FINAL

2018 WATER, WASTEWATER, AND RECYCLED WATER MASTER PLAN

B&V PROJECT NO. 183172

PREPARED FOR

Vallecitos Water District

4 OCTOBER 2018

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1 Introduction

The Vallecitos Water District (VWD or District) provides potable water and wastewater services within northern San Diego County, including service to the City of San Marcos; parts of the cities of Carlsbad, Escondido, and Vista; and unincorporated areas within the County of San Diego. In addition, The District wholesales recycled water to the City of Carlsbad and the Olivenhain Municipal Water District. Figure 1-1 shows the location of the District, as well as the planning area boundary. The planning area boundary consists of VWD's Sphere of Influence, the water service area, and the wastewater service area. To provide reliable and cost-effective service to its customers, the District routinely updates its Water, Wastewater, and Recycled Water Master Plan to:

- Evaluate the existing and future needs for water, wastewater, and recycled water services
- Develop a facilities plan and capital improvement program to accommodate these needs

The master plan and comprehensive capital improvement program provide the District with guidelines for reliable service to District customers well into the future.

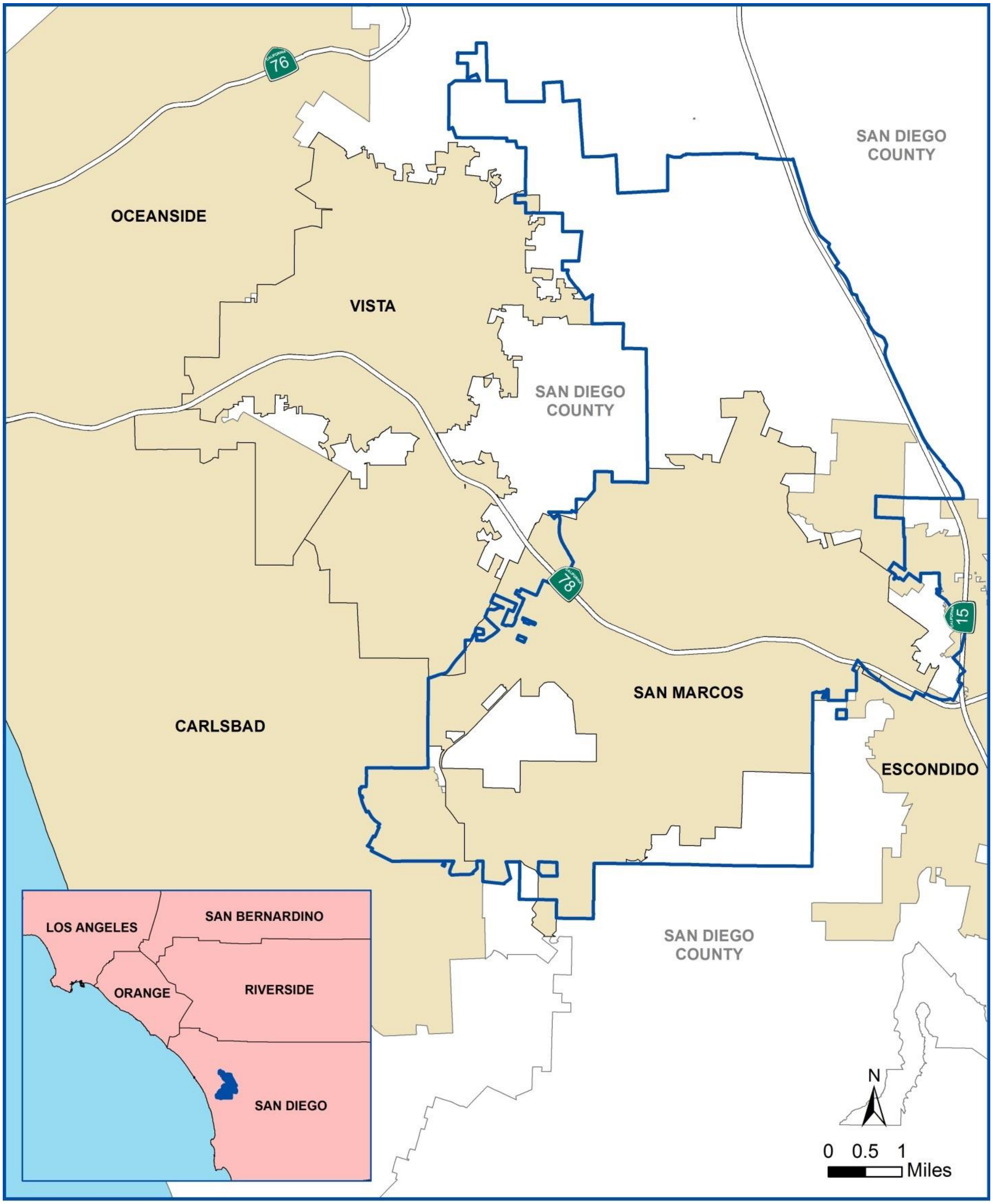
To accomplish this, the VWD Water, Wastewater and Recycled Water Master Plan (2018 Master Plan) analyzes existing and future land uses, as well as current water demands and trends. Through use of the District's Geographic Information System (GIS) and WaterGEMS / SewerGEMS hydraulic modeling software, the master plan evaluates the capacity of the existing water and sewer systems and specifies improvements necessary to serve existing and future customers. Phasing of these improvements is based on regional population projections and known plans for development within the District's sphere of influence. A capital improvement program (CIP) is then developed to guide the District in timely and cost-effective investments that contribute to the sustainability of the District's infrastructure and reliability of service to the District's customers.

1.1 BACKGROUND

VWD is a county water district governed by five directors voted into office by local citizens. It is dedicated solely to the provision of water, wastewater, and reclamation services and has been in existence for over 60 years.

The District was formed on March 12, 1955 as a water-only District by a group of local farmers who recognized that a more substantial water supply than the groundwater found in the San Marcos and Twin Oaks valleys was needed to serve the area. The District, originally named the San Marcos County Water District, was initially established as an independent special district pursuant to Section 30000 et seq., Division 12 of the California Water Code, with the purpose of bringing outside water into the area through the development and operation of a public water supply system that tapped Colorado River water supplies. With the passage of a $998,000 bond issue in 1956, water system construction began. Initially, water deliveries from the San Diego County Water Authority (SDCWA) to the District were handled through the Buena Colorado Municipal Water District.

Figure 1-1 Study Area Location



Growth in population and business activities drove the need for a sewer system. In 1958, an improvement district was formed to finance the construction of a wastewater collection system. A second improvement district, the Encina Wastewater Authority, was formed in 1961 to finance the construction of a shared wastewater treatment plant, the Encina Water Pollution Control Facility (EWPCF).

In 1961, the District built the Meadowlark Water Reclamation Facility (MRF) within its service area. In 1982, the plant was improved and re-opened as a recycled water plant. In contrast to the regional EWPCF, the MRF is a local plant focused on water reclamation. In 1981, the District became a member of the SDCWA. On May 1, 1989, the District's name was changed to the Vallecitos Water District.

The District serves a 45 square mile service area with a population of approximately 96,200 people. In 2014, the District had approximately 21,920 meters that delivered over 16,500 acre-feet per year (AFY) of potable water. Historically, the District has provided a majority of its potable water from imported water via the SDCWA. In the last decade, the District has worked to diversify its supply sources and promote water efficiency and conservation. In 2016, the District acquired an independent supply from the Olivenhain Municipal Water District for 2,750 acre-feet of potable water per year.

In the fall of 2007, the District approved a Water Purchase Agreement with Poseidon Resources Corporation, the owner and developer of the Carlsbad seawater desalination plant. The Claude "Bud" Lewis Desalination Plant began operation in 2015. The District will receive as much as 4,083 acre-feet per year of desalinated water under the current agreement, which equates to approximately 25 percent of the District's current average water demand. This new supply represents a new local water resource, which enhances the reliability of the District's supply system. The District receives water from a direct connection to the desalinated water distribution main via the SDCWA's VAL 9 turnout. This allows the District to take water from the desalination plant directly as an alternative water supply.

Average wastewater flow is currently at 6.8 million gallons per day. The majority of this wastewater flows by gravity or is diverted to the MRF. The original MRF was expanded, increasing the 2 million gallon per day plant capacity to 5 million gallons per day (MGD). Approximately 4.5 MGD is sold under contract to the City of Carlsbad and Olivenhain Municipal Water District for non-potable purposes such as landscape irrigation.

1.1.1 Mission Statement

The District's mission is to serve as water and wastewater specialists, providing exceptional and sustainable services. The District pledges to continue to provide exceptional and sustainable services by:

- Proactively, innovatively, and continuously improving the quality and efficiency of its operations and service
- Supporting and retaining highly trained staff that is knowledgeable, engaged, team oriented, and responsive to the community and other agencies

- Providing support for the good of the region to remain a respected and active industry partner, and
- Providing continuous outreach and education to its customers on issues and topics that impact the services it provides and its role as water and wastewater specialists

1.2 CURRENT DISTRICT ISSUES

The purpose of developing the 2018 Master Plan is to develop a plan that addresses the current issues and conditions that affect the District as well as identifying future facility needs to address long-term capacity improvement needs within the District. Since the last Master Plan (2008), there are a number of local and regional issues that directly impact the District and are considered in this 2018 Master Plan.

1.2.1 Water Conservation and Drought Restrictions

On May 6, 2009, the District adopted a Drought Response Conservation Program (Ordinance No. 162) that establishes regulations and procedures to be implemented during times of declared water shortages or emergencies. The ordinance establishes four levels of drought response actions with increasing restrictions on water use. Level 1 requests a voluntary 10 percent cutback in water use from all the District's customers. Level 2 imposes mandatory cutbacks of up to 20 percent. During critical emergency shortages, Levels 3 and 4 require increasingly severe mandatory restrictions on water use and setting new meters. On July 15, 2014, the State Water Resources Control Board (SWRCB) adopted emergency statewide regulations to require all California water agencies to mandate water-use restrictions. On August 6, 2014, to comply with the state mandates, the District's Board of Directors (Board) voted to increase to a Level 2 Drought Alert to require mandatory water-use restrictions for its customers.

In an executive order issued on April 1, 2015, Governor Brown ordered the SWRCB to implement reductions in cities and towns to cut overall usage by 25 percent. The SWRCB mandated a 24 percent reduction in potable water use specifically for the District from 2013 demands, which includes residential, commercial, industrial, and institutional demands. On May 20, 2015, in an effort to meet the 24 percent reduction required by the State, prevent the waste and unreasonable use of water, and promote water conservation, the District's Board adopted additional emergency drought conservation measures under Ordinance 195. These additional measures limit all outdoor irrigation, excluding certified agricultural or commercial growers, during the months of June through October to two unassigned days per week, eight minutes per station. In September 2015, the District reported a 31.8 percent reduction in water usage as compared with 2013 levels.

On February 15, 2017, the District's Board voted to rescind the drought restrictions. District customers may irrigate any day of the week with no limit on the number of watering days and may irrigate their landscapes for as many minutes as needed. However, the Board continued to express their desire to sustain water conservation as a permanent way of life. The District's Ordinance 198 still permanently prohibits wasteful practices, such as:

- Watering between the hours of 10:00 a.m. and 6:00 p.m.
- Watering within 48 hours of a measurable rain event
- Visible irrigation runoff

- Hosing down hardscapes (patios, sidewalks, etc.)
- Not using a shut-off nozzle when washing cars
- Not fixing leaks within 48 hours of discovery
- Restaurants only serving water on request

This 2018 Master Plan reviews the District's water conservation plan and evaluates the impact of potential reductions on water demands due to a successful water conservation program.

1.2.2 Imported Water Supply Cutbacks

One of the primary issues affecting the District today has been the cutback in imported water supply. The Metropolitan Water District of Southern California (MWD) delivers imported water to the SDCWA, which distributes the imported water to the Water Authority's member agencies. The State Water Project allocation to MWD has been at reduced levels through much of this extended drought period, and in some years, the reduction has been significant (less than 20 percent of requested supplies). Reduced deliveries require local water supply agencies to rely on dry water year contingency plans to meet their needs. MWD and the SDCWA have, in turn, reduced allocations to member agencies during this period. These cutbacks directly affect how the District plans to meet existing and future water demands. Water conservation, water efficiency, and local supply development have been key factors in ensuring continued reliable service and will continue to be major drivers for local agencies in the future due to uncertainty in imported water supplies.

1.2.3 Local Water Supply Development

To lessen their dependence on imported water, local water retail agencies throughout Southern California, including VWD, are implementing water conservation and efficiency measures and seeking alternative local sources of water. VWD has addressed these issues by developing and adopting an Integrated Water Resources Plan (IRP) in 2007 and by addressing potential supply options as part of the 2008 Master Plan. This 2018 Master Plan provides a brief update on the potential supply options, including recycled water options. In addition, an analysis is provided on the potential effects that recent conservation efforts may have on the District's long-term water demand and wastewater flows.

1.2.4 Wastewater Disposal Capacity

With the expanded production of recycled water at MRF from 2 MGD to 5 MGD, VWD is reducing the amount of wastewater that flows through its land outfall to the EWPCF. Solids from the MRF are conveyed back to the EWPCF. This 2018 Master Plan addresses VWD's capacity needs and determines the capital infrastructure improvements needed to continue providing conveyance and disposal of its wastewater in the future.

1.2.5 Service Area Growth

To accommodate planned growth consistent with adopted general plans of the local municipalities, this 2018 Master Plan is a critical component in determining future water needs and the District's ability to provide for those needs. The City of San Marcos adopted changes to its General Plan in 2012. Also, in 2007, the Local Agency Formation Commission of the County of San Diego (LAFCO) adopted a statement of determination affirming the delineation of the District's sphere of influence. Since 1987, the population of this area had increased dramatically, and over 34 annexations have occurred. The San Diego Association of Governments (SANDAG) has forecasted significant expansion of single family homes within the District's sphere of influence by 2035. However, with the recent economic downturn, new development may not have occurred to the extent or within the time frame previously planned. There has also been a shift in development from predominately single-family homes to a mix of single family and multifamily units. Updated population projections and development plans within the sphere of influence boundary are discussed in Chapter 2.

1.3 PREVIOUS PLANNING DOCUMENTS

Previous planning studies prepared for the District were reviewed and relevant information was updated and incorporated. The documents listed below were considered as part of this master planning effort.

- 2013 Odor Control Study, September 2013, Dudek Consultants
- 2013 Energy Management Study, DHK Consultants
- 2012 North San Diego County Regional Recycled Water Project (NSDRRWP), May 2012, RMC Consultants
- 2010 Urban Water Management Plan (2010 UWMP)
- 2008 Water, Wastewater, and Recycled Water Master Plan and Programmatic Environmental Impact Report (2008 MP), November 2010, PBS&J
- 2007 Integrated Water Resources Plan (IRP), adopted November 7, 2007, Kennedy/Jenks Consultants
- 2002 Water, Wastewater, and Water Reclamation Master Plan Update and Supplemental Environmental Impact Report (2002 MP), August 2005, Kennedy/Jenks Consultants

Additional planning documents prepared by other agencies were also used in the preparation of this 2018 Master Plan. The following documents were reviewed for information regarding the District's relationship with neighboring and regional agencies:

- Encinas Canyon Multi-Agency Relief Sewer (ECMARS Study), IEC
- San Diego County Water Authority Master Plan (SDCWA Master Plan), CH2M HILL/Black & Veatch
- City of Escondido Indirect Potable Reuse Program, Black & Veatch
- Vista Irrigation District Flume Study/Water Supply Planning Study, Black & Veatch
- Encina Master Plan, Black & Veatch

1.4 AUTHORIZATION

The District, at the regular Board meeting held on April 2, 2014, authorized execution of an Agreement between VWD and Black & Veatch for the "2014 Water, Wastewater and Recycled Water Master Plan." Authorization to proceed with the scope of the agreement was given by the District on April 3, 2014.

1.5 SCOPE OF WORK AND OBJECTIVES

The Scope of Work for the 2018 Master Plan includes:

- Review of previous master plans, planning documents, and supply sources information
- Development of updated water demands and wastewater flows based on current, approved land uses. Develop phased demands corresponding to CIP phasing periods
- Evaluation and updating of planning criteria
- Update and utilization of District-developed hydraulic water and wastewater models to assess the existing and ultimate water and wastewater systems to develop an updated CIP
- Assessment of the CIP impact caused by alternative supply scenarios identified in the IRP and integration of certain IRP elements into the Master Plan and CIP
- Summary of the issues and opportunities for increasing the District's local water supply portfolio, including through use of recycled water
- Review and update of the land outfall capacity needs based on the revised sewer flow forecasts
- Update of District wastewater capacity needs at both the EWPCF and MRF treatment plants
- Preparation of a Programmatic Environmental Impact Report (PEIR) covering the Master Plan and CIP

1.6 STUDY AREA OVERVIEW

The study area for the 2018 Master Plan is delineated by the LAFCO sphere of influence boundary, as affirmed in 2014 and shown on Figure 1-1. This boundary was originally established in the North County Inland Municipal Service Review and Sphere of Influence Update Study prepared by LAFCO in September 2003.

The following sections briefly describe VWD's existing water and sewer service areas and the special service agreements that VWD has entered into with neighboring agencies.

1.6.1 Water Service Area

VWD is a member of the SDCWA and currently receives about 75% percent of its water supply from this water wholesaler. The rest of the District's potable water supply is provided by the recently completed Carlsbad seawater desalination plant as well as up to 2,200 AFY of supply from the Olivenhain MWD. The District's current water service area encompasses a majority of the 45 square mile study area, as shown in Figure 1-2. Currently, the District delivers water through 356 miles of pipeline and operates 10 pump stations and 19 potable water storage reservoirs ranging in size from 350,000 gallons to 40 million gallons. The District's total operational storage capacity is 121.6 million gallons. During Fiscal Year 2013-2014, the District provided an average of 14.8 MGD to approximately 21,900 meters serving residential, commercial, light industrial, institutional, construction, landscape irrigation and agricultural uses.

1.6.1.1 Bennett and Boot Annexation Areas

There are two "islands" within the District's service area, referred to as the Boot and Bennett areas, which are served by the Vista Irrigation District (VID) through connections to the Vista Flume, a gravity-fed pipeline that conveys water from the joint Escondido/Vista treatment plant to VID. The locations of these Boot and Bennett areas are shown on Figure 1-2. The 2003 LAFCO report identified a number of reorganizations between VWD and VID in both the Bennett and Boot areas. The District's 1997 and 2002 Master Plans proposed capital improvements to connect these areas to the District's water service system. Over time, the District has annexed a number of parcels into its service area and anticipates that this trend will continue.

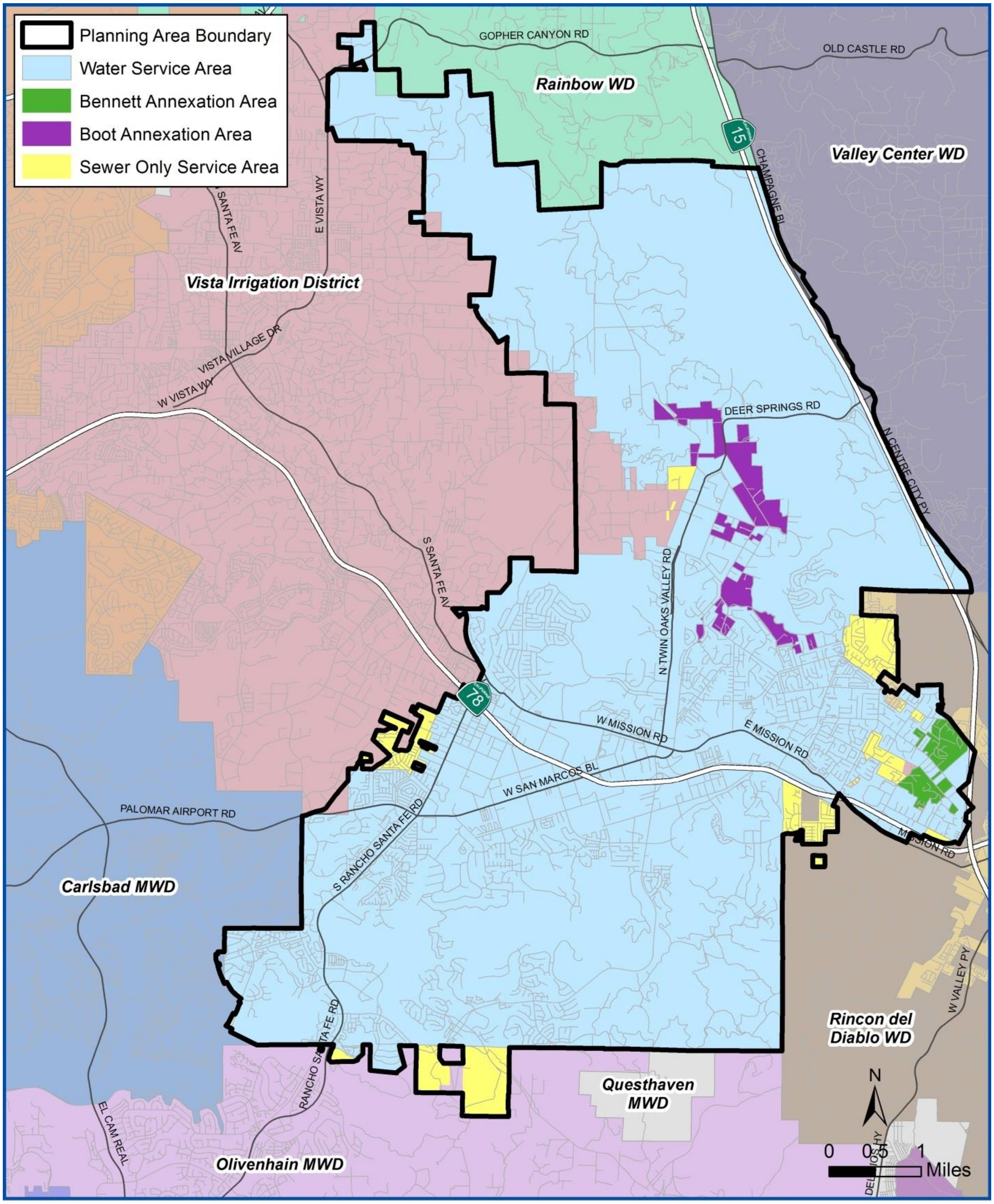
The 670-acre Boot area is located primarily in the County of San Diego, and within the City of San Marcos sphere of influence. The area is largely agricultural and residential, and currently receives water from VID. Wastewater is disposed of through individual septic systems. As this area develops, individual parcels have been and will continue to be annexed into VWD for both water and sewer service.

The 470-acre Bennett area is located within the City of San Marcos and primarily includes single family homes. This area also receives water from VID and is currently located within the District's sewer-only service area. It is anticipated that the individual parcels within this area will eventually be annexed into VWD for water service.

1.6.1.2 Other Areas with Sewer Only Service

As shown on Figure 1-2, there are additional areas within the study area that do not receive water service from the District but do receive sewer services. These areas are not anticipated to be annexed to the water service area at this time.

Figure 1-2 Water Service Area



1.6.2 Wastewater Service Area

Within the study area there are some rural areas that still use septic systems for sewage disposal, thus the District's current 23-square mile sewer service area is much smaller in size than its water service area, although the District's sphere of influence is equal in size for both. Figure 1-3 shows the District's current wastewater service area. The Northern Tributary Area is an area that is likely to remain on septic systems and therefore is not likely to be an area where the District's wastewater infrastructure will be expanded to in the future.

The District has over 20,000 sewer service connections with 4 lift stations and approximately 250 miles of pipeline. There are a number of areas within the wastewater service area that lie along the edge of the District boundary and because of the drainage patterns, are served by neighboring agencies. Agreements allowing for the exchange of sewage flows are described below. The locations of these areas are shown on Figure 1-3.

1.6.2.1 Rancho Santalina

The exchange agreement titled "Agreement for Exchange of Sewage Flows between the Vallecitos Water District and Buena Sanitation District," dated January 28, 1992 allows 151 equivalent dwelling units within the District's wastewater service area in the vicinity of Rancho Santalina (area northwest of the intersection of Rancho Santa Fe Road and South Santa Fe Avenue) to discharge wastewater to the Buena Sanitation District.

1.6.2.2 Meadowlark Estates

The exchange agreement titled "Agreement for Exchange of Sewer Flows between the Vallecitos Water District and the City of Carlsbad (Meadowlark Estates/Rancho Carrillo Sewer Flow Agreement)," dated March 24, 2000 allows for 80 equivalent dwelling units within the District's wastewater service area adjacent to the White Sands Drive/Business Park Drive/Palomar Airport Road/San Marcos Boulevard intersection to discharge wastewater to the City of Carlsbad.

1.6.2.3 Raceway Basin

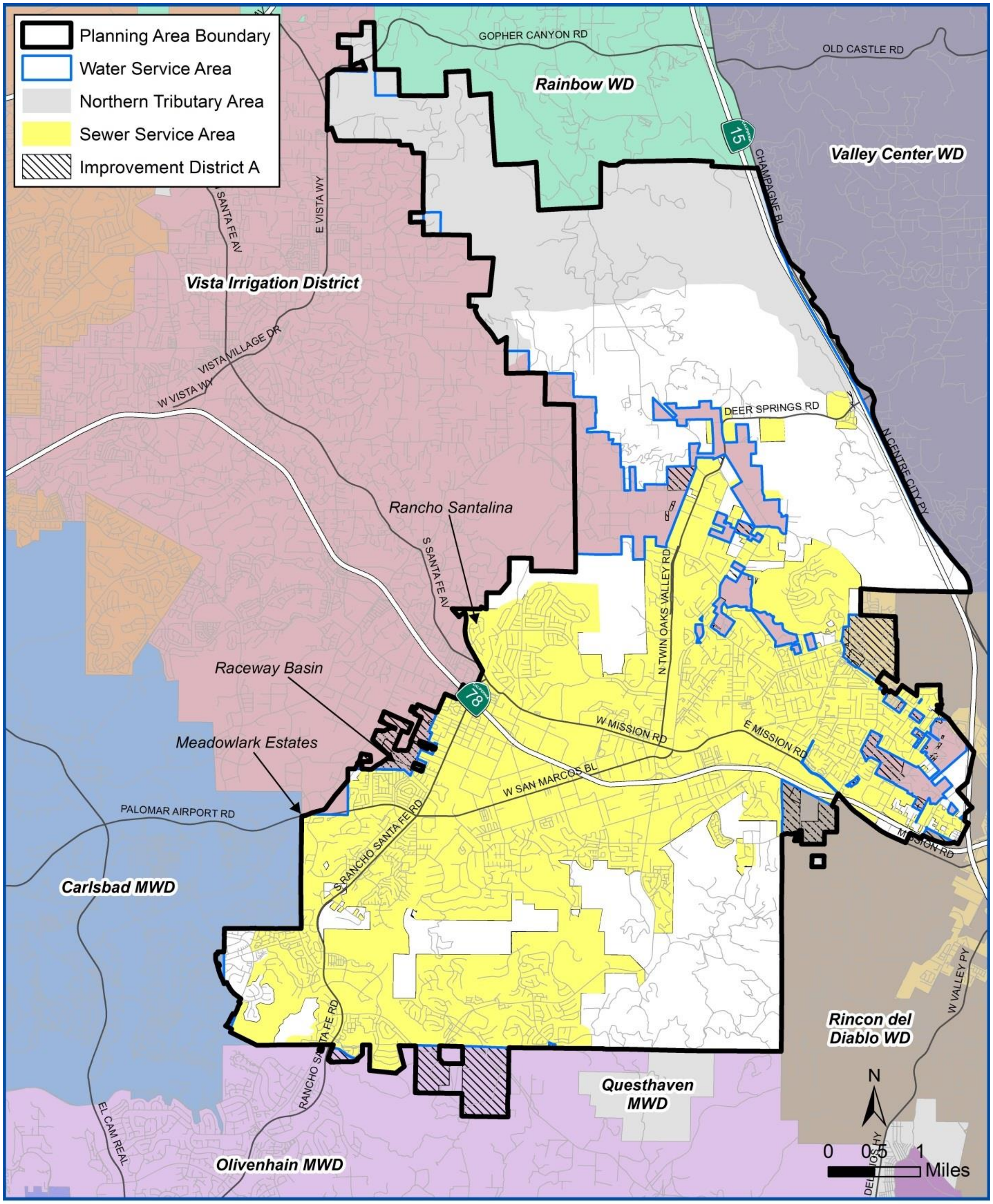
The exchange agreement titled "Agreement for Exchange of Sewage Flows between the Vallecitos Water District and the City of Vista (Raceway Basin Flow Agreement)," dated May 28, 1991 and the "First Amendment to the Agreement Between the Vallecitos Water District and the City of Vista for the Exchange of Sewer Flows," dated March 27, 2007 allows for the area within the District's wastewater service area between Poinsettia Avenue and Linda Vista Drive in the western portion of the District to discharge wastewater to the City of Vista.

1.6.2.4 Sewer Improvement District A

Sewer Improvement District A (IDA) includes a small area in the City of San Marcos, adjacent to the City of Escondido toward the southeast corner of the District. There are currently 1,708 sewer service connections within IDA that connect to the District's wastewater collection system. The customers in this area are sewer-only customers and are not served water by the District.

Additional areas outside of the study area that are served or planned to be served by VWD include the Escondido Golf Course to the east, and the San Marcos Landfill property to the south.

Figure 1-3 Wastewater Service Area



1.6.3 Recycled Water Service Area

Although the District produces up to 5 MGD of recycled water at MRF and maintains the 54 million-gallon (MG) Mahr Reservoir, the District does not maintain a recycled water service area within its sphere of influence. All of the recycled water produced is sold to the City of Carlsbad and the Olivenhain Municipal Water District. Carlsbad originally contracted for up to 2.0 MGD during peak summer months, and in 2003, increased that amount to 3.0 MGD. As part of that agreement, the District also provides Carlsbad with 32 MG of recycled water storage in the Mahr Reservoir. Also, in 2003, the Olivenhain Municipal Water District contracted for up to 1.5 MGD of recycled water and 16 MG of recycled water storage in the Mahr Reservoir. Excess recycled water is disposed of through a failsafe pipeline that connects to the ocean outfall at the EWCPF. Additional details on these agreements are discussed in Chapter 7.

2 Land Use and Population

Land use information is used to characterize existing water usage and wastewater generation patterns and to estimate future water demands and wastewater flows. Existing and projected population data is used to plan the phasing for implementing future facilities to accommodate the expected level of growth. Land use and population data for the District's service area that was used as part of this Master Plan are described below.

2.1 LAND USE DATA

VWD encompasses approximately 45 square miles and serves the City of San Marcos and parts of the cities of Carlsbad, Escondido, Vista, and the County of San Diego.

As part of this Master Plan, land use data was used to develop a parcel-based database, which characterized the parcels within the District's service area by land use type. This database was then applied to the hydraulic models for both the existing and planned system networks. The process used to develop the parcel-based land use database is described in this section.

2.1.1 Existing Land Uses

Existing land use data was obtained through the San Diego Association of Governments (SANDAG), which serves as a regional clearinghouse for land use information in San Diego County. Every three to five years, SANDAG produces a new forecast to incorporate updated data, changing trends, and new policies. In February 2010, the SANDAG Board of Directors adopted the Series 12 2050 Regional Growth Forecast (Series 12) for planning purposes. Existing land use data from the Series 12 forecast was used in the preparation of this Master Plan. The existing land use coverage for the planning area, as provided in SANDAG's Series 12 data, is shown in Figure 2-1.

To develop the parcel-based land use database, the existing land uses from the SANDAG Series 12 data were first applied to the parcels within the District's planning area using a centroid linking method. As a result, each parcel was designated a SANDAG existing land use category. Parcels are then characterized using the District's standard land use categories as per the District's standard planning methodology. Thus, the SANDAG land use category for each parcel was converted to a representative classification within the District's standard land use categories. Figure 2-2 shows the existing land uses for the planning area using the District's standard land use categories. These existing land use figures are followed by future land use estimates, and then comparative summaries of existing and future land use estimates.

Figure 2-1 Existing SANDAG Land Uses

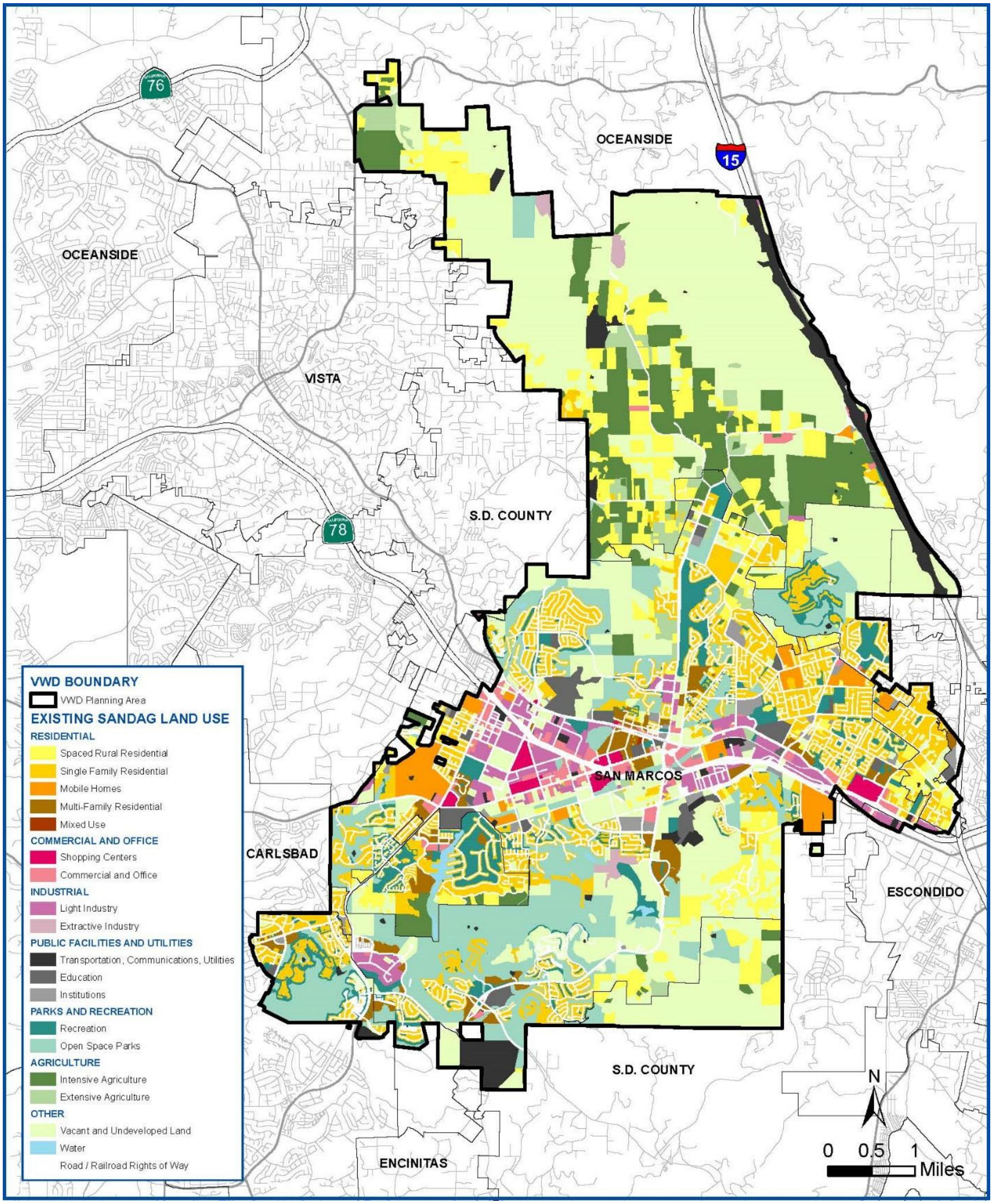
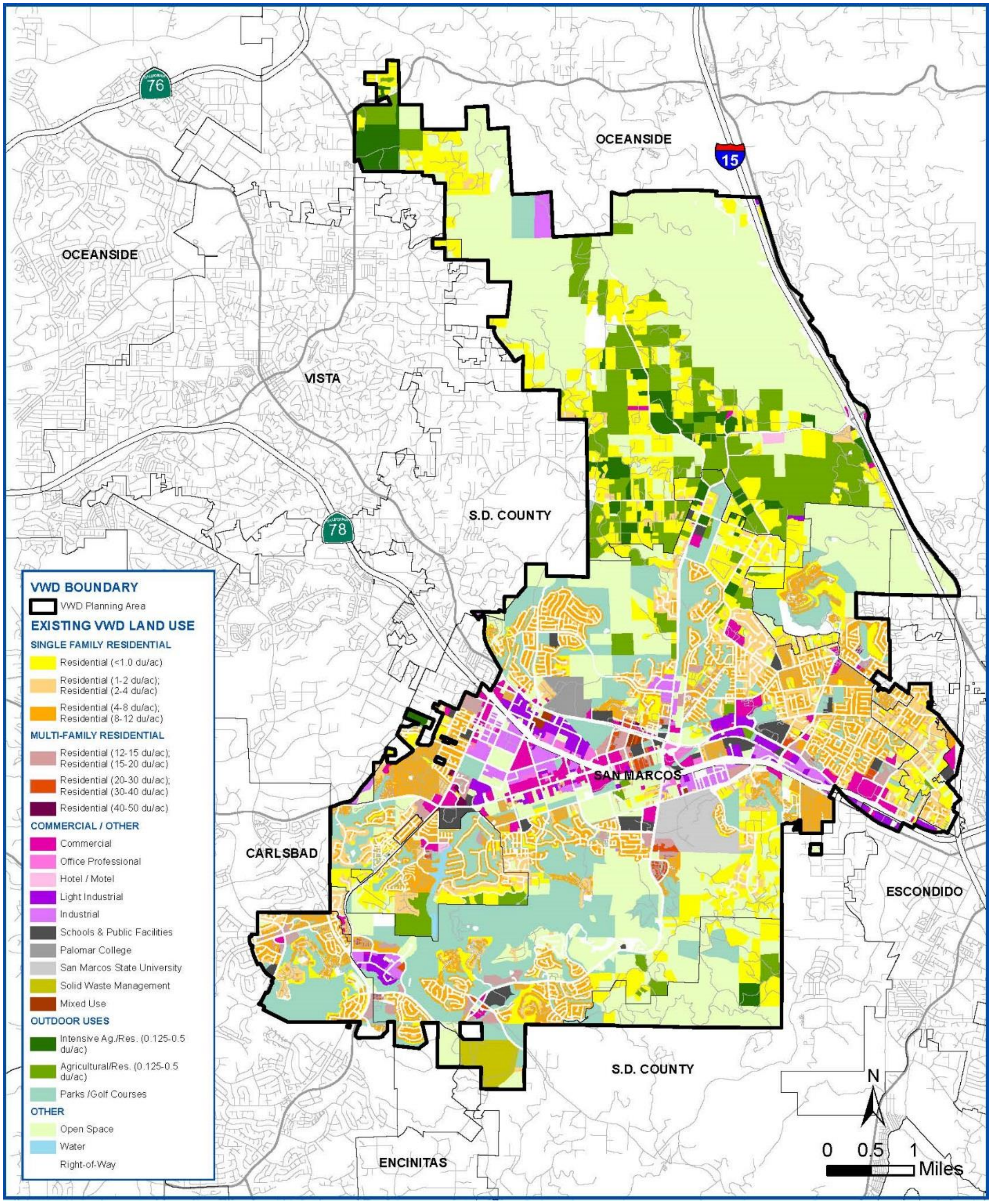


Figure 2-2 Existing VWD Land Uses and Categories



2.1.2 Planned Land Uses

Planned land uses are utilized to estimate future water demands and wastewater flows. The District, as the water and wastewater purveyor, does not establish land uses. Land planning authority in the District's service area falls under the purview of the Cities of Carlsbad, Escondido, San Marcos, and Vista, and the County of San Diego (unincorporated areas). The City of San Marcos and the County of San Diego represent the main areas of future growth in the system.

