by the Water Forum Agreement are estimated to occur 62 percent of the time.

Table 4-2. Water Year Types and Exceedance Probability as Defined by the Water Forum Agreement

Water Forum Agreement Year Type	Unimpaired Inflow Into Folsom Lake, March Through November, ac-ft	Exceedance Probability, %	Percent of Time Year Type Occurs
Wet	Greater than 1,600,00	62	62
Average	Less than 1,600,000 and greater than 950,000	62 to 87	25
Drier	Less than 950,000 and greater than 400,000	87 to 98	11
Driest[a]	Less than 400,000	98	2

Source. SGA Basin Management Report 2016 Update.

[a] *In driest year types, diverters and others confer on how best to meet demands and protect the American River.*

4.1.2.2 Placer County Water Agency Agreement

In 1999, the former Northridge Water District and PCWA entered into a take or pay agreement for delivery of up to 29,000 ac-ft/yr from PCWA's Middle Fork Project supply, and started receiving the supply in 2000. The maximum amount started at 7,000 ac-ft/yr in the year 2000, and then ramped up to a maximum of 29,000 ac-ft per year in 2008. PCWA can take back the water at any time for their needs. The terms of the agreement can be extended by mutual consent of both parties.

According to the agreement, a 12,000 to 29,000 ac-ft/yr upper supply limit will be maintained through the twenty-fifth year of the agreement or 2024. To receive over 12,000 ac-ft/yr, the District has to request that PCWA provide the additional supply. After the first 10 years of the agreement (starting in 2010), the supply became available only during Water Forum wet years when the UIFR is greater than 1,600,000 ac-ft and no longer during average years. However, the District received 4,096 ac-ft in 2012, which was a Water Forum average year. The District has agreed to provide up to 2,000 ac-ft/yr of this supply to Cal Am. PCWA has projected that their supply to the District would be reduced to 12,000 ac-ft/yr at buildout of PCWA's service area, which is anticipated to occur after 2024 (Brown and Caldwell, 2006).

Table 4-3 presents the average supply and range of supply that has actually been received from PCWA for each of the Water Forum year types, as well as the supply amounts assumed for this study.

As shown in Table 4-3, it is assumed that some supply will be provided in both wet and average years.

The PCWA water is diverted at Folsom Reservoir through USBR facilities, treated at SJWD's Peterson WTP, and delivered for use through the CTP and ACP to the NSA. The District has an annual Warren Act contract, with ongoing negotiations occurring for a long-term contract, which allows the District to "wheel" the PCWA water through USBR's Folsom Reservoir facilities.

Table 4-3. Historical PCWA/SJWD Supply Compared to Water Forum Year Type, ac-ft/yr

Water Forum Year Type	Historical Supply			2009 Master Plan Assumption	Revised Assumption For This WSMP
	Average	Min	Max		
Wet	13,223	8,573	15,518	23,000	13,500
Average	4,096	4,096	4,096	-	4,000
Drier	205	-	409	-	-
Driest	-	-	-	-	-

Note: 1999 to 2016 period used for wet years and only 2010 and later used for average, drier, and driest years to reflect the agreement change in 2010.

While the District can request up to 29,000 ac-ft/yr through 2024, there are several infrastructure constraints that limit the supply. These constraints consist of the available capacities of the infrastructure facilities that treat and deliver the water to the District. These include the availability of spare capacity at the Peterson WTP and the capacity of the CTP.

The previous master plan estimated that the WTP's spare capacity in the summer months is approximately 9 MGD and in the winter months it is approximately 80 to 90 MGD, although there are times when portions of the plant are out of service for maintenance. The CTP has a capacity of 59 MGD. The overall spare capacity varies from 9 MGD in the summer to up to 59 MGD in the winter. The available supply in the non-summer months greatly exceeds the NSA's water demands in those months. The PCWA supply is large enough to supply all of the NSA's demands except during the June to September months when the spare capacity in the Peterson WTP is limited.

There are three cost components for the water the District purchases from PCWA. The breakdown of these cost components are described as follows:

- $49/ac-ft for 12,000 ac-ft/yr. This cost is to reserve the District's rights to use this water based on their agreement with PCWA. This costs fluctuates from year to year. The District pays this per ac-ft cost annually, when the water is available, regardless if all of the 12,000 ac-ft/yr is used or not.
- $135/ac-ft for SJWD treatment costs. These treatment costs are billed based on actual use on a quarterly basis.
- $27/ac-ft for wheeling PCWA water through USBR facilities (i.e. Folsom Lake).

4.1.2.3 City of Sacramento Agreement

The City has an American River water right permit with an designated place of use (POU) referred to as "Area D". A portion of the District's service area lies within Area D. The District purchases surface water from the City of Sacramento for use within the portion of the service area of the District that is within Area D. This American River supply is treated at the City's E. A. Fairbairn WTP and delivered to the District via the City's Howe Avenue transmission main to an existing interconnection located near Enterprise Drive and Northrop Avenue in the SSA.

In January 2004, the District entered into an agreement with the City for up to 20 MGD of treated surface water plus up to 10 MGD of additional water. The instantaneous maximum flow rate described in the agreement is 20 MGD (13,900 gpm) with a 10 percent tolerance allowed for operational variations at a minimum pressure of 30 pounds per square inch (psi). A continuous supply of 20 MGD is equivalent to 22,404 ac-ft/yr. The agreement provides for the possibility of the City delivering Sacramento River water in the future. The District has been receiving this treated surface water from the City for use within the SSA since 2007.

This current City supply to the District is subject to the Water Forum diversion restrictions. A part of these restrictions reduce the City's diversions from the American River when flows are less than Hodge criteria. The frequent occurrence of American River flows less than the Hodge criteria over the last few years has resulted in the District receiving very little supply from the City. As shown in Table 3-11, during the nine-year period from 2007 to 2015, there were six years when the District received an average of 3,859 ac-ft/yr that ranged from 2,289 ac-ft/yr to 6,463 ac-ft/yr. There were three years where no supply was provided to the District. The previous master plan presented an analysis of the occurrence of Hodge flows and estimates of the average supply that would be received in the different Water Forum year types. Table 4-4 presents the previously estimated supplies, the supplies actually delivered by Water Forum year type and the supply amounts assumed for this study. Particularly noticeable in Table 4-4 is the small amount of supply received in wet years.

Table 4-4. Actual Historical City of Sacramento Supply Compared to Water Forum Year Type, ac-ft/yr

Water Forum Agreement Year Type	Historical Supply			2009 Master Plan Assumption	Revised Assumption for This WSMP
	Average	Min	Max		
Wet	2,265	423	4,084	9,300	4,000
Average	5,168	3,872	6,463	3,500	4,000
Drier	1,611	-	3,701	1,400	1,600
Driest	-	-	-	-	-

Note: Based on 2007 to 2016 period.

The District has two prior water supply agreements with the City that are still active. In 1964, the City granted to the predecessor Arcade Water District the right to divert up to 26,064 ac-ft/yr from the American River for use within the portion of Arcade that lies within Area D of the place of use of the City's American River water rights. A portion of this amount was diverted through the American River well field until 1997, when the use of the supply was ceased because of the new requirement to construct an appropriate water treatment facility to meet the requirements of the Surface Water Treatment Rule. In 1980, the City entered into an agreement with the prior Northridge Park County Water District to divert up to 9,023 ac-ft/yr from the American River for use within Area D. No water supply has been provided under the 1980 agreement. According to the 2004 agreement, the two prior agreements are not impacted by the 2004 agreement.

There are three cost components for the water the District purchases from the City. The breakdown of these cost components are described as follows:

1. $55,532 per year to pay for the District's share of the City's diversion cost that is based on a per ac-ft charge set by USBR.
2. Approximately $429/ac-ft user rate. This cost is for Fairbairn WTP costs, is based on use, and the City fixes this rate on July 1st of each year. This cost fluctuates slightly each year.
3. $342 per month for City administration fees. This cost is paid monthly whether the District uses City water or not.

4.1.2.4 Section 215 USBR CVP Agreement

Since 1991, the NSA has received a nominal amount of Section 215 USBR Central Valley Project (CVP) water. Section 215 water is surplus or spilled flood release water available typically in winter and spring in wet and average climate years. This water is treated at the Peterson WTP and delivered via the CTP for use within the NSA. The District is eligible to purchase this surplus water in average and wet water years. Nothing in the WFA is intended to restrict the District's ability to take delivery of Section 215 water from Folsom Reservoir from the USBR whenever it is available. The District can currently purchase up to 12,000 ac-ft/yr of Section 215 water when it is available. The cost of this water is $196 per acre-foot.

The District is in the process of obtaining a Long-Term Warren Act Contract with the USBR. The process began in November 2015 and anticipated to be approved in August 2016. The District's current Warren Act Contract expires in March 2017.

4.1.3 Fluoridation

The District currently fluoridates its water supply for the SSA only. There are fluoridation facilities on some of the District's SSA wells. The surface water purchased from the City for use in the SSA is also fluoridated. The District received a grant ten years ago to help pay for the installation of the fluoridation facilities at the wells. This grant obligates the District to provide for fluoridation for a twenty-year period. Having fluoridation for a portion of the District's service area results in limiting the District's operational flexibility. Fluoridated water supplies cannot be used to supply non-fluoridated systems and vice versa, such as with the NSA and neighboring water agencies.

4.2 Climate Change

Climate change is anticipated to have an impact on water demands and supplies. This section summarizes climate change information from the American River Basin Integrated Regional Water Management Plan (IRWMP) and the USBR Sacramento River Basin Study, and presents the results of an analysis of changes in the frequency of occurrence of American River water year types.

The District is a member of the RWA that prepared the American River Basin Integrated Regional Water Management Plan (IRWMP) (RWA, 2013). A quantitative vulnerability assessment was done in the IRWMP to evaluate the impacts of climate change on water resources in the region. The identified highest priority vulnerabilities in the region pertinent to urban water demands and supplies were identified as follows:

- Increased potential for summer water shortage due to increased summer demand caused by warming temperatures.
- Reduced water supply reliability due to the region's reliance on snowpack, existing storage capacity limitations, and increased drought potential. The projected reductions of Sierra snowpack, earlier snowmelt runoff, and more frequent and longer periods of drought would reduce water supply reliability for the region.

The quantitative assessment presented in the IRWMP indicated that there would be reduced diversions from the American River. The annual surface water deliveries to the District from PCWA were projected to decrease by 2 percent. The long-term average groundwater pumping in the southern portion of the North American Subbasin, the portion managed by SGA, was projected to increase by 22 percent, from 63,000 ac-ft/yr to 77,000 ac-ft/yr. Groundwater elevations would decrease from 6 to 10 feet from the baseline condition in the District's service area. Planned actions to address noted vulnerabilities from the climate change assessment include decreasing urban per capita water demand and continuing current efforts such as conjunctive use management, recycled water use, and constructing interconnections between adjacent water purveyors.

Reclamation recently completed the Sacramento and San Joaquin Basins Study (USBR, 2016) that evaluates the potential impacts of climate and socioeconomic changes. The evaluation concluded that unmet water demands would increase slightly in the Sacramento River watershed.

The WFA year types are based on the March to November inflows into Folsom Lake. Due to the anticipated runoff that would occur before March, climate change could possibly result in increasing the frequency of the Water Forum drier and driest years. The historical flow records of the American River were reviewed to confirm the frequency of occurrence of the different climate year types and to see if there have been any changes with a longer historical record compared to when the Water Forum analysis was done. Table 4-5 presents a comparison of the frequency of occurrence of the Water Forum water year types previously established in the WFA and what the analysis shows for the overall 1901 to 2015 period and the more recent 25-year period. As shown in Table 4-5, the recent 25-year period as well as the longer historical record shows a reduction in the frequency of wet years and in increase in the frequency of drier and driest years compared what was established in the earlier Water Forum analysis. While it cannot be said for certain that this change in the frequency of occurrence of water year types is indicative of what can be expected in the future, it is prudent to consider these shifts in evaluating the long-term groundwater pumping amount and availability of surface water supplies.