SANDAG works closely with local jurisdictions to understand current land use plans to develop the Series 12 land use projections. These plans are then inputted into a sub-regional model that utilizes data on existing developments, future land use plans, proximity to existing job centers, past development patterns, and travel times to project where growth is likely to occur in the future. This analysis provides the basis for SANDAG's planned land use projections.

SANDAG also provides zoning data, which describes the land uses and densities allowed in the regulated area. Zoning information was used to determine maximum possible or allowable density for a particular land use area. Because water usage and wastewater flows within a land use type generally varies with the density, the land use and zoning information were used in this Master Plan to classify the planned land uses within the District's planning area. The planned land use and zoning coverage for the planning area, as provided by SANDAG's Series 12 data, is shown in Figure 2-3.

To estimate planned land uses within the District's service area, data from SANDAG's Series 12 was obtained and reviewed. The SANDAG planned land use data was then sent to all five jurisdictions (Cities of Carlsbad, Escondido, San Marcos, and Vista, as well as the County of San Diego) within the District's planning area. These jurisdictions were asked to review and confirm the land use projections or provide updated land use plans that were approved as of June 30, 2014. The Cities of Carlsbad and San Marcos and the County of San Diego provided updated land use projections and zoning data based on their most recent General Plans and Specific Plan Areas, while the Cities of Escondido and Vista confirmed that SANDAG's Series 12 data were consistent with their planned projections. Thus, planned land use data from a variety of sources were considered as part of this Master Plan development. This approach is intended to provide the District with the most accurate land use projections.

To develop the parcel-based land use database, the planned land use data was first applied to the parcels within the District's planning area. Updated land use projections from the Cities of Carlsbad and San Marcos and the County of San Diego were incorporated into the database where applicable. Where an individual agency identified an updated land use projection, the SANDAG planned land use category and zoning for that parcel was replaced with the more recent information.

Similar to the existing land use classification process, this Master Plan requires that parcels be characterized using the District's standard land use categories. Parcels with non-residential land use types were assigned one of the District's standard land use categories, similar to the process used for existing land uses. The District's standard land use categories for parcels with residential land use types were determined one of three ways:

- If the existing land use type was the same as the planned land use type, it was assumed that the parcel would remain at the same density, and therefore District standard land use category was unchanged. For example, if a parcel's existing SANDAG land use was "Single Family Detached" and gave a District category of "Residential (4-8 du/ac)," it would be given the same District standard category if the SANDAG planned land use was also "Single Family Detached."

- If the existing land use type differed from the planned land use type, SANDAG Series 12 zoning data was applied to the parcel to determine the residential density and District standard land use category.

Figure 2-4 shows the planned land uses and applied zoning data for the planning area using the District's standard land use categories. A breakdown of the existing and planned land use areas, per the District's standard land use categories, is shown in Table 2-1, Figure 2-5, and Figure 2-6 below.

Figure 2-3 SANDAG Planned Land Uses and Zoning Coverage

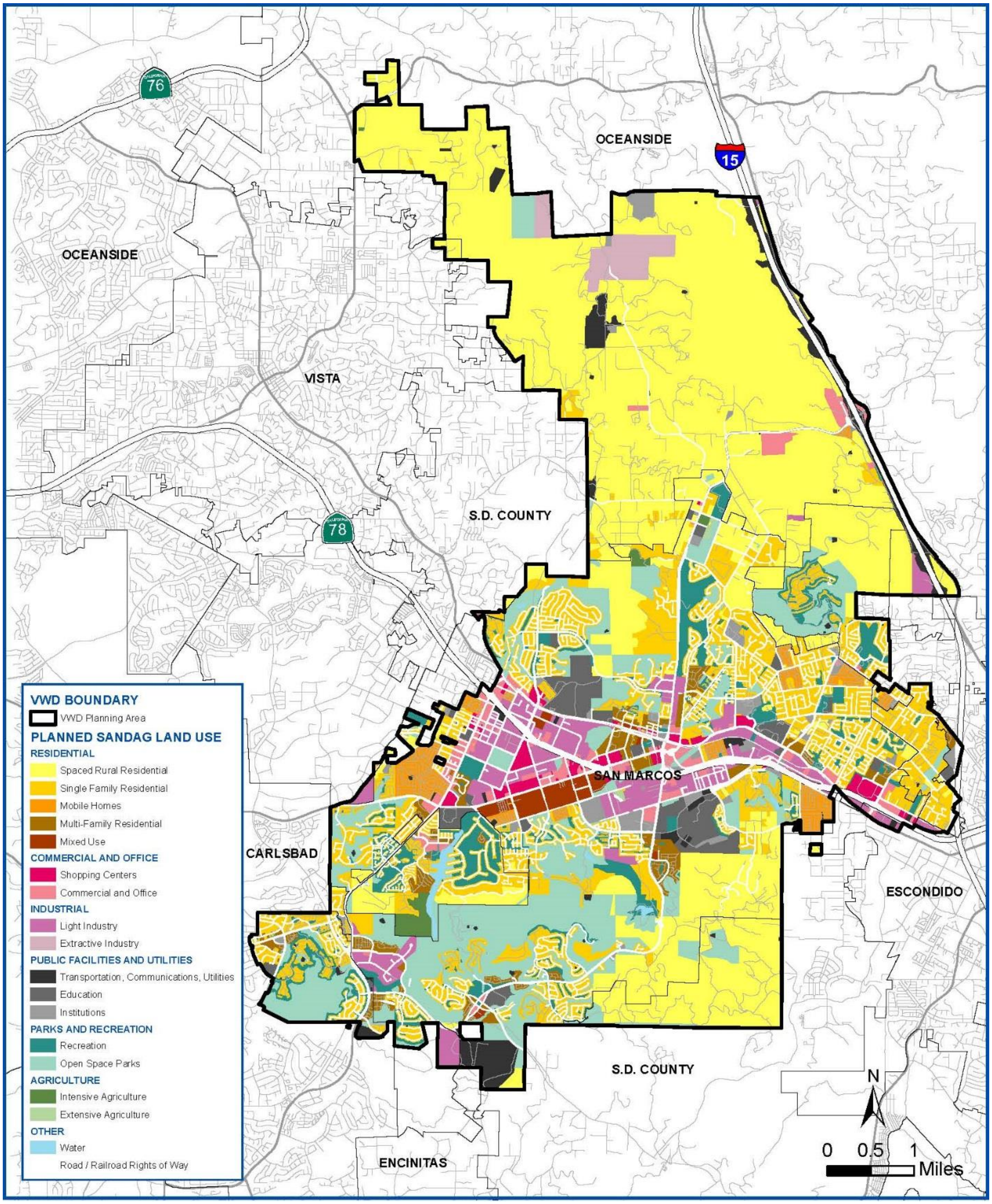


Figure 2-4 VWD Planned Land Use and Categories

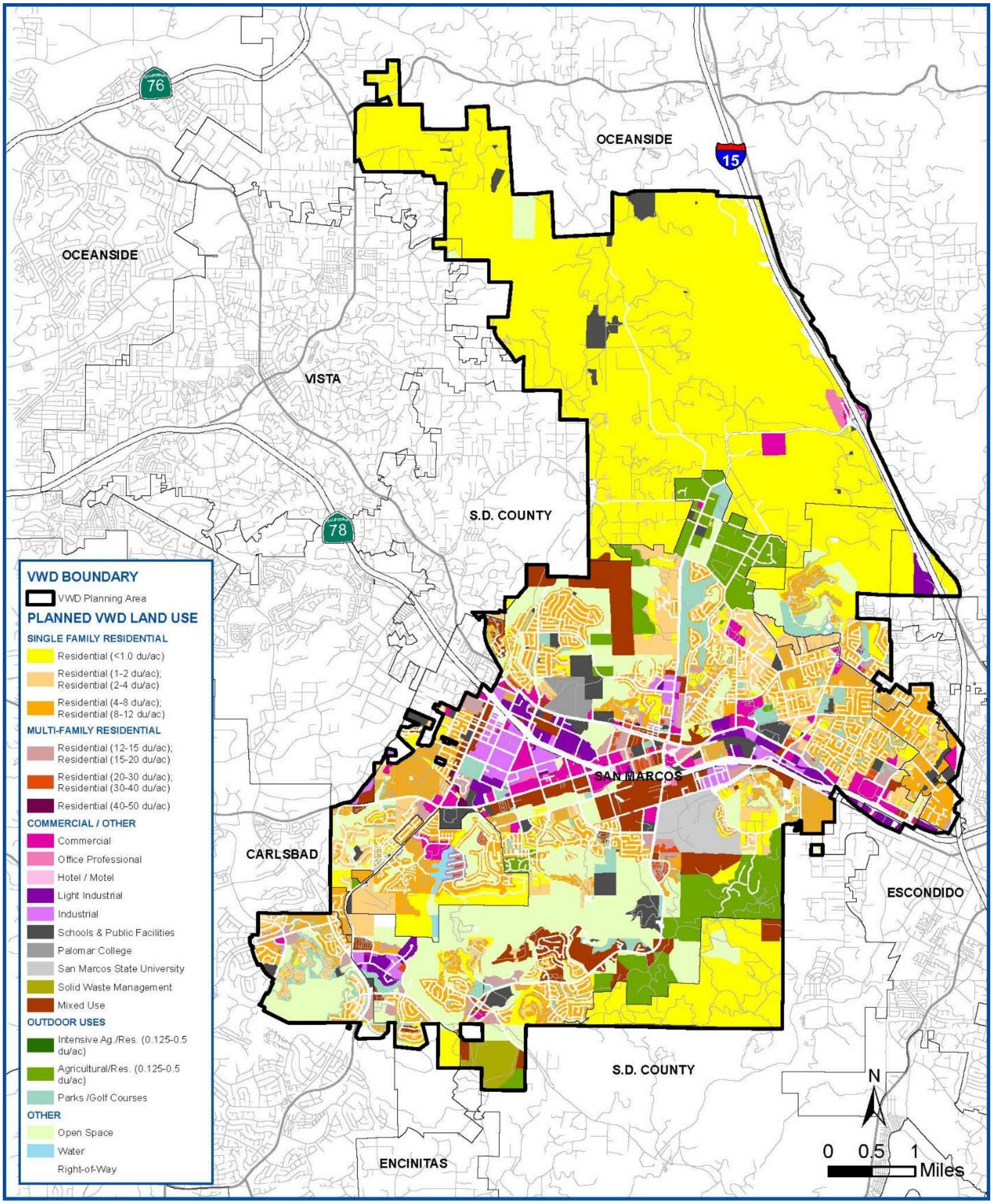


Table 2-1 VWD Land Use Area Summary

VWD LAND USE CATEGORY	GENERAL TYPE	TOTAL AREA (AC)		
		EXISTING	PLANNED 2035	2008 MP PROJECTED
Residential (<1.0 du/ac)(1)	Single Family Residential	3,707	11,405	11,037
Residential (1-2 du/ac)	Single Family Residential	589	721	1,096
Residential (2-4 du/ac)	Single Family Residential	944	892	1,471
Residential (4-8 du/ac)	Single Family Residential	2,452	2,683	2,131
Residential (8-12 du/ac)	Single Family Residential	664	696	637
Subtotal		**8,357**	**16,397**	**16,372**
Residential (12-15 du/ac)	Multi-Family Residential	148	156	130
Residential (15-20 du/ac)	Multi-Family Residential	199	218	152
Residential (20-30 du/ac)	Multi-Family Residential	101	147	147
Residential (30-40 du/ac)	Multi-Family Residential	20	14	-
Residential (40-50 du/ac)	Multi-Family Residential	20	17	-
Subtotal		**488**	**552**	**429**
Commercial	Commercial / Other	610	633	486
Hotel / Motel	Commercial / Other	30	4	-
Office Professional	Commercial / Other	74	79	115
Light Industrial	Commercial / Other	353	450	367
Industrial	Commercial / Other	488	409	465
Schools & Public Facilities	Commercial / Other	344	803	468
Palomar College	Commercial / Other	125	125	103
San Marcos State University	Commercial / Other	305	305	113
Solid Waste Management	Commercial / Other	186	172	15
Mixed Use(2)	Commercial / Other	27	1,379	392
Subtotal		**2,543**	**4,359**	**2,524**
Intensive Ag./Res. (0.125-0.5 du/ac)	Outdoor Uses	649	-	-
Agricultural/Res. (0.125-0.5 du/ac)	Outdoor Uses	2,254	1,446	775
Parks / Golf Courses	Outdoor Uses	943	892	3,041
Subtotal		**3,845**	**2,338**	**3,816**
Open Space	Open Space / Vacant	11,800	3,546	3,488
Right-of-Way	Right-of-Way	431	273	2,410
Water	Water	53	53	76
TOTAL		**27,517**	**27,517**	**29,115**

(1) The 2008 MP Projected acreage includes the total areas from the following 2008 MP Land Use Categories: (a) Hillside Residential (0.05-0.25 du/ac) and (b) Rural Residential (0.125-1.0 du/ac). For the 2014 MP Update, these categories were combined.
(2) The 2008 MP Projected acreage includes the acreage shown as “Other” in the 2008 MP Table 2-1.

Figure 2-5 Existing Land Use Type Summary

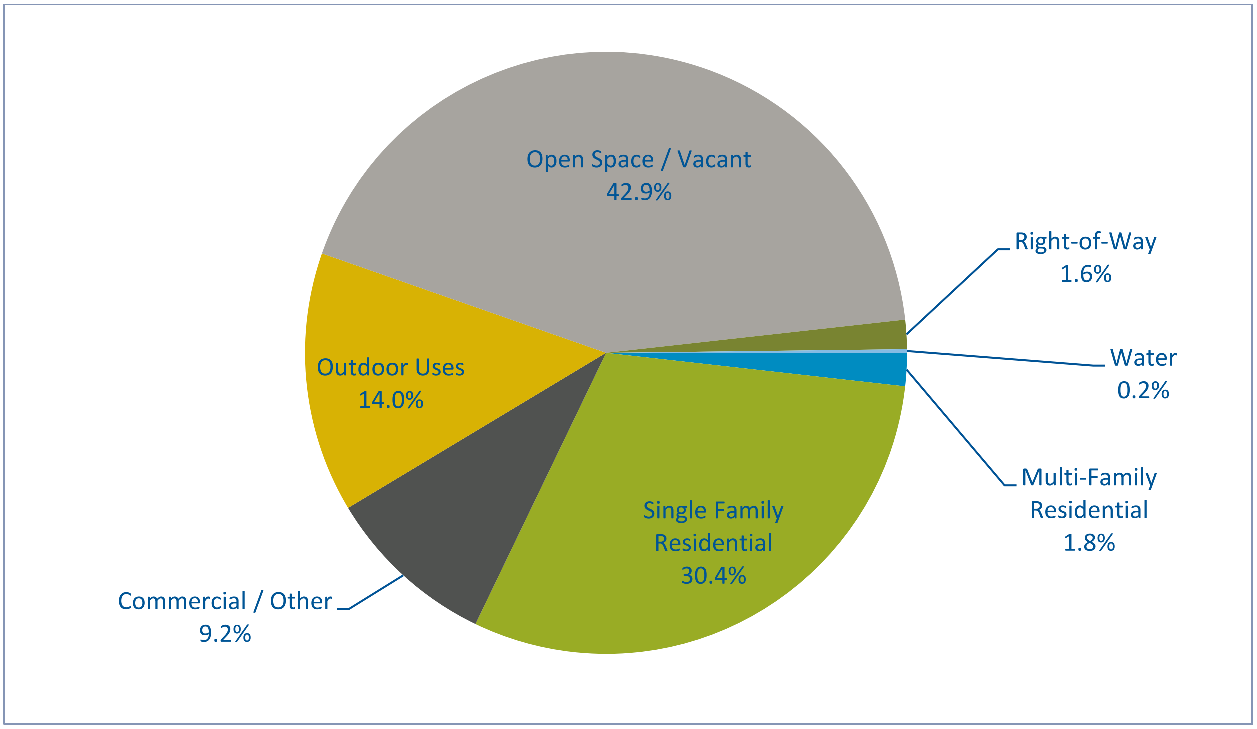
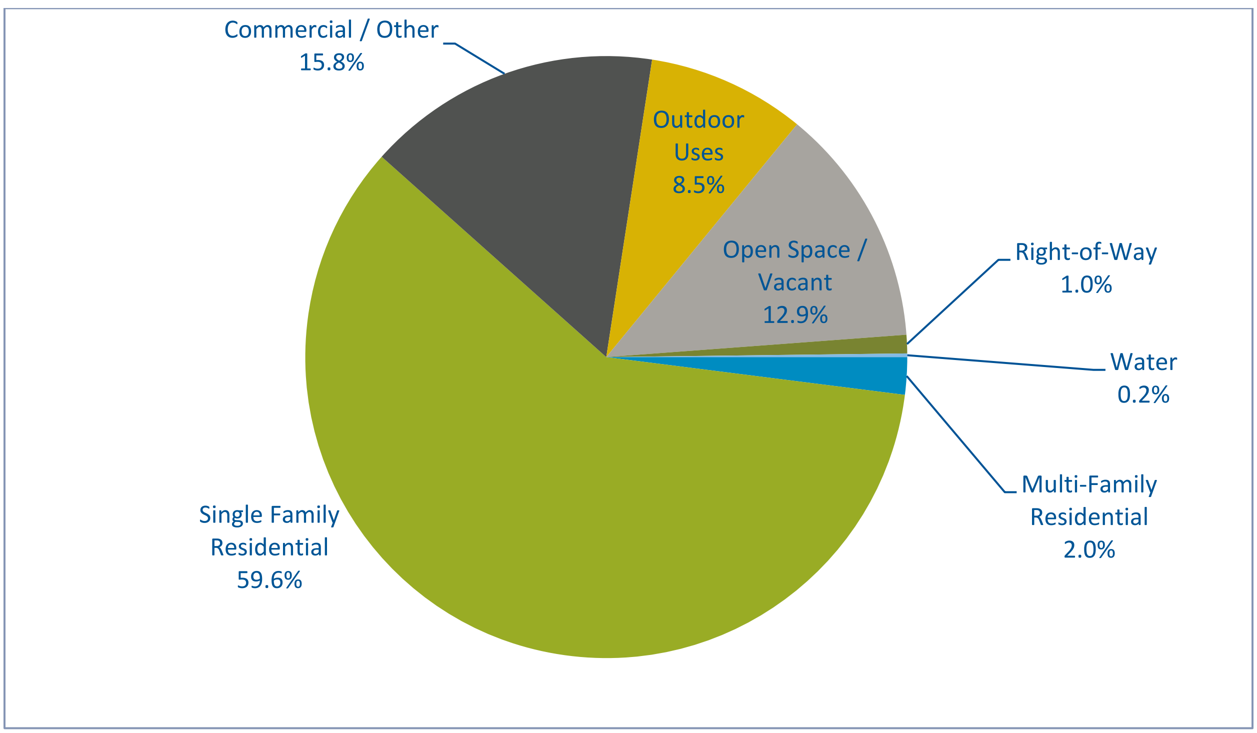


Figure 2-6 Planned Land Use Type Summary



2.1.3 Approved Developments Included in the Master Plan

This Master Plan includes development projects that have been approved since the last 2008 Master Plan. All projects that have been approved by June 30, 2014 were considered as part of the planned land use analysis. Development information was provided by the City of San Marcos and the County of San Diego. This Master Plan includes the detailed land use data for the following developments and Specific Plan Areas (SPAs) that were approved since the 2008 Master Plan.

2.1.3.1 Collucci/Mobile Development

The City of San Marcos General Plan (adopted February 2012) identifies an adopted SPA near the intersection of West Mission Road and North Las Posas Road in the City of San Marcos. In the General Plan, this development is referred to as Collucci/Mobile project. Its permitted planned development includes approximately 24,800 sf of commercial space constructed over approximately 4.3 acres.

2.1.3.2 Davia Village

Davia Village is located at 1001 Amorlite Drive, east of the Palomar Station SPA. This project was approved by the City of San Marcos City Council on January 14, 2014 and encompasses approximately 11.9 acres. The project includes a three-story multi-family residential building, including 416 residential apartments and 19,855 sf of commercial retail space.

2.1.3.3 El Dorado

The El Dorado Specific Plan is for a mixed-use development of 120 multi-family dwelling units and 7,000 sf of commercial retail space over approximately 3.8 acres of land. The project is located in the City of San Marcos near the intersection of Mission Road and Pleasant Way.

2.1.3.4 Hanson (Rancho Tesoro)

The Hanson Specific Plan was included in the City of San Marco's General Plan Update in 2012 but was then replaced with the Rancho Tesoro SPA in 2015. This project is located on along Twin Oaks Valley Road south of Village Drive. This project totals 253 acres and consists of 346 single-family dwelling units, 220 multi-family dwelling units, and 22.6 acres of mixed-use development.

2.1.3.5 Meadowlark Canyon

The City of San Marcos General Plan (adopted February 2012) identifies the Meadowlark Canyon as an adopted SPA. It is located south of Palomar Airport Road between Business Park Drive and Avenida de la Rosas in the City of San Marcos. Its permitted planned development includes 33 single-family residential units and open space.

2.1.3.6 Orlando Company Development (Montessa)

The City of San Marcos Planning Division provided information on a residential development by the Orlando Company. This development is located west of North Twin Oaks Valley Road and will include 19 single-family dwelling units over approximately 4.5 acres.

2.1.3.7 Palomar Station

The Palomar Station redevelopment project encompasses over 14 acres and is located in the City of San Marcos, north of SR-78 at Las Posas Road, along Armorlite Drive. The project includes approximately 370 multi-family residential units, 44,000 sf of commercial space, 5,400 sf of live/work space, and 5,000 sf of restaurants or food establishments.

2.1.3.8 Parkview Homes

The City of San Marcos General Plan (adopted February 2012) identifies Parkview Homes as an adopted SPA. This development is located on Autumn Drive between Knoll Road and Pico Avenue. Its permitted planned development includes 84 apartment units and 6,490 square feet of retail space.

2.1.3.9 Richmar

The City of San Marcos General Plan (adopted February 2012) identifies the Richmar development as an adopted SPA. The Westlake Village (Completed 2010) and Autumn Terrace (Completed 2010) SPAs are also within the Richmar Specific Plan. The Richmar project is located along Richmar Avenue in the City of San Marcos. Its permitted planned development is 291 multi-family units, approximately 10,000 sf of office space, and approximately 50,000 of commercial space. The development (including Westlake Village and Autumn Terrace) covers approximately 64.35 acres.

2.1.3.10 San Elijo Hills

San Elijo Hills is a planned community development on San Elijo Road, east of Rancho Santa Fe Road and the "Old Creek Ranch" SPA. The City of San Marcos General Plan (adopted February 2012) identifies this development as an adopted SPA. Its permitted planned development includes 2,496 single-family dwelling units, 972 multi-family dwelling units, and approximately 544,500 sf of commercial space.

2.1.3.11 San Marcos Highlands

The City of San Marcos General Plan (adopted February 2012) identifies San Marcos Highlands as an adopted SPA that encompasses 262 acres. This project is partially located within the City of San Marcos and partially falls within unincorporated areas of San Diego County. The project is located at the north end of Las Posas Road north of Borden Road. Its permitted planned development includes 189 single-family residential units over approximately 107 acres.

2.1.3.12 University District

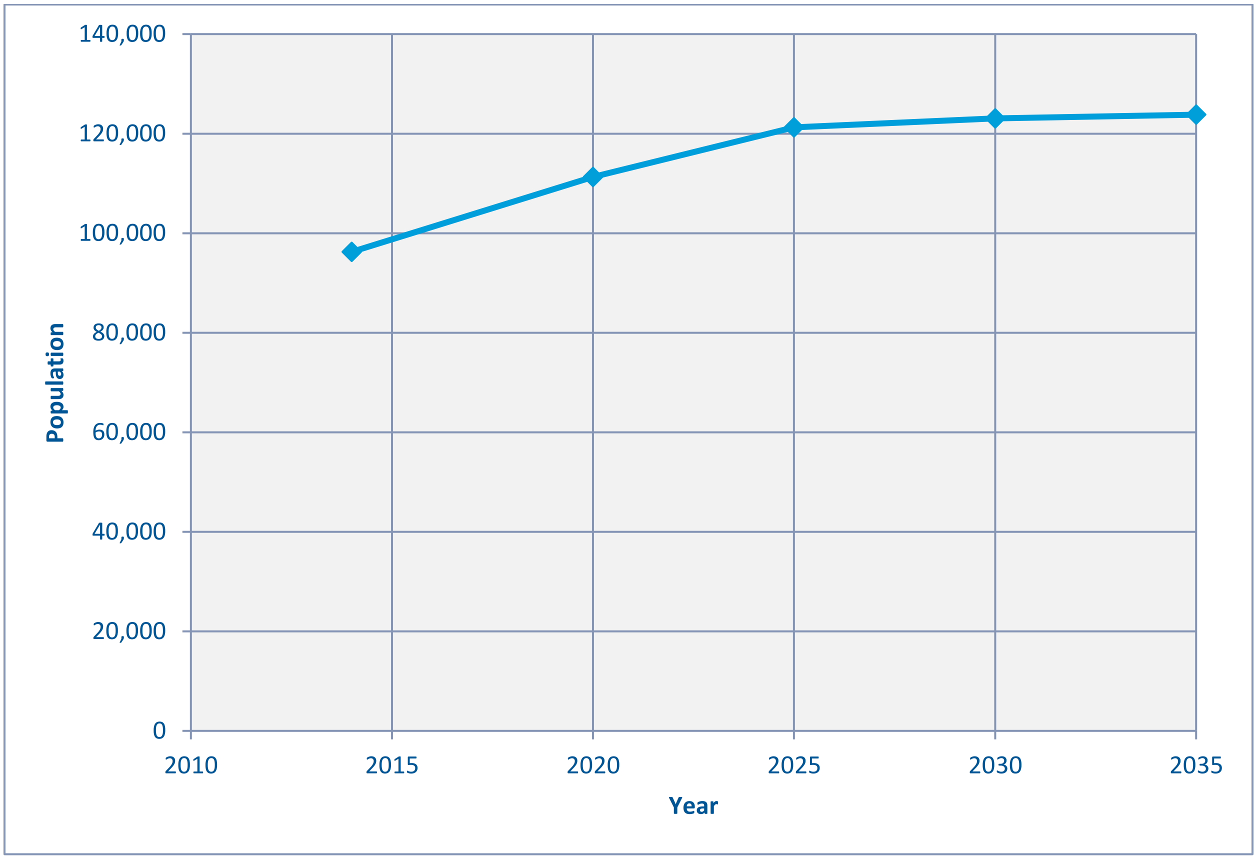
The University District is a 195-acre planned development near California State University – San Marcos. It is located on both sides of Twin Oaks Valley Road, bounded by State Route 78 and San Marcos Creek on the north, and Barham Drive and Discovery Hills to the south. The University District Specific Plan was approved by the City of San Marcos in 2009.

The City of San Marcos General Plan (February 2012) identifies the University District as an adopted SPA. Its permitted planned development includes 1,000,000 square feet (sf) of commercial space, 938,000 sf of office space, 30,000 sf of civic/community space, 2,600 multi-family residential units, 800 student housing units, and 450 hotel rooms.

2.2 POPULATION AND PROJECTIONS

Planned land use data, as described above, was used to determine water demand and wastewater generation projections under build-out, or ultimate conditions. Population growth estimates provided the basis for determining water demand and wastewater generation projections in the interim planning horizons. In April 2016, SANDAG provided updated existing population data for the District's service area, as well as projected population estimates for the years 2020, 2025, 2030, and 2035. The SANDAG's existing and projected population estimates are shown below in Figure 2-7. The data indicates that the population within the study area will increase by approximately 29 percent from 2014 to 2035, at an average rate of approximately 1.4 percent per year. This population forecast is used to forecast the phasing of future facilities needed to serve the planned level of growth. Note that SANDAG's population forecasts do not include an ultimate build-out scenario.

Figure 2-7 SANDAG Population Estimates for the District's Service Area



3 Water System Planning Criteria

This chapter presents unit demands, peaking factors, and planning criteria for the District's water distribution system. The information is used in Chapter 5 of the Master Plan to estimate water supply needs, evaluate the performance of the existing distribution system, and determine what infrastructure improvements are required to serve the existing and future needs of the District. The planning criteria are developed based on the following:

- Review of VWD's historic water billing data and master planning documents
- Comparison of District criteria to that of other southern California water purveyors
- Discussions with VWD staff to determine applicability to current conditions

3.1 UNIT WATER DEMANDS

Unit water demands were calculated using historical billing records provided by the District and the parcel-based land use database developed as part of this Master Plan (described in Chapter 2). The District provided water meter billing records for January 2008 through June 2014. The unit demand analysis considers the most recent water usage data to reflect changes in customer water usage patterns. Thus, it was determined that the unit water demand analysis would be based on the most recent six fiscal years of billing data. The District's fiscal year extends from July 1st through June 30th, and the data used included Fiscal Years (FY) 2008-09 through FY 13-14.

Billing data from the six fiscal years was compiled into a master database for analysis. The metered demands were spatially allocated to the parcel-based land use database developed as part of this Master Plan. The parcel-based database and allocated demands were then used to calculate unit demands for all VWD land use categories. Irrigation and non-irrigation demands were kept separate throughout the analysis. Table 3-1 summarizes the data used to determine the measured unit demands.

The measured unit demands for each land use category were evaluated and used to determine recommended unit demands moving forward. This process and the results are presented below.

3.1.1 Recommended Unit Demands for Standard Land Uses

Recommended unit water demands were developed per acreage based on a detailed evaluation of actual water usage for each of the District's different land use categories. Current demand data was also compared to previous planning study data and local agency standards. Table 3-2 presents the recommended unit demand factors as well as the factors used in the previous planning studies. The unit water demands represent average water demands within the District and are used for general planning purposes. Projected water demands can be calculated using the following equation:

$$\sum(Acres\ of\ Base\ Land\ Use) \times (Recommended\ Unit\ Demand, Table\ 3-2) = Total\ Demand\ (gpd)$$

Table 3-1 Measured Unit Water Demands

VWD LAND USE CATEGORY		ACRES SERVED (AC)	AVERAGE ANNUAL DAILY DEMAND (GPD)(1)			NUMBER OF ACCOUNTS(1)		
			NON-IRRIGATION	IRRIGATION	TOTAL	NON-IRRIGATION	IRRIGATION	TOTAL
1	Residential (<1.0 du/ac)	2,367	610,303	568,395	1,178,699	811	169	980
2	Residential (1-2 du/ac)	400	457,292	93,946	551,239	653	27	680
3	Residential (2-4 du/ac)	768	1,235,831	189,668	1,425,499	2,739	36	2,775
4	Residential (4-6 du/ac)(2)	-	-	-	-	-	-	-
5	Residential (4-8 du/ac)	1,720	3,893,217	282,629	4,175,846	11,690	108	11,798
6	Residential (8-12 du/ac)	449	1,196,787	87,191	1,283,979	4,782	35	4,817
7	Residential (12-15 du/ac)	64	238,117	75,886	314,002	488	24	512
8	Residential (15-20 du/ac)	103	452,135	141,670	593,805	180	32	212
9	Residential (20-30 du/ac)	63	288,929	100,218	389,147	56	22	78
10	Residential (30-40 du/ac)	10	38,617	11,557	50,174	9	6	15
11	Residential (40-50 du/ac)	16	153,606	11,492	165,098	20	7	26
12	Intensive Ag/Res. (0.125-0.5 du/ac)	345	65,199	184,893	250,092	23	16	39
13	Agricultural/Res. (0.125-0.5 du/ac)	971	54,735	581,883	636,618	33	51	83
14	Commercial	497	519,257	157,884	677,141	381	83	464
15	Hotel / Motel	30	45,269	3,729	48,998	14	4	17
16	Office Professional	54	58,616	4,735	63,350	49	6	55
17	Light Industrial	313	245,715	23,328	269,043	200	17	217
18	Industrial	340	223,562	35,574	259,136	361	23	384
19	Schools & Public Facilities	285	106,682	121,153	227,835	52	30	81
20	Palomar College	51	56,116	-	56,116	2	-	2
21	San Marcos State University	226	101,603	4,015	105,617	5	4	8
22	Mixed Use	10	23,012	2,144	25,156	14	1	15
23	Parks / Golf Courses	459	99,961	559,714	659,675	58	178	236
24	Solid Waste Management	15	171	1,621	1,793	1	1	2
25	Open Space	1,733	98,682	354,269	452,951	158	123	281
26	Right-of-Way	120	4,669	101,614	106,283	16	30	47
	TOTAL	**11,407**	**10,268,083**	**3,699,208**	**13,967,292**	**22,794**	**1,031**	**23,825**

(1) Annual average demands and number of accounts represent an approximate average of six fiscal years' worth of data: FY08-09, FY09-10, FY10-11, FY11-12, FY12-13, and FY13-14. Note that the number of accounts is based on the total accounts reviewed for all six years and is higher than the District's current number accounts due changes in customers (i.e. retired/new customers) over this time period.

(2) Residential (4-6 du/ac) and Residential (4-8 du/ac) billing data could not be separated. For the 2018 MP Update, Residential (4-6 du/ac) is included in the Residential (4-8 du/ac) category.

Table 3-2 Recommended Unit Water Demands

VWD LAND USE CATEGORY [1]		1991 MASTER PLAN (GPD/AC)	1997 MASTER PLAN (GPD/AC)	2002 MASTER PLAN (GPD/AC)	2008 MASTER PLAN (GPD/AC)	2018 MASTER PLAN MEASURED (GPD/AC)	2018 MASTER PLAN UNIT DEMAND (GPD/AC)
-	Hillside Res. (0.05-0.25 du/ac)	1,000	1,000	1,000	1,000	-	-
-	Rural Res. (0.125-1.0 du/ac)	1,000	1,000	600	600	-	-
1	Residential (<1.0 du/ac)[2]	-	-	-	-	498	800
2	Residential (1-2 du/ac)	1,500	1,300	1,200	1,200	1,377	1,400
3	Residential (2-4 du/ac)	1,750	1,900	2,100	1,800	1,857	1,800
4	Residential (4-6 du/ac)	2,000	1,800	2,200	2,200	-	2,200
5	Residential (4-8 du/ac)	2,000	1,900	2,400	2,500	2,428	2,500
6	Residential (8-12 du/ac)	2,250	2,800	2,500	2,800	2,858	2,800
7	Residential (12-15 du/ac)	3,750	3,400	2,800	3,300	4,894	4,500
8	Residential (15-20 du/ac)	3,750	3,600	3,200	3,700	5,772	5,000
9	Residential (20-30 du/ac)	4,000	3,800	4,100	5,000	6,200	6,000
10	Residential (30-40 du/ac)	-	-	-	7,000	4,877	7,000
11	Residential (40-50 du/ac)	-	-	-	9,000	10,030	9,000
12	Intensive Ag./Res. (0.125-0.5 du/ac)	2,000	2,000	600	1,400	725	1,100
13	Agricultural/Res. (0.125-0.5 du/ac)	1,000	1,000	700	800	655	800
14	Commercial	1,250	1,200	1,700	1,500	1,362	1,500
15	Hotel / Motel[3]	-	-	-	125gpd/rm	1,635	125gpd/rm
16	Office Professional	1,500	1,500	2,000	1,500	1,168	1,500
17	Light Industrial	1,500	1,500	1,800	1,800	861	1,500
18	Industrial	2,000	2,000	1,000	1,000	762	800
19	Schools & Public Facilities	1,250	1,300	1,400	1,400	801	1,000
20	Palomar College	2,250	2,300	2,300	1,200	1,102	1,200
21	San Marcos State University	-	2,300	2,300	1,200	468	1,200
22	Mixed Use	-	-	-	-	2,542	3,000
23	Parks/Golf Courses	1,250	1,300	1,700	1,700	1,438	1,500
24	Solid Waste Management	-	-	-	-	-	-
25	Open Space	-	200	200	200	261	200
26	Right-of-Way	-	-	200	200	886	200

(1) Unit demands shown in this table represent averages. Actual water use will vary based on the specific building plans and types of use. All new developments will be required to develop specific water demand estimates to be approved by the District. The District may, at its sole discretion, require higher generation rates once specific development plans are proposed.
(2) For the 2018 Master Plan, the following land use categories were combined into "Residential (<1.0 du/ac)": Hillside Residential (0.05-0.25 du/ac) and Rural Residential (0.125-1.0 du/ac)
(3) For Hotel/Motel land uses, the water demand will be based on the commercial area-based demand factor for the Hotel/Motel parcel's area (1,500 gpd/ac), plus 125 gpd/room.

In developing the unit water demands, it is important to note the number of meters and the deviation from the average plays a critical role in determining unit water demands for each category. The total area within a given land use category can also be a factor in determining the unit demands. As noted in Section 2, there was a large shift in certain land use types from the 2008 to the 2018 Master Plan (e.g. open space was significantly reduced). This greatly affected the assessment of the water demands for those categories. It is also important to note that there can be a higher level of uncertainly for some of the higher density residential categories due to the relatively small area in certain categories. Lastly, these unit demands do not reflect the most recent state-wide drought and conservation efforts by the District. This was in part due to the timing of the Master Plan occurring prior to the conservation efforts and also in part to recognize that conservation efforts can be short-term. It is typical to re-evaluate long-term effects of conservation after sustaining a longer period of post-drought conditions in order to observe customer behaviors and to then re-assess the more permanent trends and water usage levels.

3.1.2 Recommended Unit Demands for Mixed Land Uses

Mixed use developments are becoming more common in the District and typically blend commercial or office land uses with stacked, high density residential units. For water use estimation, the uses are additive. A unit demand of 3,000 gpd/ac was determined for mixed use land use types based on available metering data. This unit rate is consistent with the high-density residential land use average duty factor, on a per unit basis, as measured from the District's 2013-2014 water demand data. The District, at its discretion, may require higher residential unit rates if deemed appropriate.

3.1.3 Recommended Unit Demands for Schools and Hotels

Water demands at schools, including Palomar College and California State University – San Marcos, shall initially be calculated using the area-based duty factor given in Table 3-2. These demands shall be compared to water demands based on student capacity at a demand factor of 5 gpd/student. If the water demand based on student count is higher compared to the area-based demand, the District may utilize the higher demand figure.

The water demand for hotels and motels with commercial space is calculated using the commercial area-based demand factor for the hotel's/motel's parcel area, plus 125 gpd/room. This figure is consistent with the hotel/motel demand factor utilized by other local water purveyors within the County. Without commercial, only the 125 gpd/room unit demand factor applies.

3.2 WATER SYSTEM PEAKING

Water demands vary throughout the day and throughout the year. The size of the tributary area (for daily peaking) and the local climate (for seasonal peaking) are the two most prominent factors. When tributary areas are small, the peak-to-average ratio becomes greater. As the service area increases, there is a dampening effect and a reduction in peaking.

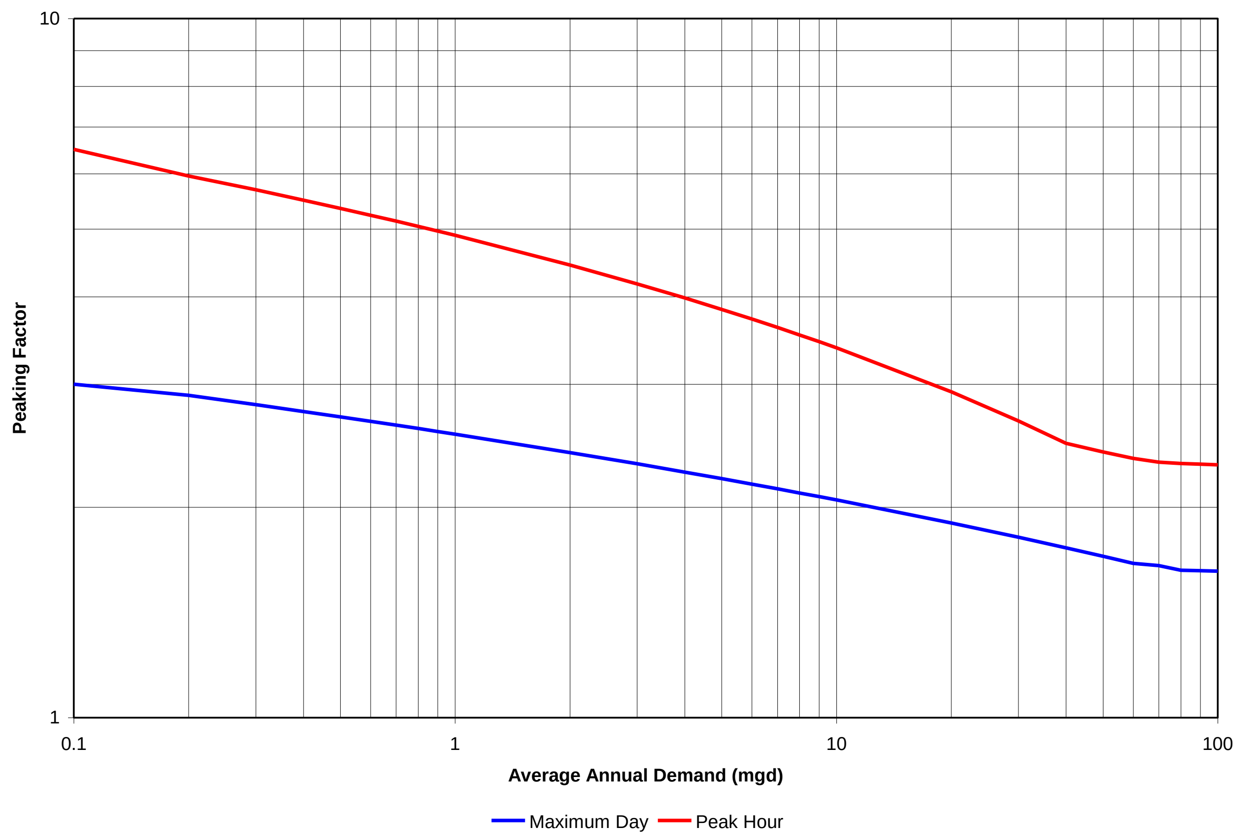
Distribution system assessment typically utilizes a number of peaked scenarios to assess system performance, including maximum day, maximum day plus fire, and peak hour conditions. Peaking factors are used to convert average annual water usage to these specific conditions. The master plan assessment area includes the entire District. Therefore, the peaking factors used in the overall master plan hydraulic model are lower than what would be appropriate for a smaller area study, such as a specific development plan, or an individual pressure zone analysis (as outlined below).

The following summarizes the master plan peaking factors utilized in the water distribution system analysis. These factors were developed based on billing records and operational data.

- Minimum day – Representative of a low demand day and is typically used to assess water quality. A value of 0.5 times the average annual use was used in the hydraulic analysis.
- Maximum day - Representative of the highest use day each year and is typically used to assess distribution system operation; often combined with fire flow scenarios. A value of 1.9 times the average annual demands was used in the hydraulic analyses.
- Peak hour – Representative of the highest water use during one hour on the maximum day and is typically used in potable water systems to assess distribution system performance during peak water use. A value of 3.0 times the average annual use was used in the hydraulic analysis.

The peaking factors noted above for maximum day and peak hour demands represent District-wide demands. Figure 3-1 displays peaking factor curves used in this Master Plan. The corresponding peaking factors obtained from these curves are multiplied by the average water demands to determine the peak flows.

Figure 3-1 Water System Peaking Curve



3.2.1 Peaking Factors for Individual Projects/Developments

Efforts involving a portion of the District's water system, such as development studies and localized analyses, may require using higher peaking factors appropriate for smaller tributary areas. Peaking factors for these applications are also determined based on the average daily demand of the area served multiplied by the appropriate peaking curve factor, as shown in Figure 3-1. Determination of the appropriate peaking factors will be at the District's discretion.

3.3 WATER DISTRIBUTION SYSTEM CRITERIA

Water system planning criteria establish the parameters within which the District plans to design and operate its water system infrastructure. Table 3-3 summarizes the planning criteria established for VWD. Additional details about specific facility design requirements may be obtained from the District.

Table 3-3 Water Infrastructure Criteria

WATER FACILITIES EVALUATION CRITERIA	
Item	**Criteria**
Pipe Criteria	
Maximum Velocity (PHD, MDD+Fire Flow)	7 fps
Maximum Headloss/1,000 feet of pipe	15 ft
Minimum Diameter	8 inches
Hazen-Williams C-factor	130
Fire Flow Criteria	
Single Family Residential	1,500 gpm, 2 hours
Multi-Family Residential (or in areas the jurisdictional fire agency deems susceptible to wildfires)	2,500 gpm, 2 hours
Commercial/Business	2,500 gpm, 2 hours
Industrial/Schools/Hospitals/High Rise Structures in the Richland Pressure Zone only	3,500 gpm, 4 hours
Pressure Criteria at VWD meter/fire hydrant	
Maximum Allowable	150 psi
Minimum Desirable Static	65 psi
Minimum Pressure (Peak Hour)	40 psi
Minimum Pressure (Max Day + Fire)	20 psi
Pump Station Criteria (Zones with Reservoirs)	
Pumping Period	During SDG&E off-peak and semi-peak rates only
Pumping Capacity	Maximum Day Demand + 150 gpm Fire Storage replenishment
Minimum Number of Pumps	2 duty + 1 standby
Standby Power	Generator (permanent)
Hydropneumatic Pump Station Criteria (Zones without Reservoirs)	
Pumping Period	24 hours
Pumping Capacity	Peak Hour (or) Maximum Day Demand + Fire Flow, whichever is greater

WATER FACILITIES EVALUATION CRITERIA	
Item	**Criteria**
Minimum Number of Pumps	4 (1 duty + 1 standby for domestic use plus 1 duty + 1 standby for fire flows)
Standby Power	Generator (permanent)
SUPPLY AND STORAGE CRITERIA	
In-Zone Supply and Storage Criteria[1]	
Operating Storage	1.5 x Average Day Demand
Fire Storage (= Fire flow X duration)	0.30 MG (all zones except Richland) 0.84 MG (Richland only)
In-Zone Emergency • Assume: Loss of largest supply source, (i.e. supply connection, pump, or PRV)	3.0 x Average Day Demand
Total In-Zone Supply/Storage	4.5 x Average Day Demand + Fire Storage
System-Wide Supply and Storage Criteria – Planned Supply Shutdown[1]	
Shutdown of Major Supply Source (SDCWA Aqueduct or Seawater Desalination)	10-day outage period 0.5 x ADD Assumes OMWD supply is not available to VWD
System-Wide Supply and Storage Criteria – Unplanned Supply Shutdown[1]	
Shutdown of Major Supply Source (SDCWA Aqueduct or Seawater Desalination)	4.5 x ADD Assumes OMWD supply is not available to VWD Assumes emergency storage is at full capacity

(1) Supply and storage criteria for in zone and shutdown conditions are separate and the greater amount should be used to determine the storage need.

3.3.1 Easements

Ordinance 200, adopted in August 2016, updated the District's easement policy. The District prefers that pipelines be placed within an existing dedicated street or right-of-way and that open space areas are avoided. Pipelines and certain facilities may be located within an easement if no other reasonable alternate alignment exists. The minimum easement width has been established at 20 feet, and the pipeline should be placed toward the center of the easement but in no case closer than five feet to the edge of the easement. District easements shall be exclusive for District facilities only. Easements shall be located along one parcel, adjacent to the property line, so that the pipeline alignment does not straddle two properties and should impact the fewest number of parcels as possible. Access easements must be provided for all facilities, including reservoirs and pump stations and also appurtenances.

3.3.2 Water Pipelines

Pipeline sizing criteria aim to minimize scouring of interior coatings, limit head loss in the system, and minimize wear on in-line valves. Pipeline velocities are limited to 7 feet per second (fps) for all operating conditions, including maximum day plus fire.

3.3.3 Water Pressure

The District is characterized by terrain ranging from 338 feet to 1,608 feet. This variation requires multiple pressure zones, and in certain areas, large pressure ranges. In general, the pressure criteria aim to: 1) provide a range of reasonable water pressures during a variety of water system conditions, 2) maintain minimum pressures during high flow fire conditions, and 3) limit maximum pressures to protect the water system infrastructure. Table 3-3 includes pressure criteria for the water system.

3.3.4 Fire Flows

Available fire flow is measured at the District's water main under maximum day demand plus fire flow conditions. The fire flow available at buildings or specific locations on private property, as required by the local fire agency, is the property owner's responsibility. Table 3-3 includes a summary of fire flow criteria based upon review of local fire agency requirements. Six local fire agencies provide fire protection services within the District: the municipal fire departments of the cities of San Marcos, Carlsbad, Vista, Escondido; the Vista Fire Protection District, and the Deer Springs Fire Department. With the exception of the City of Escondido Fire Department, the other agencies all use the 2007 California Fire Code. Per Ordinance No. 2013-13, the City of Escondido has adopted the 2013 California Fire Code, the County of San Diego 2011 Consolidated Fire Code, and local amendments.

Where specific building plans are provided, the local fire agency may use alternative criteria to calculate fire flow requirements based on several considerations such as type of occupancy, type of construction and construction materials, distance from other structures, and other factors. In general, this information is not available at the development planning stage. Regardless, alternative fire flow calculations will require approval by the City or County, or the appropriate fire agency.

3.3.5 Water Pump Stations (for Pressure Zones with Reservoirs)

Pump stations are critical components of the District's distribution system. They are designed to supply maximum day demands to higher elevation areas - areas that cannot be served by gravity via the District's aqueduct connections. Pump stations also provide backup supply to zones fed by a single supply source. Pump stations are the primary supply source to a number of zones in the District and must therefore provide consistent, reliable service. They also consume large amounts of energy, and therefore need to be designed to operate efficiently throughout a large range of operating conditions. Table 3-3 includes minimum pump station planning criteria.

The District's pump station facilities are sized to provide an installed capacity, defined as firm capacity. The firm capacity equals the maximum day demand of the pressure zones supplied, including any flows passing through the pressure zone that are once again pumped into higher zones or regulated to lower elevations through pressure reducing facilities. In addition, 150 gallons per minute of capacity is included for fire storage replenishment (based on refilling a 2-hour, 2,500 gpm fire flow in approximately two days). Peak hour and fire flow demands in excess of maximum day demand are to be met from water stored within the operational reservoirs within each pressure zone. Standby pumping units with capacity equal to the largest unit in a pump station and permanent emergency backup power are required for each station.

Recognizing the need to conserve resources, the District requires that each pump station be designed with efficient pumps and motors. In addition, the District desires to operate each facility to avoid San Diego Gas & Electric (SDG&E) on-peak demand charges and on-peak energy costs. The requirement for off-peak pumping will be determined by the District, at its sole discretion. Considerations include pump capacity, available storage, and the ability of the specific pressure zone's distribution system to meet pressure requirements when the pumps are not operating.

3.3.6 Hydropneumatic Pump Stations (for Pressure Zones without Reservoirs)

Hydropneumatic pump stations serve high elevation areas where there is no reservoir or aqueduct connection serving the pressure zone. Since theses pump stations are the only source of water, these facilities must provide added reliability and redundancy. This redundancy includes dedicated back-up pumps for both domestic and fire systems, and a dedicated, onsite backup power generator sufficient to serve both the domestic and fire pumps. For hydropneumatic pressure zones, the pumping station facilities are sized to provide installed (firm) capacity equal to peak hour demand or maximum day plus fire flow, whichever is greater, of the zone served. Hydropneumatic stations also include a hydropneumatic tank, sized to limit the number of start/stop cycles experienced by the pumps during low demand periods.

3.3.7 Water Storage

Water storage is used to supply the following water system needs:

- Operational
- Fire flows
- In-Zone Emergency
- Aqueduct Shutdown

The first three storage elements (operational, fire, and in-zone emergency) are considered critical in-zone supply/storage criteria. Aqueduct shutdown storage is required during planned and unplanned shutdown scenarios. The District's storage capacity was initially assessed against the in-zone supply/storage criteria. These criteria were also used to size recommended storage projects. Recommended storage projects were then assessed using the shutdown criteria. This analysis is described in Chapter 5. Storage for each pressure zone must be provided within the zone or located in a higher pressure zone. Storage located in higher pressure zones shall be connected to the lower zone via a pressure reducing station and shall have sufficient pipeline capacity to meet the minimum pressure requirements included herein.

3.3.7.1 Operational Storage

Transmission capacity to individual pressure zones is typically sized to provide maximum day demands. Operational storage within the zone is then used to supply the difference between peak hour demands and the maximum day supply from the aqueduct connection or pump station. For typical systems, operational storage is used during the morning and sometimes in the early evening, when demands are highest. During low demand periods (midday and late evening) the operational storage volume is typically replenished. The District's operational storage requirement is 150 percent of the pressure zone's average daily demand.

3.3.7.2 Fire Storage

Fire storage for all pressure zones is sized for a 2-hour, 2,500 gpm fire flow demand, which amounts to 300,000 gallons. One exception is the Richland Pressure Zone, a portion of which is in the City of Escondido and therefore subject to the City of Escondido Fire Code. To meet the Escondido criteria for the schools and industrial uses located in this zone, fire storage in this zone is sized for a 4-hour, 3,500 gpm fire flow, which amounts to 840,000 gallons.

3.3.7.3 In-Zone Emergency Storage

In-Zone Emergency Storage is required to supply the system during facility outages, such as a pipeline, pump station, or regulating station failure. The District has established an in-zone emergency criteria total of 300 percent of the pressure zone's average daily demand, which allows for repairs to be made within 3 days.

3.3.7.4 Total In-Zone Storage Requirement

The District requires each pressure zone to have reservoirs sized for 450 percent of the average day demand (ADD) plus fire flow storage. This is expressed as:

Operational Storage		1.5 X Average Daily Demand
Emergency Storage	+	3.0 X Average Daily Demand
Fire flow Storage	+	0.30 MG (all zones except Richland Zone) or
	+	0.84 MG (Richland Zone only)
	=	**Total Storage**

3.3.7.5 Storage for Densification Projects

The storage criteria and recommended storage totals included in this Master Plan are for approved land uses as of June 2014 only. Any future land use changes or densification projects, as approved by the regulating land use agency, will require an evaluation by the District to determine the need for additional storage capacity.

The Twin Oaks Reservoir site houses two buried reservoirs with a total storage volume of 73 MG adjacent to the SDCWA Twin Oaks Plant. The North Twin Oaks Reservoir is also shown on a hill in the background.

3.3.7.6 Aqueduct Shutdown Storage

The San Diego County Water Authority (SDCWA) recommends that each member agency have backup facilities and/or be able to reduce demands allowing an aqueduct pipeline to be out of service for up to 10 days. Aqueduct shutdowns are typically scheduled during lower wintertime demands. Therefore, each agency establishes an approach and criteria to meet this outage. Key considerations to setting these criteria include how diversified the agency's supply sources are and whether the agency wishes to ask customers to conserve water during these periods. Other considerations include costs and water quality since large volumes of water in storage can have water quality issues during low demand periods. The District has established a planned aqueduct shutdown storage criteria of 500 percent of the average daily demand (equivalent to 10-days of water supply assuming wintertime demands of 50-percent of average use).

Furthermore, the District also has established storage criteria to provide sufficient supplies in the event of an unplanned aqueduct shutdown. In this scenario, it is assumed that the emergency storage is at full capacity. The District's unplanned aqueduct shutdown criteria is 450 percent of the average daily demand.

3.3.7.7 Storage for Regional Emergencies

The SDCWA has developed the Emergency Storage Program, which includes a plan for allocating regional storage to local water purveyors. Chapter 4 includes additional discussion on this program and supply implications.

3.3.8 Water Pressure Regulating Stations

Pressure reducing stations are utilized to reduce water pressure to lower elevation areas. Where pressure zones are served exclusively by pressure reducing stations, a minimum of two stations are required for redundancy. Each pressure reducing station will have a minimum of two regulating valves. The larger valve will provide the most critical flow condition, maximum day plus fire or peak hour. A smaller low flow valve will also be provided to deliver lower flows. Valves will be checked to ensure that they will operate outside cavitation ranges. The District also requires at least one station per zone to have a pressure relief valve with an above-grade venting system. The relief valve is required to prevent over-pressurizing the downstream distribution system in the event of a regulating valve failure.

3.3.9 District's Discretionary Authority

The Vallecitos Water District reserves the right to modify any criteria as appropriate to address project-specific considerations or issues. All design criteria established in the 2018 Master Plan are minimums and may be adjusted at the District's discretion.

4 Water Supply

4.1 INTRODUCTION

The District is committed to providing a reliable and fiscally sound water supply to its customers. As presented in previous chapters, SANDAG's forecasts show continued growth in population and economic activity within the District's service area, which will lead to increased water demands relative to current conditions and the need for additional water supplies to serve these demands.

The District has previously investigated several potential water supply and recycled water alternatives to help improve the District's overall supply reliability. These efforts included the 2008 Master Plan (PBS&J) and the 2007 Integrated Water Resources Plan (IRP) (Kennedy/Jenks Consultants, October 2007). In addition, the District is nearing completion on a parallel study focused on assessing recycled water options as part of its Recycled Water Business Plan (Black & Veatch, 2017).

As much of the detailed evaluations on water supply options was conducted as part of the previous 2008 Master Plan and IRP studies, the goal of this 2018 Master Plan is to provide a summary-level review and update to the previous work as well as the current Recycled Water Business Plan. Specific objectives of this section are therefore to provide:

- Update of the District's existing water supplies
- Update on the status of previously identified potable water supply project options
- Summary of previous and current recycled water options
- Summary-level analysis of the potable water supply and recycled water options

4.2 OVERVIEW OF DISTRICT WATER SUPPLY AND CURRENT CHALLENGES

Prior to 2012, the District obtained 100 percent of its water supply from two imported water sources – northern California via the California State Water Project (SWP), and from the Colorado River via the Colorado River Aqueduct (CRA). These supplies are provided to the District by the San Diego County Water Authority (SDCWA) and the Metropolitan Water District of Southern California (Metropolitan).

4.2.1 Imported Water Challenges

Metropolitan and the SDCWA have met the water demands of Southern California's growing population and economy by pursuing new sources of supply, including storage, water management programs, and water transfer and exchange agreements. In addition, water agencies throughout the region have implemented water conservation, recycled water, and other local supply and water management measures to help balance supplies and demands and to provide a higher level of water supply reliability to their customers.

As the region's water importers, both Metropolitan and the SDCWA recognize the solution to providing long-term water supply reliability will depend in large part on the collective efforts of retail agencies such as the Vallecitos Water District to develop conservation and local supply projects suitable for their respective service areas. Despite these collective efforts to provide water supply reliability, drought conditions have at times led to water supply shortages and the need for water agencies to implement water use restrictions and rationing to reduce water demands. Periods of widespread water use restrictions have occurred in 1976-77, 1992-93, and most recently beginning in 2014.

The effect of the most recent drought on water supplies was compounded by other challenges facing the region's water supplies, including environmental and endangered species related restrictions on pumping operations of the State Water Project (SWP). These conditions led the District and most other southern California water agencies to declare Level 2 Drought Alert conditions and to implement mandatory water use restrictions for their customers. In addition:

- On July 15, 2014, the State Water Resources Control Board (SWRCB) adopted emergency statewide regulations to require all California water agencies to mandate water-use restrictions.
- On August 6, 2014, the District's Board of Directors voted to increase to a Level 2 "Drought Alert" to require mandatory water-use restrictions for its customers.
- In an executive order issued on April 1, 2015, Governor Brown ordered the SWRCB to implement reductions in cities and towns to cut usage by 25 percent. The SWRCB mandated a 24 percent reduction from 2013 demands in potable water use for the District.
- On May 20, 2015, the District's Board of Directors adopted additional emergency drought conservation measures to meet the 24 percent reduction required by the state, prevent the waste and unreasonable use of water, and promote water conservation.

It was against this backdrop of water supply shortage and uncertainty that the District prepared its 2018 Master Plan. While water supplies have greatly rebounded due to the higher than average precipitation levels across the State in the 2016-17 winter period, the extended drought conditions point to the importance of water supply planning and the need to regularly evaluate local supply options and demand management measures to help ensure the District's continued ability to provide a reliable and fiscally sound water supply to its customers.

In addition, at the time of publishing of this master plan, there remains uncertainty regarding the California Bay Delta and the proposed conveyance program, which is planned to strengthen the delivery system. These factors continue to reinforce the need for local supply investment.

4.2.2 Local Water Diversification Investments

To address the District's water supply reliability challenges, the District implemented two projects as a result of the IRP and 2008 Master Plan studies. In 2012, the District executed an agreement to purchase potable water from OMWD that will provide improved reliability as the water will be supplied from OMWD's David C. McCollom Water Treatment Plant. In 2015, the District began receiving high-quality desalinated seawater with the opening of the Claude "Bud" Lewis Desalination Plant in the City of Carlsbad. The plant is a result of a 30-year public-private partnership between the plant's owner and developer, Poseidon Water, and the SDCWA. It is anticipated that desalinated water will remain a major component of the District's water portfolio, further minimizing the District's reliance on imported water supplies. The District's willingness to invest in diversifying the water supply has improved the resilience of the organization to better serve rate payers during supply impacts such as drought, earthquakes, or other major supply interruptions.

4.3 EXISTING SUPPLIES

Currently the District obtains most of its water supply from the SDCWA, of which it is one of 24 member agencies. The SDCWA in turn obtains most of its water from Metropolitan.

4.3.1 Metropolitan Water District of Southern California

Metropolitan was formed in 1928 to develop, store, and provide wholesale distribution of supplemental water in Southern California for domestic and municipal purposes. Metropolitan is a consortium of 26 cities and water agencies, including the SDCWA. It obtains supplies from the Colorado River via the CRA, which it owns and operates, and from northern California via the SWP. Metropolitan's mission statement is: "To provide Metropolitan's service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way."

Metropolitan's plans for providing supply reliability to its member agencies are summarized in its 2015 Integrated Resources Plan (IRP) and its 2015 Regional Urban Water Management Plan (UWMP). The UWMP identifies Metropolitan's current local and imported water supplies, while the IRP is a stakeholder driven process that Metropolitan utilizes to prepare for the future with an evolving long-term water strategy. The 2015 IRP builds upon the adaptive management strategy established in the previous 2010 IRP Update, and continues to refine that strategy to ensure water supply reliability. This strategy includes a diversified portfolio of actions that calls for stabilizing and maintaining imported supplies, meeting future growth through increased water conservation and sustaining and developing new local supplies, pursuing a comprehensive transfers and exchanges strategy, building storage in wet and normal years to manage risks and drought, and preparing for uncertainty with Future Supply Actions, which may be most pertinent to the District.

Future Supply Actions aim to improve the viability of potential contingency resources and position the region to effectively implement these resources in a timely manner should they be needed. These resources include recycled water, seawater desalination, storm water capture, and groundwater cleanup. The 2015 IRP Update calls for the region to continue to perform Future Supply Actions to prepare for long-term changes that the future may bring. Funding from Metropolitan for such local projects is implemented through is Local Resources Program and other programs that the Metropolitan Board enacts on occasion to help address regional supply reliability through support of local supply, recycled water, or conservation programs.

4.3.2 San Diego County Water Authority

The SDCWA is one of Metropolitan's 26 member agencies and is its largest member agency in terms of purchases. The SDCWA was formed in 1944 by the California Legislature to provide a supplemental supply of water as the San Diego region's civilian and military populations expanded to meet wartime activity needs. Today, the SDCWA has 24 member agencies and supplies between 75 to 95 percent of the water needs of its service area.

4.3.2.1 SDCWA Delivery System

The SDCWA delivers treated and raw water through five large diameter pipelines, located in two principal corridors known as the First and Second San Diego Aqueducts. The system has evolved over time to serve the growing needs of the service area. The aqueduct pipelines connect to treated and raw water feeds from Metropolitan facilities at Lake Skinner, in southern Riverside County. The

SDCWA aqueduct system and service area are illustrated in Figure 4-1. The system also includes the recently completed Emergency Storage Project, which provides emergency storage and a delivery system in the event of an earthquake or other major water supply outage.

Figure 4-1 SDCWA Service Area and Aqueduct System

Source: SDCWA 2013 Regional Water Facilities Optimization and Master Plan Update

4.3.2.2 SDCWA Water Supply Initiatives

To reduce its dependency on Metropolitan Water District and diversify its supplies, the SDCWA in recent years has undertaken several initiatives, including the following:

- **Imperial Irrigation District (IID) Transfer:** The SDCWA signed a Water Conservation and Transfer Agreement with Imperial Irrigation District in 1998. Through the transfer agreement, the SDCWA is purchasing water from IID at volumes that will gradually increase year-to-year, reaching 200,000 AFY in 2021. The water is physically delivered to San Diego via Metropolitan's CRA.

- **All-American and Coachella Canal Lining Conserved Water:** In 2003, as part of the execution of the Quantification Settlement Agreement (QSA) on the Colorado River, the SDCWA was assigned rights to 77,700 AFY of conserved water from projects to line the All-American and Coachella Canals. These projects are now complete and the SDCWA is receiving this water. As with the IID transfer water, the water is physically delivered to San Diego via Metropolitan's CRA.
- **Carlsbad Desalination Plant:** Since the 2008 Master Plan, the SDCWA entered into a Water Purchase Agreement to purchase desalinated seawater supplies from the 50 million gallons per day (MGD) Claude "Bud" Lewis Carlsbad Desalination Plant (Carlsbad Desalination Plant). This project came on-line in December 2015 and supplies the District with its desalinated seawater supplies as previously noted.
- **Water Transfer and Banking Programs:** In addition to the above, the SDCWA has entered into water transfer and water banking arrangements with Central Valley area agricultural agencies and groundwater storage ventures. These projects are designed to make additional water available to the SDCWA during dry-year supply shortages from Metropolitan.

The SDCWA's supply planning is most recently documented in its 2015 Urban Water Management Plan. As with the Metropolitan supply projections, the SDCWA's goal of providing supply reliability to its member agencies has been challenged by the recent drought conditions and pumping restrictions on the SWP. In response to these challenges, the SDCWA is continuing to pursue efforts and programs to obtain new water supplies via water transfers and other means and to provide financial support to retail agencies for the development of conservation programs and of local water supplies such as recycled water and brackish groundwater demineralization projects. This strategy recognizes that regional water supply reliability is dependent in part on the collective efforts of the District and retail agencies to identify and implement beneficial local supply projects in their services areas.

4.3.3 VWD Connections to SDCWA

The District receives water from the SDCWA through five treated water connections (turnouts) to the SDCWA aqueduct system. Figure 4-2 depicts the locations of the five connections. Table 4-1 lists the location, capacity, and the average annual delivery to the District for each connection.

Figure 4-2 VWD Water Supply Connections

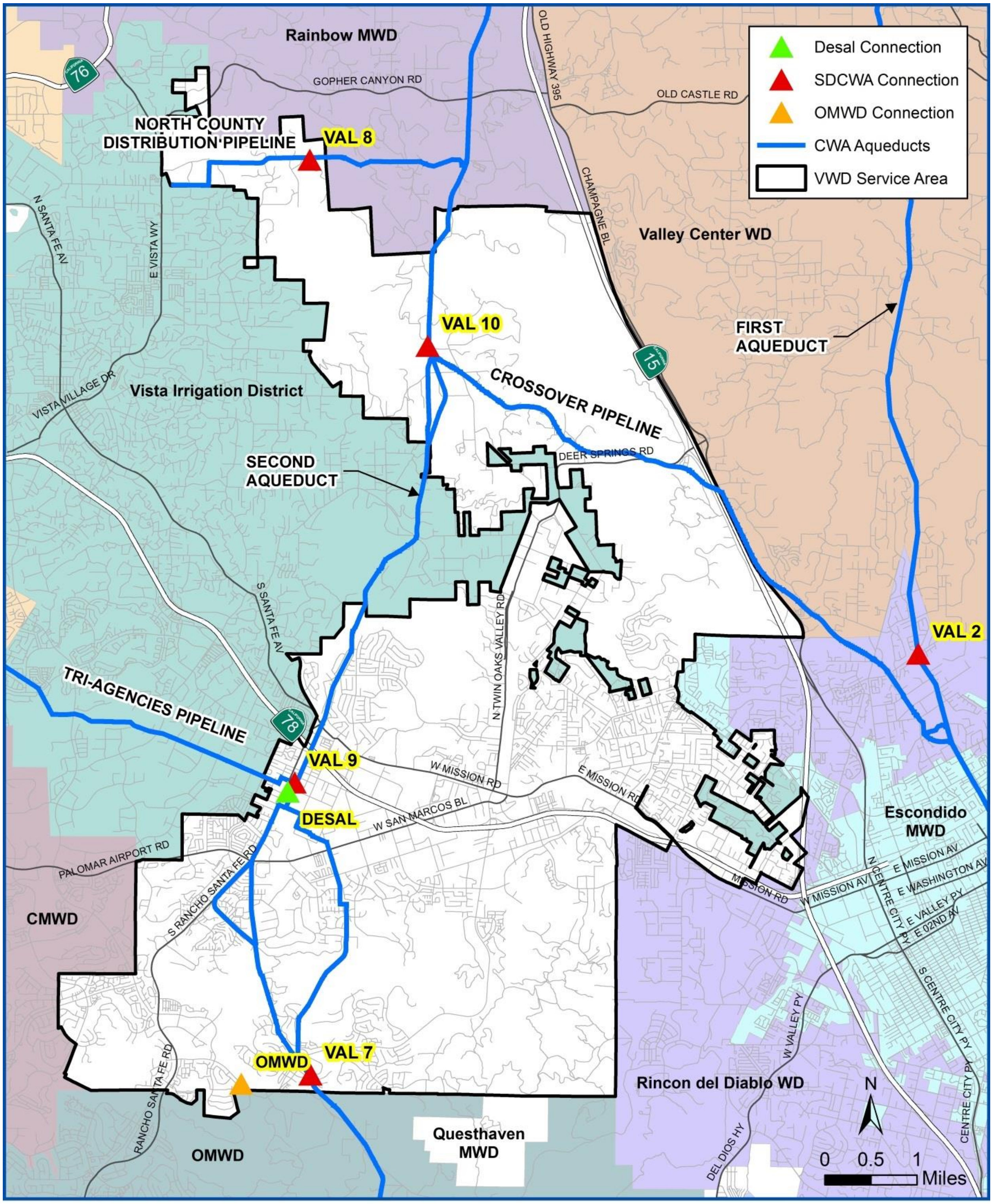


Table 4-1 VWD Connections to San Diego County Water Authority and Production History

CONNECTION	LOCATION	CAPACITY		2013 AVERAGE DELIVERY TO VWD(1)	
		CFS	MGD	GPM	MGD
VAL 2	First Aqueduct(2)	12 (10)	8 (6)	243	0.35
VAL 7	Second Aqueduct, south edge of District(3)	40	26	2,176	3.13
VAL 8	Second Aqueduct, off North County Distribution Pipeline, northwest corner of District	11	7	195	0.28
VAL 9	Second Aqueduct, center of District, south of Twin Oaks Diversion Structure	30	19	1,605	2.31
VAL 10	Second Aqueduct, north-center of District, north of Twin Oaks Diversion Structure	60	39	6,518	9.38
	Total	**153**	**99**	**10,733**	**15.45**

Source: Monthly Operations Report 2013

(1) Based on SDCWA Delivery to the District from January through December 2013

(2) SDCWA connection capacity is 12 cfs, however, downstream system has flow constraints that limit flow to 10 cfs.

(3) 2013 flows for VAL 7 do not include OMWD or CMWD demands.

The District's connections are further described below:

- **VAL 2:** This facility is the only one of the District's five aqueduct connections that connects to and is fed by the SDCWA's First Aqueduct. The facility is located east of the District service area, in Escondido on North Ash Street near its intersection with Rincon Avenue. The minimum HGL at the connection point is approximately 1,054 feet, as determined by the invert elevation of the SDCWA Hubbard Hill overflow structure.

  The facility delivers water to the District's 920 Zone via an approximately 12,500-foot, 18-inch diameter, District-owned transmission pipeline. Under normal operating conditions the available HGL allows for delivery of a maximum of approximately 10 to 11 cfs (6 to 7 MGD). These flows enter the District's 920 Zone from where they can also feed the 855 and 1500 Zones. The District also has limited capacity to pump water from the 920 Zone south to the 1530 Zone from where it can flow to lower zones in the southern portion of the District.

- **VAL 7:** This facility is the southernmost of the District's four connections to the SDCWA's Second Aqueduct system and is located off Elfin Forest Road, just south of the San Elijo Middle School. The facility is fed directly from the Second Aqueduct. The Second Aqueduct in this reach is located south of the SDCWA's Twin Oaks compound and contains two treated water pipelines, Pipelines 3 and 4. VAL 7 can be served by either of these two treated water aqueduct pipelines. The minimum HGL at the connection point is approximately 935 feet, as determined by the invert elevation of the Pipeline 4 Paint Mountain Vent.

The facility delivers water into the District's 877 Zone, which in turn can feed the lower elevation zones to the west. The District also has limited capacity to pump water from the 877 Zone east to the 1530 Zone, from where it can flow to lower zones to the west and north.

In addition to supplying District demands, VAL 7 also supplies water to the OMWD and Carlsbad MWD via connecting transmission pipelines, as further described in Chapter 5.