Table 4-5. Frequency of Occurrence of Climate Year Types

	Wet	Average	Drier	Driest	Total
Water Forum Agreement assumption	62%	25%	11%	2%	100%
1901-2015	59%	24%	14%	3%	100%
1991-2015	44%	24%	28%	4%	100%

4.3 Alternatives to Meet District's Needs

This section defines and evaluates alternatives to meet the District's water supply needs through buildout. The alternatives evaluated are as follows:

1) Use PCWA and City of Sacramento surface water plus District groundwater.
2) Use reduced PCWA surface water plus District groundwater.
3) Use District groundwater only.

Most of these alternatives are based on a continued conjunctive use strategy. The conjunctive use strategy consists of using available surface water in wet years and groundwater in dry years. The alternatives are analyzed for the NSA and SSA separately because of place of use restrictions on the current surface water supplies and infrastructure limitations. The annual supplies for each alternative are presented for wet, average, drier, and driest years, as well as the long-term average. The long-term average quantities are calculated based on the Water Forum's estimate of the frequency of occurrence of the different climate year types as presented in Table 4-4.

An estimate of the annual costs of obtaining water supplies is presented for each alternative. These cost estimates include the costs of purchasing surface water supplies, but do not include the cost of pumping the surface water once it is within the District's service area. The water is conveyed to the District with some pressure already. The costs of the groundwater supply are for the power costs to pump the groundwater. Table 4-6 presents the cost assumptions. Table 4-6 also presents the cost assumptions that are used in Section 4.4 to evaluate alternatives to sell water to other agencies. The water supply cost and revenue assumptions presented in Table 4-6 represent current water supply costs, and exclude any costs for constructing facilities that might be needed. For example, the District may need to construct transmission pipelines to convey the water for some of the alternatives. The ultimate vision wellfield will have limited spare supply capacity during the days of maximum demand, which may make the construction of a few more wells desirable for export purposes. The facilities that might be needed and their costs are not reflected in the cost assumptions. The alternatives to meet District needs and the alternatives to sell water to other agencies that are presented in Section 4.4 are summarized and compared in Section 4.5.

Table 4-6. Cost of Supply Assumptions

Item	Cost
PCWA Supply	
Reserve 12,000 ac-ft/yr, cost/ac-ft	$49
SJWD treatment cost, cost/ac-ft	$135
Wheeling cost, cost/ac-ft	$27
City of Sacramento supply	
Diversion cost, cost/year	$55,532
User cost, cost/ac-ft	$429
Service charge, cost/month	$342
Groundwater supply	
Operating cost, cost/ac-ft	$100
Water transfer	
Transfer recovery factor	0.90
Transfer sale price, cost/ac-ft	
Wet year	$300
Average year	$500
Drier year	$700
Driest year	$900
Transfer cost, cost/ac-ft	$75
Area D or PCWA transfer fee	$100

4.3.1 Use PCWA and City of Sacramento Surface Water plus District Groundwater

This alternative consists of the continuing with the District's current practice of using surface water supplies to the extent they are available in wet years and using only groundwater in the dry years.

Tables 4-7, 4-8, and 4-9 present the groundwater use and surface water use for each of the WFA year types for the NSA, SSA, and the overall District at buildout. The resulting conjunctive use strategy for the total system is illustrated on Figure 4-2. As shown in Table 4-9, the District's long term groundwater pumping is less than the long-term groundwater pumping target of 35,000 ac-ft/yr. The long-term average use is calculated based on the Water Forum's estimate of the frequency of occurrence of the different climate year types as presented in Table 4-4. Table 4-10 presents the estimated water supply costs of this alternative expressed as the annual cost and the associated per acre-foot cost for each supply source and for each Water Forum year type.

Table 4-7. PCWA and City Surface Water plus District Groundwater – North Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long term Average Use
Buildout demand	24,893	24,893	24,893	24,893	24,893
Surface water available, PCWA	13,500	4,000	0	0	9,370
Surface water use, PCWA	13,500	4,000	0	0	9,370
Groundwater use	11,393	20,893	24,893	24,893	15,523
Total supply used	24,893	24,893	24,893	24,893	24,893

Table 4-8. PCWA and City Surface Water plus District Groundwater – South Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long term Average Use
Buildout demand	16,483	16,483	16,483	16,483	16,483
Surface water available, City of Sac	4,000	4,000	1,600	0	3,656
Surface water use, City of Sac	4,000	4,000	1,600	0	3,656
Groundwater use	12,483	12,483	14,883	16,483	12,827
Total supply used	16,483	16,483	16,483	16,483	16,483

Table 4-9. PCWA and City Surface Water plus District Groundwater – Total System, ac-ft/yr

	Wet	Average	Drier	Driest	long term Average Use
Buildout demand	41,376	41,376	41,376	41,376	41,376
Surface water available	17,500	8,000	1,600	0	13,026
Surface water use	17,500	8,000	1,600	0	13,026
Groundwater use	23,876	33,376	39,776	41,376	28,350
Total supply used	41,376	41,376	41,376	41,376	41,376

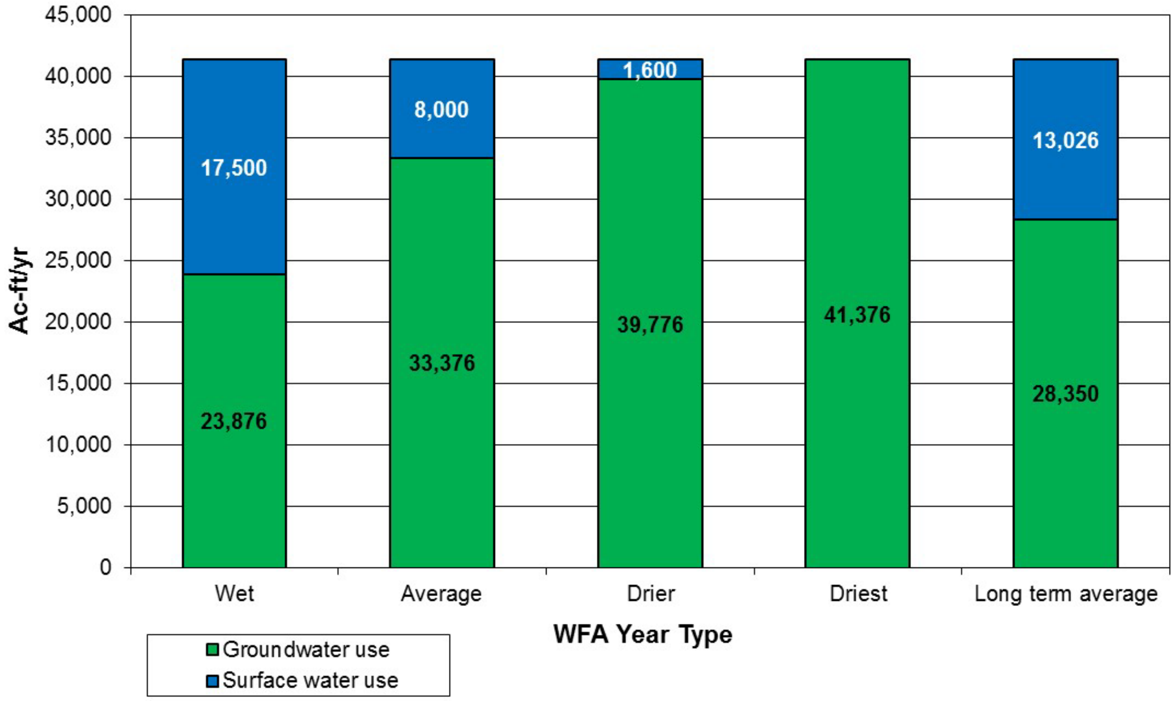


Figure 4-2. PCWA and City Surface Water plus District Groundwater

Table 4-10. Annual Cost of PCWA and City of Sacramento Surface Water plus District Groundwater

	Wet	Average	Drier	Driest	Long Term Average
Annual Cost, $/yr					
Groundwater, $/yr	$2,387,600	$3,337,600	$3,977,600	$4,137,600	$2,835,000
PCWA water, $/yr	$2,775,000	$1,236,000			$2,029,500
City of Sacramento water, $/yr	$1,775,744	$1,775,744	$746,144	$4,104	$1,627,055
Total, $/yr	$6,938,344	$6,349,344	$4,723,744	$4,141,704	$6,491,555
Unit costs, $/ac-ft					
Overall, $/ac-ft	$168	$153	$114	$100	$157
Groundwater, $/ac-ft	$100	$100	$100	$100	$100
PCWA water, $/ac-ft	$206	$309			$217
City of Sacramento water, $/ac-ft	$444	$444	$466		$445

4.3.2 Use Reduced PCWA Surface Water plus District Groundwater

This alternative is the same as the previous alternative except that the PCWA supply is capped at 12,000 ac-ft/yr to consider the possibility that PCWA may not provide any more than this amount in the future. This alternative addresses the issue that the PCWA water supply source may be reduced in future years to meet PCWA's own needs. This alternative also assumes that the surface water supply from the City would not be used due to its higher costs.

Tables 4-11, 4-12, and 4-13 present the groundwater use and surface water use for each of the WFA year types for the NSA, SSA, and the overall District at buildout. The resulting conjunctive use strategy for the total system is illustrated on Figure 4-3. As shown in Table 4-13, the District's long term groundwater pumping is less than the long-term groundwater pumping target of 35,000 ac-ft/yr. Table 4-14 presents the estimated water supply costs of this alternative.

Table 4-11. Reduced PCWA Surface Water plus District Groundwater – North Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long Term Average Use
Buildout demand	24,893	24,893	24,893	24,893	24,893
Surface water available, PCWA	12,000		0	0	7,440
Surface water use, PCWA	12,000	0	0	0	7,440
Groundwater use	12,893	24,893	24,893	24,893	17,453
Total supply used	24,893	24,893	24,893	24,893	24,893

Table 4-12. Reduced PCWA Surface Water plus District Groundwater – South Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long Term Average Use
Buildout demand	16,483	16,483	16,483	16,483	16,483
Surface water available, City of Sac	0	0	0	0	0
Surface water use, City of Sac	0	0	0	0	0
Groundwater use	16,483	16,483	16,483	16,483	16,483
Total supply used	16,483	16,483	16,483	16,483	16,483

Table 4-13. Reduced PCWA Surface Water plus District Groundwater – Total System, ac-ft/yr

	Wet	Average	Drier	Driest	Long Term Average Use
Buildout demand	41,376	41,376	41,376	41,376	41,376
Surface water available	12,000	0	0	0	7,440
Surface water use	12,000	0	0	0	7,440
Groundwater use	29,376	41,376	41,376	41,376	33,936
Total supply used	41,376	41,376	41,376	41,376	41,376