- **VAL 8:** This facility is the northernmost of the District's four connections to the SDCWA's Second Aqueduct system and is located off Panoramic Place, south of Gopher Canyon Road and east of East Vista Way. The facility is fed by the North County Distribution Pipeline (NCDP), which is a spur pipeline of the Second Aqueduct, as shown in Figure 4-2. The minimum HGL at the connection point is approximately 963 feet, as determined by the floor elevation of the NCDP Flow Regulatory Storage (FRS) facility, which is supplied from both the Second Aqueduct and Oceanside's Weese WTP.

  The facility delivers water to the District's 900 Zone. There are no lower zones fed by the 900 Zone, and the District does not currently have pumping facilities to lift water out of the 900 Zone to the higher zones to the southeast. Deliveries at this location are therefore constrained by the demand capacity of the 900 Zone. This constraint could be lessened if the District decides to pursue construction of the Mountain Belle Pump Station, which would lift water from the 900 Zone to the 1330 Zone. See Chapter 5 for additional information on the Mountain Belle Pump Station.

- **VAL 9:** This facility is one of the District's four connections to the SDCWA's Second Aqueduct system and is located in the southwest portion of the District, off Cherokee Street just east of Rancho Santa Fe Road. Although the facility is almost directly on top of the Second Aqueduct pipeline, it is fed by the SDCWA's Tri-Agencies Pipeline (TAP), a spur pipeline of the Second Aqueduct. The Second Aqueduct in this reach, south of the SDCWA's Twin Oaks compound, contains two treated water pipelines, Pipelines 3 and 4. The TAP, and hence VAL 9, can be served by either of these two treated water aqueduct pipelines. The desalinated seawater pipeline connects to SDCWA's system at the VAL 9 location. VWD can take water from either the desalinated seawater or SDCWA pipeline through this VAL 9 connection. The minimum HGL at the connection point is approximately 978 feet, as determined by the invert elevation of the Pipeline 4 San Marcos Vent.

  Although physically located within the District's 855 Zone, the facility delivers water to the 920 Zone, which in turn can feed the 855 and 1500 Zones via pumping. The District also has some limited capacity to pump water from the 920 Zone south to the 1530 Zone, from where it can flow to lower zones in the southern portion of the District.

- **VAL 10:** This facility is the most utilized of the District's four connections to the SDCWA's Second Aqueduct system. The facility is located in the northern portion of the District in the Twin Oaks Valley, west of Twin Oaks Valley Road and adjacent to the SDCWA's Twin Oaks Water Treatment Plant (WTP) and Twin Oaks Diversion Structure. The facility is fed directly from the Second Aqueduct. The Second Aqueduct in this reach, north of the Twin Oaks Diversion Structure, contains only a single treated water pipeline, Pipeline 4. The minimum HGL at the connection point is approximately 1078 feet, as determined by the weir elevation of the Twin Oaks Diversion Structure.

The facility delivers water to the District's Twin Oaks 1 & 2 Reservoirs, and hence to the 1028 Zone, from where it can be reduced down into the 920 Zone and subsequently reduced again to the lower zones to the southwest. The District also pumps from the 1028 Zone into the higher elevation zones to the east and north.

Certain aspects of the District's aqueduct connections deserve note:

- **Surplus Capacity / Operational Flexibility:** As shown in Table 4-1, the District has connection capacity to the SDCWA aqueduct system that significantly exceeds its average annual demands. This surplus capacity provides operational flexibility to accommodate peaking and to allow for one or more of the connections to be off-line.
- **Connections to Each Aqueduct:** Of the District's five connections, four (VAL 7, VAL 8, VAL 9, and VAL 10) are supplied by the SDCWA's Second Aqueduct system. One of the connections, VAL 2, is supplied by the SDCWA's First Aqueduct system. This ability to draw treated water from either aqueduct provides an important reliability benefit, allowing for continued deliveries to the District even if one aqueduct is off-line.

4.3.3.1 District Inter-Agency Connections

In addition to its SDCWA aqueduct connections and desalinated water supply connection, the District also has the capability to obtain limited deliveries from the City of Escondido, Rincon del Diablo MWD, Vista Irrigation District, OMWD, and the Carlsbad MWD. These inter-agency connections are detailed further in Chapter 5.

4.4 POTABLE WATER SUPPLY OPTIONS UPDATE

As part of the District's 2007 IPR and 2008 Master Plan, several new supply options were identified and evaluated. In considering new water supply options as part of the 2008 Master Plan, the District's considered the following criteria:

- Maximize Supply Reliability, which considered dry-year shortages, emergency outages, scheduled aqueduct shutdowns, and in-District facility outages
- Minimize Costs
- Maximize Water Quality
- Minimize Environmental Impacts
- Maximize Implementability

As part of this Master Plan, only an update on the status and potential opportunities are provided for the previously identified supply options. Since the 2008 Master Plan, the District has completed two water supply projects, which have diversified its water supply sources:

- Seawater Desalination
- Treated Water Purchases from OMWD WTP

In addition, three other potential supply projects were identified but not implemented:

- Expanded Transmission Capacity from VAL2 Connection

- Treated Water Purchases from Escondido-Vista WTP
- Treated Water Purchases from City of Oceanside's Weese WTP

The following sections describe the two completed supply projects and provide a short summary and status update on the three potential supply projects.

4.4.1 Seawater Desalination

In November 2012, the SDCWA approved a 30-year Water Purchase Agreement with Poseidon Water for the purchase of the entire supply output from the Claude "Bud" Lewis Desalination Plant constructed in the city of Carlsbad. The District has entered a contract with the SDCWA for the purchase of 3,500 AFY of desalinated water, with the option to increase this volume to 7,500 AFY in 10 years. At 7,500 AFY, desalinated water would make up approximately 45 percent of the District's supply at current demand levels.

In December 2015, the District began receiving water from the desalination plant via its direct connection near the existing VAL9 turnout, as shown in Figure 4-2. This allows the District to take water from the desalination plant directly as an alternative water supply. Seawater desalination offers the advantage of being a highly reliable supply, immune from the effects of drought and aqueduct shutdowns. As part of this Master Plan (see Section 5), additional analysis was conducted to determine if the District could utilize the full 7,500 AFY of desalinated water during minimum demand conditions.

4.4.2 Treated Water Purchases from Olivenhain MWD

The District has entered a purchase agreement with OMWD to purchase treated water from the OMWD's David C. McCollom WTP for delivery via the existing Vallecitos-Carlsbad-Olivenhain Tri-Agencies Pipeline. This capacity could help improve operational flexibility and reliability during Aqueduct service outages. The WTP is owned and operated by the OMWD. Under the current agreement, the District receives up to 2,750 AFY of water supply from OWMD. The water is treated at OMWD's WTP and then transported to OMWD's Denk Reservoir. From the reservoir, water is then delivered to the District where it is pumped into the distribution system via the District's new San Elijo Hills Pump Station. It is important to note that this supply is for operational flexibility and is not guaranteed to be available in severe water shortage events.

4.4.3 Expanded Transmission Capacity from VAL 2 Connection

Under this alternative, the District would expand its transmission capacity from its VAL 2 connection, its lone connection to the First Aqueduct. This project would not provide new supply to the District but could help improve operational flexibility and reliability during Second Aqueduct service outages.

The existing transmission pipeline has a diameter of 18-inches and extends approximately 12,500 feet from the VAL 2 connection (minimum HGL 1054 feet) in Escondido to the eastern portion of the District's 920 Zone. The pipeline diameter and hydraulic conditions result in a delivery capacity to the 920 Zone of approximately 10 to 11 cubic feet per second (cfs).

Replacing the pipeline with a new 24-inch diameter pipeline would double the transmission capacity to approximately 22 cfs. Absorbing this much flow into the 920 Zone would likely require the District to construct a 920 to 1028 Zone pumping station facility of the type addressed in Chapter 5. The combination of the expanded transmission capacity from the First Aqueduct and the ability to move water out of the 920 Zone into the 1028 Zone would allow the District to operate independent of the Second Aqueduct for days or weeks at a time, depending on seasonal demand conditions.

The current VAL 2 connection has a rated capacity of 12 cfs. The facility would need to be expanded to 22 cfs to match the delivery capacity of the new 24-inch transmission pipeline.

Expanded capacity from the VAL 2 connection would not provide a new local water supply, and therefore would not provide any benefits during drought conditions. The project would provide only minimal benefits during an emergency on the Second Aqueduct south of the Twin Oaks WTP and or during a planned shutdown of the Second Aqueduct. With the implementation of the Desalination project, the District has decided to not pursue this project at this time.

4.4.4 Treated Water Purchases from the Escondido Vista WTP

Under this alternative, the District would arrange to purchase treated water from the Escondido-Vista WTP, for delivery to the District via the Vista Flume. These facilities are owned and operated by the City of Escondido and the Vista Irrigation District (VID). This alternative includes variations relative to whether the District obtains capacity rights in the treatment and delivery facilities:

- **Surplus Purchases without Capacity Rights**: The simplest variation would be where the District does not purchase capacity rights in either the WTP or the Flume, but merely purchases surplus flows of treated water as may be available. This variation would be of limited reliability benefit to the District, in that absent capacity rights it could not count on water being available when needed, such as during an aqueduct shutdown. This project variation might be considered simply on the merits of its costs in comparison to the District's treated water purchases from the SDCWA.
- **Purchases with Capacity Rights in Flume or in both Flume and WTP**: The other variation would be where the District worked with VID or with both VID and Escondido to obtain capacity rights in the Flume or in both the Flume and WTP. This would provide the District with the assurance of reliable supply as long as raw imported water remained available to the WTP.

To utilize this water, the District would need to make use of its existing emergency interconnection to VID's system, via the Vista Flume, near the intersection of El Norte Parkway and Rees Road. The connection requires pumping to boost the VID gradient to the District's 920 Zone. During past aqueduct shutdowns, the District has installed a portable pump at this connection and received delivery of up to 2,200 gpm (3.2 MGD, 4.9 cfs) from VID. To utilize this connection on an ongoing basis, the District would need to install permanent pumping and metering facilities. In addition to the El Norte / Rees connection, the District has similar connections at Mulberry and at South Santa Fe, each of which could be considered as alternative locations for a permanent interconnect to VID should the District elect to pursue this project.

As the City of Escondido and VID had previously advised the District that they are not interested in considering selling their local water rights, this project would not provide a new local water supply. Therefore, this project would not provide any benefits during a drought or an emergency event. The project would provide only minimal benefits during an emergency on the Second Aqueduct south of the Twin Oaks WTP and or during a planned shutdown of the Second Aqueduct. None of these options are currently feasible to the District due to a combination of high cost as well as lack of dry-year reliability. The cost estimate conducted in the 2008 Master Plan indicated that the project would only be cost-effective to the District if the District obtained a reliability benefit from the project sufficient to justify the higher cost.

Since the 2008 Master Plan, the City of Escondido has started implementation of its Potable Reuse Program. Under this Program, the first phase involved expanding its current Title 22 recycled water system to agricultural users. In the second phase, the City would send advanced treated water to Lake Dixon where it would be blended with raw water supplies and treated at the Escondido-Vista Water Treatment Plant. While this water would provide for an additional local supply, it is not certain that the City would sell this supply to the District via the Vista Flume. The costs for this water would likely be much higher than current raw-treated water supplies due to the additional infrastructure needs. With the City of Escondido pursing this Program, it is uncertain if a partnership with the District is possible in the future.

4.4.5 Treated Water Purchases from the Weese (Oceanside) WTP

Under this option, the District would arrange to purchase treated water from the City of Oceanside's Weese WTP, for delivery via the District's existing VAL 8 connection on the North County Distribution Pipeline. Within this alternative are two variations relative to whether the District obtains capacity rights in the treatment plant.

- **Surplus Purchases without Capacity Rights:** The simplest variation would be where the District does not purchase capacity rights in the WTP, but merely purchases surplus flows of treated water as may be available. This variation would be of limited reliability benefit to the District, in that absent capacity rights in the WTP it could not count on water being available when needed, such as during an aqueduct shutdown. This project variation might be considered simply on the merits of its costs in comparison to the District's treated water purchases from the SDCWA.
- **Purchases with Capacity Rights in WTP**: The next variation would be where the District worked with Oceanside to obtain capacity rights in the Weese WTP. This would provide the District with the assurance of reliable supply as long as raw imported water remained available to the WTP.

To utilize this water, the District would need to make use of the existing interconnect facilities to allow for a maximum delivery at the District's VAL 8 connection of up to 11 cfs (7 MGD). However, in practice, deliveries are limited to the approximately 0.3 MGD (average annual) demand of the 900 Zone. The District would need to construct the proposed Mountain Belle Pump Station to allow additional deliveries at the VAL 8 connection.

The Weese plant treats raw water from the Second Aqueduct and conveys this treated water to the City of Oceanside through one of two transmission routes: the SDCWA's 72-inch-diameter NCDP or the two existing parallel 24-inch-diameter pipelines owned by Oceanside. Supply from this plant could improve the District's reliability as it is independent from SDCWA's treated water supplies and could operate during planned shutdowns of the SDCWA's raw water pipeline. However, supplies to this plant would be subject to the same regional drought supply allocations by the SDCWA as treated water supplies.

The cost estimate conducted in the 2008 Master Plan indicated that the project would only be cost-effective to the District if the District obtained a reliability benefit from the project sufficient to justify the higher cost. This potential supply option is no longer being considered by the District as the City of Oceanside is not currently planning to expand the plant's capacity.

4.5 RECYCLED WATER OPTIONS

In conjunction with this report, a Recycled Water Facilities Plan (RWFP) was prepared by the District and Black & Veatch. The purpose of that plan is to identify and assess all potential recycled water options, ranging from non-potable to direct potable reuse applications. The RWFP considers a number of potential supplies and uses as part of a comprehensive alternatives analyses process. The following sub-sections summarize the results of the RWFP.

4.5.1 Supply Options

Potential water sources considered for reuse opportunities in the RWFP include:

- Vallecitos wastewater/recycled water supplies via the MRF
- Wastewater/recycled water supplies via the Encina Water Pollution Control Facility (EWPCF)
- Stormwater capture via South Lake
- Stormwater Capture via Lake San Marcos
- Dry weather runoff capture

The following sections summarize the supply opportunities along their potential benefits and challenges as identified in the RWFP.

4.5.1.1 Vallecitos Wastewater/Recycled Water Supplies via MRF

Description: District wastewater that flows to the MRF facility and is currently treated to State Title 22 non-potable reuse standards. Currently the District wholesales a total of 4.5 MGD of this water annually to CMWD and OMWD.

Opportunities: There are several options for using this resource:

- Continue to wholesale to CMWD and OMWD long-term
- Add up to 1.5 MGD of treatment for use by VWD for non-potable uses
- Eliminate or reduce the wholesale agreements in the future to use up to 6.5 MGD of recycled water from this facility. Increasing capacity to 6.5 MGD would require additional tertiary treatment capacity.
- Make improvements to create advanced treated recycled water ranging from 1.6 to 5.2 MGD of flow. An advanced treatment flow of 1.6 MGD is based on 6.5 MGD maximum flow/capacity minus 4.5 MGD of wholesale tertiary and minus about 20% due to loses through an advanced treatment process. Similarly, a flow of 5.2 MGD is based on 6.5 MGD of maximum flow/capacity and losses from advanced treatment and assuming no wholesaling of recycled water.

Benefits: The following benefits were identified in utilizing this facility:

- District would control all the supplies
- Potential for the District to reduce downstream treatment and costs at the EWPCF depending on the alternative selected
- Currently baseline flows are barely 5 MGD, but in long-term, flow can be increased as the District's wastewater flows increase with growth in its service area

Challenges: The following challenges were identified in utilizing this facility:

- Limited wastewater capacity available as the site is space constrained
- Limited wastewater flows currently due to pumping constraints and wholesale agreements
- Treatment/ocean disposal still needed via EWPCF to address Biosolids handling and off-peak season/wet-weather flow conditions
- Brine-concentrate disposal via the land outfall would be needed if advanced (reverse osmosis based) treatment process were added

Conclusion: The MRF is a preferred source of recycled water for the district since it is owned and controlled by the District and already produces recycled water for non-potable uses.

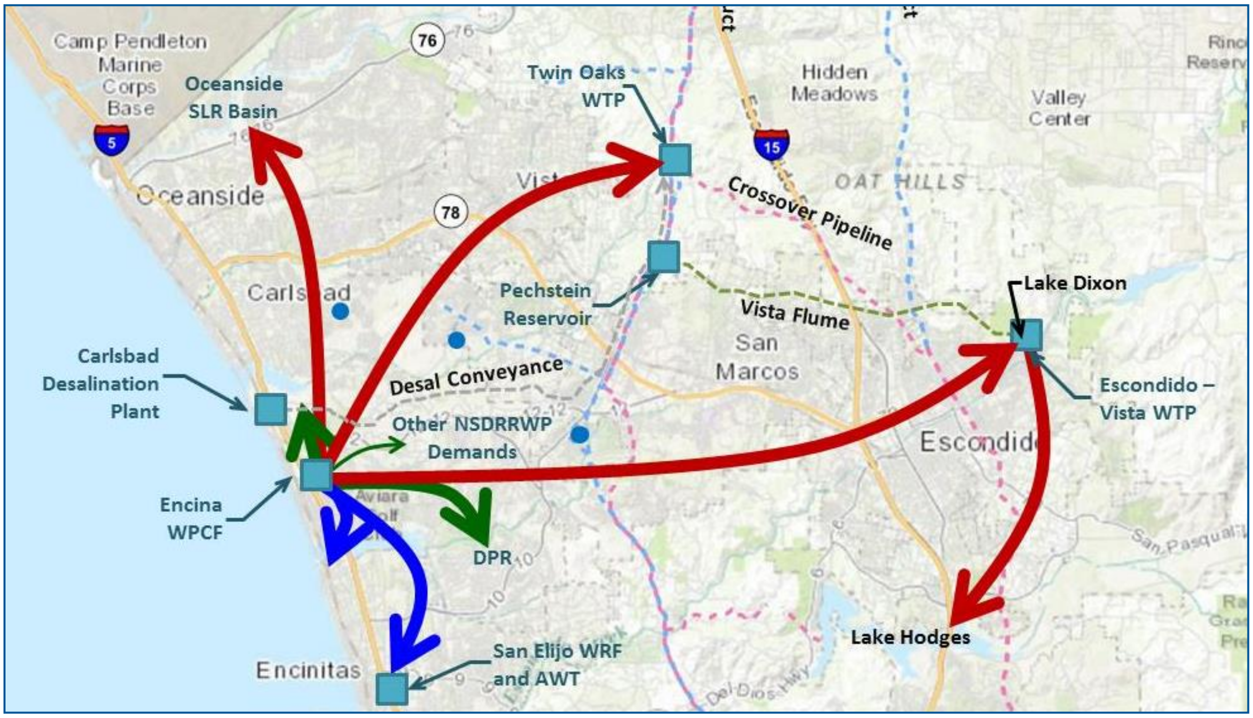
4.5.1.2 Wastewater/Recycled Water Supplies via EWPCF

Description: The EWPCF is a regional plant that could serve to treat all of VWD's wastewater as well as the other JPA partners. As shown in Figure 4-3, recycled water could be treated to non-potable by adding tertiary and disinfection process or to potable reuse levels by adding advanced treatment processes.

Opportunities: There are several options for using this resource:

- The North San Diego Water Reuse Coalition is currently studying and implementing a regional reuse program that is looking at short- and long-term options for maximizing the use of recycled water for both non-potable and potable uses. VWD is currently participating in this study that includes looking at utilizing the EWPCF wastewater flows as a potential supply source that agencies could use for local and regional recycled water projects.
- VWD could also use the flows, especially its own wastewater flows, to treat and distribute for both non-potable and potable reuse opportunities.

Figure 4-3 Potential Recycled Water Options from EWPCF



Benefits: The following benefits were identified in utilizing this facility:

- Regional collaboration opportunities
- Timing may be better suited for direct potable reuse due to economy of scale, especially when VWD non-potable uses are not large in comparison to the potential size (20 to 30 MGD) of potable reuse on a regional level.

Challenges: The following challenges were identified in utilizing this facility:

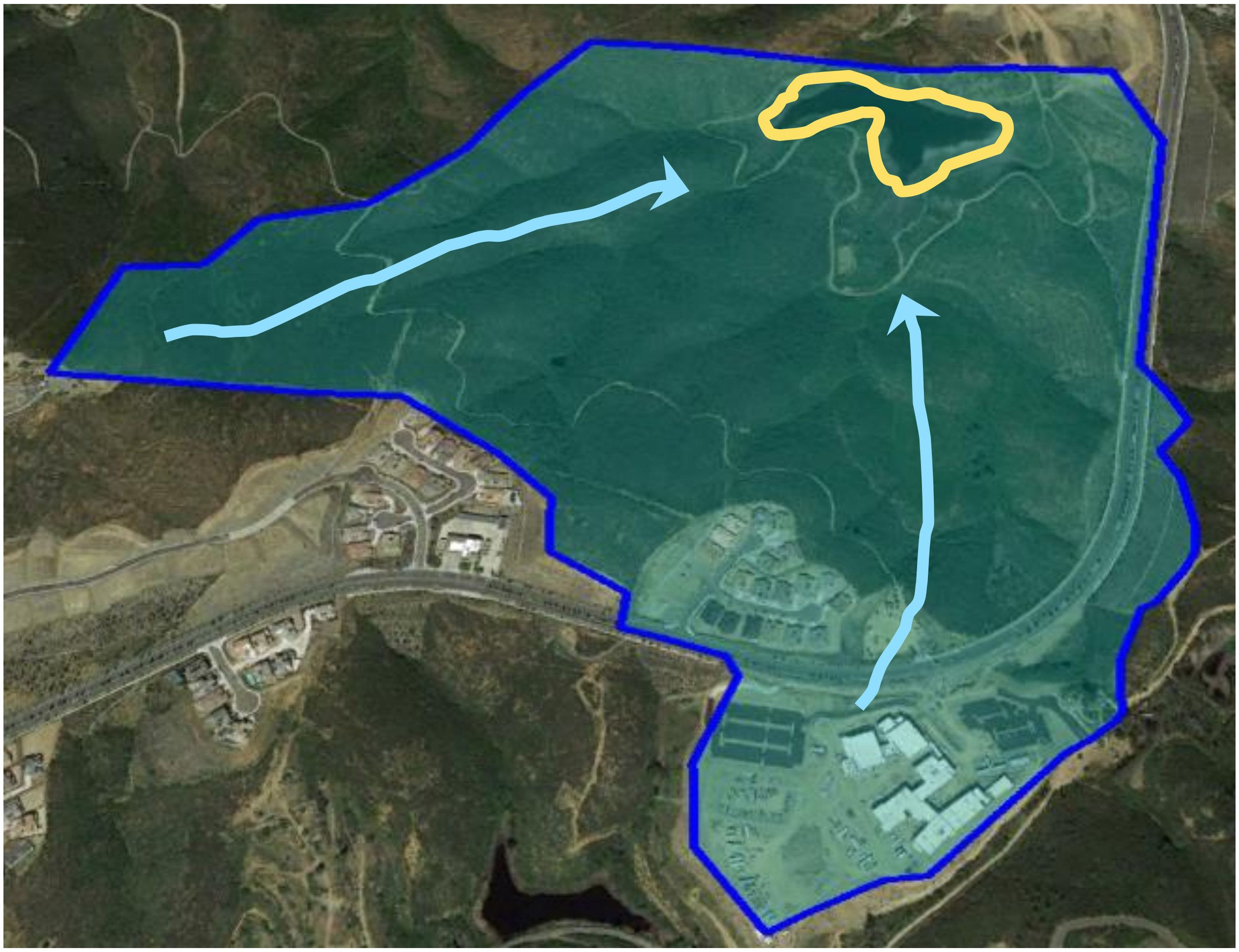
- Long distances for transmission piping to serve VWD
- Lift and energy for pumping will be costly
- Regulations for potable reuse still being developed

Conclusion: Non-potable reuse from the EWPCF is not very feasible due to the lack of potential demands in VWD's service area and the distance needed to pump supplies up to VWD's service area. The MRF is a more viable supply source for non-potable reuse. For potable reuse, the EWPCF should be considered for long-term as a direct potable reuse supply source, especially on a regional level where the economies of scale and regional cooperation can be advantageous

4.5.1.3 Stormwater Capture via South Lake

Description: During wet weather events, South Lake could be used to capture stormwater flows within its watershed. Figure 4-4 shows South Lake and its surrounding watershed area.

Figure 4-4 South Lake Watershed



Opportunities: There are several options for using this resource:

- During peak spring and summer water use periods, the captured water could be pumped into VWD's local sewer system where it could supplement wastewater flows to the MRF.
- Captured water could also be used directly to serve local irrigation needs, such as City of San Marcos park and school sites.

Benefits: The following benefits were identified in utilizing this facility:

- Provide supplemental supply flows to the MRF in the short- to mid-term as part of a non-potable reuse system.
- Provide non-potable reuse opportunities

Challenges: The following challenges were identified in utilizing this facility:

- As growth occurs in the District, supplemental flows to the wastewater system are not likely to be needed as the MRF could be maximized year round
- Could result in diverting water supplies out of the lake that normally help stabilize lake levels

Conclusion: Opportunity to use this South Lake for stormwater capture is possible to supplement a short- to mid-term non-potable reuse program. However, the District would need to work with the City of San Marcos to identify and resolve potential downstream impacts (e.g. Lake San Marcos). Long-term, such supplies would provide little benefit to a VWD wastewater recycled system, but they could be used as a source for irrigation applications in the immediate area in conjunction with the City or other entities.

4.5.1.4 Stormwater Capture via Lake San Marcos

Description: During wet weather events, Lake San Marcos could be used to capture stormwater flows within its watershed. Figure 4-5 shows Lake San Marcos and the path of inflow to the lake.

Figure 4-5 Lake San Marcos Storm Water Capture

Opportunities: There are several options for using this resource:

- During peak spring and summer water use periods, the captured water could be pumped into VWD's local sewer system where it could supplement wastewater flows to the MRF.
- Captured water could also be used directly to serve local irrigation needs, such as City of San Marcos park and school sites.

Benefits: The following benefits were identified in utilizing this facility:

- Provide supplemental supply flows to the MRF in the short- to mid-term as part of a non-potable reuse system.
- Provide non-potable reuse opportunities

Challenges: The following challenges were identified in utilizing this facility:

- As growth occurs in the District, supplemental flows to the wastewater system are not likely to be needed as the MRF could be maximized year round
- Diverts water away from Lake San Marcos, which is currently impeded by water quality challenges
- Requires jurisdictional arrangements as the lake is under private ownership
- Need to address existing water quality challenges (currently in litigation)
- Requires regulatory approvals and institutional/operational changes

Conclusion: Opportunity to use Lake San Marcos is very limited given the current water quality challenges, private ownership, and on-going litigation issues. Therefore, use of the Lake is not being considered at this time by the District.

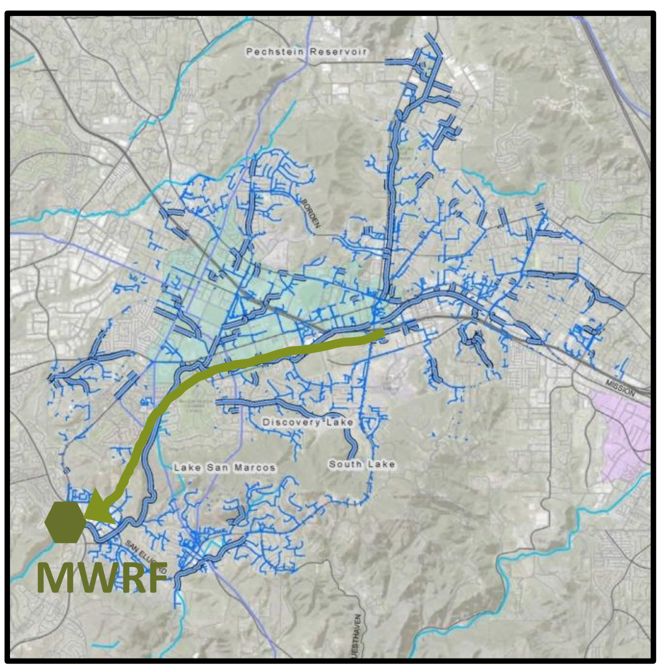


Figure 4-6 San Marcos Creek Watershed

4.5.1.5 Dry Weather Runoff Capture

Description: Utilizing the San Marcos Creek watershed, dry weather runoff could be captured and diverted for reuse. Figure 4-6 shows the MRF and the San Marcos Creek watershed as well as the general flow direction of both the creek and the District's wastewater flow to the southwest.

Opportunities: There are several options for using this resource:

- Captured water could be diverted into VWD's sewer system to supplement wastewater flows to the MRF.
- Captured water could also be used directly to serve local irrigation needs, such as City of San Marcos park and school sites.

- Per Table 4-2, the estimated yield for urban runoff ranges from 0 to 2.9 MGD

Table 4-2 Estimated Yield of Urban Runoff in San Marcos Creek

CONDITION	FLOW GENERATION (GPD/ACRE)	POTENTIAL YIELD FOR VWD FROM 9,000 ACRES OF URBAN WATERSHED[1] (MGD)
Pre-Conservation	320	2.9
With Conservation	190	1.7
Soft Bottom	0-190	0 to 1.7 (Varies by reach of creek)

(1) Watershed area derived from Upper San Marcos Creek Nutrient Management Plan, 2010. Assumes approximately 50% of entire watershed is urbanized.

Benefits: The following benefits were identified in utilizing this resource:

- Cost effective when diversion located near sewer or users
- Water quality enhancement to streams
- Partner with City of San Marcos

Challenges: The following challenges were identified in using this resource:

- Water rights, including potential diversions to flows currently going to Lake San Marcos
- Regulatory approval
- Water conservation efforts to reduce incidental runoff are likely to reduce flows over time
- Treatment plant modifications would be necessary if water quality from streams affects MRF processes

Conclusion: Dry weather runoff could be used to enhance recycled water supplies, but the District would need to partner with the City of San Marcos to address a number of challenges.

4.5.2 Reuse Options

In the RWFP, several potential uses for recycled water are identified:

- Non-potable reuse options included:
  - Continuation of wholesaling non-potable recycled water to City of Carlsbad and the Olivenhain Municipal Water District
  - Non-potable reuse within the District
- Potable Reuse options included:
  - Indirect Potable Reuse (IPR) via groundwater recharge in the San Marcos Area Groundwater Basin
  - IPR via Surface Water Augmentation of Lake Dixon, Lake San Marcos, South Lake, and Olivenhain Reservoir

- DPR via a new Advanced Water Treatment (AWT) facility at MRF
- Direct Potable Reuse (DRP) via a regional AWT at the EWPCF

The following sections summarize the reuse opportunities along with their potential benefits and challenges as identified in the RWFP.

4.5.2.1 Non-Potable Reuse - Local

Description: Develop a Title 22 non-potable reuse system that would serve VWD agriculture, irrigation, and/or industrial customers. The MRF would be expanded to produce the necessary recycled water for distribution to the larger users located near the plant as depicted in Figure 4-7.

Opportunities: There are not many large potential recycled water customers within the District's service area. In addition, the existing wholesale contract that VWD has with CMWD and OMWD limits how much VWD could use under this option. Therefore, this alternative is limited to serving only a few potential customers located near the MRF.

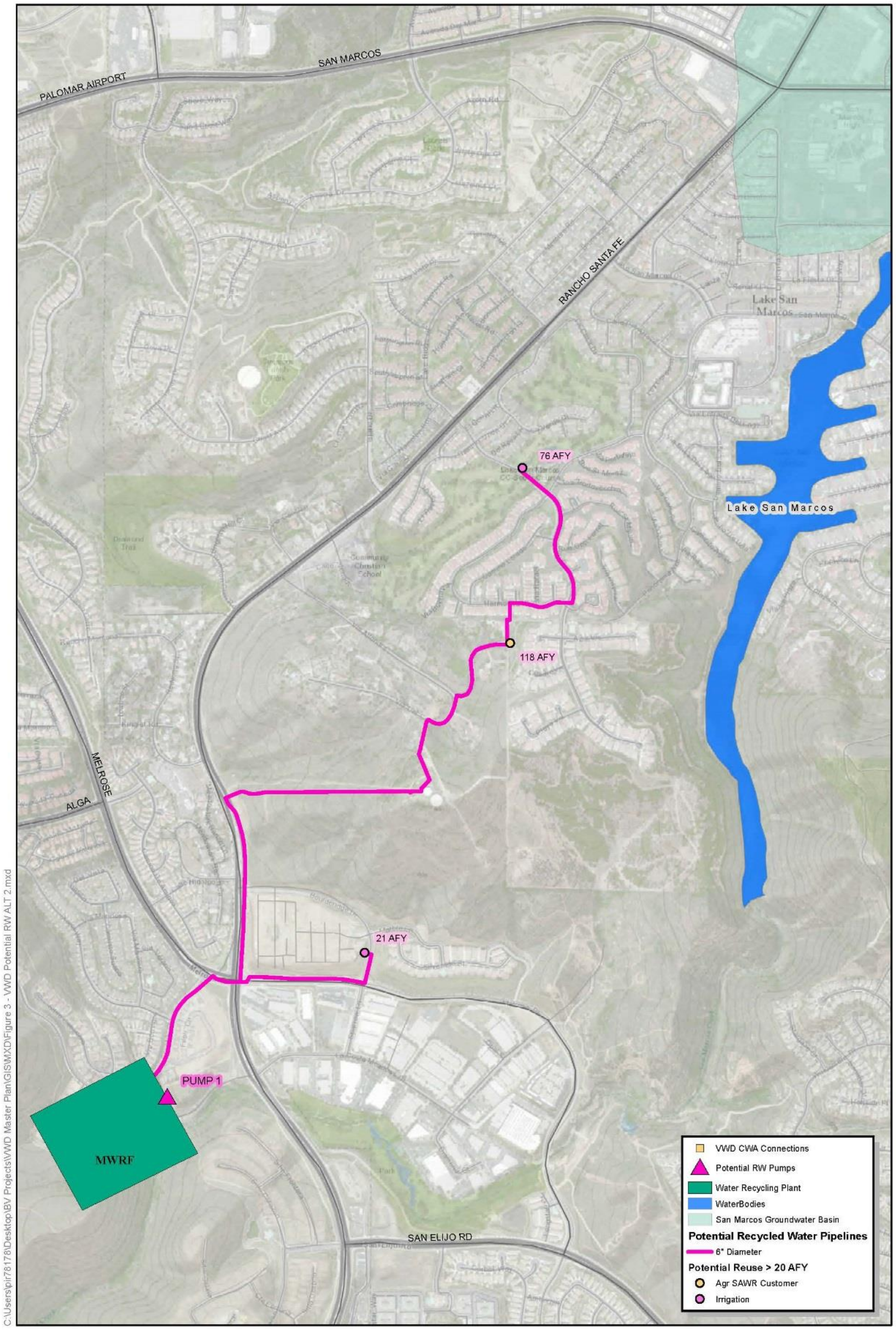
Benefits: The following benefits were identified under this alternative:

- This is a potential short- to mid-term project that VWD could implement with little regulatory challenges.
- The system could be increased in size to serve more users as funding becomes available and as more wastewater flows become available to the District (either through growth or changes in the wholesale contract amounts).

Challenges: The following challenges were identified under this alternative:

- The District does not have current funding or budget plans for such a system.
- Current wastewater supplies are not available during peak season usage periods due to the existing wholesale of the District's recycled water from the MRF.
- Some of these users are City of San Marcos properties (e.g. golf course and parks) and may be using groundwater wells to supply some of their water. Agreements may be needed with the City to ensure that VWD is maximizing the use of recycled water and is kept financially whole based on such agreements.
- Given its size, the cost-effectiveness may not be very feasible compared to other near-term potable water supply options (e.g. increase use of desalinated seawater) or compared to larger potable reuse alternatives in the future that may involve multiple partners.

Figure 4-7 Local Non-Potable Reuse Alternative



Conclusion: This is a viable short- to mid-term opportunity for the District once wastewater flows increase and one that could be expanded in the future based on continued growth and future funding.

4.5.2.2 Non-Potable Reuse - Maximized

Description: Develop a Title 22 non-potable reuse system that would serve all of the largest identified VWD agriculture, irrigation, and/or industrial customers. Supply would come from VWD reducing its wholesaling of recycled water, increasing the tertiary capacity of the plant as additional baseflows grow, or some combination of the two to meet its own projected demands. A new VWD non-potable system would extend into the central and north portions of the District's service area as depicted in Figure 4-8.

Opportunities:

- Up to 1,000 AFY of potential recycled water use was projected based on current agriculture, irrigation, and industrial demand. Under this alternative, VWD would serve nearly all the larger (20 AFY and larger) demands identified in the system.
- Smaller demands located along the final alignment could also be connected if deemed feasible.

Benefits: The following benefits were identified under this alternative:

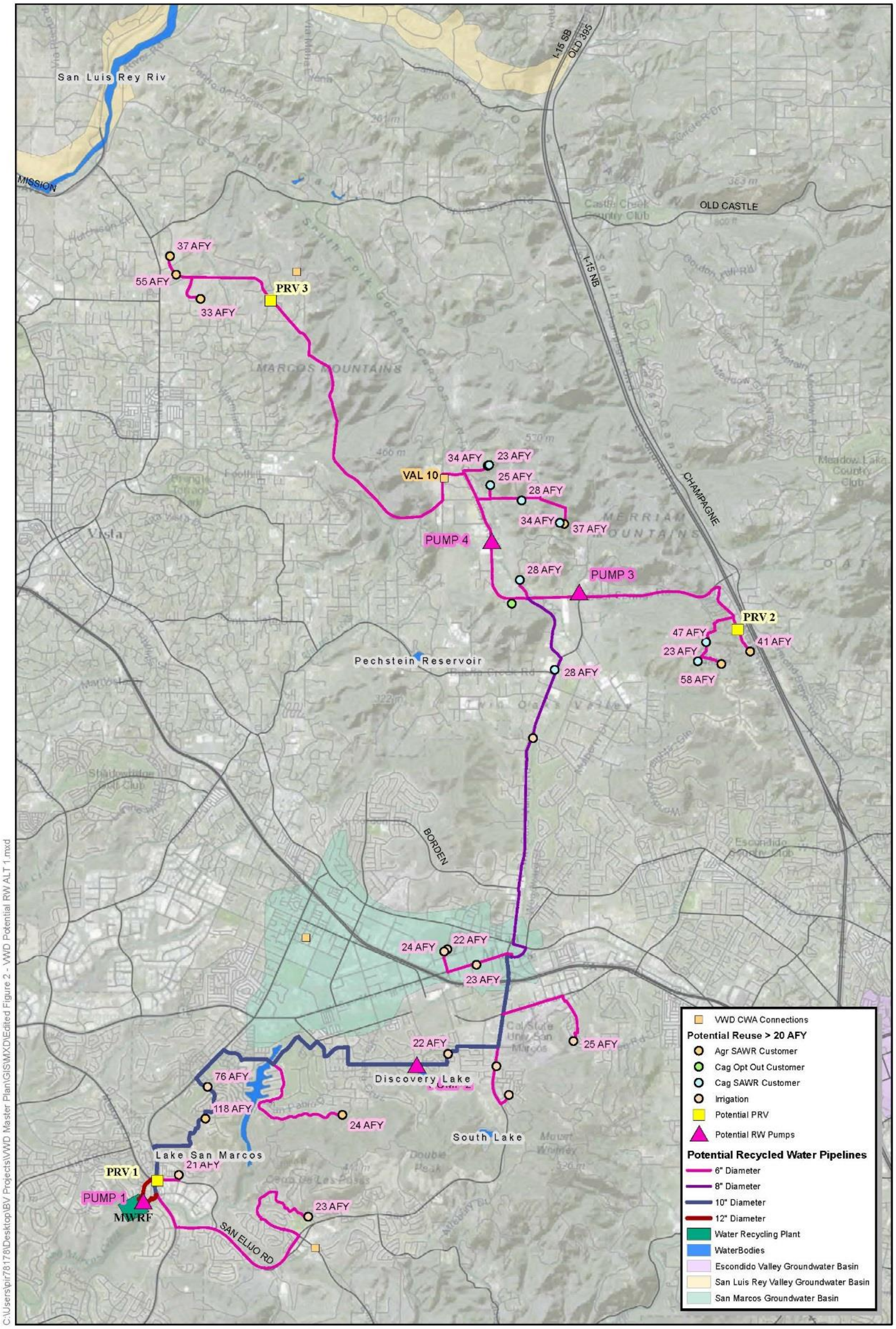
- This option could be implemented as a future phase to the local non-potable reuse alternative if recycled water trunk lines were sized to accommodate future demands.
- The system could be increased in size to serve more users as funding becomes available.
- Development could provide funding and/or infrastructure to help expand the system as growth occurs.

Challenges: The following challenges were identified under this alternative:

- Current wastewater supplies are not available during peak season usage periods due to the existing wholesale of the District's recycled water from the MRF.
- Some of these users are City of San Marcos properties (e.g. golf course and parks) and may be using groundwater wells to supply some of their water. Agreements may be needed with the City to ensure that VWD is maximizing the use of recycled water and is kept financially whole based on such agreements.
- This larger system would require a much greater budget than the smaller-localized system due to the length of the system and crossing of several pressure zones.

Conclusion: This is a viable mid- to long-term opportunity for the District that could be expanded upon an initial smaller system.

Figure 4-8 Maximized Non-Potable Reuse Alternative



4.5.2.3 Potable Reuse - Groundwater Recharge

Description: Under this alternative, an advanced treatment plant would be installed at MRF to provide highly purified recycled water for recharge or injection into the San Marcos Area Groundwater Basin. Wells would be installed downgradient to recover, treat and distribute the water into VWD's potable water system or possibly up to the San Diego County Water Authority's (SDCWA) Twin Oaks WTP for further blending and treatment. Figure 4-9 shows a conceptual layout of a potential system from the MRF.

Opportunities: The ground water basin provides two opportunities for recycled water:

- **Potable Reuse**. Additional studies are needed to better quantify the basin's production potential and address potential water quality issues in the basin. However, for conceptual level analyses, the 3-MGD alternative developed as part of EWA's recent Advanced Treatment and Water Reuse Analysis Study (2012) was used to compare with the potable and non-potable alternatives as presented later in this section.
- **Non-Potable Reuse**. While this opportunity was not explored in any detail, since the basin is a non-potable use basin, non-potable recycled water could be used to recharge and help stabilize the basin's water levels and yield. However, VWD does not currently utilize the basin, so agreements with the City of San Marcos and other pumpers would have to be established as well as addressing potential water quality challenges. Under the Sustainable Groundwater Management Act (SGMA) that was signed into law on September 16, 2014, use of the basin would likely require the formation of a Groundwater Sustainability Agency (GSA). This GSA would then be required to develop a Groundwater Sustainability Plan (GSP) and submit to the California Department of Water Resources for review. Further development of the basin would require additional testing, including drilling of new wells, and development of a Groundwater Management Plan as well as a Salt-and Nutrient Management Plan.

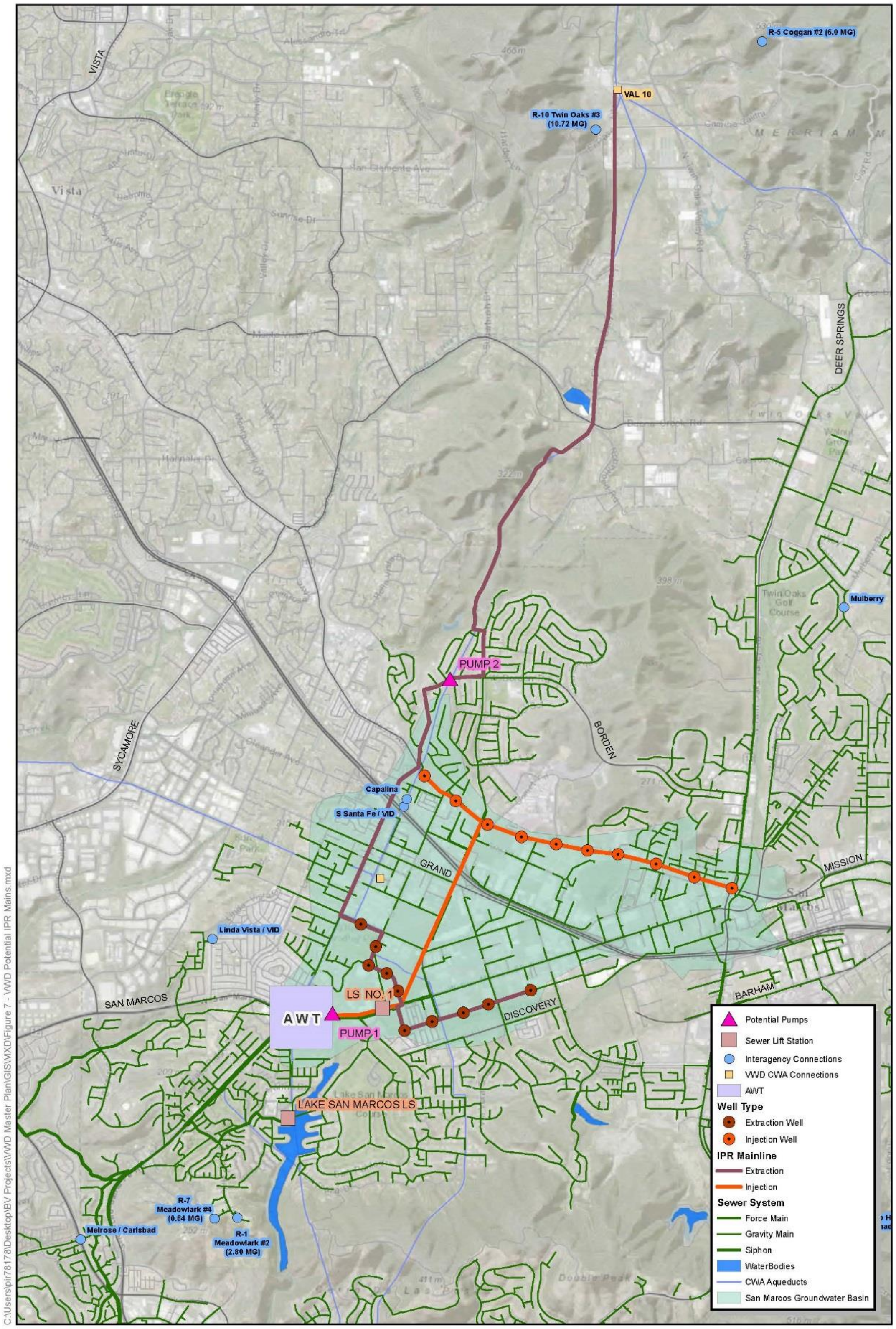
Benefits: The following benefits were identified under this alternative:

- Diversified water supply
- May improve basin water quality in long-term

Challenges: The following challenges were identified under this alternative:

- Additional wastewater flows or reduction in wholesale recycled water sales would be needed to provide the necessary wastewater supply
- Water rights could be a challenge
- Uncertainty in basin yield (may be much lower than 3 MGD)
- Basin's water quality challenges may require additional treatment upon extraction of the water
- Decomposed and fractured bedrock will likely lead to losses of recharged water
- Siting for recharge and extraction facilities
- Fractured rock and small basin may create a challenge or barrier to implementation of a potable reuse project under current California recycled water recharge regulations

Figure 4-9 Groundwater Potable Reuse Alternative



- Requires land purchase for recharge or injection wells
- Potable reuse would require source of blend water
- Brine-concentrate from the AWT would need to be discharged and conveyed out the EWA land outfall
- High cost just to evaluate the potential yield and operational parameters of the basin

Conclusion: The basin has too many uncertainties to be considered a short- or mid-term project. The District would first need to develop key partnerships with the City of San Marcos and pumpers and then conduct numerous studies to better quantify the basin and its potential use for any recharge and recovery program.

4.5.2.4 Potable Reuse - Surface Water at South Lake

Description: Under this alternative, advanced treatment of recycled water would be implemented at the MRF plant and water would be conveyed to South Lake, where it would be blended with raw or potable water, pumped out, and treated again via a new conventional surface water treatment plant and distributed into VWD's potable water system. Figure 4-10 depicts the conceptual layout of this alternative. Additional process would be needed as part of an advanced treatment process scheme. While typical potable reuse processes include only the addition of microfiltration (MF), reverse osmosis and UV/AOP, because of the small reservoir size, the addition of ozone and BAC filters upstream of the MF units is included. This is based on the City of San Diego's current work with state regulators to approve a reservoir augmentation system with their Miramar Reservoir that has a shorter retention time than their originally proposed San Vicente Reservoir system. As the State does not have current regulations for such systems, this process scheme is only conceptual.

Figure 4-10 Conceptual Potable Reuse Surface Water Augmentation Alternative

Opportunities: The opportunity at South Lake was developed based on the lake's size (165 AF), which would allow for a 0.15 MGD system that meets a 6-month retention time and a 50/50 blend with raw or potable water.

Benefits: The following benefits were identified under this alternative:

- Year-round utilization of recycled water
- Diversified potable water supply
- Enhancement and utilization of South Lake

Challenges: The following challenges were identified under this alternative:

- Very small amount of new water supply
- Must construct a new water treatment plant in addition to the advanced treatment system
- Regulatory challenges due to the lack of current State regulations and pending regulations that make small surface water augmentation projects in-feasible
- Public acceptance challenges
- Blending water source would require additional infrastructure
- Major facility needs
- Economy of scale

Conclusion: Due to the complexity, lack of regulations, and project size, this alternative is not deemed feasible in the short- or long-term for the District.

4.5.2.5 Direct Potable Reuse via AWT at MRF

Description: As shown in Figure 4-11, this alternative would involve building an AWT at MRF and conveying it to the SDCWA's Twin Oaks WTP. At the Twin Oaks WTP, the recycled water would be blending with the raw water inflows and then undergo further surface water treatment before it is distributed into the SDCWA's potable water system. Brine-concentrate reject streams would be sent to the EWPCF for disposal via the land outfall.

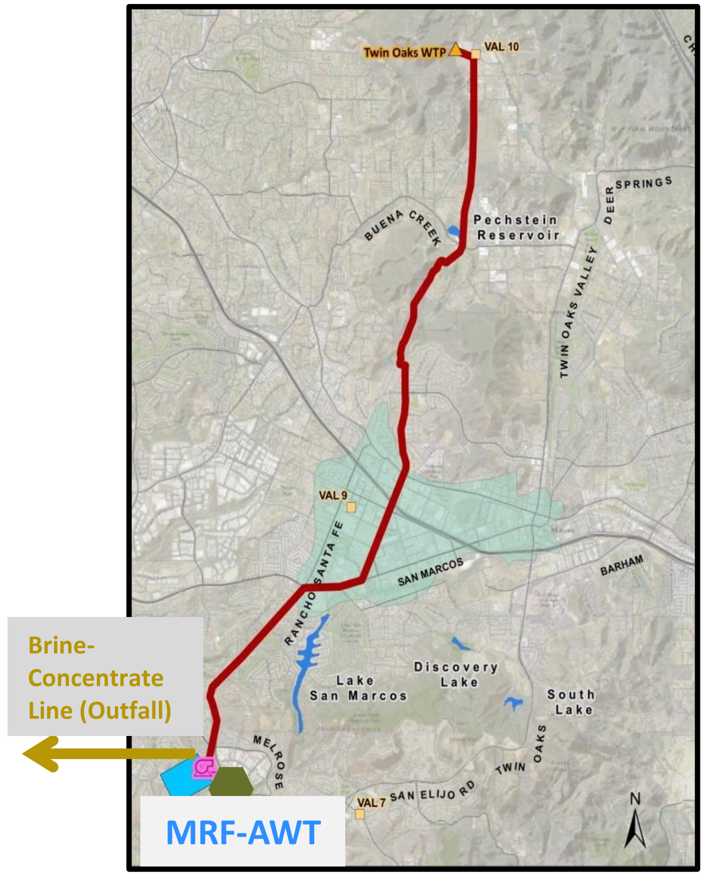
Opportunities: There are a couple of potential opportunities under this concept.

- The first opportunity is the available capacity at the MRF to produce 1.6 MGD (6.5 capacity minus 4.5 MGD wholesale and minus 20% for advanced treatment losses) of potable reuse water while still maintaining VWD's 4.5 MGD recycled water wholesale commitment.
- The second opportunity would be to reduce or eliminate the wholesaling of recycled water and to produce up to 5.2 MGD (6.5 MGD capacity minus 20% for advanced treatment losses) of potable reuse water by maximizing the available capacity and space at MRF by constructing an AWT process system.

Benefits: The following benefits were identified under this alternative:

- No new distribution system would be needed as water would be distributed via SDCWA's wholesale system
- Utilize recycled water year-round
- VWD controlled system and maximization of available VWD wastewater sources
- Possibly reduce some downstream outfall capacity needs and costs. However, the State (via Regional Water Quality Board (RWQCB) permit) would likely require a full backup system in case of an emergency plant shutdown. This consideration would be determined as part of a permitting process for the DPR system.
- Reduce the cost for disposal of effluent via the EWPCF

Figure 4-11 Conceptual Direct Potable Reuse System via AWT at MRF



Challenges: The following challenges were identified under this alternative:

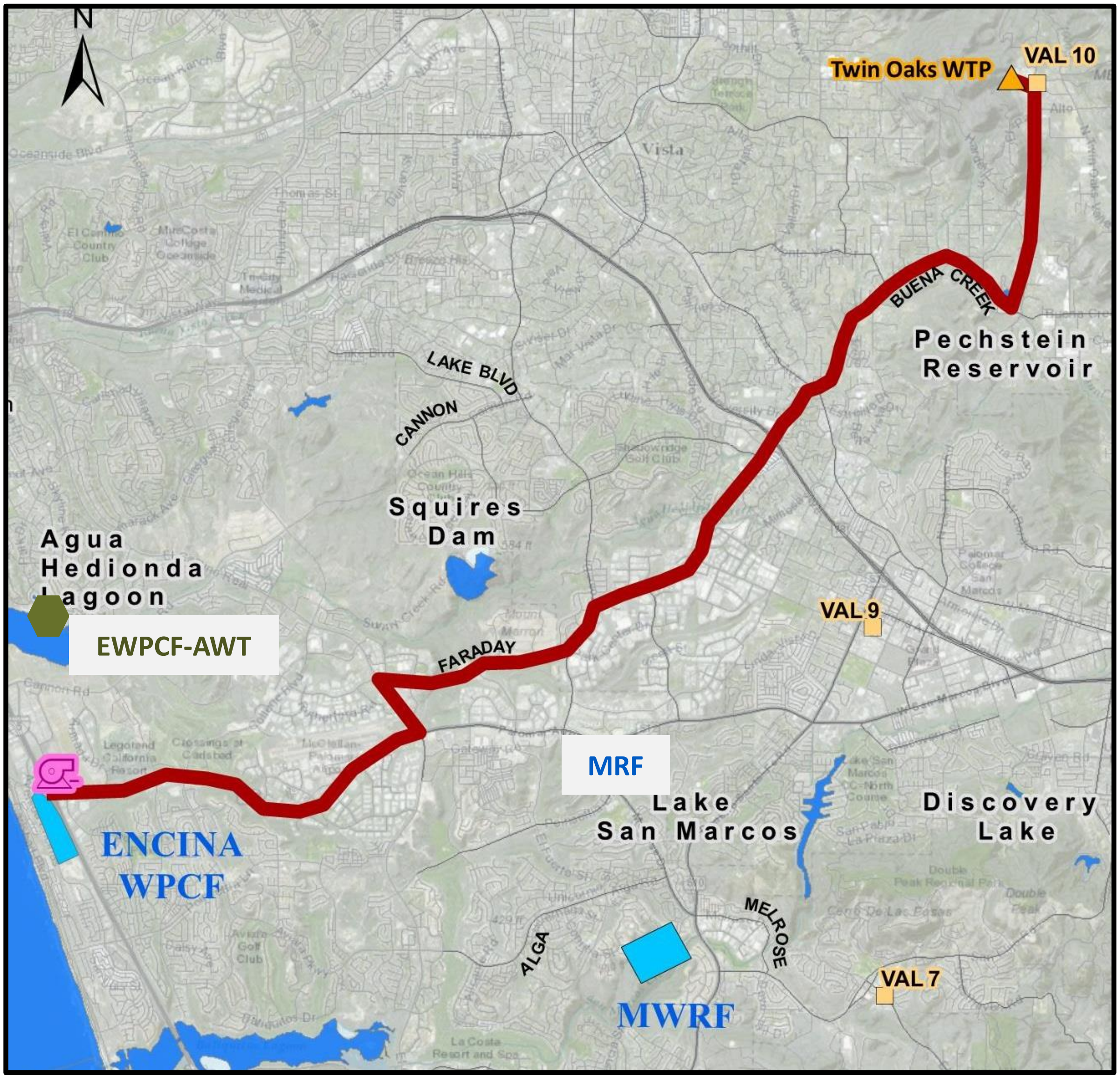
- Brine-concentrate flows would need to be conveyed via the land outfall and may require additional treatment and costs prior to discharge
- Regulatory conditions do not currently exist for such an alternative and are at least 10 years away based on recent SWRCB updates
- Direct potable reuse lacks an environmental buffer that would provide a longer response time in case of a process or other system failure
- Public acceptance
- Sending water to SDCWA's Twin Oaks WTP would result in that water being distributed to all the downstream SDCWA agencies. Therefore, acceptance would be needed from all the member agencies. Another alternative would be to distribute the AWT water directly in to VWD's distribution system, however, this concept would lack the additional blending and water treatment that the Twin Oaks WTP option provides.
- The project requires major infrastructure improvements (AWT, major pump station, and pipeline) compared with size of the project's supply product (especially 1.6 MGD). Thus, it lacks economy of scale opportunities that may make it highly un-feasible.

Conclusion: The alternative lacks an economy of scale and would not likely be implemented for 20 or more years due to the lack of regulations.

4.5.2.6 Direct Potable Reuse via AWT at EWPCF

Description: This would be a regional program that produces advanced treated water at the EWPCF and conveys it to the SDCWA's Twin Oaks WTP for blending with raw water and further surface water treatment before it is distributed into the SDCWA's potable water system. Figure 4-12 depicts the conceptual layout for this alternative.

Figure 4-12 Conceptual Direct Potable Reuse System via AWT at EWPCF



Opportunities: This opportunity could provide as much as 32 MGD of potable reuse on a regional level and as much as 9.4 MGD (10,500 AFY) to VWD based on the District's long-term wastewater projections.

Benefits: The following benefits were identified under this alternative:

- Better economy of scale compared with a VWD only system

- No new distribution system would be needed as water would be distributed via the SDCWA's wholesale system
- Utilize recycled water year-round

Challenges: The following challenges were identified under this alternative:

- Public acceptance
- Longer transmission line than an AWT located at MRF
- Regulatory conditions do not currently exist for such an alternative and are at least 10 years away based on recent SWRCB updates
- Direct potable reuse lacks an environmental buffer that would provide a longer response time in case of a process or other system failure
- Public acceptance
- Sending water to SDCWA's Twin Oaks WTP would result in that water being distributed to all the downstream SDCWA agencies. Therefore, acceptance would be needed from all the member agencies.

Conclusion: EWA has been studying this option with its member agencies' support, including VWD. While this is not a short-term alternative, such a project may be feasible in the mid- to long-term range and should continue to be monitored for regulatory changes and the opportunity for regional support.

4.5.3 Alternatives Analysis Results

As part of the alternative analysis phase, the District's staff and Board of Directors were engaged in a collaborative process in developing the alternatives and in assessing their short- and long-term potential to benefit the District.

The major goal of the RWFP was to consider the full set of possibilities to provide the District direction on how best to consider if and where recycled water may fit into its water supply and reliability portfolio. Therefore, the RWFP considered a wide-range of alternatives, from non-potable to direct potable reuse and included both local and regional opportunities.

Key findings from the RWFP include:

- Wastewater could be a valuable asset to the district in the future as more flow becomes available for use
- The District has several major challenges when looking to implement a recycled water program:
  - VWD lacks typical "resources" that drive solutions, including:
    - Large non-potable recycled water customer base
    - Large wastewater plant with available space
    - VWD owned water treatment plant
  - Limited wastewater supplies currently

- Lakes and groundwater basin that are small with significant political and environmental hurdles
- Not enough economy of scale that could make some alternatives more cost-effective
- Lack of significant wastewater disposal avoidance costs that tend to drive many other recycled water programs

While all the identified alternatives are considered "doable" each one requires several steps and cost to overcome significant hurdles. Table 4-3 presents a summary of the alternatives and their relative challenges (high/medium/low) and the potential timeframe for their implementation.

Table 4-3 Recycled Water Alternatives Summary

Alternatives	Key Challenges	Relative Challenges (H/M/L)	Potential Timeframe
Non-Potable Reuse			
NPR-Local	Cost-effectiveness, availability of supply currently	Low	Short
NPR-Max	Cost-effectiveness, availability of supply currently	Med	5 to 10 years
Indirect Potable Reuse			
IPR-GW	Size/cost, uncertainty with basin production capability, regulations	High	N/a
IPR-SWA	Size/cost, regulations	High	15+ years
Direct Potable Reuse			
DPR-AWT-1	Size/cost, no current regulations	High	15+ years
DPR-AWT-2	Size/cost, no current regulations	High	15+ years
DPR-Encina	Partnerships necessary, no current regulations	High	15+ years

4.5.4 Recommended Plan

Based on the assessment of alternatives, there is no clear or obvious path forward for the District at this time. As such, the District will continue to consider other water supply and reliability options and continuing conservation efforts. The aim of the District is to set up a pathway based on what could confront or provide opportunities to the District in the future. These include:

- Seawater desalination
- Local wholesale contracts
- Regulatory environment
- Cost of water

4.5.4.1 Strategies

Two strategies were developed by the District in the RWFP to consider recycled water in the future. One focused on short-term efforts involving non-potable reuse and another one focused on more long-term efforts that would involve potable reuse options.

Short-term Strategy: Non-potable Reuse Opportunities

In the shot-term (next 10 to 15 years), the District would focus on the monitoring and continued assessment of possible non-potable projects via the following strategies:

- Implement small-local reuse based on available flow and funding
- Maintain future flexibility for:
  - Expanding NPR as supply/funding is available
  - Keeping IPR/DPR in play for long-term
  - Consider runoff/stormwater capture to enhance supplies
- Continue to stay part of the North San Diego County Regional Recycled Water Coalition

Long-term Strategy: Potable Reuse Opportunities

In the long-term (next 15+ years), the District would focus on the monitoring and continued assessment of possible potable reuse projects via the following strategies:

- VWD lacks key resources for single agency projects, and therefore should only reassess these options in the long-term as:
  - Groundwater is a major challenge
  - Surface water options not viable currently
- Continue to engage in regional plans/options that may be more beneficial to the District:
  - North San Diego County Regional Recycled Water Coalition study
  - EWPCF Potable Reuse study
- Monitor state regulations for direct potable reuse that could change the potential feasibility for some alternatives

4.5.4.2 Monitoring

There are many drivers for recycled water programs, and these drivers can be influenced by a variety of factors that constantly evolve over time. Therefore, it is prudent that agencies, including VWD, continue to watch and regularly re-assess their recycled water options to know when to take action towards implementation. Based on the District's current situation, the RFMP identified several key areas to monitor:

- **District wastewater flows**: Increases in flow, especially peak summer usage time, are needed to implement a non-potable system in the near-term.
- **Price of imported water**: While currently below the projected costs for all the recycled water alternatives and future desalination supplies, an increase in imported water costs could make these other options more cost-feasible, especially when reliability is included.
- **Opportunities to work with City and Developers on future systems**: Partnering may provide additional funding or infrastructure resources that could make the recycled water alternatives more feasible. Also, additional benefits (e.g. water quality in the environment) could be realized.

- **Regional cooperation**: Working with other agencies to construct bigger projects could provide for better economy of scale of projects, additional funding, and increased grant opportunities.
- **Benefits of wholesaling of recycled water**: There is some benefit for VWD to continue to partner with other local agencies in providing wholesale recycled water. In the future, additional benefits may be found related to water supply reliability and future project funding.
- **Regulations on potable reuse**: Changes in recycled water regulations, especially for implementation of direct potable reuse, will likely open up the potential for VWD to further consider some of the potable reuse alternatives identified in this study.

4.6 OVERVIEW OF DISTRICT WATER CONSERVATION PROGRAMS

Vallecitos Water District is not only committed to implementing water supply strategy, it is also an advocate to preserving this precious natural resource. Conservation programs help meet the District's long-term water needs and lessen the region's demand for future imported water supplies. Historically, the main approach to developing more water supplies has focused on building new conveyance and storage structures, such as dams, water diversions and tanks. Over the past few decades, conservation has increasingly become a major factor in enhancing supply reliability. Water demand management measures are typically low-cost and promote a sense of co-stewardship with the customer.

Vallecitos Water District started a water conservation program in 1975 and with the support of the Board of Directors, the District's Water Conservation Program expanded significantly during the drought of 1976-77. At the program's inception, efforts steered toward a long-term public information program and active cooperation with the regional water conservation programs of the SDCWA. Though the drought ended, many of the programs that emerged during that time remained focused on switching from an "emergency situation" agenda to a long term public information effort aimed at outreach in wise water management.

Through the addition of a Water Conservation Supervisor and Resources Assistant, the framework of a long-term conservation program continued to serve as a backdrop for the next major drought of 1987-1992. With the extra staff and a clear understanding of the importance of conservation, Vallecitos Water District aggressively revamped the conservation program and developed a variety of innovative and effective approaches to demand management. Reaffirming its commitment to conservation, Vallecitos Water District officials became one of the original signatories on September 16, 1991, to the "Memorandum of Understanding (MOU) Regarding Urban Water Conservation" in California. The California Urban Water Conservation Council (CUWCC), of which Vallecitos Water District is a long-time member, emerged from the MOU, as well as urban water conservation practices known as the Best Management Practices (BMPs) aimed at reducing California's long-term urban water demands. In July 2005, the District welcomed aboard a Water Conservation Specialist. This person is charged with the coordination of all water conservation programs and BMP implementation, and to improve the customer's water conservation efforts through education and specialized programs.

The structure of the department was later changed to include a Public Information/Conservation Supervisor and two Public Information Representatives. As conservation and public information go hand in hand, all members of the team are now responsible for water conservation programs and related outreach.

4.6.1 Water Shortage Contingency Plan

The California Urban Water Management Planning Act requires water agencies to incorporate a Water Shortage Contingency Plan (WSCP) focusing on the allocation of water supplies and the management of water consumption during periods of shortage due to extended drought or a water emergency. VWD's WSCP is documented in detail in its 2015 UWMP and identifies specific water supply conditions that trigger the activation of voluntary and mandatory rationing efforts. It explains what the ability is to meet projected short-term demands during extended dry periods and emphasizes some of the significant proactive measures that enhance VWD's ability to respond to interruptions in water supply should a natural or manmade disaster occur. The contingency plan outlines the planned response to failures in the infrastructure of the water system in the event of an earthquake, extensive power outage, or other catastrophic event.

All water agencies are required to administer a strategy – an adopted ordinance or terms of service – to meet water waste prevention. For compliance, VWD has adopted Ordinances No. 162 and 195. Ordinance 162 is patterned after the conservation actions of its water wholesaler, the SDCWA, and establishes regulations to be implemented during times of declared water shortages or emergencies to conserve water. This ordinance establishes four levels of drought response with corresponding actions to be implemented in times of shortage or emergency, with increasing restriction on water use in response to worsening drought or emergency conditions and decreasing available supplies.

- Level 1 – Drought Watch: With this alert, VWD will increase public outreach and take action to encourage voluntary conservation practices.
- Level 2- Drought Alert: With this alert, VWD will implement mandatory conservation practices to reduce water use by up to 20 percent. These practices include limiting landscape irrigation and repairing leaks within 72 hours of notification.
- Level 3 – Drought Critical: With this alert, VWD will implement mandatory conservation practices to reduce water use by up to 40%. Additional conservation practices include the prohibition of filling pools or fountains and washing vehicles and require the repair of leaks within 48 hours of notification. With minor exceptions, no new potable water services will be allowed during a Level 3 Drought alert.
- Level 4 – Drought Emergency: With this alert, VWD will implement mandatory conservation practices to reduce water use above 40% for the District to have adequate supplies to meet anticipated demands. Additional conservation practices include prohibition of landscape irrigation, excluding commercial growers or nurseries and the repair of leaks within 24 hours of notification.

The WSCP also provides details about the prohibitions and penalties against specific water uses during water shortages and evaluates potential impacts to the water funds should water sales decrease as a result of supply shortages. These measures are described in VWD's 2015 UWMP.

If supply interruptions were caused by a major failure or other related situation, a Water Emergency would declare severe restrictions. This could result in a mandatory water reduction beyond 40 percent. In this case, the General Manager has the authority to declare a reduction beyond measures detailed in the ordinance.

Ordinance No. 195 was adopted by VWD on May 20, 2015 in response to the Governor Brown's issuance of Proclamation No. 1-17- 2014, declaring a state of emergency throughout the State of California due to severe drought conditions and subsequent orders issued by the SWRCB and MWD. This ordinance established the following emergency measures:

- SECTION 1: The provisions of Ordinance No. 162, Drought Response Level 2 - Drought Alert Section (a) Level 2 Mandatory Conservation Practices would remain in full force and effect and would apply to this Emergency Declaration.
- SECTION 2: Each of the following additional actions were prohibited, except where necessary to address an immediate health and safety need or to comply with a term or condition in a permit issued by a state or federal agency:
  - (a) The use of potable water for irrigation of ornamental turf within public street rights of ways including adjacent landscape strips.
  - (b) The use of potable water outside of newly constructed homes and buildings inconsistent with regulations established by the California Building Standards Commission.
  - (c) The application of potable water to outdoor landscaping during and after 48 hours of a measurable rain event.
  - (d) All leaks to be repaired within forty-eight hours of notification by VWD unless other arrangements were made with the General Manager.
- SECTION 3: To obtain the required 24% District-wide reduction in water demands, the following limitations would apply to all outdoor irrigation, excluding qualified agriculture and commercial growers:
  - (a) Residential and commercial landscape irrigation would be limited to two assigned days per week between June and October on a schedule established by the VWD General Manager. Agriculture and commercial growers would remain exempt.
  - (b) Irrigation, using sprinklers, would be limited to no more than 8 minutes per watering station per assigned day. Systems using water-efficient devices, including but not limited to, weather-based controllers with drip/micro-irrigation systems and stream rotors were excluded.
- SECTION 4: The reductions in demands associated with watering 2 days per week may not meet the 24% reduction requirements of the Executive Order and after July 1, 2015, VWD may reduce outside irrigation use to 1 day per week as follows:
  - (a) Residential and commercial landscape irrigation would be limited to one assigned day per week between June and October on a schedule established by the General Manager. Nurseries and commercial growers would remain exempt.

(b) Irrigation, using sprinklers, would be limited to no more than 8 minutes per watering station per assigned day. Systems using water-efficient devices, including but not limited to, weather-based controllers with drip/micro-irrigation systems and stream rotors were excluded.

- SECTION 5: Established violation and penalties for any person who used, caused to be used, or permitted the use of water in violation of this ordinance.

On February 15, 2017, the District's Board of Directors voted to rescind water use restrictions in response to SDCWA's action on January 26, 2017 to declare the drought over in San Diego County. Neither SDCWA nor VWD are currently experiencing supply shortages due to drought. VWD's ordinance still permanently prohibits wasteful practices, such as:

- Watering between the hours of 10:00 a.m. and 6:00 p.m.
- Watering within 48 hours of a measurable rain event
- Visible irrigation runoff
- Hosing down hardscapes (patios, sidewalks, etc.)
- Not using a shut-off nozzle when washing cars
- Not fixing leaks within 48 hours of discovery
- Restaurants only serving water on request

4.6.2 Demand Management Measures

During the past few decades, conservation has become a vital part of VWD's overall reliability strategy. This is similar to the regional strategy of its water wholesaler, SDCWA, which has projected that conservation will account for 11 percent of the San Diego region's overall water diversification program for 2011 and increase to 17 percent by 2020. To help achieve these water savings, VWD, as well as the other 23 member agencies of the SDCWA and the MWD, collaborate on programs that benefit the entire region. The combined effort has yielded increased conservation and water knowledge through education, messaging and financial incentives for water-efficient devices and WaterSmart landscape.

In addition to the WSCP noted above, VWD also implements most of the urban water conservation Best Management Practices (BMPs) as proposed by the CUWCC. VWD's compliance strategies for these BMPs are described in more detail in its 2015 UWMP. The BMPs cover the following key areas:

- Metering - Requirements associated with meeting this BMP include meters for all new service connections; establishing a program to retrofit existing unmetered connections; reading meters and billing customers by volume of use; billing intervals of no greater than bi-monthly; performing at least five meter readings for every 12-month period; and preparing a written plan that includes a census of all meters by size, type, year installed, and customers served.
- Conservation pricing - This BMP promotes water conserving retail water rate structures. VWD's customers are billed based on monthly reads and according to "Tier Ranges." The "Tier Ranges" are divided into four step pricing tiers with separate use requirements for residential, irrigation, agriculture, and commercial/industrial.

- Public education and outreach – The primary basis for this BMP is to use public information programs as an effective tool to inform customers about the need for water conservation and ways they can conserve, and to influence customer behavior to conserve.
- Programs to assess and manage distribution system real loss - The goals of modern water loss control methods include both an increase in water use efficiency in the utility operations and proper economic valuation of water losses to support water loss control activities. VWD complies with this BMP through a host of programs targeted at averting unbilled water loss before they happen, including:
  - Water audits
  - Leak detection
  - Water system improvements
  - Meter maintenance and replacement program
  - Prosecution for water theft
  - Water loss billing
- Other demand management measures include
  - High User Ranking and Letter Programs (HURL) - To address the need for water conservation in the face of drought and state-mandated water-use restrictions, VWD developed an outreach plan that targets its high usage customers. Rather than expending efforts on achieving usage reductions across all its customers, VWD focused the HURL Program for those customers who have the highest usage patterns.
  - BMPs that are focused on specific user categories: residential; commercial, industrial, and institutional, and landscape

4.6.3 City of San Marcos Water Efficient Landscape Ordinance

In September 2009, the State of California Department of Water Resources adopted a State Model Water Efficient Landscape Ordinance, as required by Assembly Bill 1881. AB 1881 required that local agencies adopt the updated ordinance, or equivalent, by January 1, 2010, or the model ordinance would automatically be adopted by State statute. Based on the model ordinance, the City of San Marcos adopted Ordinance No. 2009-1328, dated January 2010, to amend the City's Municipal Code to include a new Section 20.82 Water Efficient Landscape Ordinance.

The ordinance establishes specific standards for landscape and irrigation design and installation to ensure beneficial, efficient and responsible use of all available water resources for residences and businesses within the City. These requirements include erosion prevention, filtering, treating and utilizing storm water runoff, and offering fire protection. They apply to new construction and rehabilitated landscapes for both public and private entities with a landscape area equal to or greater than 2,500 square feet. New construction landscapes that are homeowner provided with a total project landscape of equal to or greater than 5,000 square feet are also required to comply with this ordinance. The City of San Marcos will also enforce the ordinance for new and rehabilitated cemeteries and model homes that include landscaped areas.