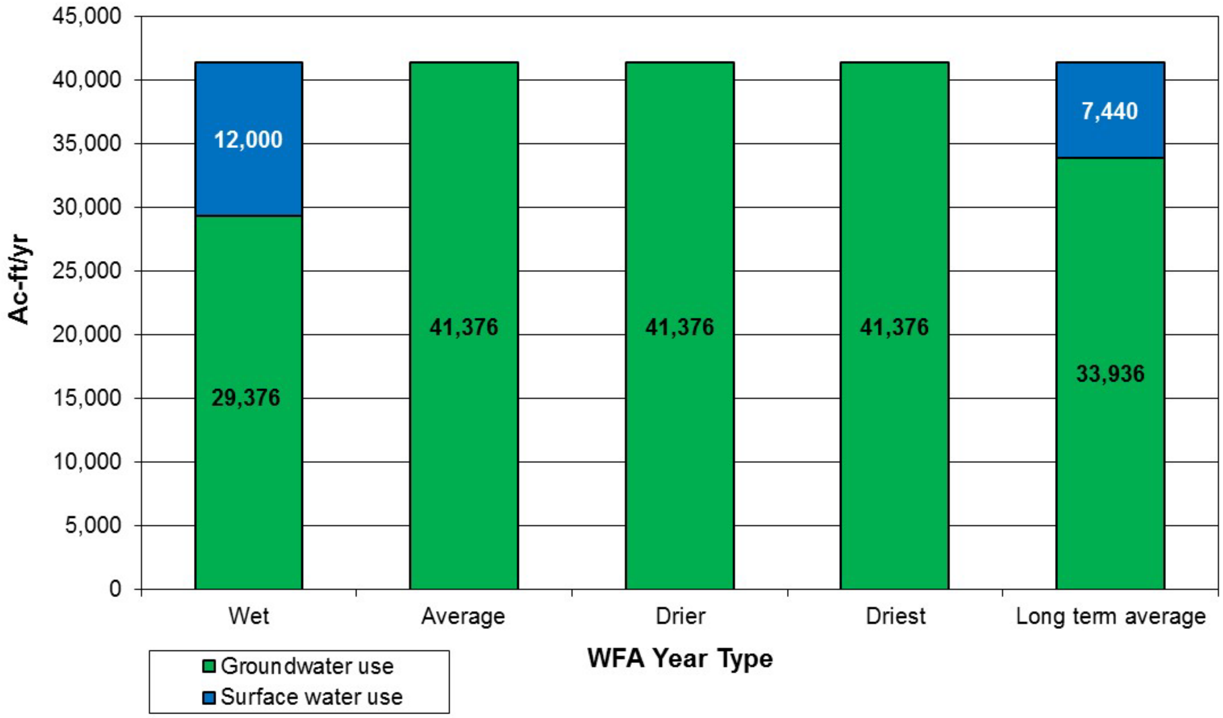


Figure 4-3. Reduced PCWA Surface Water plus District Groundwater

Table 4-14. Annual Cost of Reduced PCWA Surface Water plus District Groundwater

	Wet	Average	Drier	Driest	Average
Annual cost, $/yr					
Groundwater	$2,937,600	$4,137,600	$4,137,600	$4,137,600	$3,393,600
PCWA water, $/yr	$2,532,000	$-	$-	$-	$1,569,840
City of Sac water, $/yr	$4,104	$4,104	$4,104	$4,104	$4,104
Total net cost, $/yr	$5,473,704	$4,141,704	$4,141,704	$4,141,704	$4,967,544
Unit cost, $/ac-ft					
Overall, $/ac-ft	$132	$100	$100	$100	$120
Groundwater, $/ac-ft	$100	$100	$100	$100	$100
PCWA water, $/ac-ft	$211	$-	$-	$-	$211
City of Sac water, $/ac-ft	$-	$-	$-	$-	$-

4.3.3 Use District Groundwater Only

This alternative consists of using solely groundwater to meet the District's demands. No surface water would be used. The combined sustainable pumping estimate of 35,000 ac-ft/yr for the District indicates that the District cannot use only groundwater to meet its needs over the long-term while maintaining stable groundwater levels unless buildout water demands are reduced to 35,000 ac-ft/yr. The recent decline in water demands combined with efforts by the SWRCB to develop permanent demand targets makes this alternative possibly feasible. This alternative assumes that the District would reduce its buildout demand by fifteen percent, which is approximately the same as the groundwater pumping target.

Tables 4-15, 4-16, and 4-17 present the groundwater use for each of the WFA year types for the NSA, SSA, and the overall District at buildout. The resulting groundwater use for the total system is illustrated on Figure 4-4. Table 4-18 presents the estimated water supply costs of this alternative.

Table 4-15. Groundwater Only with 15% Demand Reduction – North Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long Term Average Use
Buildout demand	21,056	21,056	21,056	21,056	21,056
Surface water available, PCWA	0	0	0	0	0
Surface water use, PCWA	0	0	0	0	0
Groundwater use	21,056	21,056	21,056	21,056	21,056
Total supply used	21,056	21,056	21,056	21,056	21,056

Table 4-16. Groundwater Only with 15% Demand Reduction – South Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long Term Average Use
Buildout demand	13,944	13,944	13,944	13,944	13,944
Surface water available, City of Sac	0	0	0	0	0
Surface water use, City of Sac	0	0	0	0	0
Groundwater use	13,944	13,944	13,944	13,944	13,944
Total supply used	13,944	13,944	13,944	13,944	13,944

Table 4-17. Groundwater Only with 15% Demand Reduction – Total System[a], ac-ft

	Wet	Average	Drier	Driest	Long Term Average Use
Buildout demand	35,000	35,000	35,000	35,000	35,000
Suface water available	0	0	0	0	0
Surface water use	0	0	0	0	0
Groundwater use	35,000	35,000	35,000	35,000	35,000
Total supply used	35,000	35,000	35,000	35,000	35,000

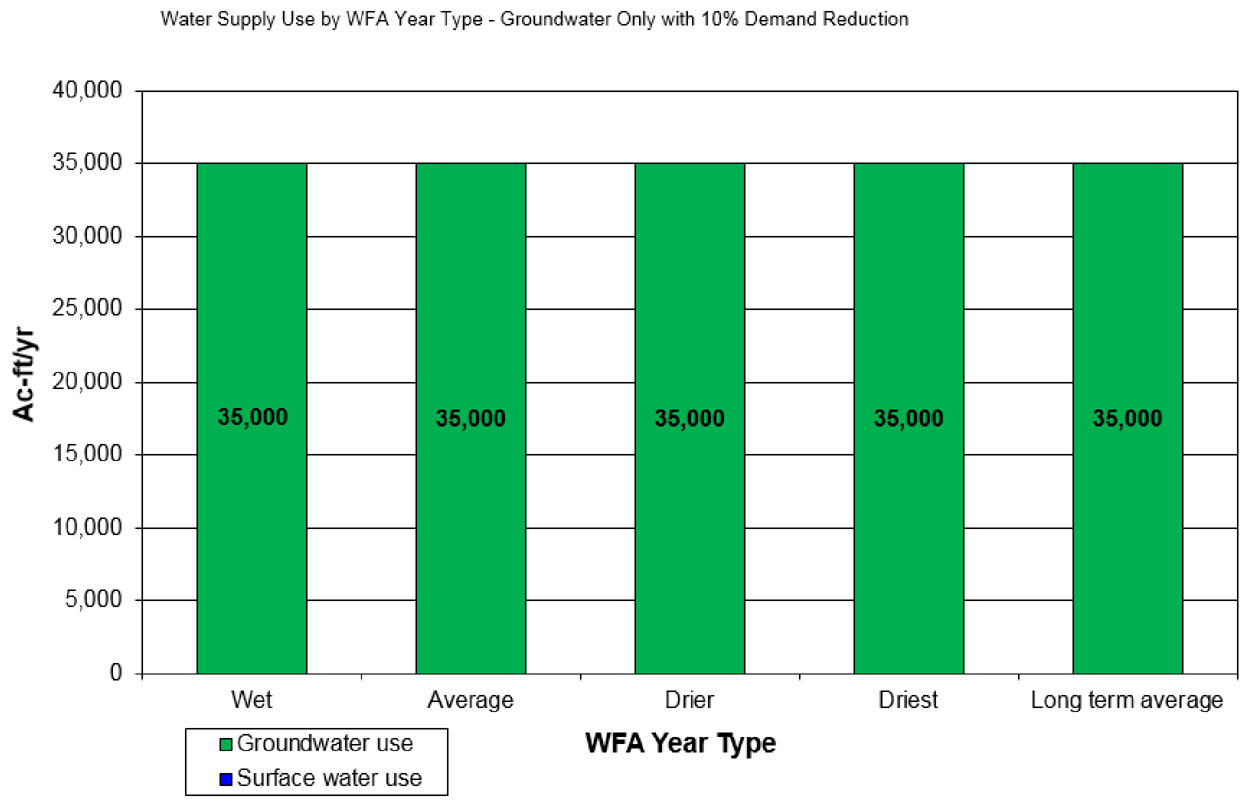


Figure 4-4. Groundwater Only with 15% Demand Reduction

Table 4-18. Annual Cost of Groundwater Only with 15% Demand Reduction					
	Wet	Average	Drier	Driest	Average
Annual costs, $/yr					
Groundwater use	$3,500,000	$3,500,000	$3,500,000	$3,500,000	$3,500,000
PCWA water use	$-	$-	$-	$-	$-
City of Sac water use	$-	$-	$-	$-	$-
Total net cost	$3,500,000	$3,500,000	$3,500,000	$3,500,000	$3,500,000
Unit cost, $/ac-ft					
Overall, $/ac-ft	$100	$100	$100	$100	$100
Groundwater, $/ac-ft	$100	$100	$100	$100	$100
PCWA water, $/ac-ft	$-	$-	$-	$-	$-
City of Sac water, $/ac-ft	$-	$-	$-	$-	$-

4.4 Opportunities to Maximize Facility Value

This section presents alternatives the District could choose to optimize the existing District's facilities to generate revenue that could offset necessary rate increases needed for system replacement and rehabilitation. The District has sufficient surface and groundwater supplies and invested in constructing infrastructure to meet its own needs and still have capacity to supply water to others. The intent of this section is to define some potential alternatives to supply water from the District to others for the benefit of the District rate payers by generating revenue to offset District costs. These alternatives are a form of groundwater banking and exchange.

The alternatives that are developed are as follows:

- Partner with other agencies to sell water.
- Transfer the District's Area D surface water when available via groundwater substitution.
- Transfer the District's PCWA surface water supply when available via groundwater substitution.
- Supply water directly to downstream users.

4.4.1 Maximum Limit of Export

The first step is to quantify the maximum amount of water that the District could export in different climate year types while not exceeding the groundwater pumping limit and regardless of infrastructure capacity. This analysis helps to define the upper limit of the amount of supplies that could be exported to others for developing the alternatives. Tables 4-19, 4-20, and 4-21 present the water balance for the NSA, SSA, and the entire District for this alternative. As shown in Figure 4-5, the District could export up to 24,000 ac-ft/yr in the average, drier, and driest years while still meeting its own needs and not exceeding the long-term groundwater pumping target.