Each qualifying project must provide the City with a Landscape Document Package that includes a Project Description, Landscape Water Budget Calculations, a Soil Management Report, a Grading Plan, Landscape and Irrigation Design and Maintenance Plans, a Fuel Management Plan and a Biological Constraints Plan. Prior to final approval and permitting, the City's Planning Department must obtain the approval of the local water purveyor to verify that the water budget calculations specified in the Landscape Document Package meet the water allocation specified by that purveyor.

By implementing this Water Efficient Landscape Ordinance, the City of San Marcos, in coordination with the local water purveyors such as Vallecitos Water District, will discourage water waste resulting from inefficient landscape irrigation. Runoff will be prohibited from leaving the target landscape due to low head drainage, overspray or other similar conditions where water flows on to adjacent property, non-irrigated areas, walks, roadways, parking lots or structures. Penalties for violation of these prohibitions will be administered by the City. Neighboring municipalities, such as the cities of Carlsbad, Vista, and Escondido as well as the County of San Diego, have also adopted landscape ordinances with similar requirements.

5 Potable Water Distribution System

This chapter reviews the District's existing water distribution system, evaluates the system's ability to serve existing and projected future water demands, and identifies necessary system improvements.

This chapter builds on information presented in previous chapters. The land use and unit demand factors developed in Chapter 2 (Land Use and Population) form the basis for the water demand projections presented here. The system planning criteria presented in Chapter 3 (Water Planning Criteria) define the system performance requirements used to evaluate the adequacy and improvement needs of the District's water system. Lastly, the descriptions of the District's water supply sources presented in Chapter 4 (Water Supply and Conservation) provide the necessary background for understanding the source of potable water supply to VWD's distribution system.

5.1 WATER SYSTEM INVENTORY

This section provides an inventory of the District's water distribution system, including:

- Supply Sources
- Pressure Zones
- Pumping Stations
- Reservoirs (Tanks)
- Pressure Reducing Stations
- Pipelines
- Interagency Service Agreements

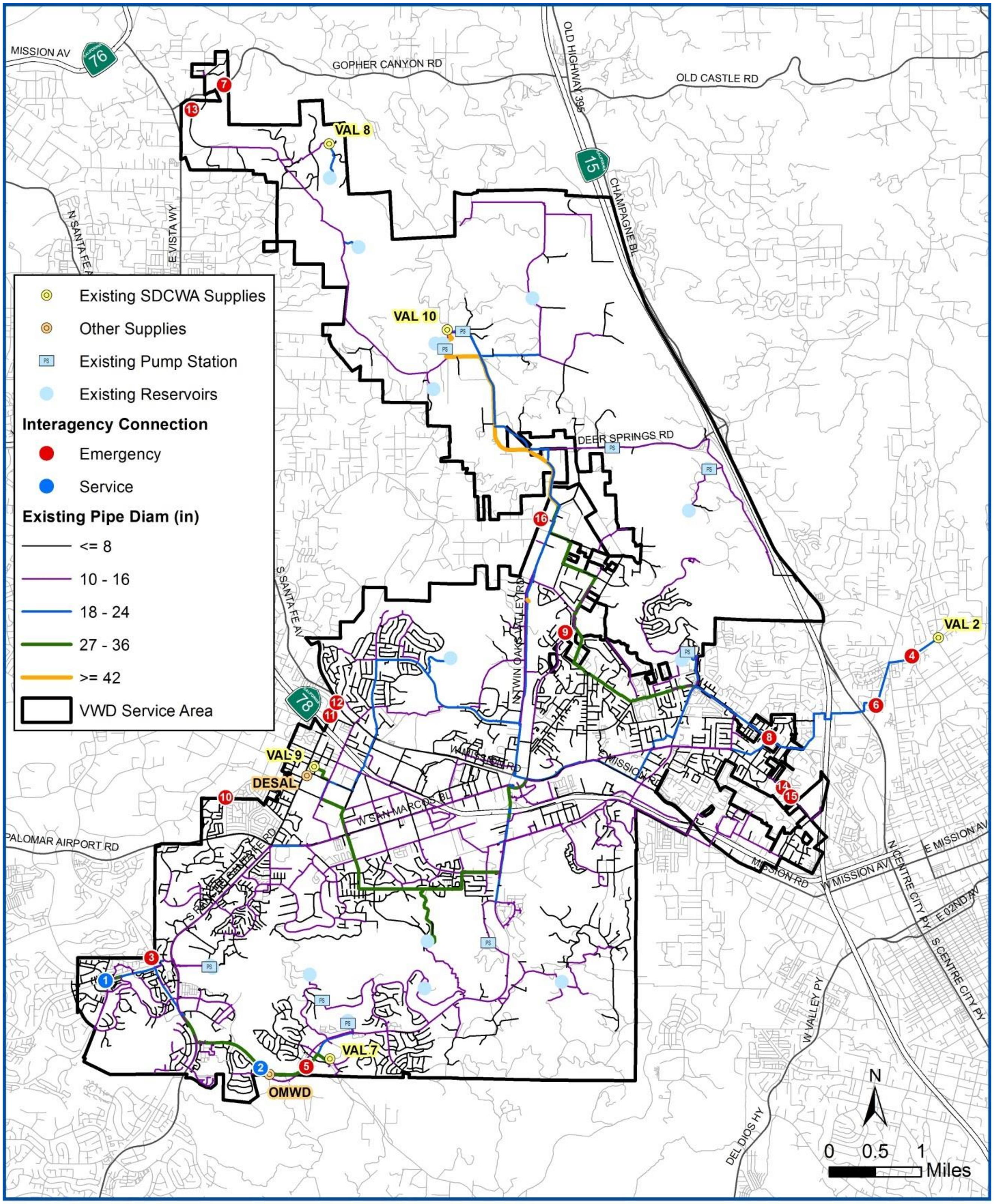
5.1.1 Supply Sources

Historically, the District has relied solely upon supplies delivered by the San Diego County Water Authority's (SDCWA) aqueducts. However, significant efforts have been made in recent years to diversify the region's water supply and have some impact on the District's water distribution system. This section summarizes the existing and potential supply sources available to meet VWD's demands.

5.1.1.1 SDCWA Supplies

The District currently receives water from the SDCWA through five potable water connections (turnouts) to the SDCWA's aqueduct system. The District's connections to the SDCWA are described in Chapter 4, and their locations are depicted in Figure 5-1. The capacity of each connection and the average supply delivery to the District at each connection during calendar year 2013 are presented in Chapter 4 and are repeated in Table 5-1 for ease of reference.

Figure 5-1 Existing Water System Facilities



Note: Refer to Table 5-7 for list of Interagency Connections.

Table 5-1 San Diego County Water Authority 2013 Supply to VWD

CONNECTION	LOCATION	CAPACITY		2013 AVERAGE SUPPLY TO VWD(1)	
		cfs	MGD	gpm	MGD
VAL 2	First Aqueduct(2)	12 (10)	8 (6)	243	0.35
VAL 7	Second Aqueduct, south edge of District(3)	40	26	2,176	3.13
VAL 8	Second Aqueduct, off North County Distribution Pipeline, northwest corner of District	11	7	195	0.28
VAL 9	Second Aqueduct, center of District, south of Twin Oaks Diversion Structure	30	19	1,605	2.31
VAL 10	Second Aqueduct, north-center of District, north of Twin Oaks Diversion Structure	60	39	6,518	9.38
	Total	**153**	**99**	**10,733**	**15.45**

Source: Monthly Operations Report 2013

(1) Based on SDCWA Delivery to the District from January through December 2013

(2) SDCWA connection capacity is 12 cfs, however, downstream system has flow constraints that limit flow to 10 cfs.

(3) 2013 flows for VAL 7 do not include OMWD or CMWD demands.

In addition to the deliveries listed in Table 5-1, the District also takes flows at the VAL 7 connection for delivery to the Carlsbad Municipal Water District (CMWD) and the Olivenhain Municipal Water District (OMWD). The interagency service agreements governing these deliveries are described in Section 5.1.7 (Interagency Connections). These deliveries flow through a dedicated transmission pipeline, the Questhaven Pipeline, to the two agencies. CMWD and OMWD deliveries are therefore accounted for as additional demands in the District's hydraulic model.

5.1.1.2 Desalinated Water Supplies

During the development of this Master Plan, the District began receiving water from the 50 MGD capacity Claude "Bud" Lewis Carlsbad Desalination Plant, located in the City of Carlsbad. The District receives desalinated water from desalination plant and pipeline through the SDCWA VAL 9 connection. The desalinated water connection provides at least 3,500 acre-feet per year (AFY) of new water supply to the District.

5.1.1.3 OMWD Supplies

The District entered into an agreement in 2012 to purchase a minimum of 2,750 AFY of treatment services from OMWD's David C. McCollom WTP. This additional capacity will help improve operational flexibility and reliability during SDCWA Aqueduct service outages. Under this agreement, potable water is transported from OMWD to District customers via a newly constructed San Elijo Hills Pump Station located at the existing connection site between OMWD and the District. Construction of the San Elijo Hills Pump Station was completed in April 2016. Note that this supply is independent from the VAL 7 SDCWA supplies that pass through VWD to serve OMWD.

5.1.1.4 Future Supplies

During the development of this Master Plan, the District diversified their water supply sources with the purchase of desalinated water and deliveries from OMWD. The District will continue to improve and protect water supply reliability to best serve their customers. Regarding future supply alternatives, the District has the option to increase their allocation of desalinated water from the Claude "Bud" Lewis Carlsbad Desalination Plant. This option is discussed in detail in the Desalinated Water Delivery Analysis section presented later in this chapter.

5.1.2 Pressure Zones

The District operates and maintains 27 pressure zones to serve customers with appropriate system pressures. The varied topography of the District dictates a wide range of pressure zones which are listed in Table 5-2 and their approximate boundaries are shown in Figure 5-2. A hydraulic profile of the District's existing potable water system is provided in Figure 5-3. This figure illustrates how the different pressure zones are interrelated under existing conditions.

The pressure zones are supplied primarily from the SDCWA 2nd Aqueduct, the OMWD connection via the San Elijo Hills Pump Station, and the new desalinated water connection. The SDCWA 1st Aqueduct can also provide supply from the east, but typically in a more minor role or as a back-up supply. Water is delivered through a network of pump stations, reservoirs, and pressure reducing stations. The hydraulic grade line (HGL) of pressure zones within the District are determined by the downstream valve settings or base elevation of the tank. The Northern Pressure Zones primarily receive water from the SDCWA VAL 8 and VAL 10 connections. The Central Pressure Zones primarily receive water from the 1028 Twin Oaks Reservoirs via VAL 10 and two large pressure reducing stations. These zones can also receive water from the SDCWA VAL 9, VAL 2, and the desalinated water connection. The Southern Pressure Zones primarily receive water from the SDCWA VAL 7 connection. The OMWD supply connection also feeds into the District's Southern Pressure Zones.

Table 5-2 Pressure Zone and Supply Source Summary

HGL[1]	NAME	SUPPLY SOURCE(S)
Northern Pressure Zones		
900	Tres Amigos Zone	VAL 8, reduced from North Twin Oaks Zone (1330)
1028	Twin Oaks Zone	VAL 10
1059	1059 Zone	Reduced from North Twin Oaks Zone (1330)
1228	North Zone	Reduced from Coggan Zone (1608)
1235	Deer Springs Zone	Pumped from Twin Oaks Zone (1028)
1330	North Twin Oaks Zone	Pumped from Twin Oaks Zone (1028)
1567	Wulff Zone	Pumped from Deer Springs Zone (1235)
1608	Coggan Zone	Pumped from Twin Oaks Zone (1028)
Central Pressure Zones		
855	855 Zone	Reduced from Richland Zone (920)

HGL(1)	NAME	SUPPLY SOURCE(S)
920	Richland Zone	VAL 2, VAL 9, reduced from Twin Oaks Zone (1028), Desalinated Water
1025	1025 Zone	Reduced from 1380 Zone (1380)
1380	1380 Zone	Reduced from Palos Vista Zone (1500)
1500	Palos Vista Zone	Pumped from Richland Zone (920)
Southern Pressure Zones		
622	La Costa Zone	Reduced from Meadowlark Zone (815)
660	La Costa Ridge / Melrose Zone	Reduced from Meadowlark Zone (815)
670	670 Zone	Reduced from Meadowlark Zone (815)
686	Alga Zone	Reduced from Meadowlark Zone (815)
700	700 Zone	Reduced from Meadowlark Zone (815)
750	750 Zone	Reduced from 877 Zone (877)
815	Meadowlark Zone	Reduced from 877 Zone (877)
877	877 Zone (formerly Las Posas)	VAL 7, OMWD
930	930 Zone	Pumped from Meadowlark Zone (815)
1115	1115 Zone	Pumped from 877 Zone (877)
1125	1125 Zone	Reduced from Coronado Hills Zone (1530)
1320	1320 Zone	Reduced from Double Peak Zone (1530)
1530(2)	Coronado Hills Zone	Pumped from Richland Zone (920)
1530(2)	Double Peak Zone	Pumped from 1115 Zone (1115)

(1) Pressure Zone HGLs are based on the bottom elevation of the tank serving the zone or the setting of the PRV.
(2) The 1530 Zone is currently operated as two separate systems via a closed valve to maximize water quality. Once Double Peak builds out and more demand is brought online, the pressure zones may be operated together.

Figure 5-2 Pressure Zones

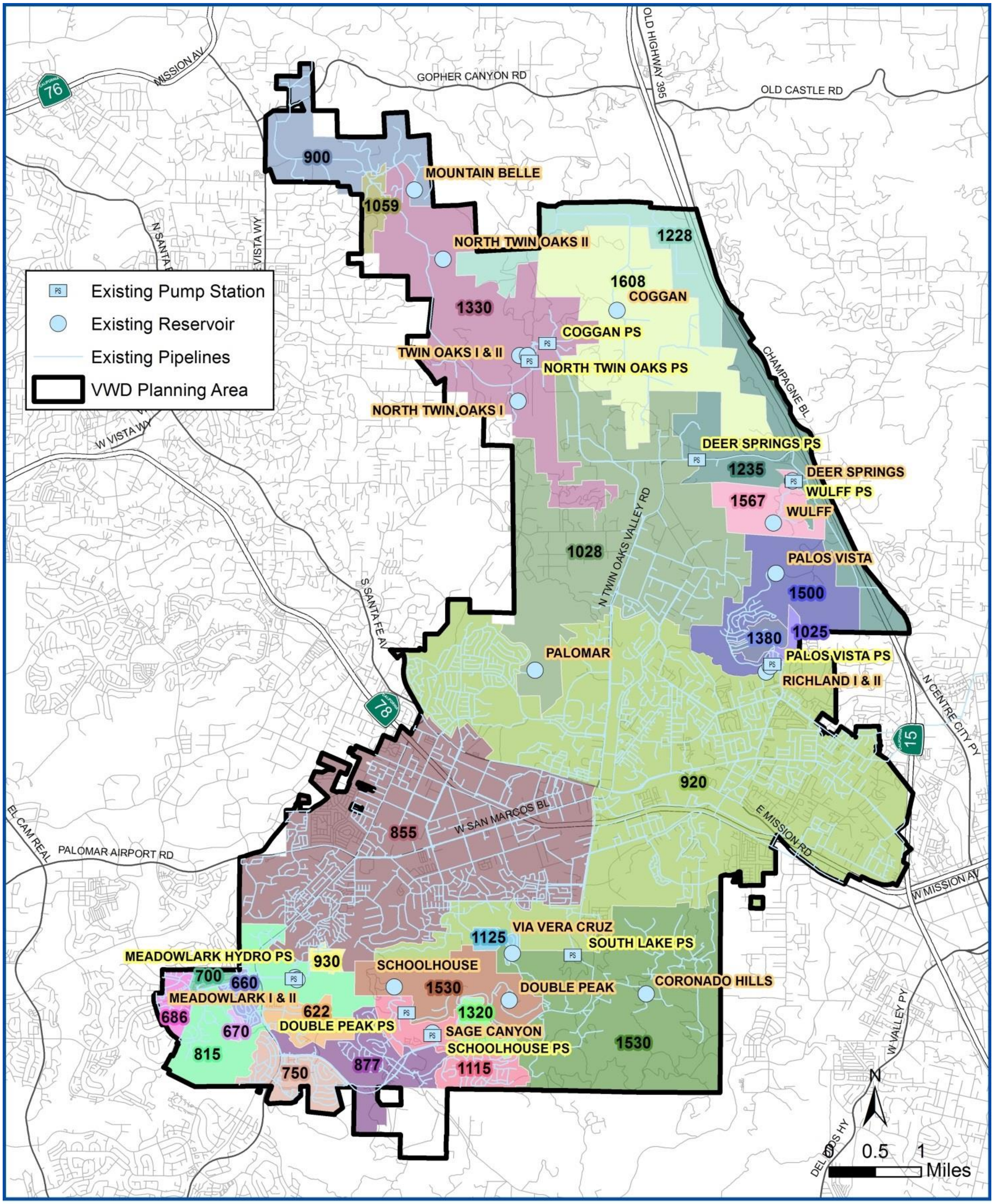
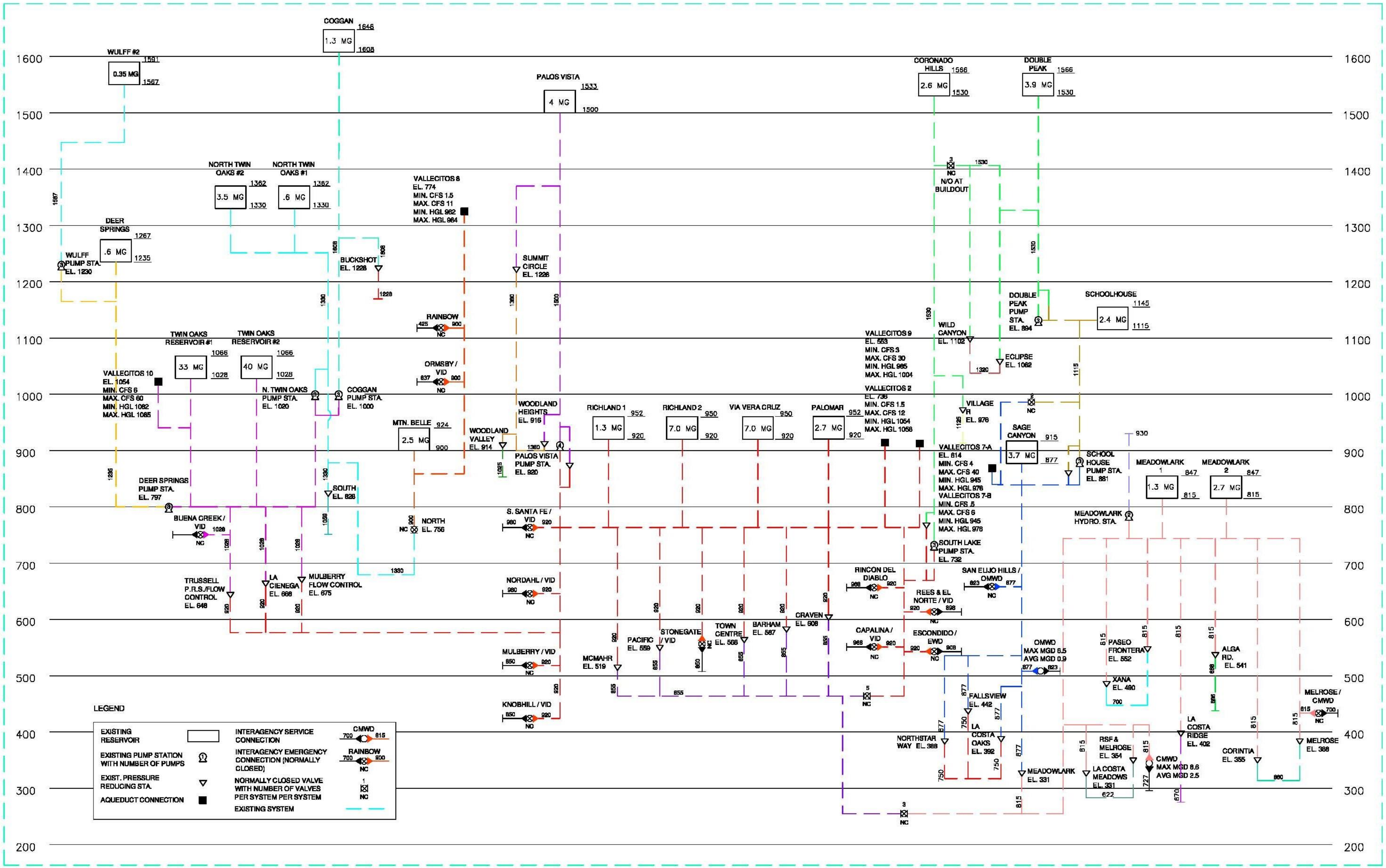
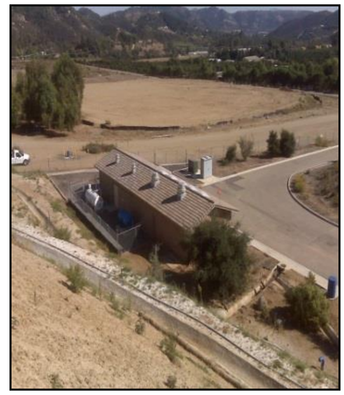


Figure 5-3 Existing System Hydraulic Profile



5.1.3 Pump Stations

The District currently operates ten pump stations, including the Meadowlark Hydropneumatic Pump Station. Each of these pump stations feed directly to storage tanks in the system. Table 5-3 provides a summary of the District's pump stations, including the hydraulic grade line (HGL), the number of pumps and rated capacity per pump, total pump station capacity, and firm pump station capacity. Firm capacity is defined as the capacity of the pump station with the largest pump out of service.



The North Twin Oaks Pump Station is located at the Twin Oaks reservoir site, and pump water from the reservoirs to the North Twin Oaks 1330 Zone.

5.1.4 Reservoirs

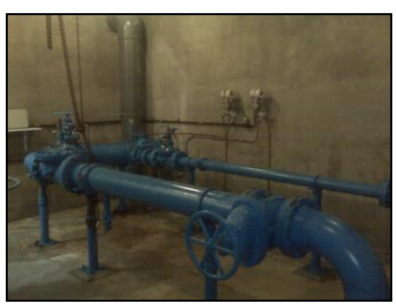
Reservoirs serve four critical water storage needs: operational storage for daily use, fire flow storage, and both in-zone emergency storage and storage during aqueduct shutdowns, as previously defined in Chapter 3. The District operates and maintains 19 potable water reservoirs, which are listed in Table 5-4. This table includes the size, age, and HGL for each reservoir. The total existing storage capacity for the District's potable water system is 120.5 million gallons (MG). Changes from the previous master plan include replacement of the Wulff #1 reservoir with the Wulff #2 reservoir, and elimination of the North Reservoir with the North Pressure Zone now served via a regulation station from the Coggan Pressure Zone.

The 877 Reservoir and the 1115 Pump Station serve new development in San Elijo Hills. The reservoir helps regulate flows from VAL-7 in the 877 Zone.

5.1.5 System Control Valves

The District currently operates 27 Pressure Regulating Stations (PRSs) and 3 Flow Control Facilities (FCFs) within the District. Table 5-5 summarizes the District's system control valves with station elevations, valve diameters, and valve settings. In general, the PRSs allow water to flow from an upper zone into a lower zone by reducing the pressure through a globe style valve based on downstream pressure control.

The Trussell and Mulberry PRSs operate as FCFs, which provide higher flows from the District's transmission system. These valves are operated remotely by changing the pressure set points to provide higher flows into the Richland Zone (920) from the Twin Oaks Zone (1028). This also allows for better cycling of the Richland Zone Reservoirs. Similarly, the Meadowlark FCF allows flow from the 877 Zone into the Meadowlark Zone (815).



The Trussell Flow Control valves (left) and pressure reducing valves (right) are in a common vault along Twin Oaks Valley Road. The valves each reduce water from the 1028 Zone to the 920 Zone, however, the flow control valves provide higher flows to a transmission system and the reducing valves serve more localized distribution systems.

Table 5-3 Existing Pump Station Summary

PUMP STATION	HGL		PUMP UNIT	RATED CAPACITY		FIRM CAPACITY[(1)(2)]	
	FROM	TO		GPM	MGD	GPM	MGD
Northern Pump Stations							
Deer Springs	1028	1235	1	775	1.12	1,500	2.23
			2	775	1.12		
			3	775	1.12		
North Twin Oaks	1028	1330	1	1,000	1.44	2,000	2.88
			2	1,000	1.44		
			3	1,000	1.44		
Wulff	1235	1567	1	500	0.72	1,000	1.44
			2	500	0.72		
			3	500	0.72		
Coggan	1028	1608	1	2,000	2.88	4,000	5.76
			2	2,000	2.88		
			3	2,000	2.88		
Central Pump Stations							
Palos Vista	920	1500	1	1,125	1.62	3,375	4.86
			2	1,125	1.62		
			4	1,125	1.62		
			5	1,125	1.62		
South Lake	920	1530	1	1,100	1.58	2,200	3.17
			2	1,100	1.58		
			3	1,100	1.58		
Southern Pump Stations							
Meadowlark Hydro	815	930	1	235	0.34	470	0.68
			2	235	0.34		
			3 (Fire)	1,500	2.16		
Schoolhouse	877	1115	1	1,050	1.51	2,100	3.02
			2	1,050	1.51		
			3	1,050	1.51		
Double Peak	1115	1530	1	525	0.76	1,050	1.51
			2	525	0.76		
			3	525	0.76		

PUMP STATION	HGL		PUMP UNIT	RATED CAPACITY		FIRM CAPACITY(1)(2)	
	FROM	TO		GPM	MGD	GPM	MGD
San Elijo Hills	OMWD	877	1	3,180	4.58	3,180	4.58
			2	3,180	4.58		

(1) For pump stations without standby pumps available, firm capacity is defined as the available capacity with the largest pump out of service. For all other stations, firm capacity assumes the standby pump is available.
(2) Firm or operational capacity may be further reduced due to restrictions in the capacity of the transmission system.

Table 5-4 Existing Reservoir Summary

PRESSURE ZONE		FACILITY ID (NAME)	YEAR BUILT	MATERIAL	HEIGHT (FT)	DIAMETER (FT)	CAPACITY (MG)
HGL(1)	NAME						
Northern Reservoirs							
900	Tres Amigos	Mountain Belle	1996	Steel	24	134	2.5
1028	Twin Oaks	Twin Oaks #1	2000	Concrete	38	388	33.0
		Twin Oaks #2	2007	Concrete	38	432	40.0
		Subtotal 1028 Pressure Zone					*73.0*
1235	Deer Springs	Deer Springs	1961	Steel	32	55	0.6
1330	North Twin Oaks	North Twin Oaks #1	1961	Steel	32	55	0.6
		North Twin Oaks #2	2007	Steel	32	138	3.5
		Subtotal 1330 Pressure Zone					*4.1*
1567	Wulff	Wulff Tank #2	2011	Steel	34	42	0.35
1608	Coggan	Coggan	1977	Steel	40	74	1.3
Total North							**81.85**
Central Reservoirs							
920	Richland	Richland #1	1961	Steel	32	82	1.3
		Richland #2	1981	Steel	30	200	7.0
		Palomar	1989	Steel	32	120	2.7
		Via Vera Cruz	1987	Steel	30	200	7.0
		Subtotal 920 Pressure Zone					*18.0*
1500	Palos Vista	Palos Vista	1991	Steel	33	143	4.0
Total Central							**22.0**
Southern Reservoirs							
815	Meadowlark	Meadowlark #1	1961	Steel	32	82	1.3
		Meadowlark #2	1979	Steel	32	120	2.7
		Subtotal 815 Pressure Zone					*4.0*
877	877 Zone	Sage Canyon	2001	Steel	38	129	3.7
1115	1115 Zone	Schoolhouse	2001	Steel	32	116	2.4

PRESSURE ZONE		FACILITY ID (NAME)	YEAR BUILT	MATERIAL	HEIGHT (FT)	DIAMETER (FT)	CAPACITY (MG)
HGL(1)	NAME						
1530 (2)	Coronado Hills	Coronado Hills	1981	Steel	36	110	2.6
		Double Peak	2006	Steel	36	135	3.9
						Subtotal 1530 Pressure Zone	*6.5*
						Total South	**16.6**
						TOTAL SYSTEM-WIDE STORAGE	**120.45**

Source Data: VWD 2007 Operational Data
(1) Hydraulic Grade Line (HGL) for the District is defined as the base elevation of the reservoir.
(2) The 1530 Zone is currently operated separately via a closed valve to maximize water quality. Once the Double Peak PZ builds out and more demand is brought online, the PZs may be operated together.

Table 5-5 Existing System Control Valves

STATION NAME	VALVE TYPE	DOWNSTREAM PRESSURE ZONE	UPSTREAM PRESSURE ZONE	# OF VALVES	VALVE SIZE (IN)	ELEV. (FT)	HYDRAULIC GRADE SETTING (FT)	PRESSURE SETTING (PSI)
Northern Pressure Reducing Stations(1)								
Buckshot	PRS	North (1228)	Coggan (1608)	1	8	1228	1275	10
La Cienega	PRS	Richland (920)	Twin Oaks (1028)	2	2 8	668	920	109
Mulberry	FCF	Richland (920)	Twin Oaks (1028)	2	6 14	675	--	--
North	PRS	Tres Amigos (900)	North Twin Oaks (1330)	2	6 10	756	900	62
South	PRS	1059 Zone	North Twin Oaks (1330)	2	2 4	828	1060	100
Trussell	FCF	Richland (920)	Twin Oaks (1028)	2	6 14	648	--	--
	PRS			2	4 8	648	920	118
Central Pressure Reducing Stations(1)								
Barham	PRS	855 Zone	Richland (920)	2	4 8	587	855	116
Craven	PRS	855 Zone	Richland (920)	2	4 8	603	855	109
McMahr	PRS	855 Zone	Richland (920)	2	8 12	519	855	145
Pacific	PRS	855 Zone	Richland	2	4	559	855	128

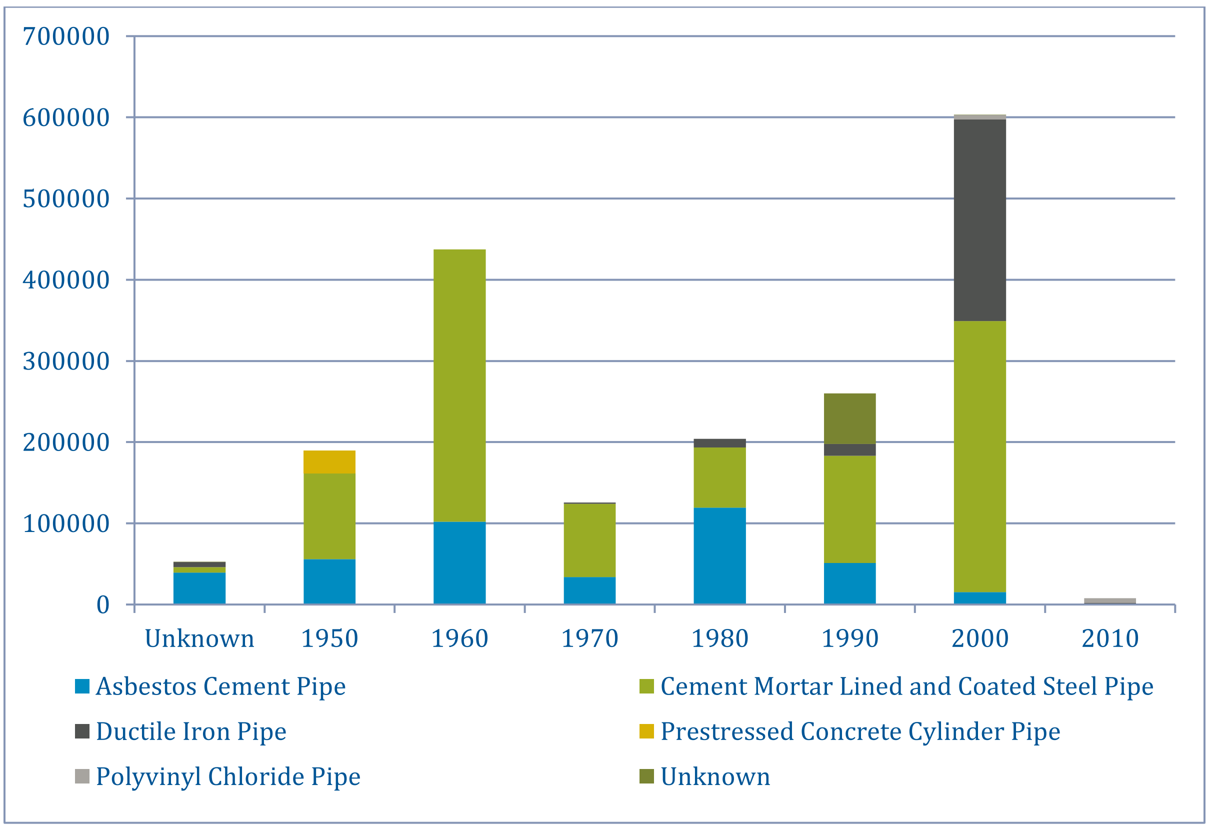
STATION NAME	VALVE TYPE	DOWNSTREAM PRESSURE ZONE	UPSTREAM PRESSURE ZONE	# OF VALVES	VALVE SIZE (IN)	ELEV. (FT)	HYDRAULIC GRADE SETTING (FT)	PRESSURE SETTING (PSI)
			(920)		12			
Town Center	PRS	855 Zone	Richland (920)	2	8 8	568	855	124
Village R	PRS	1125 Zone	Coronado Hills (1530)	2	3 6	976	1125	65
Summit Circle	PRS	1380 Zone	Palos Vista (1500)	2	2 4	1226	1380	67
Woodland Heights	PRS	1380 Zone	Palos Vista (1500)	2	2 4	916	1380	201
Southern Pressure Reducing Stations[1]								
Melrose	PRS	La Costa Ridge/Melrose (660) Zone	Meadowlark (815)	2	3 8	388	660	118
Alga Road	PRS	Alga (686)	Meadowlark (815)	2	4 8	541	685	62
Corintia	PRS	La Costa Ridge/Melrose (660)	Meadowlark (815)	2	3 8	351	660	134
Fallsview	PRS	750 Zone	877 Zone	2	3 6	442	750	133
La Costa Meadows	PRS	La Costa Meadows (622)	Meadowlark (815)	2	3 10	331	622	126
La Costa Oaks	PRS	750 Zone	877 Zone	2	3 6	392	750	155
La Costa Ridge	PRS	700 Zone	Meadowlark (815)	2	3 6	402	670	116
Northstar	PRS	750 Zone	877 Zone	2	3 6	388	750	157
Meadowlark	FCF	Meadowlark (815)	877 Zone	2	16 8	331	--	--
Paseo Frontera	PRS	700 Zone	Meadowlark (815)	2	4 8	552	700	64
Wild Canyon	PRS	1320 Zone	Double Peak (1530)	2	3 6	1102	1320	94
Woodland Valley	PRS	1025 Zone (1025)	1380 Zone (1380)	2	3 4	914	1025	48

STATION NAME	VALVE TYPE	DOWNSTREAM PRESSURE ZONE	UPSTREAM PRESSURE ZONE	# OF VALVES	VALVE SIZE (IN)	ELEV. (FT)	HYDRAULIC GRADE SETTING (FT)	PRESSURE SETTING (PSI)
RSF & Melrose	PRS	La Costa (622)	Meadowlark (815)	2	3 8	354	622	116
Eclipse	PRS	1320 Zone	Double Peak (1530)	2	3 6	1062	1320	112
Xana Way	PRS	700 Zone	Meadowlark (815)	2	4 8	490	700	91
(1) Pressure reducing stations are identified as Northern, Central, or Southern based on the upstream pressure zone.								

5.1.6 Distribution System Pipelines

The District maintains over 356 miles of water mains ranging in size from 4-inches to 48-inches in diameter. Water distribution system pipeline inventory is summarized in Figure 5-4. As shown, nearly 80 percent of the District's existing pipelines consist of asbestos cement pipe (ACP) and concrete-mortar lined and coated steel pipe (CMLC) material.

Figure 5-4 Water Distribution Pipeline Inventory by Installation Date



Notes:

- *Source: Master_Plan_Data_2014 geodatabase (VWD)*

5.1.7 Interagency Connections

The District maintains 16 interagency connections with neighboring water districts, shown in Figure 5-1. At these connection points, the District is able to provide regular or emergency service to these neighboring districts as needed. Supply turnouts, such as the new OMWD connection, are not included in this list. Two of these connections provide regular service to OMWD and CMWD, and fourteen of the connections are reserved for use under emergency conditions only. Details regarding these two connection types are provided below.

5.1.7.1 Service Connections

The District provides potable water to OMWD and CMWD from its SDCWA connection at VAL 7 via the Questhaven Pipeline. These interconnections are summarized in Table 5-6 and numbered 1 and 2 in Figure 5-1. Supply services are provided through an interagency service agreement entitled *Construction of a Water Transmission and Storage System – Questhaven Pipeline* dated July 1, 1978 and its supplement dated September 1979. The District is designated as the lead agency in the agreement and is responsible for operating and maintaining the project. The agreement is summarized in the following paragraphs.

The service agreement limits OMWD's connection capacity to 6.47 MGD. The corresponding OMWD pressure zone, served by the Questhaven Pipeline, is the 823 Zone. In the 2013-2014 Fiscal Year, OMWD received an average of 0.02 MGD through this connection.

The service agreement limits CMWD's connection capacity to 8.61 MGD. CMWD is supplied via an FCF from the District's Meadowlark Zone (815), which ultimately receives supply from the District's 877 Zone via a number of PRSs. The Alga Road FCF serving CMWD consists of two 10-inch diameter flow control valves that are fed by a 21-inch line. The corresponding CMWD pressure zone served by the Questhaven Pipeline is the 727 La Costa Hi Zone. In the 2013-2014 Fiscal Year, CMWD received an average of 3.8 MGD through this connection.

Table 5-6 Interagency Service Connections

REF ID[1]	NAME	SIZE (IN)	SERVICE TO		VWD PRESSURE ZONE	APPROX. CAPACITY (GPM)
			SYSTEM	CONNECTING AGENCY		
1	Carlsbad Flow Control Facility	10 (2)	VWD	CMWD	815	9,000
2	Olivenhain Flow Control Facility	18	VWD	OMWD	877	9,000

[1] Reference ID refers to the locations shown in Figure 5-1.

5.1.7.2 Emergency Connections

The District has 14 emergency connections with neighboring water districts, which are reserved solely for use under emergency conditions. The District has emergency connections with CMWD (1), Vista Irrigation District (9), the City of Escondido (1), Rincon del Diablo Municipal Water District (1), Rainbow Municipal Water District (1), and OMWD (1), as shown on Figure 5-1. The emergency connections can deliver limited flows, and thus, should only be used for short-term outages within the District or the neighboring agency. With the improved reliability of the regional system following the implementation of the Emergency Supply Project and the anticipated delivery of desalinated water to the District, as discussed in Chapter 4, there is no immediate need to supplement or increase the capacity of the existing connections.

Table 5-7 Interagency Emergency Connections

REF ID[1]	NAME	SIZE (IN)	SERVICE TO		VWD PRESSURE ZONE	APPROX. CAPACITY (GPM)
			SYSTEM	CONNECTING AGENCY		
3	Melrose/Carlsbad Crosstie	8	VWD	CMWD	815	900
4	Escondido Pump Connection[2]	8	EWD	VWD	920	1,000
5	San Elijo Hills Pump Connection[2]	8	OMWD	VWD	877	2,000
6	Rincon del Diablo Crosstie	8	VWD	Rincon	920	900
7	Rainbow Crosstie[3]	8	VWD	RMWD	900	1,800
8	Rees & El Norte VID Crosstie[4]	8	VWD/VID	VID/VWD	920	450
9	Mulberry Crosstie[2, 5]	6	VWD	VID	920	900
10	Stonegate/VID Crosstie	6	VWD	VID	920	450
11	S. Santa Fe Crosstie[2, 5]	8	VWD	VID	920	450
12	Capalina Crosstie	8	VWD	VID	920	450
13	Ormsby Crosstie	8	VWD	VID	900	450
14	Nordahl Crosstie	12	VWD	VID	920	N/A
15	Knobhill/Center St Crosstie	N/A	VWD	VID	920	N/A
16	Buena Creek Crosstie	8	VWD	VID	1028	900

(1) Reference IDs refer to the locations shown in Figure 5-1.
(2) Connections have only been used during SDCWA shutdowns and require a portable pump and piping to be set up.
(3) Crosstie would be established with a couple lengths of pipe and a meter but is currently not connected.
(4) VID can supply VWD water using a portable pump. VWD can supply VID water under gravity flow.
(5) Connection also utilized during scheduled VID maintenance.

5.2 WATER DEMANDS

This section summarizes the District's historical water supply from the SDCWA, as well as existing and projected future water demands.

5.2.1 Historical Water Supply

The District orders potable water through the SDCWA up to two times a day, depending on system demands and reservoir levels. The supplies from the SDCWA are recorded at each of the five connections to the District's potable water transmission system. The District's average annual supply and maximum month water supply, expressed in MGD, during the calendar years 2002 through 2013 are presented in Table 5-8, and the annual trends are graphically represented in Figure 5-5.

Table 5-8 San Diego County Water Authority Historical Annual Supply Data

YEAR	TOTAL AVERAGE ANNUAL SUPPLY[1] (MGD)	PERCENT CHANGE IN AVERAGE ANNUAL SUPPLY	MAXIMUM MONTH SUPPLY (MGD)	MAXIMUM MONTH TO AVERAGE ANNUAL RATIO
2002	16.3	--	22.1	1.36
2003	15.6	-4.2%	22.1	1.42
2004	17.1	9.6%	23.9	1.40
2005	17.4	1.8%	24.5	1.41
2006	17.3	-0.3%	25.9	1.49
2007	20.4	17.5%	25.9	1.27
2008	17.1	-16.0%	24.9	1.45
2009	15.4	-9.8%	20.9	1.35
2010	13.9	-10.0%	20.3	1.46
2011	14.1	1.6%	19.9	1.41
2012	15.1	6.7%	21.8	1.45
2013	15.5	2.5%	20.1	1.30

Source Data: VWD Operational Delivery Log Sheets, as recorded by District staff
(1) Average Annual Delivery does not include pass-through flows for CMWD and OMWD.

Figure 5-5 San Diego County Water Authority Historical Supply

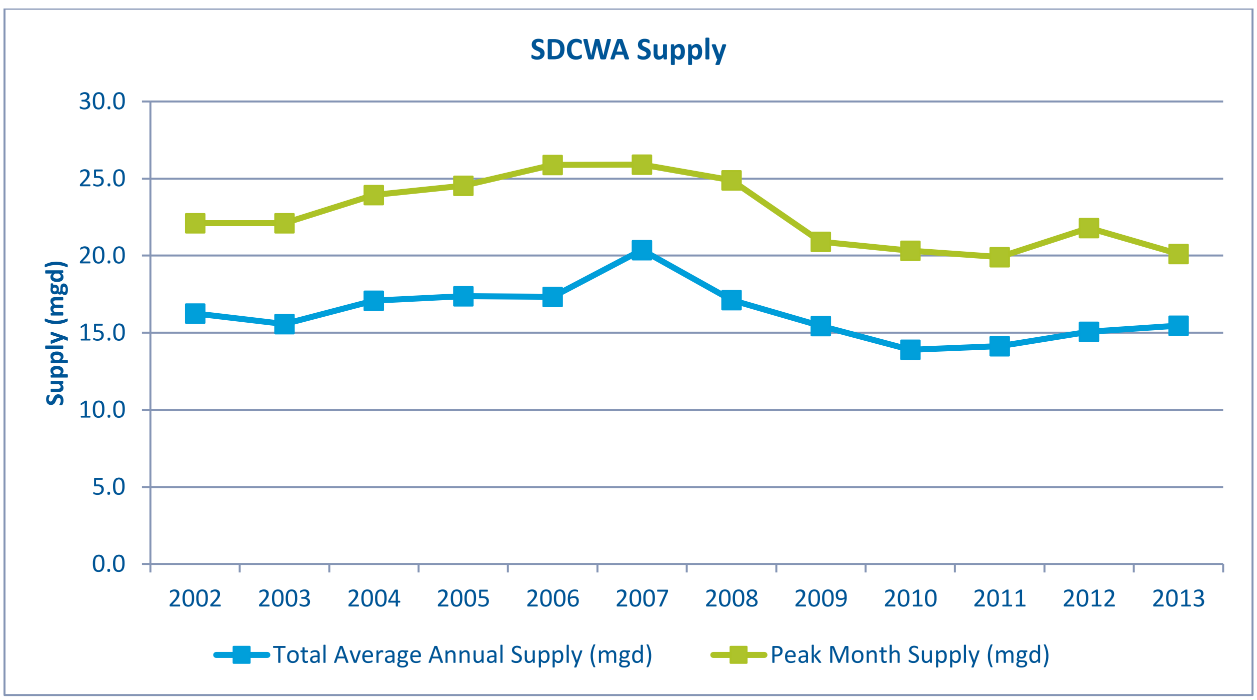
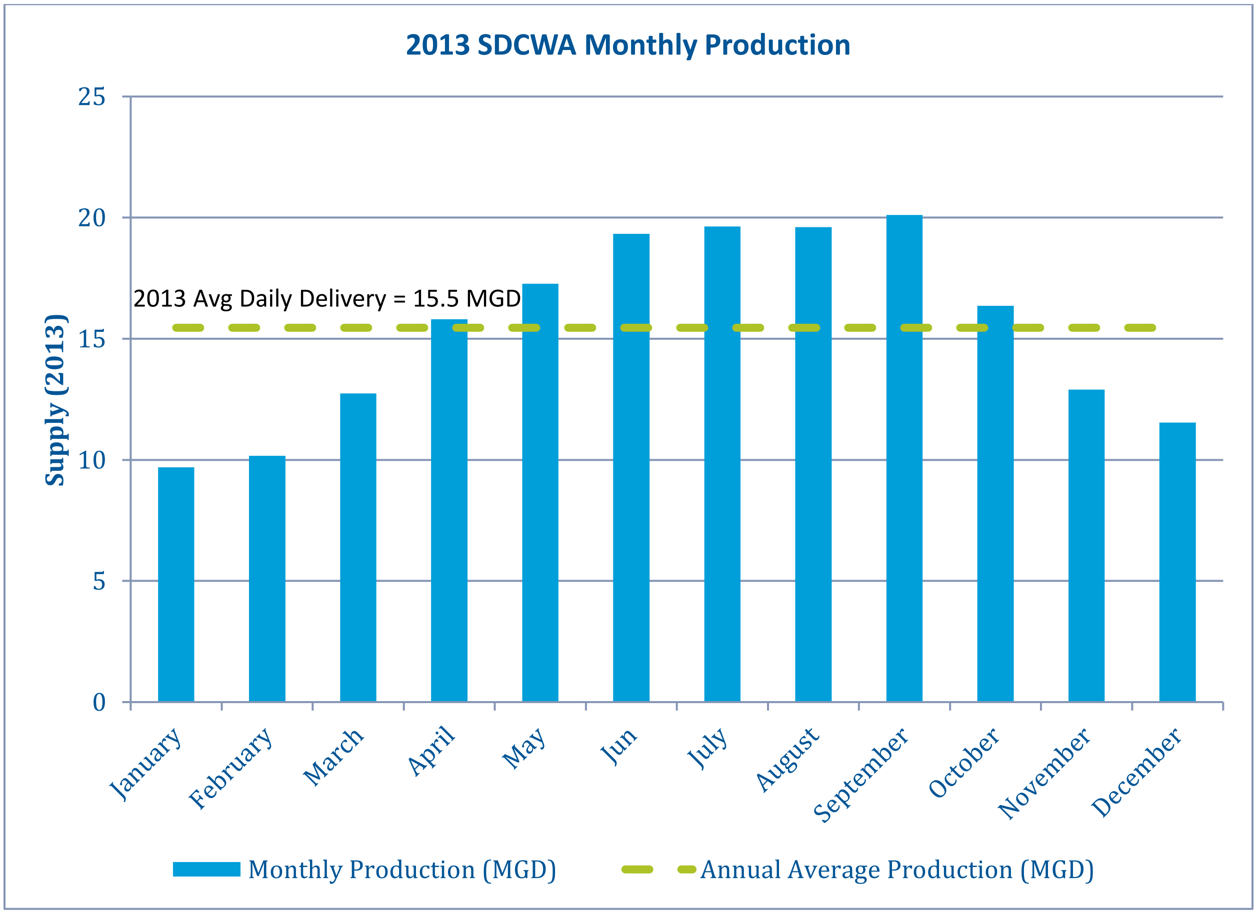


Figure 5-6 displays the monthly potable water deliveries for 2013. The 2013 production data shows that the District received approximately 30 percent more water than the average daily delivery during the month of September, which is considered to be the maximum month in this Master Plan. The District received approximately 63 percent of the average daily delivery during the month of January, which is considered to be the minimum month. As expected, residential demands, which includes residential landscape uses, and irrigation only water demands vary seasonally with higher demands in the hotter summer months and lower demands in the winter months.

Figure 5-6 San Diego County Water Authority 2013 Monthly Supply



5.2.2 Existing Metered Demands

Current water use in the District was evaluated by examining the monthly meter sales records from January through December 2013. A total of 21,859 water meters were identified within the database. According to the 2013 billing data, the District experienced an average day metered demand of approximately 14.3 MGD. The maximum month to average day ratio per the 2013 billing data was approximately 1.4.

Unbilled water is the difference between the total supply (15.5 MGD from SDCWA in 2013) and the total amount billed by the District to its customers (14.3 MGD in 2013). Generally unbilled water is associated with leaks, pipeline breaks, older meters that are not correctly calibrated, system flushing, and unmetered hydrant uses such as firefighting and illegal construction water usage. Annual unbilled water usage and losses for 2013 are estimated to be 420 MG, which represents approximately 7.4 percent of the total water purchased from the SDCWA by the District in 2013. These factors are consistent with industry standard losses. Unbilled water data since 2002 is presented in Table 5-9.

Table 5-9 Unbilled Water Summary

YEAR	ANNUAL SDCWA SUPPLY (MG)	ANNUAL WATER SALES (MG)	UNBILLED WATER (MG)	% ANNUAL UNBILLED WATER
2002	5,934	5,274	660	11.1%
2003	5,683	5,137	546	9.6%
2004	6,248	5,764	484	7.7%
2005	6,343	5,673	670	10.6%
2006	6,325	6,009	315	5.0%
2007	7,434	6,679	755	10.2%
2008(1)	6,264	N/A	N/A	N/A
2009	5,637	5,412	226	4.0%
2010	5,071	4,867	204	4.0%
2011	5,155	4,818	337	6.5%
2012	5,516	5,155	361	6.6%
2013	5,641	5,221	420	7.4%

(1) Due to a change in the District's billing system software, data was only available for the August to December period in 2008.

Table 5-10 presents the Average Day Demand (ADD) by pressure zone for Fiscal Year 2013-2014. Pass-through flows serving OMWD and CMWD are not included in Table 5-10. It should be noted that the ADD includes water consumption through temporary meters but does not include other end delivery facilities that are typically unbilled uses such as fire hydrant testing or system flushing.

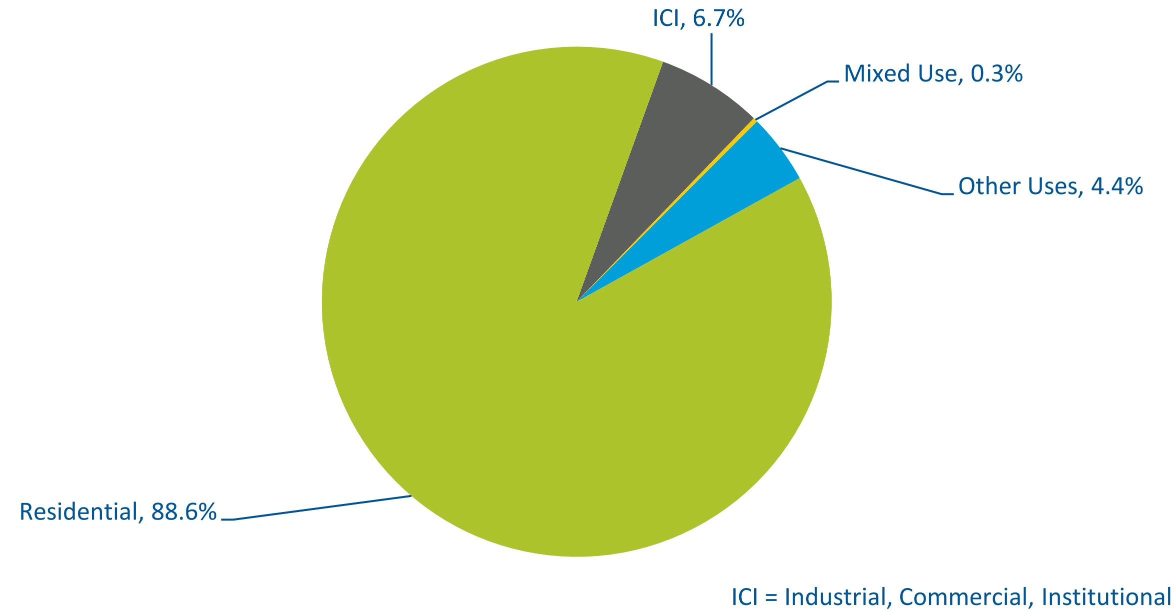
Table 5-10 Fiscal Year 2013-2014 Potable Water Metered Demands by Pressure Zone

PRESSURE ZONE		AVERAGE DAY DEMAND (ADD)	
HGL	NAME	(GPM)	(MGD)
Northern Pressure Zones			
900	Tres Amigos Zone	178	0.26
1028	Twin Oaks Zone	458	0.66
1059	1059 Zone	31	0.04
1228	North Zone	30	0.04
1235	Deer Springs Zone	84	0.12
1330	North Twin Oaks Zone	120	0.17

PRESSURE ZONE		AVERAGE DAY DEMAND (ADD)	
HGL	NAME	(GPM)	(MGD)
1567	Wulff Zone	129	0.19
1608	Coggan Zone	125	0.18
	Total Northern Zones	**1,155**	**1.66**
Central Pressure Zones			
855	855 Zone	2,600	3.74
920	Richland Zone	3,893	5.61
1025	1025 Zone	15	0.02
1380	1380 Zone	73	0.11
1500	Palos Vista Zone	173	0.25
	Total Central Zones	**6,754**	**9.73**
Southern Pressure Zones			
622	La Costa	177	0.25
660	La Costa Ridge / Melrose Zone	120	0.17
670	670 Zone	26	0.04
686	Alga Zone	147	0.21
700	700 Zone	98	0.14
750	750 Zone	324	0.47
815	Meadowlark Zone	163	0.23
877	877 Zone (formerly Las Posas)	365	0.53
930	930 Zone	101	0.15
1115	1115 Zone	419	0.60
1125	1125 Zone	54	0.08
1320	1320 Zone	169	0.24
1530	Coronado Hills Zone	118	0.17
1530	Double Peak Zone	70	0.10
	Total Southern Zones	**2,351**	**3.39**
	TOTAL	**10,260**	**14.77**

The District serves a predominantly residential community, where nearly 89 percent of the water use is single-family and multi-family residential. This water use includes both indoor-domestic uses and outdoor users, including individual residential and outdoor community landscape irrigation uses. Figure 5-7 summarizes the demands by meter type.

Figure 5-7 FY 2013-2014 Potable Water Demands by Meter Type



5.2.3 Future Demands

To develop demand projections, the ultimate water demand was first calculated. The ultimate water demand was calculated based on the established unit demands (presented in Chapter 3) and the approved planned land use data (presented in Chapter 2). The steps to calculate the ultimate future demands are summarized below.

- The planned land use coverage was provided to the land use agencies for comment and the land use agencies provided their approved zoning maps and comments to the planned land use, as discussed in Chapter 2.
- All parcels were attributed with their approved planned land use and zoning. Approved redevelopment projects were then identified as discussed in Chapter 2. The land use database now represents the ultimate land use condition with the maximum potential development of existing and future parcels.
- Areas outside the existing water service area, but within the District's Sphere of Influence, were examined in more detail. The District assisted in identifying which of these areas outside the existing service area may be served by the District in the future. These areas were included in the ultimate demand calculations even though they may currently receive water from another agency or source.
- The established unit rates were applied to all parcels that indicated growth, or where the existing land use differed from the ultimate planned land use.
- For areas where there is no projected change in land use, the actual existing demand was assumed to be the same as the future ultimate demand for that parcel.

- Ultimate demands for the approved Special Project Areas, identified in Chapter 2, were calculated individually based on the most recent information provided to the District from the land use agencies.
- Demand projections for the interim planning years were calculated by using the population increase as the basis of water demand increase from one planning period to the next. Details regarding the population projection and growth summary can be found in Chapter 2.

5.2.4 Phased Water Demands

Table 5-11 presents the existing and projected ADD for the District at 5-year increments from 2014 (existing) to 2035 and ultimate buildout conditions. Projected water demands for interim years 2020, 2025, 2030, and 2035 were estimated based upon SANDAG's population growth forecasts for the District's service area, described in Chapter 2.

A comparison between this 2018 Master Plan and 2008 Master Plan ADD projections is included in Table 5-11. The updated ultimate water demand projection for the District is approximately 33.6 MGD, which is slightly lower than the 34.1 predicted in the 2008 Master Plan and is primarily a result of increased customer conservation over the last few years. Table 5-12 presents the projected ADD for each pressure zone within the District through ultimate buildout conditions.

Table 5-11 Demand Projection Comparison

YEAR	2008 MASTER PLAN PROJECTED ADD (MGD)	2018 MASTER PLAN	
		PROJECTED ADD (MGD)	PROJECTED ANNUAL INCREASE (%)
2014[1]	--	14.8	--
2020	26.9	17.0	2.34%
2025	29.1	18.6	1.82%
2030	31.2	19.0	0.43%
2035	--	19.2	0.21%
Ultimate	34.1	33.6	--

(1) Based on District billing records for Fiscal Year 2013/2014.

Table 5-12 Demand Projections by Pressure Zone

PRESSURE ZONE		EXISTING AND PROJECTED AVERAGE DAY DEMAND (MGD)					
HGL	ZONE NAME	EXISTING[1]	2020	2025	2030	2035	ULTIMATE
622	La Costa Zone	0.25	0.32	0.33	0.33	0.33	0.37
660	La Costa Ridge/Melrose Zone	0.17	0.22	0.22	0.22	0.22	0.20
670	670 Zone	0.04	0.05	0.05	0.05	0.05	0.05
686	Alga Zone	0.21	0.27	0.27	0.27	0.27	0.27
700	700 Zone	0.14	0.18	0.18	0.18	0.18	0.14

PRESSURE ZONE		EXISTING AND PROJECTED AVERAGE DAY DEMAND (MGD)					
HGL	ZONE NAME	EXISTING(1)	2020	2025	2030	2035	ULTIMATE
750	750 Zone	0.47	0.58	0.60	0.60	0.60	0.58
815	Meadowlark Zone	0.23	0.29	0.30	0.30	0.30	0.71
855	855 Zone	3.74	4.27	4.71	4.77	4.85	6.79
877	877 Zone (formerly Las Posas)	0.53	0.66	0.67	0.68	0.68	0.72
900	Tres Amigos Zone	0.26	0.26	0.31	0.34	0.34	0.66
920	Richland Zone	5.61	6.39	7.05	7.14	7.26	10.40
930	930 Zone	0.14	0.18	0.18	0.19	0.19	0.11
1025	1025 Zone	0.02	0.02	0.03	0.03	0.03	0.04
1028	Twin Oaks Zone	0.66	0.67	0.80	0.87	0.87	3.06
1059	1059 Zone	0.04	0.04	0.05	0.06	0.06	0.09
1115	1115 Zone	0.60	0.75	0.77	0.78	0.78	0.66
1125	1125 Zone	0.08	0.10	0.10	0.10	0.10	0.08
1228	North Zone	0.04	0.04	0.05	0.06	0.06	0.58
1235	Deer Springs Zone	0.12	0.12	0.15	0.16	0.16	0.77
1320	1320 Zone	0.24	0.30	0.31	0.31	0.31	0.21
1330	North Twin Oaks Zone	0.17	0.18	0.21	0.23	0.23	1.93
1380	1380 Zone	0.10	0.12	0.13	0.13	0.14	0.11
1500	Palos Vista Zone	0.25	0.28	0.31	0.32	0.32	0.80
1530	Coronado Hills Zone	0.17	0.21	0.22	0.22	0.22	2.09
1530	Double Peak Zone	0.10	0.13	0.13	0.13	0.13	0.40
1567	Wulff Zone	0.19	0.19	0.23	0.25	0.25	0.29
1608	Coggan Zone	0.18	0.18	0.22	0.24	0.24	1.49
	TOTAL	**14.78**	**17.02**	**18.58**	**18.96**	**19.15**	**33.58**

(1) Based on District billing demands for Fiscal Year 2013/2014.

5.3 HYDRAULIC MODEL DEVELOPMENT

A hydraulic model of the existing water system was provided by the District for analysis. The District developed the model internally using WaterGEMS software by Bentley. The FY 2013-2014 water demands were input into the model by the District based on actual water usage for the existing system. This section describes the water model development and model calibration.

5.3.1 Existing System Hydraulic Model Development

The District provided an updated dynamic hydraulic model for use in the Master Plan. The hydraulic model contained existing facilities and typical operational controls. During the existing system model development, projects that were recently completed or under construction were added to the water system network using information provided by the District. Operational controls and settings were also adjusted to reflect typical existing system operations. The model also included capital improvement projects completed since the last master plan.

The WaterGEMS model has the capability to interface directly with GIS data to create the necessary facilities for the model. All relevant information was linked directly to the GIS, rather than having to digitize and manually input. In addition, this software allows for efficient future model updates from GIS data as the District continues to build out.

5.3.2 Model Calibration

To confirm that the model accurately represents existing system conditions, a distribution system calibration was performed. The initial calibration was performed using a 24-hour EPS calibration using SCADA data from August 13, 2012, which was the peak day demand in 2012. The main objective for the EPS model calibration was to evaluate model results against the actual measured values provided by the SCADA network, which included key pressure points, reservoir flows, and water supplies, to verify model pipe connectivity and pump characteristics, and to confirm that there was an accurate spatial distribution of demands in the model. This calibration ensures the model can simulate the overall pressures, reservoir levels, and other system data given the recorded system inputs.

For the 24-hour calibration, 87 percent of the flows were within 10 percent of the recorded values, 83 percent of pump station pressure readings were within 5 psi, and 75 percent of PRV pressure readings were within 5 psi. The calibration is well within typical calibration ranges for a hydraulic model, based on the available information.

5.3.3 Ultimate System Hydraulic Model Development

The hydraulic model of the District's ultimate water distribution system was based on the calibrated existing system model, ultimate demands projected in Section 5.2, completion of planned projects currently in various levels of design and construction, and the completion of necessary CIP Projects. The need for these CIP projects and their timing were verified using the hydraulic model, input from District staff, and knowledge of planned development timing.

5.3.4 District Planned Projects

The District provided information on several planned projects that were in construction during the development of the 2018 Master Plan. These projects are summarized below. These facilities were not included in the calibrated hydraulic model network as they were not in service during the calibration period. However, they were included in all other modeling scenarios and system evaluations. These projects are not included in the CIP because they were planned and under construction during the development of this Master Plan.

- **Relocation of 16-inch Main.** A new 16-inch pipeline was constructed between San Elijo Road and Attebury Road to relocate an existing 16-inch line that ran through the new Double Peak school site. The existing 16-inch main needed to be relocated to make way for grading and a new building. Once the new 16-inch main is completed, the existing line will be abandoned.

- **New Double Peak 16-inch Main.** A new 16-inch pipeline was constructed from the 1530 Coronado Hills Zone to the 1530 Double Peak Zone. The pipeline alignment within Ledge Street stretches from San Elijo Road to Double Peak Drive, near the existing Double Peak Reservoir. This connection allows the 1530 Coronado Hills Zone and the 1530 Double Peak Zone to operate as a single 1530 pressure zone.
- **OMWD Pump Station.** During the development of this 2018 Master Plan, the San Elijo Hills Pump Station was being constructed at the site of the existing OMWD connection. This new pump station transfers potable water from the David C. McCollom WTP into the District's 877 Zone, providing a new supply source.

5.4 SYSTEM-WIDE SUPPLY STORAGE EVALUATION

A supply-storage evaluation was performed over the entire system to identify in-zone storage and pumping (supply) deficiencies, and ultimately to recommend improvement projects. This analysis and results are described in the following sections.

5.4.1 Approach

As part of the 2018 Master Plan, a supply-storage spreadsheet model was developed, which provides a zone-by-zone analysis for the entire water system. This evaluation considered the projected demands and the District's water system criteria to identify in-zone storage and pumping deficiencies as well as determining the recommended sizing and phasing of improvement projects.

The spreadsheet model provides zone-by-zone results for each planning year and can easily adjust the alternative demand scenarios, such as a minimum monthly demand. The demands versus available supplies were evaluated for each zone to determine the sizing and phasing of recommended storage and pump station improvement projects. These results are presented and discussed below.

5.4.2 Existing System Evaluation

Existing demands were used to calculate the in-zone storage capacity and pumping capacity required per the District's water system criteria. The storage analysis results show that the water distribution system has sufficient supply and pumping capacity to serve existing demands and replenish operational storage. Total operational storage and pumping requirements are calculated based on the planning criteria outlined in Chapter 3 and are presented in the following section.

5.4.2.1 Existing System Storage Analysis

The existing system storage analysis shows that there is sufficient storage system-wide to meet the criteria under existing demands. Table 5-13 presents the reservoir balance calculations for the required storage for each primary zone. These storage calculations for each primary zone include the secondary pressure zone demands served by pressure reducing stations and hydropneumatic pump stations.

The storage analysis shows that several pressure zones have in-zone storage deficiencies. However, these deficiencies are mitigated by providing excess storage in a neighboring connected zone to cover the deficit. Under existing conditions, the 815 Zone, 877 Zone, 1115 Zone, 1235 Zone, 1567 Zone, and 1608 Zone show storage deficits. The current deficit in the 815 Zone can be offset by storage provided in the 1028 Zone, if a normally closed valve is opened. The surplus storage in the 1530 Double Peak Zone can offset the current deficits in the 877 and 1115 Zones. The surplus storage in the 1028 Zone can also offset the deficits in the 1235, 1567, and 1608 Zones provided that adequate pumping capacity and redundancy is in place.

The remaining pressure zones within the District have adequate storage capacity to meet existing demands and storage criteria. Overall, the District has a net surplus storage volume of 49.52 MG as shown on Table 5-13, the majority of which is in the 1028 Twin Oaks Reservoirs.

5.4.2.2 Existing System Pump Station Capacity Analysis

Capacity requirements are based on the planning criteria as discussed in Chapter 3. The pumping calculations for supplying primary pressure zones are cumulative and include demands for the direct pumped zone and the firm capacity of any pump stations supplying higher zones. Table 5-14 presents the pump station capacity analysis for the existing system. As shown in Table 5-14, the existing pump stations have adequate capacity to meet existing system conditions. While the Schoolhouse PS shows a supply deficit of 211 gpm, additional supply can be provided during high demand periods from the 1530 (CH) zone, as VWD can open a normally closed valve to move water via the South Lake PS. No pump station upgrades are required to maintain existing demand requirements.

An off-peak analysis of the existing pump stations was performed to determine the ability of the existing pump stations to deliver maximum day demands over a 16-hour period. Off peak pumping allows the District to avoid the higher energy costs associated with operating during peak energy use hours. Table 5-15 indicates a deficit in pumping capacity in the 1235 Deer Springs Pump Station, 1115 Schoolhouse Pump Station, and 1530 Double Peak Pump Station if the pump stations are run only during off-peak pumping periods. Since the deficit in the 1235 Deer Springs Pump Station is small and only occurs during off-peak pumping periods, no improvement is recommended at this time as additional supply could be provided during on-peak periods as needed or until the pump station can be upsized. The 1115 Schoolhouse Pressure Zone is nearly built out and anticipated to experience minimal increases in ADD over the planning horizon. In addition, while the 1115 Schoolhouse Pump Station currently includes the 1530 Double Peak and 1320 Zone demands, it is expected that these zones will be also be supplied through a pipeline connection with the 1530 Coronado Hills Zone via the South Lake Pump Station in the future. This may allow the 1115 Schoolhouse Pump Station to operate off peak without improvements. Because of this understanding of the future system operations, no improvements are recommended at this time.

Table 5-13 Existing System Storage Analysis

PRESSURE ZONE			STORAGE CAPACITY (MG)	EXISTING ADD (MGD)	STORAGE REQUIRED PER CRITERIA (MG)				SURPLUS/ DEFICIT (MG)
PRIMARY ZONE	ZONE(S) SERVED	RESERVOIR NAME			OPERATIONAL (1)	FIRE (2)	EMERGENCY (3)	TOTAL (4)	
815	622	*no storage*	*0.00*	0.25	1.80	0.30	3.59	5.69	**(1.69)**
	660	*no storage*	*0.00*	0.17					
	670	*no storage*	*0.00*	0.04					
	686	*no storage*	*0.00*	0.21					
	700	*no storage*	*0.00*	0.14					
	815	Meadowlark #1	1.30	0.23					
		Meadowlark #2	2.70						
	930	*no storage*	*0.00*	0.14					
	815 Primary Zone Total		4.00	1.20					
877	750	*no storage*	*0.00*	0.47	1.49	0.30	2.98	4.77	**(1.07)**
	877	Sage Canyon	3.70	0.53					
	877 Primary Zone Total		3.70	0.99					
900	900	Mountain Belle	2.50	0.26	0.39	0.30	0.77	1.46	1.04
1028	855	*no storage*	*0.00*	3.74	15.01	0.84	30.03	45.88	45.12
	920	Richland #1	1.30	5.61					
		Richland #2	7.00						
		Palomar	2.70						
		Via Vera Cruz	7.00						
	1028	Twin Oaks #1	33.00	0.66					
		Twin Oaks #2	40.00						
	1028 Primary Zone Total		91.00	10.01					

PRESSURE ZONE			STORAGE CAPACITY (MG)	EXISTING ADD (MGD)	STORAGE REQUIRED PER CRITERIA (MG)				SURPLUS/ DEFICIT (MG)
PRIMARY ZONE	ZONE(S) SERVED	RESERVOIR NAME			OPERATIONAL (1)	FIRE (2)	EMERGENCY (3)	TOTAL (4)	
1115	1115	Schoolhouse	2.40	0.60	0.90	0.30	1.81	3.01	**(0.61)**
1235	1235	Deer Spring	0.60	0.12	0.18	0.30	0.36	0.84	**(0.24)**
1330	1059	*no storage*	*0.00*	0.04	0.33	0.30	0.65	1.28	2.82
	1330	North Twin Oaks #1	0.60	0.17					
		North Twin Oaks #2	3.50						
		1330 Primary Zone Total	4.10	0.22					
1500	1025	*no storage*	*0.00*	0.02	0.56	0.30	1.13	1.99	2.01
	1380	*no storage*	*0.00*	0.10					
	1500	Palos Vista	4.00	0.25					
		1500 Primary Zone Total	4.00	0.38					
1530 CH	1125	*no storage*	*0.00*	0.08	0.37	0.30	0.75	1.42	1.18
	1530	Coronado Hills	2.60	0.17					
		1530 CH Primary Zone Total	2.60	0.25					
1530 DP	1320	*no storage*	*0.00*	0.24	0.52	0.30	1.03	1.85	2.05
	1530	Double Peak	3.90	0.10					
		1530 DP Primary Zone Total	3.90	0.34					
1567	1567	Wulff #2	0.35	0.19	0.28	0.30	0.56	1.14	**(0.79)**

PRESSURE ZONE			STORAGE CAPACITY (MG)	EXISTING ADD (MGD)	STORAGE REQUIRED PER CRITERIA (MG)				SURPLUS/ DEFICIT (MG)
PRIMARY ZONE	ZONE(S) SERVED	RESERVOIR NAME			OPERATIONAL (1)	FIRE (2)	EMERGENCY (3)	TOTAL (4)	
1608	1228	*no storage*	*0.00*	0.04	0.34	0.30	0.67	1.31	**(0.01)**
	1608	Coggan	1.30	0.18					
	1608 Primary Zone Total		1.30	0.22					
SYSTEM-WIDE TOTAL			**120.45**	**14.78**				**70.63**	**49.82**

(1) Operational Storage is 1.5 x ADD of the Primary and Secondary Zones served.
(2) Fire Storage is the maximum volume (fire flow rate x duration) required by the Primary and Secondary Zones served.
(3) Emergency Storage is 3.0 x ADD of the Primary and Secondary Zones served.
(4) Total Storage required is the sum of the Operational, Fire, and Emergency Storage.

Table 5-14 Existing Pump Station Capacity Analysis

PUMP STATION	INCLUDES CAPACITY FOR ZONES	EXISTING ADD (GPM)	EXISTING MDD(1) (GPM)	REQUIRED PUMPING CAPACITY (GPM) (2)	EXISTING FIRM CAPACITY (GPM) (3)	SURPLUS / (DEFICIT) (GPM)
Northern Pump Stations						
Deer Springs (1235)(4)	1235	84	251	1,401	1,550	149
North Twin Oaks (1330)	900, 1059, 1330	329	890	1,040	2,000	960
Wulff (1567)	1567	129	388	538	1,000	462
Coggan (1608)	1228, 1608	155	445	595	4,000	3,405
Central Pump Stations						
Palos Vista (1500)	1025, 1380, 1500	260	718	868	3,375	2,507
South Lake (1530 CH)	1125, 1530 CH	173	491	641	2,200	1,559
Southern Pump Stations						
Meadowlark Hydro (930)(5)	930	101	302	302	470	168
Schoolhouse (1115)(6)	1115, 1320	419	1,111	2,311	2,100	-211
Double Peak (1530)	1320, 1530 DP	239	663	813	1,050	237

(1) Maximum Day Demand (MDD) = ADD of the primary and secondary zones served x MD Peaking Factor (PF) determined from Figure 3-1.
(2) Required pumping capacity = MDD + 150 gpm for fire storage recharge + firm capacity of pump stations delivering demand to higher zones (if applicable).
(3) Pump station firm capacity is the total pump station capacity minus the capacity of the largest pumping unit.
(4) Deer Springs PS required pumping capacity also includes firm capacity of Wulff PS.
(5) Meadowlark Hydro pump station has a separate fire pump and no fire storage within the hydropneumatic tank, so fire recharge is not needed.
(6) Schoolhouse PS required pumping capacity also includes firm capacity of Double Peak PS. If additional supply is needed during high demand periods, VWD can open a normally closed valve to move water from 1530 (CH) zone via the South Lake PS.