Table 4-19. Maximum Limit of Export - North Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	24,893	24,893	24,893	24,893	24,893
Demand-For export	0	12,000	12,000	12,000	4,560
Surface water available, PCWA	13,500	4,000	0	0	9,370
Surface water use, PCWA	13,500	4,000	0	0	9,370
Groundwater total use	11,393	32,893	36,893	36,893	20,083
Groundwater-for District needs	11,393	20,893	24,893	24,893	15,523
Groundwater-for export	0	12,000	12,000	12,000	4,560
Total supply used	24,893	36,893	36,893	36,893	29,453

Table 4-20. Maximum Limit of Export - South Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	16,483	16,483	16,483	16,483	16,483
Demand-For export	0	12,000	12,000	12,000	4,560
Surface water available, City of Sac	4,000	4,000	1,600	0	3,656
Surface water use, City of Sac	4,000	4,000	1,600	0	3,656
Groundwater total use	12,483	24,483	26,883	28,483	17,387
Groundwater-for District needs	12,483	12,483	14,883	16,483	12,827
Groundwater-for export	0	12,000	12,000	12,000	4,560
Total supply used	16,483	28,483	28,483	28,483	21,043

Table 4-21. Maximum Limit of Export - Total System, ac-ft/yr					
	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	41,376	41,376	41,376	41,376	41,376
Demand-For export	0	24,000	24,000	24,000	9,120
Suface water available	17,500	8,000	1,600	0	13,026
Surface water use	17,500	8,000	1,600	0	13,026
Groundwater total use	23,876	57,376	63,776	65,376	37,470
Groundwater-for District needs	23,876	33,376	39,776	41,376	28,350
Groundwater-for export	0	24,000	24,000	24,000	9,120
Total supply used	41,376	65,376	65,376	65,376	50,496

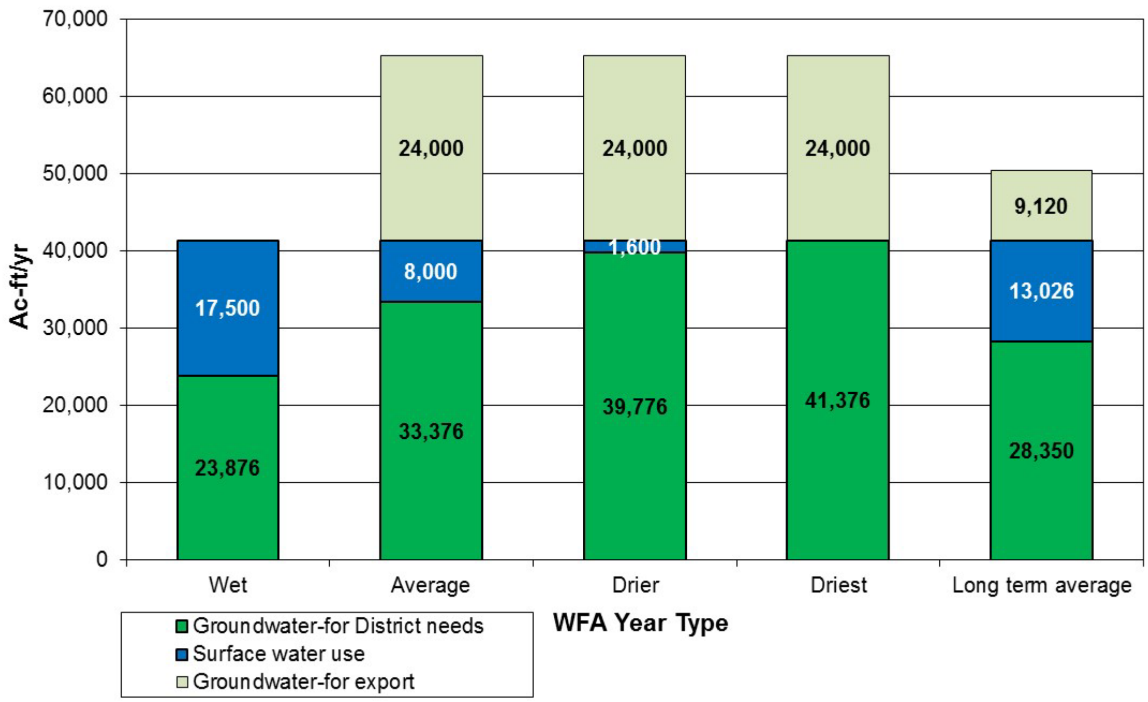


Figure 4-5. Maximum Limit of Export

4.4.2 Partner with Other Agencies to Sell Surface Water

This alternative consists of partnering with other agencies to sell surface water. In this case it is assumed that the District would provide groundwater to the City, which would allow the City to sell some of its surface water to others. The City would return some of the water back to the District as surface water in wet and average years at no cost as part of this alternative. Tables 4-22, 4-23, and 4-24 present the water balance for the NSA, SSA, and the entire District for this alternative. As shown in Table 4-23, it is assumed that the District would provide groundwater to the City in the drier and driest years. Figure 4-6 depicts the 12,000 ac-ft/yr amount that would be transferred from the SSA to the City. Table 4-25 presents the costs for this alternative and the possible revenue based on the cost assumptions presented in Table 4-6.

Table 4-22. Partner with Other Agencies to Sell Surface Water - North Service Area, ac-ft/yr					
	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	24,893	24,893	24,893	24,893	24,893
Demand-For export	0	0	0	0	0
Surface water available, PCWA	13,500	4,000	0	0	9,370
Surface water use, PCWA	13,500	4,000	0	0	9,370
Groundwater total use	11,393	20,893	24,893	24,893	15,523
Groundwater-for District needs	11,393	20,893	24,893	24,893	15,523
Groundwater-for export	0	0	0	0	0
Total supply used	24,893	24,893	24,893	24,893	24,893

Table 4-23. Partner with Other Agencies to Sell Surface Water - South Service Area, ac-ft/yr					
	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	16,483	16,483	16,483	16,483	16,483
Demand-For export	0	0	12,000	12,000	1,560
Surface water available, City of Sac	4,000	4,000	1,600	0	3,656
Surface water use, City of Sac	4,000	4,000	1,600	0	3,656
Groundwater total use	12,483	12,483	26,883	28,483	14,387
Groundwater-for District needs	12,483	12,483	14,883	16,483	12,827
Groundwater-for export	0	0	12,000	12,000	1,560
Total supply used	16,483	16,483	28,483	28,483	18,043

Table 4-24. Partner with Other Agencies to Sell Surface Water - Total System, ac-ft/yr					
	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	41,376	41,376	41,376	41,376	41,376
Demand-For export	0	0	12,000	12,000	1,560
Surface water available	17,500	8,000	1,600	0	13,026
Surface water use	17,500	8,000	1,600	0	13,026
Groundwater total use	23,876	33,376	51,776	53,376	29,910
Groundwater-for District needs	23,876	33,376	39,776	41,376	28,350
Groundwater-for export	0	0	12,000	12,000	1,560
Total supply used	41,376	41,376	53,376	53,376	42,936

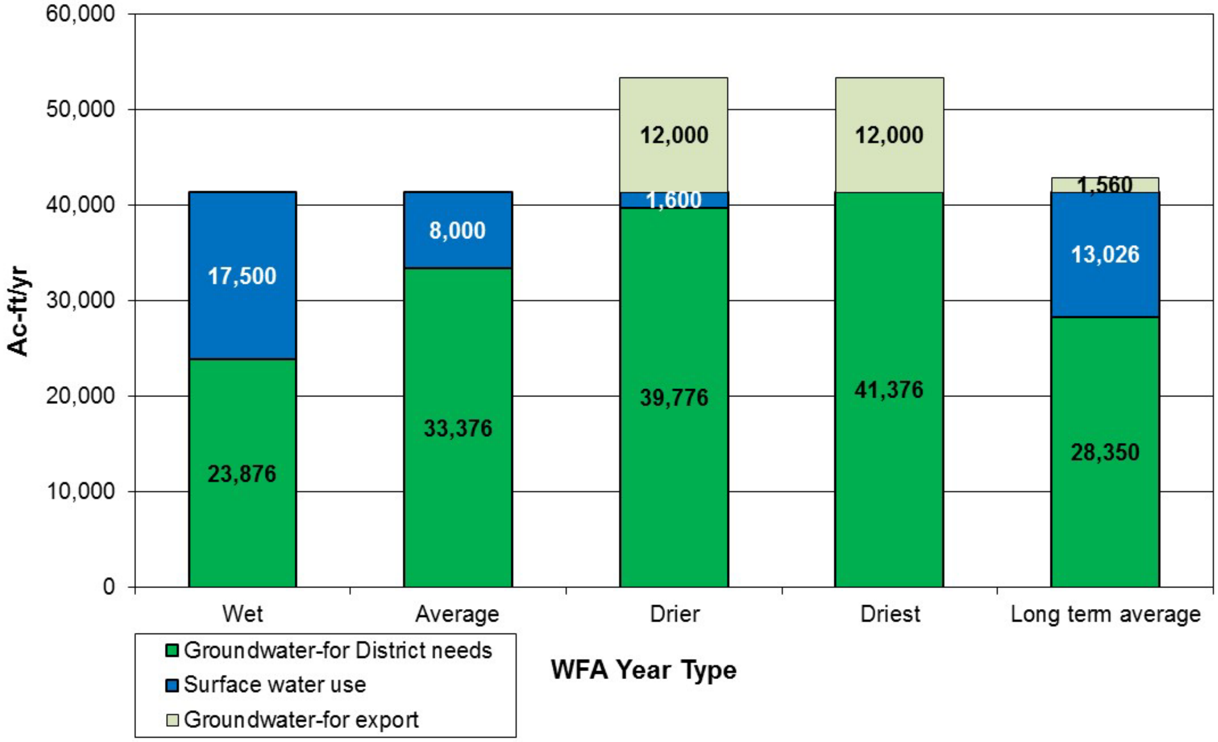


Figure 4-6. Partner with Other Agencies to Sell Surface Water

Table 4-25. Annual Cost to Partner with Other Agencies to Sell Surface Water					
	Wet	Average	Drier	Driest	Long Term Average
Annual cost, $/yr					
Groundwater	$2,387,600	$3,337,600	$5,177,600	$5,337,600	$2,991,000
PCWA water	$2,775,000	$1,236,000			$2,029,500
City of Sac water	$1,775,744	$1,775,744	$746,144	$4,104	$1,627,055
Transfer cost	$-	$-	$900,000	$900,000	$117,000
Total cost	$6,938,344	$6,349,344	$6,823,744	$6,241,704	$6,764,555
Revenue, $/yr					
Surface water transfer	$-	$-	$7,560,000	$9,720,000	$1,026,000
SSWD 50% share	$-	$-	$3,780,000	$4,860,000	$513,000
Value of returned surface water	$1,716,000	$1,716,000	$686,400	$-	$1,568,424
Total revenue	$1,716,000	$1,716,000	$4,466,400	$4,860,000	$2,081,424
Total net cost	$5,222,344	$4,633,344	$2,357,344	$1,381,704	$4,683,131

4.4.3 Transfer District's Area D Surface Water

This alternative consists of selling the District's Area D surface water. The District would work with the City to have some of the Area D water remain in the American River to flow downstream to a potential buyer. Steps would have to be taken to allow for the use of this water outside of its currently designated place of use. It is not known if this could be successfully accomplished. Tables

4-26, 4-27, and 4-28 present the water balance for the NSA, SSA, and the entire District for this alternative. As shown in Table 4-27, the Area D water is assumed to be transferred in all year types. Since this water would remain in the American River, the Hodge flow restrictions on diversions would not apply. Figure 4-7 depicts the 12,000 ac-ft/yr amount that is assumed that would be transferred. Table 4-29 presents the costs for this alternative and the possible revenue based on the cost assumptions presented in Table 4-6.

Table 4-26. Transfer District's Area D Surface Water - North Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Average
Demand-District Needs	24,893	24,893	24,893	24,893	24,893
Surface water export	0	0	0	0	0
Surface water available, PCWA	13,500	4,000	0	0	9,370
Surface water use by SSWD, PCWA	13,500	4,000	0	0	9,370
Groundwater total use	11,393	20,893	24,893	24,893	15,523
Groundwater-for District needs	11,393	20,893	24,893	24,893	15,523
Groundwater-for export	0	0	0	0	0
Total supply used	24,893	24,893	24,893	24,893	24,893

Table 4-27. Transfer District's Area D Surface Water - South Service Area, ac-ft/yr

	Wet	Average	Drier	Driest	Average
Demand-District Needs	16,483	16,483	16,483	16,483	16,483
Surface water export	12,000	12,000	12,000	12,000	12,000
Surface water available, City of Sac	0	0	0	0	0
Surface water use by SSWD, City of Sac	0	0	0	0	0
Groundwater total use	16,483	16,483	16,483	16,483	16,483
Groundwater-for District needs	16,483	16,483	16,483	16,483	16,483
Groundwater-for export	0	0	0	0	0
Total supply used (a)	28,483	28,483	28,483	28,483	28,483

Table 4-28. Transfer District's Area D Surface Water - Total System, ac-ft/yr

	Wet	Average	Drier	Driest	Average
Demand-District Needs	41,376	41,376	41,376	41,376	41,376
Surface water export	12,000	12,000	12,000	12,000	12,000
Surface water available	13,500	4,000	0	0	9,370
Surface water use by SSWD	13,500	4,000	0	0	9,370
Groundwater total use	27,876	37,376	41,376	41,376	32,006
Groundwater-for District needs	27,876	37,376	41,376	41,376	32,006
Groundwater-for export	0	0	0	0	0
Total supply used	53,376	53,376	53,376	53,376	53,376

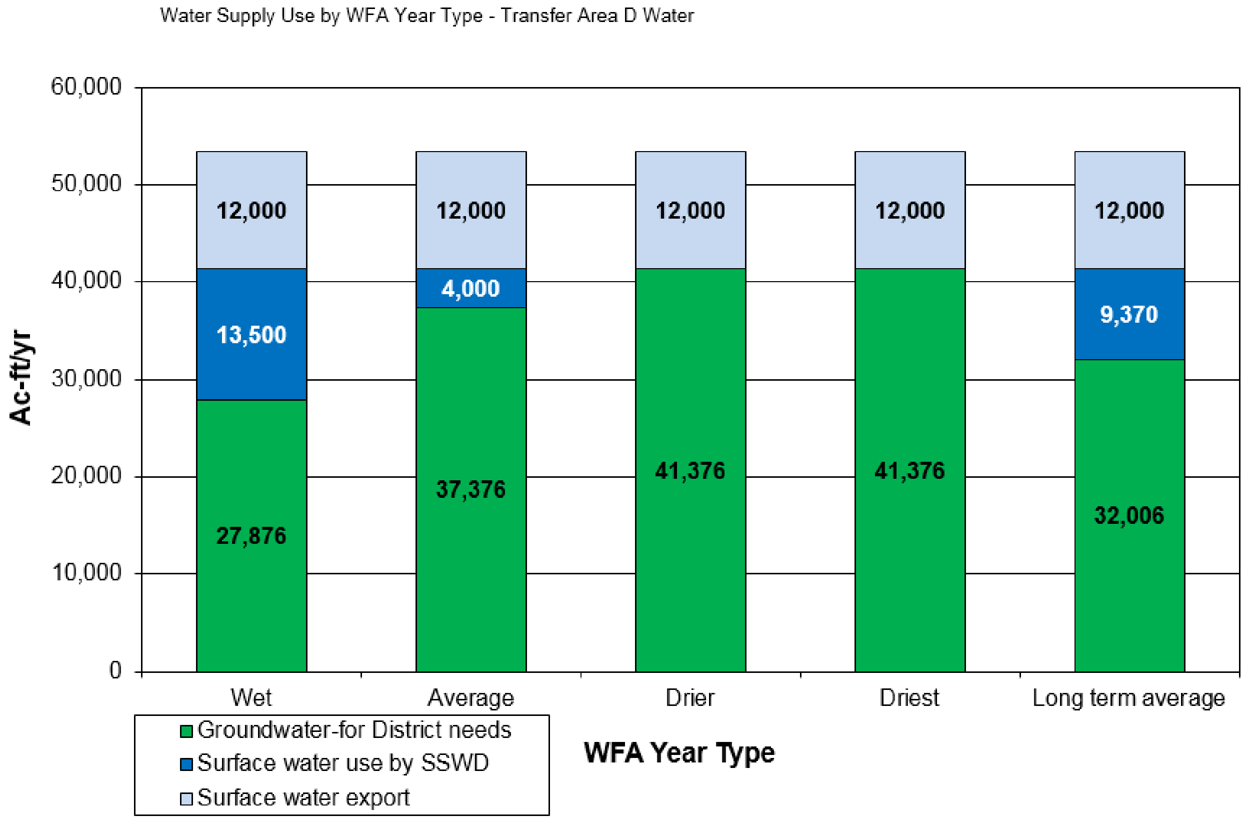


Figure 4-7. Transfer District's Area D Surface Water

Table 4-29. Annual Cost to Transfer District's Area D Surface Water					
	Wet	Average	Drier	Driest	Long Term Average
Annual cost, $/yr					
Groundwater	$2,787,600	$3,737,600	$4,137,600	$4,137,600	$3,200,600
PCWA water	$2,775,000	$1,236,000			$2,029,500
City of Sac water					$-
Area D transfer fee	$1,200,000	$1,200,000	$1,200,000	$1,200,000	$1,200,000
Total cost	$6,762,600	$6,173,600	$5,337,600	$5,337,600	$6,430,100
Revenue, $/yr					
Surface water transfer	$3,240,000	$5,400,000	$7,560,000	$9,720,000	$4,384,800
Total net cost	$3,522,600	$773,600	$(2,222,400)	$(4,382,400)	$2,045,300

4.4.4 Transfer District's PCWA Surface Water

This alternative consists of transferring the District's PCWA supply to others. It is assumed that this supply would be available to transfer in only the wet and average years. Tables 4-30, 4-31, and 4-32 present the water balance for the NSA, SSA, and the entire District for this alternative. As shown in Table 4-30, the PCWA water amount is assumed to be 12,000 ac-ft/yr, and the NSA would rely on solely groundwater for its supply in the wet and average years. Figure 4-8 depicts the 12,000 ac-ft/yr amount that would be transferred. Table 4-33 presents the costs for this alternative and the possible revenue based on the cost assumptions presented in Table 4-6.

Table 4-30. Transfer District's PCWA Surface Water - North Service Area, ac-ft/yr, ac-ft/yr					
	Wet	Average	Drier	Driest	Average
Demand-District Needs	24,893	24,893	24,893	24,893	24,893
Surface water export	12,000	12,000	0	0	10,440
Surface water available, PCWA	13,500	4,000	0	0	9,370
Surface water use by SSWD, PCWA	0	0	0	0	0
Groundwater total use	24,893	24,893	24,893	24,893	24,893
Groundwater-for District needs	24,893	24,893	24,893	24,893	24,893
Groundwater-for export	0	0	0	0	0
Total supply used	36,893	36,893	24,893	24,893	35,333

Table 4-31. Transfer District's PCWA Surface Water - South Service Area, ac-ft/yr					
	Wet	Average	Drier	Driest	Average
Demand-District Needs	16,483	16,483	16,483	16,483	16,483
Surface water export	0	0	0	0	0
Surface water available, City of Sac	4,000	4,000	1,600	0	3,656
Surface water use by SSWD, City of Sac	4,000	4,000	1,600	0	3,656
Groundwater total use	12,483	12,483	14,883	16,483	12,827
Groundwater-for District needs	12,483	12,483	14,883	16,483	12,827
Groundwater-for export	0	0	0	0	0
Total supply used	16,483	16,483	16,483	16,483	16,483

Table 4-32. Transfer District's PCWA Surface Water - Total System, ac-ft/yr					
	Wet	Average	Drier	Driest	Average
Demand-District Needs	41,376	41,376	41,376	41,376	41,376
Surface water export	12,000	12,000	0	0	10,440
Surface water available	17,500	8,000	1,600	0	13,026
Surface water use by SSWD	4,000	4,000	1,600	0	3,656
Groundwater total use	37,376	37,376	39,776	41,376	37,720
Groundwater-for District needs	37,376	37,376	39,776	41,376	37,720
Groundwater-for export	0	0	0	0	0
Total supply used	53,376	53,376	41,376	41,376	51,816

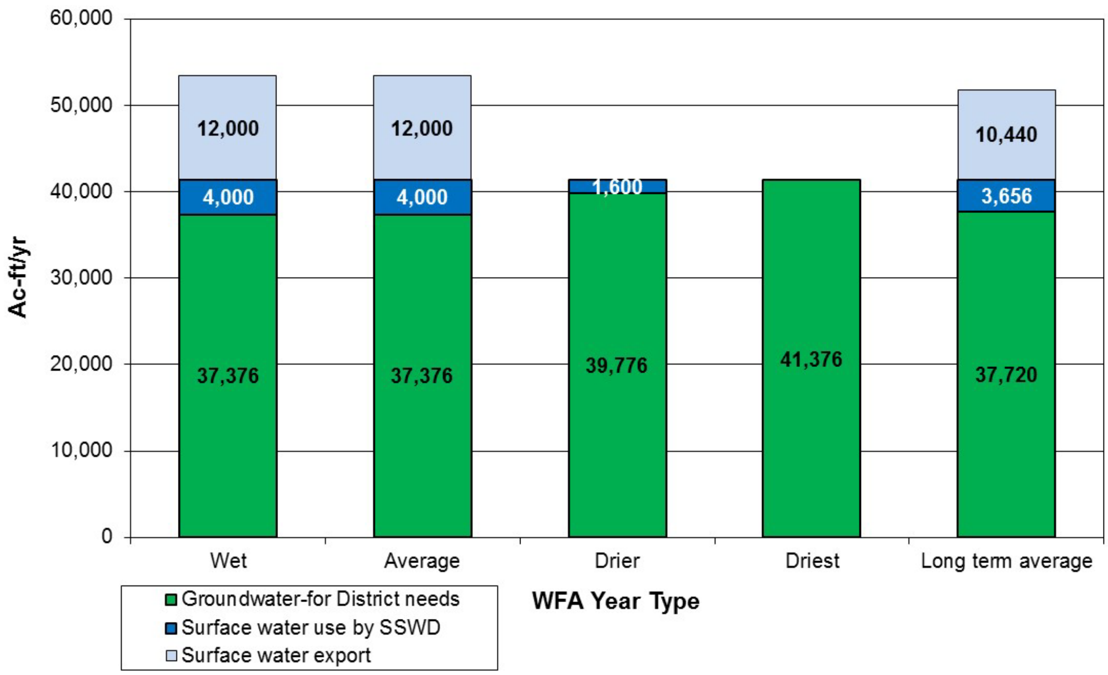


Figure 4-8. Transfer District's PCWA Surface Water

Table 4-33. Annual Cost to Transfer District's PCWA Surface Water					
	Wet	Average	Drier	Driest	Long Term Average
Annual cost, $/yr					
Groundwater	$3,737,600	$3,737,600	$3,977,600	$4,137,600	$3,772,000
PCWA water					$-
City of Sac water	$1,775,744	$1,775,744	$746,144	$4,104	$1,627,055
PCWA transfer fee	$1,200,000	$1,200,000	$-	$-	$1,044,000
Total cost	$6,713,344	$6,713,344	$4,723,744	$4,141,704	$6,443,055
Revenue, $/yr					
Surface water transfer	$3,240,000	$5,400,000	$-	$-	$3,358,800
Total net cost	$3,473,344	$1,313,344	$4,723,744	$4,141,704	$3,084,255

4.4.5 Supply Water Directly to Downstream Users

This alternative consists of the District directly selling water to downstream users. The District would pump some of its banked groundwater directly into the American River using the existing stormwater system as the means of conveyance from the wells to the river. Tables 4-34, 4-35, and 4-36 present the water balance for the NSA, SSA, and the entire District for this alternative. As shown in Table 4-34 and 4-35, it is assumed that water would be provided from both the NSA and SSA. As shown in Figure 4-9, the supply would be provided in the average, drier, and driest climate years. Table 4-37 presents the costs for this alternative and the possible revenue based on the cost assumptions presented in Table 4-6.

Table 4-34. Supply Water Directly to Downstream Users – North Service Area, ac-ft/yr					
	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	24,893	24,893	24,893	24,893	24,893
Demand-For export		6,000	6,000	6,000	2,280
Surface water available, PCWA	13,500	4,000	0	0	9,370
Surface water use, PCWA	13,500	4,000	0	0	9,370
Groundwater total use	11,393	26,893	30,893	30,893	17,803
Groundwater-for District needs	11,393	20,893	24,893	24,893	15,523
Groundwater-for export	0	6,000	6,000	6,000	2,280
Total supply used	24,893	30,893	30,893	30,893	27,173

Table 4-35. Supply Water Directly to Downstream Users – South Service Area, ac-ft/yr					
	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	16,483	16,483	16,483	16,483	16,483
Demand-For export		6,000	6,000	6,000	2,280
Surface water available, City of Sac	4,000	4,000	1,600	0	3,656
Surface water use, City of Sac	4,000	4,000	1,600	0	3,656
Groundwater total use	12,483	18,483	20,883	22,483	15,107
Groundwater-for District needs	12,483	12,483	14,883	16,483	12,827
Groundwater-for export	0	6,000	6,000	6,000	2,280
Total supply used	16,483	22,483	22,483	22,483	18,763

Table 4-36. Supply Water Directly to Downstream Users - Total System, ac-ft/yr					
	Wet	Average	Drier	Driest	Long Term Average
Demand-District Needs	41,376	41,376	41,376	41,376	41,376
Demand-For export	0	12,000	12,000	12,000	4,560
Surface water available	17,500	8,000	1,600	0	13,026
Surface water use	17,500	8,000	1,600	0	13,026
Groundwater total use	23,876	45,376	51,776	53,376	32,910
Groundwater-for District needs	23,876	33,376	39,776	41,376	28,350
Groundwater-for export	0	12,000	12,000	12,000	4,560
Total supply used	41,376	53,376	53,376	53,376	45,936

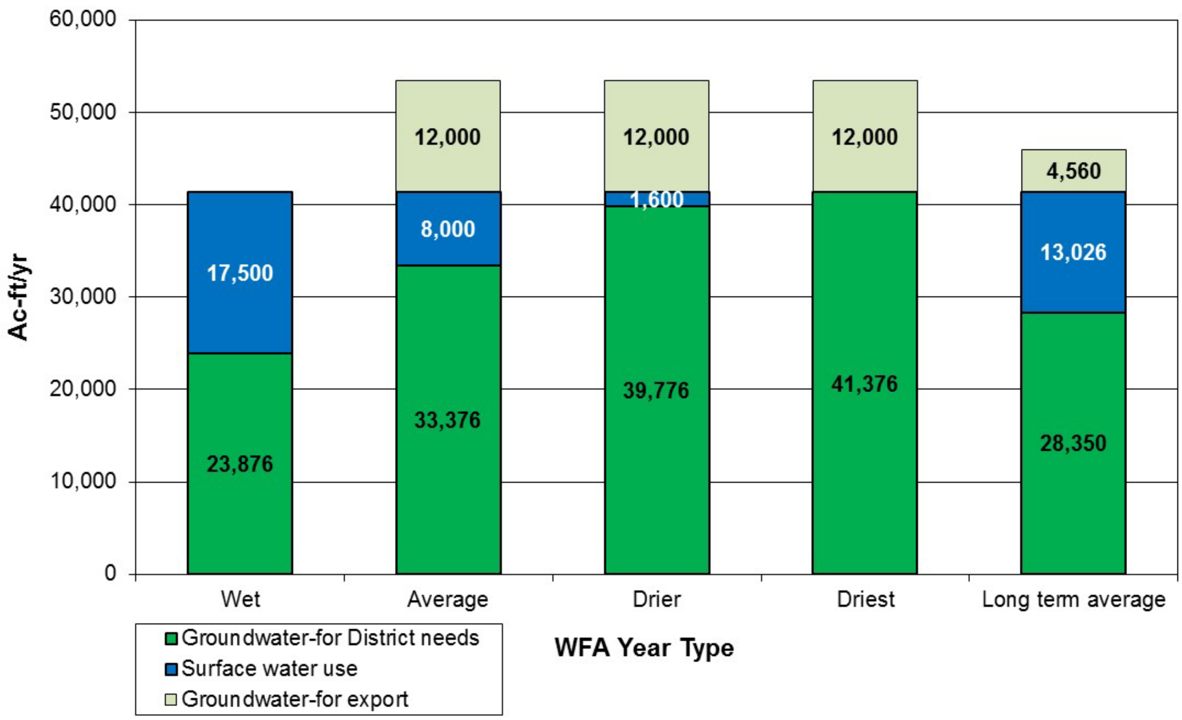


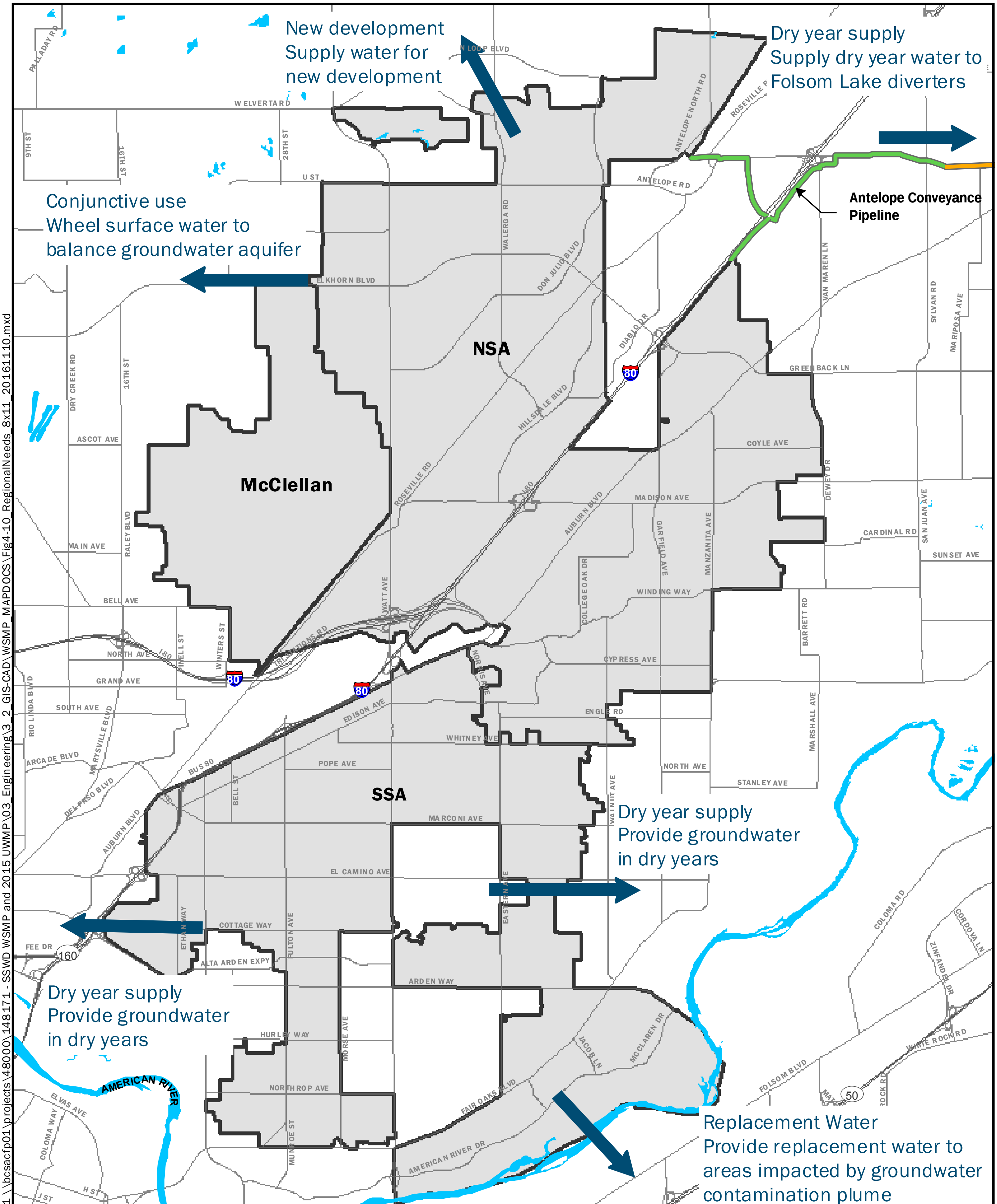
Figure 4-9. Supply Water Directly to Downstream Users

Table 4-37. Annual Cost to Supply Water Directly to Downstream Users					
	Wet	Average	Drier	Driest	Long Term Average
Annual cost, $/yr					
Groundwater	$2,387,600	$4,537,600	$5,177,600	$5,337,600	$3,291,000
PCWA water	$2,775,000	$1,236,000			$2,029,500
City of Sac water	$1,775,744	$1,775,744	$746,144	$4,104	$1,627,055
Transfer cost	$-	$900,000	$900,000	$900,000	$342,000
Total cost	$6,938,344	$8,449,344	$6,823,744	$6,241,704	$7,289,555
Revenue, $/yr					
Surface water transfer	$-	$5,400,000	$7,560,000	$9,720,000	$2,376,000
Total net cost	$6,938,344	$3,049,344	$(736,256)	$(3,478,296)	$4,913,555

4.4.6 Summary

As shown in Sections 4.3 and 4.4, there are several alternatives available to meet the District's needs and alternatives to sell water to other agencies that would lower the costs for the District's rate payers. A key policy decision for the District is whether the District desires to solely provide for its own needs or if it would also like to generate additional revenue by selling water to other agencies to reduce costs for its customers. The information provided for the alternatives should be used by the District to help inform a policy direction.

Figure 4-10 describes on a map the alternatives to sell water to other agencies. Figure 4-11 presents a summary of the long term annual costs, revenues, and net revenue by climate year type for each alternative. Table 4-38 presents the same information as Figure 4-11, plus the information for the various climate year types. As shown in Table 4-38, the costs vary significantly for the different climate year types for each alternative based on the varying mix of supplies that are available and being used. As noted earlier, these costs represent water supply costs, and exclude any costs for constructing facilities that might be needed.



DATE	PROJECT	SITE	
11/9/16	148171	**Water System Master Plan** **Sacramento Suburban Water District**	**Figure 4-10**
Brown AND Caldwell		TITLE **Regional Water Supply**	

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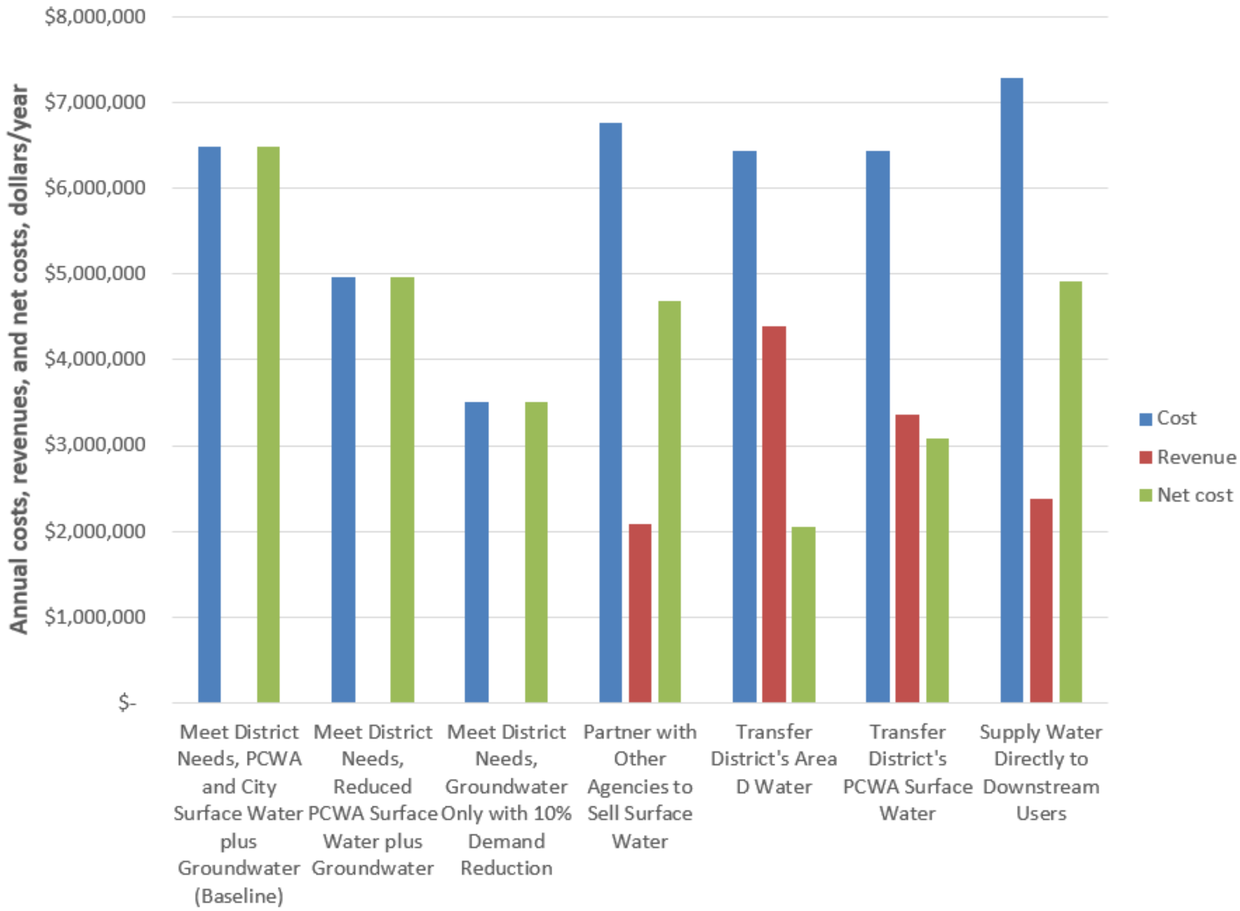

Figure 4-11. Alternatives Cost Summary

Table 4-38. Alternatives Annual Cost Summary					
	Wet	Average	Drier	Driest	Long Term Average
Meet District Needs, PCWA and City Surface Water plus Groundwater (Baseline)					
Cost	$6,938,344	$6,349,344	$4,723,744	$4,141,704	$6,491,555
Revenue	$-	$-	$-	$-	$-
Net	$6,938,344	$6,349,344	$4,723,744	$4,141,704	$6,491,555
Meet District Needs, Reduced PCWA Surface Water plus Groundwater					
Cost	$5,473,704	$4,141,704	$4,141,704	$4,141,704	$4,967,544
Revenue	$-	$-	$-	$-	$-
Net	$5,473,704	$4,141,704	$4,141,704	$4,141,704	$4,967,544
Meet District Needs, Groundwater Only with 10% Demand Reduction					
Cost	$3,500,000	$3,500,000	$3,500,000	$3,500,000	$3,500,000
Revenue	$-	$-	$-	$-	$-
Net	$3,500,000	$3,500,000	$3,500,000	$3,500,000	$3,500,000
Partner with Other Agencies to Sell Surface Water					
Cost	$6,938,344	$6,349,344	$6,823,744	$6,241,704	$6,764,555
Revenue	$1,716,000	$1,716,000	$4,466,400	$4,860,000	$2,081,424
Net	$5,222,344	$4,633,344	$2,357,344	$1,381,704	$4,683,131
Transfer District's Area D Water					
Cost	$6,762,600	$6,173,600	$5,337,600	$5,337,600	$6,430,100
Revenue	$3,240,000	$5,400,000	$7,560,000	$9,720,000	$4,384,800
Net	$3,522,600	$773,600	$(2,222,400)	$(4,382,400)	$2,045,300
Transfer District's PCWA Surface Water					
Cost	$6,713,344	$6,713,344	$4,723,744	$4,141,704	$6,443,055
Revenue	$3,240,000	$5,400,000	$-	$-	$3,358,800
Net	$3,473,344	$1,313,344	$4,723,744	$4,141,704	$3,084,255
Supply Water Directly to Downstream Users					
Cost	$6,938,344	$8,449,344	$6,823,744	$6,241,704	$7,289,555
Revenue	$-	$5,400,000	$7,560,000	$9,720,000	$2,376,000
Net	$6,938,344	$3,049,344	$(736,256)	$(3,478,296)	$4,913,555

The three alternatives that are designed to just meet the District's needs do not have any revenue as shown in Table 4-38. The long-term average costs of the alternatives to meet the District's needs range from $3.5 million to $6.5 million per year. The alternative to use PCWA and City surface water plus groundwater reflects the District's current operating mode. The alternative to just use groundwater combined with a 15 percent reduction in demand to meet the District's needs has the lowest overall cost since the demand is reduced and groundwater is the lowest cost supply. However, the risks with this alternative is that groundwater treatment may ultimately be needed on all wells and the groundwater pumping target may change to the upside when a sustainable groundwater management plan is eventually prepared by the SGA. Also, the District is currently paying debt for the CTP and ACP, and this alternative would result in those pipelines becoming a stranded asset, an asset the District would not be utilizing but still making debt payments for.

The four alternatives that generate revenue have net long term annual costs that range from $2.8 million to $4.9 million. Table 4-38 makes clear that there are approaches to selling water to other agencies that would significantly reduce the net annual cost of water supply for the District's customers. The best approach to generate revenue by selling water to others consists of maximizing the number of years that the water sale is made and the sale cost of the water and minimizing the cost of purchasing surface water for in lieu or active groundwater recharge.

The District has several advantages that help make selling water to other agencies attractive, as described below.

1. The District overlies a groundwater basin that can be exercised by increasing the amount in storage through in-lieu recharge and active recharge and drawing down that storage by groundwater pumping using the District's extensive network of wells.
2. The District has invested in infrastructure and negotiated water supply contracts to allow for the purchase and use of surface water supplies.
3. The District is interconnected with other water agencies and has much of the infrastructure needed to move water to outside of the District. The District's existing assets have available capacity due to reduced demands.
4. The District is geographically located such that it can supply water to other agencies in the region that may have a need for water supplies in dry years or because of other reasons. The recent drought highlighted water supply vulnerabilities that local water agencies have,

Steps are being taken in the Sacramento region to develop a regional approach to conjunctive use and the development of a groundwater bank for the purpose of bringing in outside dollars to the region. The RWA is developing a regional water reliability plan, an updated Integrated Regional Water Management Plan, a drought contingency plan, a basin study, and a USBR grant application for banking and exchange. The SGA and RWA have the intention to establish a USBR recognized groundwater bank. Increasing regional cooperation provide the potential for the District to be able to access firmer surface water supplies for conjunctive use and potentially for firm year-round supply.

A possible future supply source for the District is the RiverArc project. This project consists of diverting water from the Sacramento River near the Sacramento International Airport and constructing a water treatment plant and a transmission pipeline that would deliver water to areas within western Placer County and northern Sacramento County. The current project participants are six local water agencies. Some of the District's pipelines that have spare capacity might be able to be utilized to convey water for the RiverArc project. RiverArc could be a possible source of surface water for the District to replace a reduced or eliminated PCWA surface water supply.

The combination of the District's advantages, the regional efforts to establish a groundwater bank, and the need for dry year water supply in other regions of the state and locally provides the District opportunities to use its existing infrastructure to generate revenue to reduce costs for its rate payers.

It is recommended that the District further advance approaches to using its infrastructure to generate revenue and reduce rate payer costs as follows:

1. Work with the District's surface water suppliers to get better contract terms and lower costs of surface water.
2. Investigate direct transfer of stored groundwater through the storm drain systems or direct discharge to the American River.

3. Investigate opportunities to expand conjunctive use with neighboring water agencies, including the use of active aquifer storage and recovery (ASR).
4. Participate in RWA's efforts to establish a regional groundwater bank.
5. Track SGA's efforts to comply with SGMA including groundwater modeling and the development of a groundwater plan.
6. Track the development of the RiverArc project as a possible source of surface water for the District, or as a source of revenue if the District can make available some of its pipeline infrastructure to facilitate the conveyance of water for that project. It is recommended that the District work with the other project participants to define the benefits and costs of participation in the project.
7. Track the water quality of the District's groundwater supply and the movement and status of groundwater contamination plumes that are within or near the District's service area. Consider the development of groundwater quality models.

The evaluated alternatives are based on using in-lieu groundwater recharge and do not include the use of active groundwater recharge or ASR. ASR consists of injecting surplus water into the groundwater aquifer in wet periods and extracting the stored water in dry years. ASR is the next step beyond in-lieu groundwater recharge that would allow the District to transfer even greater amounts of water. The District has six wells that are equipped for ASR. The District is moving forward with well recharge permitting.

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Section 5

Asset Management

This section provides an overview of asset management planning and a review of the District's asset management plans.

Strategic Plan Alignment

Facilities and Operations – 2.A. - The District will utilize appropriate planning tools, identify financial resources necessary, and prioritize system requirements to protect and maintain District assets and attain water resource objectives incorporating resource sustainability and lifecycle cost analysis into the framework.

- **Review of asset management industry standards.**
- **Review of District's asset management plans.**

Policy Implications

- **Recommends best practices for asset management planning elements to include in future updates of the District's asset management plans.**

5.1 Asset Management Planning Overview

Asset management is a cross departmental initiative. Operations, Engineering, and Finance departments must operate in concert for an optimal program, as illustrated on Figure 6-1. The District's asset renewal strategy is based on industry standards. The two key documents that form the basis of the strategy are the International Standard for Organization (ISO) 55000 Asset Management Standard and the International Infrastructure Management Manual (IIMM). The ISO 55000 Asset Management Standard defines the principals and requirements for asset management systems. It provides the structure for what is to be done as part of asset management planning. The IIMM defines how to set up infrastructure asset management standards. The latest version of the IIMM incorporates the ISO 55000 requirements. It provides the guidance for asset management.

Figure 5-1. Asset Management is a Cross Departmental Initiative

As discussed more in Section 5.2 the District has develop AMPs for each of its asset classes. The AMPs guide asset management processes for each asset class, recognizing that different types of assets have specific conditions and requirements under which they are managed, operated and maintained. They provide a systematic approach to understanding the District's equipment and infrastructure. AMPs should provide the District staff clear direction for how assets will be managed. AMPs typically include an introduction that defines the purpose of the AMP, how it will be used, how it will be maintained, and the roles and responsibilities of District staff. Best practice AMP elements that were used to conduct the review of the District AMPs are described below.

5.1.1 Asset Information

Assets are items that have potential value to an organization, such as equipment, pipes, and buildings. They are typically inventoried to identify the quantity, types, and locations of assets and are sometimes organized into a hierarchy that also identifies the components that make up the asset. Detailed information associated with the asset that will be tracked to support decision-making is typically tracked and stored in a data management system. The AMP should define the asset inventory, asset hierarchy, required asset data, and how systems will be used to manage asset data for a specific asset class.

5.1.2 Levels of Service and Performance Measures

Levels of Service (LOS) are any organizational services that the District perceives as valuable and that can be defined and measured. LOS usually relate to quality, quantity, reliability, responsiveness, environmental acceptability, and cost. LOS set expectations for managing the District's assets and the outcomes that the District strives to achieve. Performance measures are specific indicators used to demonstrate how an organization is doing in relation to delivering LOS. They are written in a clear, easy to understand language so that they may be shared with a wide audience – both internally and externally. The AMP should define the LOS and performance measures that will be tracked for a specific asset class.

5.1.3 Risk Management

Risk relates to the consequence of an event happening and the certainty that it will happen. Within the context of asset management, risk is defined as the "likelihood" that an asset is unable to provide the function for which it was installed, combined with the impacts or "consequence" resulting from the asset failure. The AMP should document key risks, identify the highest priority assets, and documents risk mitigation strategies for a specific asset class.

5.1.4 Condition Assessment

Monitoring and assessing asset condition provides essential information to decision-makers regarding when to repair, rehabilitate, and replace assets. In addition to making rehabilitation and replacement decisions, condition assessment also informs asset managers on how best to operate and maintain an asset. The AMP should define how the condition assessment will be conducted and how condition data will be managed for a specific asset class.

5.1.5 Maintenance Management

Maintenance relates to activities conducted to achieve and possibly exceed asset useful life cycles. Corrective maintenance involves the repair of equipment to restore it to its designed LOS. Preventive maintenance involves replacing or restoring an asset at a fixed interval (calendar or hours of operation) that is planned and scheduled. Predictive maintenance, also sometimes referred to as condition monitoring, involves tracking specific asset parameters (i.e. vibration or temperature) over time with the goal of identifying changes that may indicate an impending failure. The AMP should define the maintenance programs for a specific asset class and establishes how failure records (i.e. problem, cause, remedy) will be used to analyze failures.

5.1.6 Asset Needs

An effective capital planning strategy includes both long-term and near-term components to address R/R needs. Long-term R/R plans involve identifying the aggregate R/R needs of each asset class over the next fifty to a hundred years, using assumed estimated useful lives to estimate needed funding levels. Near-term capital planning involves the identification and justification of specific R/R projects, prioritization of those projects, and the development of a five to ten-year capital improvement program. As part of the capital planning strategy, commissioning and decommissioning needs to be considered to reflect how new assets are delivered and old assets are retired as part of the engineering design and construction process. The AMP should define the capital planning strategy for a specific asset class, including how asset needs are identified, justified, prioritized, and funded.

5.1.7 Rehabilitation and Replacement

R/R plans are comprised of estimated R/R costs for each asset class over a designated period of time (i.e. 50-year horizon). Long-term R/R plans are typically developed as follows:

1. Identify the year the asset was installed.
2. Calculate remaining useful life of the asset.
3. Determine the number of needed rehabilitations and the fiscal year when they will be conducted.
4. Calculate rehabilitation costs and allocate them to the appropriate fiscal year.
5. Determine the estimated fiscal year when the asset will be replaced.
6. Calculate the replacement cost and allocate it within the appropriate fiscal year.

5.2 Asset Management Plans Peer Review

The District's AMPs were reviewed for completeness and appropriate cost and service life assumptions. Recommendations are provided related to AMP content, approach, and assumptions.

The following District AMPs were reviewed:

- Transmission Mains – January 2016
- Distribution Mains – Updated October 2014
- Buildings and Structures – Updated November 2011
- Reservoirs and Booster Stations – Updated October 2011
- Groundwater Well Facility - Updated August 2015, Long Term Well Plan (WSMP 2016)
- Water Meter Asset Management Plan - Updated May 2015

The District also has a SCADA Master Plan, developed in January 2012 (Westin Engineering, 2012). This is not as asset management plan and as a result it is not included in the Asset Management Plan review in Table 5-1. Components of the District's SCADA Master Plan are incorporated into the recommendations described in Section 10.2.

The completeness review included an assessment of whether the key AMP components were addressed by the District AMPs. It should be noted that staff interviews and review of other District documentation was not conducted. If a component was not shown in the AMP, it was assumed to not have been developed.

The Buildings and Structures AMP was the most effective at demonstrating the District's R/R plan. Specific project needs were identified based on condition assessment observations and estimates of remaining useful lives for the roofs. The Distribution Mains AMP includes a risk-based approach to project identification and prioritization that is used to identify future main replacement areas. Similar approaches are recommended for the other asset classes. However, even in the case of the building roofs and distribution mains, the proposed near-term CIP was not clear, and specific projects along with project funding requests were not included in the AMPs.

Table 5-1 summarizes the findings resulting from the review.

Table 5-1. Review of District Asset Management Plans

AMP Component and Description	Benefit	Asset Management Plan Documents					
		Transmission Main	Distribution	Buildings and Structures	Reservoirs and Booster Stations	Meter Retrofits	Groundwater Well Facility
Asset Management Plan							
Purpose and objectives - How will the AMP be used?	Provides strategic direction and establishes priorities for implementing asset management that can be communicated across the organization.	Included	Included	Included	Included	Included	Included
AMP Development and Maintenance - How will the AMP be developed? How will the AMP be maintained over time?	Ensures asset management is a priority and evolves over time.	Included	Included	Included	Included	-	Included
Roles and Responsibilities - Who will be the primary owner of the AMP? What will be their key responsibilities?	Clearly defines and communicates how staff will contribute to asset management.	-	-	-	-	-	-
Asset Information							
Asset hierarchy - Has an asset hierarchy been established? Have naming conventions been established to label assets/locations?	Allows for tracking of information at the appropriate asset level	-	-	-	-	-	Included
Asset inventory - Are assets that are operated and maintained by the District inventoried?	Essential building block for maintenance management and R/R planning	Included	Included	Included	Included	Included	Included
Required asset data - Has critical asset data been documented? Is a field inventory needed to collect missing asset data?	Essential building block for maintenance management and R/R planning	Included	Included	Included	Included	Included	Included
Levels of Service and Performance Measures							
Levels of service - Have levels of service been established?	Tracking allows for evaluating and communicating performance across the organization with the purpose of continually improving and making adjustments.	-	-	-	-	-	-
Performance Measures - Have performance measures been established? Is the data needed to calculate the measures currently collected and available?	Tracking allows for evaluating and communicating performance across the organization with the purpose of continually improving and making adjustments.	-	-	-	-	-	Included

Table 5-1. Review of District Asset Management Plans

AMP Component and Description	Benefit	Asset Management Plan Documents					
		Transmission Main	Distribution	Buildings and Structures	Reservoirs and Booster Stations	Meter Retrofits	Groundwater Well Facility
Risk Management							
Critical Assets - Have the most critical assets (high likelihood and consequence of failure) been identified?	Provides a structured, repeatable framework to focus and prioritize rehabilitation and replacement projects, maintenance programs, and staff resources on the highest priority assets.	-	Included	-	-	Included	-
Risk Management Strategies - Have risk mitigation strategies been developed to address the highest risks? Have risk mitigation measures been implemented for the most critical assets?	Focuses resources on the greatest risk to the organization.	-	-	-	-	Included	-
Condition Assessment							
Condition Assessment - Has the condition of critical assets been documented?	Consistent documentation of asset condition supports decisions about when to repair, rehabilitate and replace assets and also informs asset managers on how best to operate and maintain an asset.	-	-	Included	Included	-	Included
Condition monitoring - Are changes in the condition of critical assets being monitored over time?	Consistent documentation of asset condition supports decisions about when to repair, rehabilitate and replace assets and also informs asset managers on how best to operate and maintain an asset.	-	-	-	-	-	-
Condition information - Is condition data collected and entered into the CMMS? Is it used to make decisions?	Consistent documentation of asset condition supports decisions about when to repair, rehabilitate and replace assets and also informs asset managers on how best to operate and maintain an asset.	-	-	-	-	-	-
Maintenance Management							
Preventive maintenance - Has a preventive maintenance strategy been developed for critical assets?	Proactive maintenance helps to maximize the useful life of assets and prevent failures.	-	-	Included	Included	-	-
Failure analysis - Are failure records (i.e. problem, cause, remedy) being used for failure analysis and R/R planning?	Allows for tracking of failures at the asset level for evaluating trends to make operational and/or maintenance adjustments to address recurring issues.	-	Included	-	-	-	-

Table 5-1. Review of District Asset Management Plans							
		Asset Management Plan Documents					
AMP Component and Description	Benefit	Transmission Main	Distribution	Buildings and Structures	Reservoirs and Booster Stations	Meter Retrofits	Groundwater Well Facility
Asset Needs							
New assets - Have the needs for new assets (i.e. expansion, capacity improvements) been identified, including costs and a time frame for design and construction?	Allows the District to set funding level and provides justification for funding requests.	Included	-	-	Included	Included	-
Long-term R/R Plans - Has a long-term R/R plan been established for critical assets?	Allows the District to set funding level and provides justification for funding requests.	Included	Included	Included	Included	Included	-
Near-term R/R Plans - Has a near-term R/R plan been established for critical assets?	Provides justification for funding requests and development of the CIP.	-	-	-	-	Included	-
Project Justification - Have project justifications and/or business cases been developed?	Provides justification for funding requests and project approvals.	-	Included	-	-	Included	-
CIP Development and Prioritization - Has a CIP development and prioritization process been documented and implemented?	Ensures that funding is spent wisely on the highest priority projects.	-	-	-	-	Included	-
Asset Commissioning and Decommissioning - Has an asset commissioning and decommissioning process been defined and implemented?	Allows for adjustments to operational and maintenance practices based on asset changes.	-	-	-	-	-	-

The AMPs effectively explain and provide the background and basis for how the useful life and cost assumptions were derived and how they are used to develop the long-term R/R plans. The useful life estimates used by the District are consistent with industry standard assumptions. The cost estimates have been developed based on historical costs for previous District projects in most cases, which is the preferred method for obtaining costs for planning level estimates.

Table 5-2 provides AMP improvement recommendations organized into the best practice AMP elements and based on the AMP review observations and findings. The asset classes where the recommended improvements are needed are identified.

Table 5-2. AMP Recommendations by Category and Asset Class

AMP Category	Recommendations	Transmission Main	Distribution	Buildings and Structures	Reservoirs and Booster Stations	Meter Retrofits	Groundwater Well Facility
Asset Management Plan	Standardize on an AMP template to encourage a consistent AMP structure and to ensure each asset class addresses the key AMP elements.	X	X	X	X	X	X
Asset Management Plan	Define and document AMP roles and responsibilities for plan development, maintenance and implementation.	X	X	X	X	X	X
Asset Information	Define and document the asset hierarchy.	X	X	X	X	X	-
Levels of Service and Performance Measures	Define and document levels of service.	X	X	X	X	X	X
Levels of Service and Performance Measures	Define and track performance measures to monitor delivery of service levels.	X	X	X	X	X	X
Risk Management	Identify and document the highest priority assets.	X	-	X	X	-	X
Risk Management	Identify and document risk management strategies to mitigate key risks at the highest priority assets.	X	X	X	X	-	X
Condition Assessment	Develop and document a plan to assess and document the condition of the highest priority assets.	X	X	-	-	X	-
Condition Assessment	Develop and document a plan to monitor the condition of the highest priority assets.	-	-	-	X	X	X
Condition Assessment	Develop and document a plan to manage condition information.	X	X	X	X	X	X
Maintenance Management	Develop and document a maintenance strategy for the highest priority assets.	X	X	-	-	X	X

Table 5-2. AMP Recommendations by Category and Asset Class

AMP Category	Recommendations	Transmission Main	Distribution	Buildings and Structures	Reservoirs and Booster Stations	Meter Retrofits	Groundwater Well Facility
Maintenance Management	Use historical failure records for failure analysis and rehabilitation/ replacement planning.	X	-	X	X	X	X
Asset Needs	Identify and document the future needs for new assets.	-	X	X	-	-	X
Asset Needs	Develop near-term R/R Plan that identifies specific projects needed within the next 5 to 10 years and their associated costs.	X	X	X	X	-	X
Asset Needs	Develop project justifications for the projects identified under the near-term R/R Plan.	X	X	X	X	-	X
Asset Needs	Document and implement a CIP Development and Prioritization Process. Develop and document a project prioritization methodology.	X	X	X	X	-	X
Asset Needs	Document and implement an Asset Commissioning and Decommissioning Process.	X	X	X	X	X	X