Table 5-15 Existing Pump Station Off-Peak Pumping Capacity Analysis

PUMP STATION	INCLUDES CAPACITY FOR ZONES	EXISTING MDD(1) (GPM)	REQUIRED PUMPING CAPACITY (GPM) (2)	REQUIRED OFF-PEAK PUMPING CAPACITY (GPM) (3)	EXISTING FIRM CAPACITY (GPM) (4)	SURPLUS / (DEFICIT) (GPM)
Northern Pump Stations						
Deer Springs (1235)(5)	1235	251	1,401	1,602	1,550	-52
North Twin Oaks (1330)	900, 1059, 1330	890	1,040	1,560	2,000	440
Wulff (1567)	1567	388	538	808	1,000	192
Coggan (1608)	1228, 1608	445	595	893	4,000	3,107

PUMP STATION	INCLUDES CAPACITY FOR ZONES	EXISTING MDD(1) (GPM)	REQUIRED PUMPING CAPACITY (GPM) (2)	REQUIRED OFF-PEAK PUMPING CAPACITY (GPM) (3)	EXISTING FIRM CAPACITY (GPM) (4)	SURPLUS / (DEFICIT) (GPM)
Central Pump Stations						
Palos Vista (1500)	1025, 1380, 1500	718	868	1,302	3,375	2,073
South Lake (1530 CH)	1125, 1530 CH	491	641	1,131	2,200	1,069
Southern Pump Stations						
Meadowlark Hydro (930)(6)	930	302	302	N/A	470	168
Schoolhouse (1115)(7)	1115, 1320	1,111	2,311	2,941	2,100	-841
Double Peak (1530)	1320, 1530 DP	663	813	1,220	1,050	-170

(1) Maximum Day Demand (MDD) = ADD of the primary and secondary zones served x MD PF determined from Figure 3-1.
(2) Required pumping capacity = MDD + 150 gpm for fire storage recharge + firm capacity of pump stations delivering demand to higher zones (if applicable).
(3) Off-peak pumping period is 16 hours.
(4) Pump station firm capacity is the total pump station capacity minus the capacity of the largest pumping unit.
(5) Deer Springs PS required pumping capacity also includes firm capacity of Wulff PS.
(6) Meadowlark Hydro pump station has a separate fire pump and no fire storage within the hydropneumatic tank, so fire recharge is not needed. Meadowlark Hydro pump station cannot operate off-peak.
(7) Schoolhouse PS required pumping capacity also includes firm capacity of Double Peak PS.

5.4.3 Water System Analysis - Ultimate

The hydraulic model was also used to analyze the water system under ultimate demand conditions to evaluate the system's ability to meet future needs. As shown in Table 5-12, average day demands are projected to increase to 33.6 MGD at buildout. These demands were used to analyze the existing storage, pumping, and pipeline facilities within the District.

5.4.3.1 Ultimate Storage Analysis

Table 5-16 presents the ultimate storage analysis. The District currently has 120.45 MG of potable water storage, and based on future demand projections, a total of 155.55 MG of storage will be required under ultimate conditions. The analysis indicates that most pressure zones will require storage improvement projects to meet the District's storage criteria under ultimate conditions. The proposed capacities of new reservoirs were calculated to offset these deficiencies. In some cases, the new reservoir will replace an aging reservoir. The new or replacement reservoirs are shown in bold in Table 5-16.

Consideration was made for the following zones that did not have an adequate site that would allow the District to add or expand a reservoir:

- Lack of space at the 877 Sage Canyon Reservoir and 1115 Schoolhouse Reservoir sites to add a second reservoir requires the storage deficiency in these zones to be accommodated in the new 1530 Coronado Hills Reservoirs.

Table 5-16 Ultimate Storage Analysis

PRESSURE ZONE			STORAGE CAPACITY (MG)	ULTIMATE ADD (MGD)	STORAGE REQUIRED PER CRITERIA (MG)				SURPLUS/ DEFICIT (MG)
PRIMARY ZONE	ZONE(S) SERVED	RESERVOIR NAME			OPERATIONAL (1)	FIRE (2)	EMERGENCY (3)	TOTAL (4)	
815	622	*no storage*	*0.00*	0.37	2.77	0.30	5.55	8.62	0.05
	660	*no storage*	*0.00*	0.20					
	670	*no storage*	*0.00*	0.05					
	686	*no storage*	*0.00*	0.27					
	700	*no storage*	*0.00*	0.14					
	815	*Meadowlark #1 (To be retired)*	*0.00*	0.71					
		Meadowlark #2	2.70						
		Proposed - Meadowlark #3	**2.47**						
		Proposed – Meadowlark #4	**3.50**						
	930	*no storage*	*0.00*	0.11					
		815 Primary Zone Total	8.67	1.85					
877	750	*no storage*	*0.00*	0.58	1.94	0.30	3.89	6.13	**(2.43)**
	877	Sage Canyon	3.70	0.72					
		877 Primary Zone Total	3.70	1.30					
900	900	Mountain Belle	2.50	0.66	0.99	0.30	1.98	3.27	**(0.77)**
1028	855	*no storage*	*0.00*	6.79	30.35	0.84	60.71	91.90	7.10
	920	Richland #1	1.30	10.40					
		Richland #2	7.00						
		Palomar	2.70						
		Via Vera Cruz	7.00						
	1028	Twin Oaks #1	33.00	3.06					

PRESSURE ZONE			STORAGE CAPACITY (MG)	ULTIMATE ADD (MGD)	STORAGE REQUIRED PER CRITERIA (MG)				SURPLUS/ DEFICIT (MG)
PRIMARY ZONE	ZONE(S) SERVED	RESERVOIR NAME			OPERATIONAL (1)	FIRE (2)	EMERGENCY (3)	TOTAL (4)	
		Twin Oaks #2	40.00						
		Proposed – Twin Oaks #3	**8.00**						
	1028 Primary Zone Total		99.00	20.24					
1115	1115	Schoolhouse	2.40	0.66	0.99	0.30	1.98	3.27	**(0.87)**
1235	1235	*Deer Spring (To be retired)*	*0.00*	0.77	1.15	0.30	2.30	3.75	**(2.75)**
		Proposed – Deer Spring #2	**1.00**						
	1235 Primary Zone Total		1.00	0.77					
1330	1059	*no storage*	*0.00*	0.09	3.03	0.30	6.07	9.40	**(2.30)**
	1330	*North Twin Oaks #1 (To be retired)*	*0.00*	1.93					
		North Twin Oaks #2	3.50						
		Proposed – North Twin Oaks #3	**3.60**						
	1330 Primary Zone Total		7.10	2.02					
1500	1025	*no storage*	*0.00*	0.04	1.41	0.30	2.82	4.53	0.00
	1380	*no storage*	*0.00*	0.11					
	1500	Palos Vista	4.00	0.80					
		Proposed – Palos Vista Rehab	**0.53**						
	1500 Primary Zone Total		4.53	0.94					
1530 CH	1125	*no storage*	*0.00*	0.08	3.26	0.30	6.51	10.07	2.63
	1530	Coronado Hills	2.60	2.09					
		Proposed – Coronado Hills #2	**2.60**						
		Proposed – Coronado Hills #3	**7.50**						
	1530 CH Primary Zone Total		12.70	2.17					

PRESSURE ZONE			STORAGE CAPACITY (MG)	ULTIMATE ADD (MGD)	STORAGE REQUIRED PER CRITERIA (MG)				SURPLUS/ DEFICIT (MG)
PRIMARY ZONE	ZONE(S) SERVED	RESERVOIR NAME			OPERATIONAL (1)	FIRE (2)	EMERGENCY (3)	TOTAL (4)	
1530 DP	1320	*no storage*	*0.00*	0.21	0.92	0.30	1.85	3.07	0.83
	1530	Double Peak	3.90	0.40					
	1530 DP Primary Zone Total		3.90	0.62					
1567	1567	Wulff #2	0.35	0.29	0.44	0.30	0.87	1.61	**(1.26)**
1608	1228	*no storage*	*0.00*	0.58	3.10	0.30	6.20	9.60	0.10
	1608	*Coggan (To be retired)*	*0.00*	1.49					
		Proposed – Coggan #2	**6.00**						
		Proposed – Coggan #3	**3.70**						
	1608 Primary Zone Total		9.70	2.07					
SYSTEM-WIDE TOTAL			**155.55**	**33.58**				**155.23**	**0.32**

(1) Operational Storage is 1.5 x ADD of the Primary and Secondary Zones served.
(2) Fire Storage is the maximum volume (fire flow rate x duration) required by the Primary and Secondary Zones served.
(3) Emergency Storage is 3.0 x ADD of the Primary and Secondary Zones served.
(4) Total Storage required is the sum of the Operational, Fire, and Emergency Storage.

- The North Twin Oaks Reservoir #3 size (3.6 MG) and siting has already been established by the District. The storage deficit is a result of demolishing the North Twin Oaks #1 Reservoir will be made up via storage from the 1028 Twin Oaks Zone. The 900 Mountain Belle Reservoir storage deficit is also accommodated in the new 1028 Twin Oaks Reservoir.
- The demolition and replacement of the Deer Springs Reservoir is constrained due to available site conditions, so the deficit storage in these zones is accommodated in the 1028 Twin Oaks Zone as is the Wulff Zone deficiency.

5.4.3.2 Ultimate Pump Station Capacity Analysis

A pumping analysis was performed under ultimate demand conditions to evaluate the system's current ability to meet projected pumping needs. Table 5-17 presents the pumping conditions for the ultimate water system. Based on projected demands and pumping requirements, several pump stations will need to be expanded to support the anticipated growth for the ultimate condition.

The ultimate pump station capacity analysis shown in Table 5-17 assumes no time of use or operational restrictions. Even without these restrictions, the results show that the existing operational capacities of the South Lake PS, Deer Springs PS, North Twin Oaks PS, Schoolhouse PS, and Double Peak PS are insufficient to meet the pump station capacity requirements under ultimate demand conditions.

A pump station off-peak capacity analysis was also performed to determine the ability of each pump station to meet the capacity requirements over a 16-hour period, as opposed to a 24-hour period. Results from this analysis are summarized in Table 5-18. Off-peak and semi-peak pumping allows the District to avoid higher energy costs associated with operating during peak energy use hours. Assuming the off-peak and semi-peak pumping restrictions, the results show that the existing operational capacities of the Schoolhouse PS, South Lake PS, Deer Springs PS, North Twin Oaks PS, Coggan PS, Wulff PS, and Double Peak PS are insufficient to meet the pump station off-peak capacity requirements under ultimate demand conditions. However, due to changing conditions in electrical supplies, the operational cost-savings should be re-examined in the future.

Pump station improvement projects were proposed based on the results of the ultimate pump station off-peak capacity analysis, shown in Table 5-18. Proposed upgrades are recommended for the Deer Springs PS, North Twin Oaks PS, Coggan PS, South Lake PS, and Schoolhouse PS. While the analysis shows capacity deficiencies at the Double Peak PS, no improvements are recommended at this location. In the future, it is expected that the 1530 Coronado Hills Zone and 1530 Double Peak Zone will operate as a single 1530 pressure zone. Due to space constraints in the 1530 Double Peak Zone and future combined-zone operations, the Double Peak PS deficiency was incorporated into the recommended South Lake PS expansion. Due to the small difference in ultimate required off-peak capacity and existing capacity, improvements are also not recommended for the Wulff PS. Growth in this zone should be monitored and the need for additional capacity should be re-examined in the future.

Table 5-17 Ultimate Pump Station Capacity Analysis

PUMP STATION	INCLUDES CAPACITY FOR ZONES	ULTIMATE ADD (GPM)	ULTIMATE MDD (GPM) (1)	REQUIRED PUMPING CAPACITY (GPM) (2)	EXISTING FIRM CAPACITY (GPM) (3)	EXISTING SURPLUS / (DEFICIT) (GPM)	PROPOSED FIRM CAPACITY (GPM) (3)	PROPOSED SURPLUS / (DEFICIT) (GPM)
Northern Pump Stations								
Deer Springs (1235)(4)	1235	532	1,384	2,534	1,550	(984)	**3,400**	866
North Twin Oaks (1330)	900, 1059, 1330	1,863	4,344	4,494	2,000	(2,494)	**6,800**	2,306
Wulff (1567)	1567	202	568	718	1,000	282	1,000	282
Coggan (1608)	1228, 1608	1,435	3,427	3,577	4,000	423	**5,400**	1,823
Central Pump Stations								
Palos Vista (1500)	1025, 1380, 1500	653	1,670	1,820	3,375	1,555	3,375	1,555
South Lake (1530 CH)(5)	1125, 1530 CH	1,508	3,585	3,969	2,200	(1,769)	**6,500**	2,531
Southern Pump Stations								
Meadowlark Hydro (930)(6)	930	74	222	222	470	248	470	248
Schoolhouse (1115)(7)	1115, 1320	459	1,209	2,409	2,100	(309)	**3,100**	691
Double Peak (1530)(5)	1320, 1530 DP	428	1,134	1,284	1,050	(234)	1,050	(234)

(1) Maximum Day Demand (MDD) = ADD of the primary and secondary zones served x MD PF determined from Figure 3-1.
(2) Required pumping capacity = MDD + 150 gpm for fire storage recharge + firm capacity of pump stations delivering demand to higher zones (if applicable).
(3) Pump station firm capacity is the total pump station capacity minus the capacity of the largest pumping unit.
(4) Deer Springs PS required pumping capacity also includes firm capacity of Wulff PS.
(5) Under ultimate conditions, the 1530 Coronado Hills and 1530 Double Peak Zones are expected to operate as a single zone. Due to space constraints in the 1530 Double Peak Zone, the storage volume and pumping capacity deficits for the 1530 Double Peak Zone will be provided in the 1530 Coronado Hills Zone. Therefore, no pump station improvement is recommended for the 1530 Double Peak PS.
(6) Meadowlark Hydro pump station has a separate fire pump and no fire storage within the hydropneumatic tank, so fire recharge is not needed.
(7) Schoolhouse PS required pumping capacity also includes firm capacity of Double Peak PS.

Table 5-18 Ultimate Pump Station Off-Peak Pumping Capacity Analysis

PUMP STATION	INCLUDES CAPACITY FOR ZONES	ULTIMATE MDD (GPM) (1)	REQUIRED PUMPING CAPACITY (GPM) (2)	REQUIRED OFF-PEAK PUMPING CAPACITY (GPM) (3)	EXISTING FIRM CAPACITY (GPM) (4)	EXISTING SURPLUS / (DEFICIT) (GPM)	PROPOSED FIRM CAPACITY (GPM) (4)	PROPOSED SURPLUS / (DEFICIT) (GPM)
Northern Pump Stations								
Deer Springs (1235)(5)	1235	1,384	2,634	3,301	1,550	(1,751)	**3,400**	99
North Twin Oaks (1330)	900, 1059, 1330	4,344	4,494	6,741	2,000	(4,741)	**6,800**	59
Wulff (1567)	1567	568	718	1,076	1,000	(76)	1,000	(76)
Coggan (1608)	1228, 1608	3,427	3,577	5,365	4,000	(1,365)	**5,400**	35
Central Pump Stations								
Palos Vista (1500)	1025, 1380, 1500	1,670	1,820	2,730	3,375	645	3,375	645
South Lake (1530 CH)	1125, 1530 CH	3,585	3,969	6,478	2,200	(4,278)	**6,500**	22
Southern Pump Stations								
Meadowlark Hydro (930)(6)	930	222	222	N/A	470	248	470	248
Schoolhouse (1115)(7)	1115, 1320	1,209	2,409	3,088	2,100	(988)	**3,100**	12
Double Peak (1530)(8)	1320, 1530 DP	1,134	1,284	1,925	1,050	(875)	1,050	(875)

(1) Maximum Day Demand (MDD) = ADD of the primary and secondary zones served x MD PF determined from Figure 3-1.
(2) Required pumping capacity = MDD + 150 gpm for fire storage recharge + firm capacity of pump stations delivering demand to higher zones (if applicable).
(3) Off-peak pumping period is 16 hours.
(4) Pump station firm capacity is the total pump station capacity minus the capacity of the largest pumping unit.
(5) Deer Springs PS required pumping capacity also includes firm capacity of Wulff PS.
(6) Meadowlark Hydro pump station has a separate fire pump and no fire storage within the hydropneumatic tank, so fire recharge is not needed. Meadowlark Hydro pump station cannot operate off-peak.
(7) Schoolhouse PS required pumping capacity also includes firm capacity of Double Peak PS.
(8) Under ultimate conditions, the 1530 Coronado Hills and 1530 Double Peak Zones are expected to operate as a single zone. Due to space constraints in the 1530 Double Peak Zone, the storage volume and pumping capacity deficits for the 1530 Double Peak Zone will be provided in the 1530 Coronado Hills Zone. Therefore, no pump station improvement is recommended for the 1530 Double Peak PS.

5.4.4 Desalinated Water Delivery Analysis

As discussed in Chapter 4, the District signed a water purchase agreement with the SDCWA for 3,500 AFY of treated water from the Claude "Bud" Lewis Carlsbad Desalination Plant that was built and owned by Poseidon Water. The 3,500 AFY total is referred to herein as the Existing Desalinated Supply. The District began receiving its existing desalinated water supply in December 2015 with the opening of the water treatment plant located in the City of Carlsbad. Desalinated seawater is delivered into the District's 920 Richland Zone at the same location as the VAL 9 supply connection. The two supplies blend just before it enters the District system.

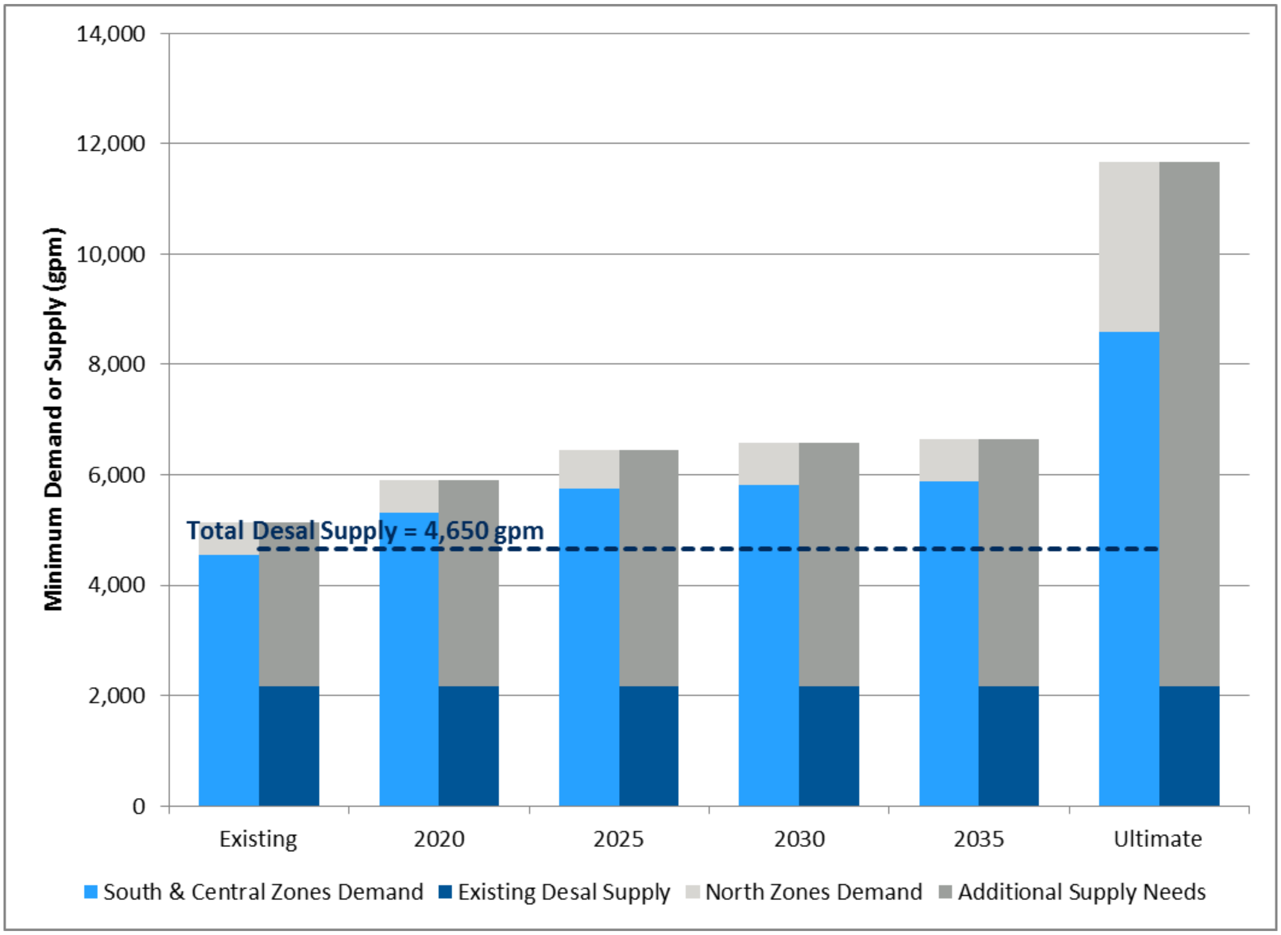
The District has an option to increase this volume up to 7,500 AFY in 10 years. At 7,500 AFY, desalinated water would make up approximately 45 percent of the District's supply at current demand levels. The 7,500 AFY total is referred to herein as the Potential Desalinated Supply. A supply-storage spreadsheet was used to evaluate whether the District could use the entire contract allotment of 7,500 AFY (4,650 gpm, 6.7 MGD) under current demand conditions, and if not, when would an increase in water demands allow them to increase the desalinated supply to its contract capacity. The evaluation included an analysis on the system operations – specifically the introducing of both the existing and potential desalinated water supplies into the District's system. Planning considerations include the following:

- **Minimum-Day as Critical Condition:** Most of the other existing and future system analyses have focused on Maximum Day conditions as the critical case. For the desalinated water analysis, however, the critical condition shifts to Minimum Day when the system will be most challenged to accept desalinated water flow. Minimum day typically occurs during storm events in the winter months.
- **Existing Conditions and Projected Conditions in 2020, 2025, 2030, 2035 and Ultimate:** The District may have the option to increase desalinated water deliveries up to 7,500 AFY over 10 years. Existing and projected critical demand conditions were evaluated to determine if/when the District may be able to utilize the Potential Desalinated Supply allotment.
- **New 1028 Pump Station:** The District currently does not have the means to move water from the Central Pressure Zones to the Northern Pressure Zones. This would require a pump station between the 920 Richland Zone and the 1028 Twin Oaks Zone. This analysis considers how a new pump station delivering water from the 920 Zone to the 1028 Zone could provide relief for any reservoir cycling problems occurring in the Central Pressure Zones due to increased usage of the desalinated water supply. The analysis also identifies how a pump station might allow the District to contract for additional desalinated water deliveries should they be available.
- **Separate Desalination Connection from SDCWA Aqueduct 2:** Under the current configuration, the desalinated water pipeline connects to the District through the SDCWA's Aqueduct 2 - VAL 9 turnout. Installing a valve or other means to separate the two sources would provide the District with more supply reliability in the case of an Aqueduct shutdown.

5.4.4.1 Desalinated Supply Utilization under Minimum Day Conditions

As part of this Master Plan, the District's ability to utilize the new desalinated water supply was evaluated under minimum demand conditions. Figure 5-8 shows how the District can use the existing (2,170 gpm) and potential (4,650 gpm) desalinated water supply to meet existing and projected minimum demands. As shown, the District can utilize all the existing desalination deliveries to meet demands in the Southern and Central Pressure Zones. The figure also displays that the District cannot currently utilize all the potential desalination supply in the Southern and Central Pressure Zones without pumping to the Northern Pressure Zones. It is important to note that for all scenarios, there are conveyance and operational constraints that can further limit utilization below these values (as noted below).

Figure 5-8 Existing Desalination Supply Utilization under Minimum Day Conditions



Notes:

- Existing Desalinated supplies amount to 3,500 acre-feet per year (2,170 gpm)
- Total Desalinated supplies amount to 7,500 acre-feet per year (4,650 gpm)

Table 5-19 summarizes the additional supply needs that will be required to meet existing and projected minimum day demands with the existing desalinated water supply of 2,170 gpm. As shown, the District will need supply to serve the Northern Pressure Zones demand via the existing VAL8 and VAL10 SDCWA Aqueduct 2 connections because 1) the existing desalinated water supply available will be fully used in the lower zones; and, 2) the desalination water cannot currently be pumped from the Central to the Northern Zones. Additional supplies will also be required to meet the Southern and Central Pressure Zones demands.

Table 5-19 Supplies Needed to Supplement Existing Desalinated Water Supply Under Minimum Day Conditions

YEAR	MINIMUM DEMAND (GPM)(1)		ADDITIONAL SUPPLY NEEDS(2)		
	SOUTHERN + CENTRAL ZONES	NORTHERN ZONES	SOUTHERN + CENTRAL ZONES	NORTHERN ZONES	DISTRICT-WIDE TOTAL
Existing	4,552	578	2,382	578	2,960
2020	5,320	590	3,150	590	3,740
2025	5,748	704	3,578	704	4,281
2030	5,818	765	3,648	765	4,413
2035	5,886	765	3,716	765	4,481
Ultimate	8,582	3,077	6,412	3,077	9,489

(1) Minimum demands = ADD * 0.5
(2) Additional Supply Needs represent the difference in demands and existing desalination supply (2,170 gpm). The existing water system infrastructure cannot pump desalinated water supply to meet the Northern Pressure Zones' demand.

It should be noted that the District also has limited infrastructure to send water between the central and southern pressure zone groups. To use all the potential desalinated water supply, the District would have to open normally closed valves between the 855 Zone and the 815 Meadowlark Zone and would have to convey water from the 920 Richland Zone to the 1530 Coronado Hills Zone via the South Lake Pump Station. The water could then be transferred to the 1115 and 877 Zones through the existing bypass pressure reducing valves at the 1530 Double Peak PS and 1115 Schoolhouse PS. This flow scheme would reduce the need for the District to receive water at the VAL 7 connection, as well as provide operational flexibility to better control the levels in the 920 Reservoirs.

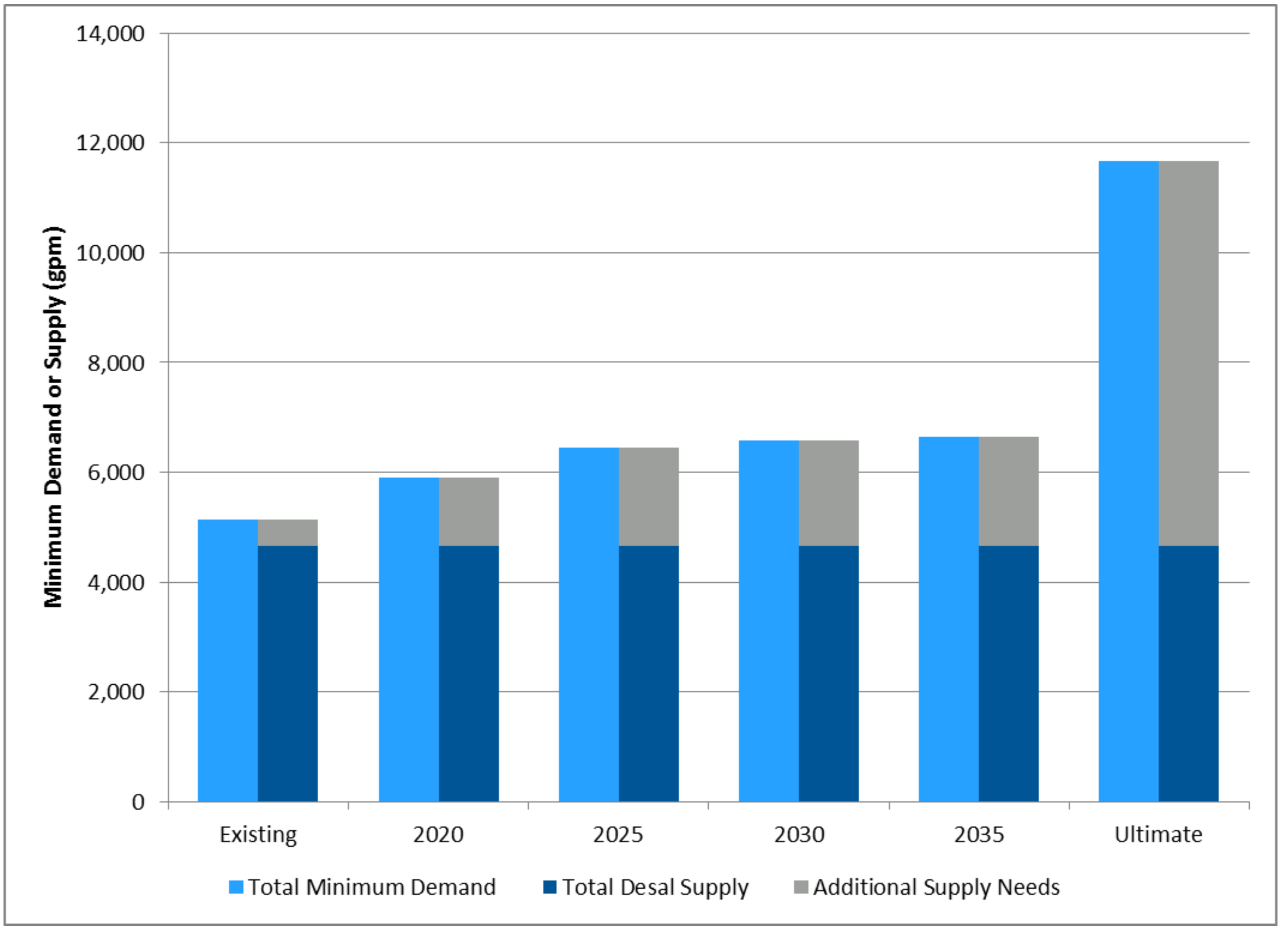
5.4.4.2 District-wide Desalination Supply via a New 920-1028 Pump Station

As shown in Figure 5-8, the District cannot utilize the expanded total potential desalinated water allotment within just the Southern and Central Pressure Zones under existing minimum day demand conditions. While the potential desalinated water allotment can be used to meet minimum demands in the Southern and Central Pressure Zones in the future, it may cause cycling issues in the 920 Zone reservoirs. Without appropriate cycling, the water in these reservoirs becomes stagnant and can cause water quality problems in the system. Delivery of the desalinated water may need to be reduced or shut down periodically to deep cycle the Central Pressure Zone reservoirs, which may subject the District to wheeling charges.

To maximize the use of the desalinated water supply and minimize operational challenges, the District may consider constructing a new pump station to move water from the Central Pressure Zones (originating in the 920 Richland Zone) to the Northern Pressure Zones (initially into the 1028 Twin Oaks Zone). Under typical operations, the District receives most of its supply from the VAL10 connection in the 1028 Twin Oaks Zone and conveys flow south to the 920 Richland Zone via the Trussell and Mulberry FCFs. The 920-1028 Pump Station would reverse the flow.

Figure 5-9 shows how the District can utilize the total (4,650 gpm) potential desalinated water allotment to meet existing and projected demands under minimum demand conditions. If this new pump station were constructed, the District would be able to utilize the total potential desalination supplies to meet all existing and projected demands under critical conditions.

Figure 5-9 Potential Desalination Supply Utilization under Minimum Day Conditions



Notes:

- Total Desalinated supplies amount to 7,500 acre-feet per year (4,650 gpm)

Table 5-20 summarizes the additional supply needs that will be required to meet existing and projected minimum day demands with the potential desalinated water supply of 4,650 gpm. As shown, the District will be able to utilize all the desalinated water contract allotment to meet its system-wide demands. Additional supplies will be needed to supplement the desalinated water supply, which can come from aqueduct deliveries or other water sources.

Table 5-20 Supplies Needed to Supplement Potential Desalinated Water Supply Under Minimum Day Conditions

YEAR	MINIMUM DEMAND (GPM)[1]			TOTAL ADDITIONAL SUPPLY NEEDS (GPM)[2]
	SOUTHERN + CENTRAL ZONES	NORTHERN ZONES	TOTAL	
Existing	4,552	578	5,130	480
2020	5,320	590	5,910	1,260

YEAR	MINIMUM DEMAND (GPM)(1)			TOTAL ADDITIONAL SUPPLY NEEDS (GPM)(2)
	SOUTHERN + CENTRAL ZONES	NORTHERN ZONES	TOTAL	
2025	5,748	704	6,451	1,801
2030	5,818	765	6,583	1,933
2035	5,886	765	6,651	2,001
Ultimate	8,582	3,077	11,659	7,009

(1) Minimum demands = ADD * 0.5
(2) Additional Supply Needs represent the difference in demands and total potential desalination supply (4,650 gpm). The existing water system infrastructure cannot pump desalinated water supply to meet the Northern Zones demand.

Furthermore, a new 920 Zone-1028 Zone pump station may improve the District's supply reliability. The District has one connection to the First Aqueduct (VAL 2), located in the 920 Richland Zone. In the event of a 2nd Aqueduct shutdown, the Central and Southern Pressure Zones could receive supply from the 1st Aqueduct with the existing system infrastructure. A new 920 Zone-1028 Zone pump station would also allow supply from the 1st Aqueduct to help meet demands in the Northern Pressure Zones.

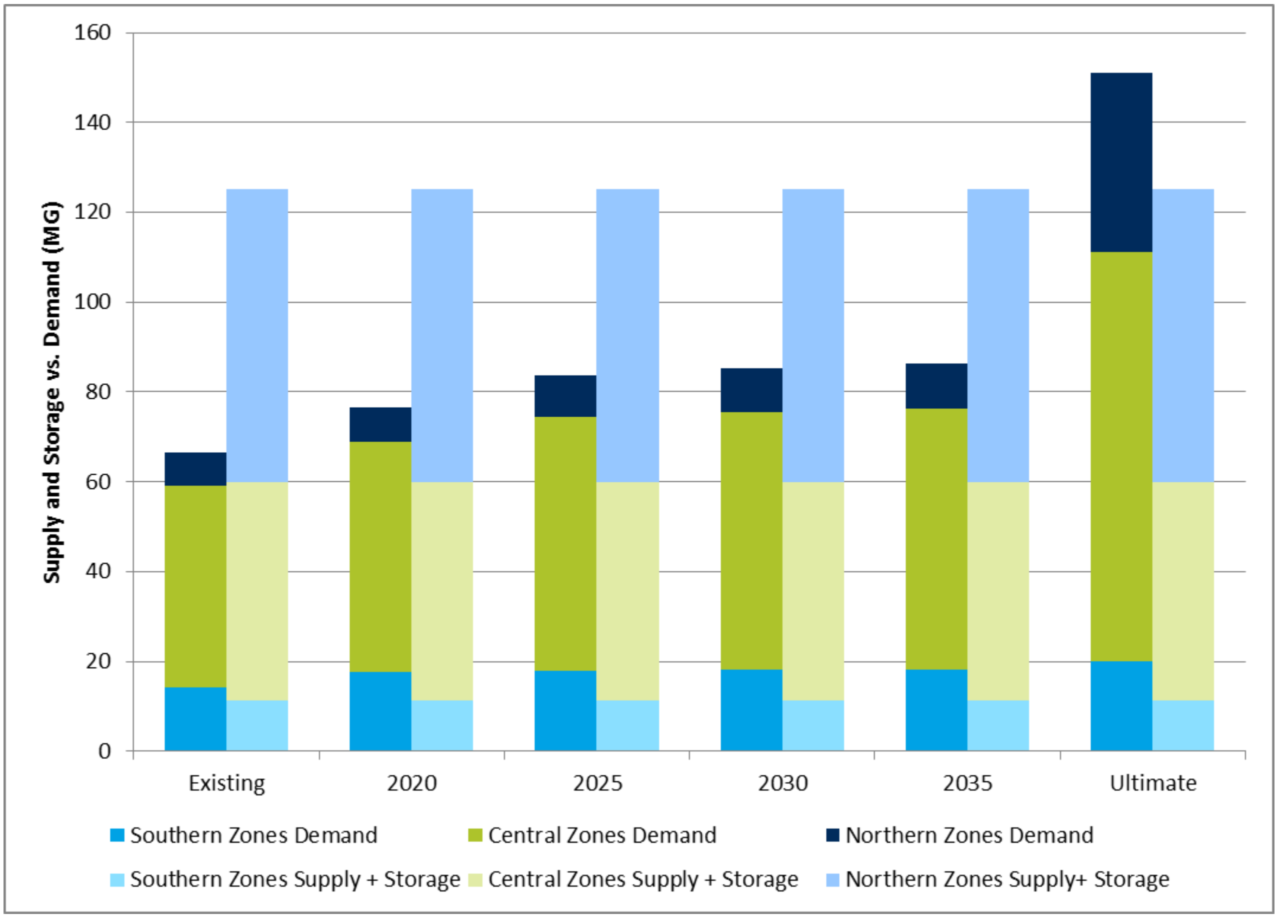
5.4.4.3 Separate Desalinated Water Connection

One of the major benefits of the desalinated water supply is that the District can reduce its dependence on imported water deliveries from the SDCWA as well as offering supply redundancy in certain cases when SDCWA supplies are unavailable. However, the existing desalinated water connection currently utilizes the District's VAL9 connection to the 2nd Aqueduct. Under this current configuration, the desalinated water supply would not be available in the event of a 2nd Aqueduct shutdown.

The supply-storage spreadsheet was used to analyze the benefits of having a separate desalinated water connection. This analysis evaluated the system against the unplanned aqueduct shutdown scenarios. Under these scenarios, it was assumed that the SDCWA 2nd Aqueduct connections (VAL 7, VAL8, VAL9, and VAL10) as well as the OMWD supplies are unavailable. Other assumptions include average day demands throughout the system and that the shutdown would last approximately 4.5 days. Existing storage capacity was assumed, and tanks were assumed to be 80% full.

Figure 5-10 below shows the supply-storage vs. demand balance under the current configuration, where in the event of a 2nd Aqueduct 2 shutdown, the desalinated water connection would also be unavailable. As shown, the demand during this shutdown period exceeds available supply and storage capacities under ultimate conditions. There are multiple means to address the ultimate system supply gap, including: 1) obtain a direct desalination connection to allow the supply to operate independent of the 2nd aqueduct, 2) provide additional storage as part of the ultimate system CIP, or 3) develop a new independent water source. While there is time to evaluate these options in future master plans, the independent connection is considered below.

Figure 5-10 Supply-Storage Evaluation During Unplanned Shutdown of Aqueduct 2, with Current Configuration

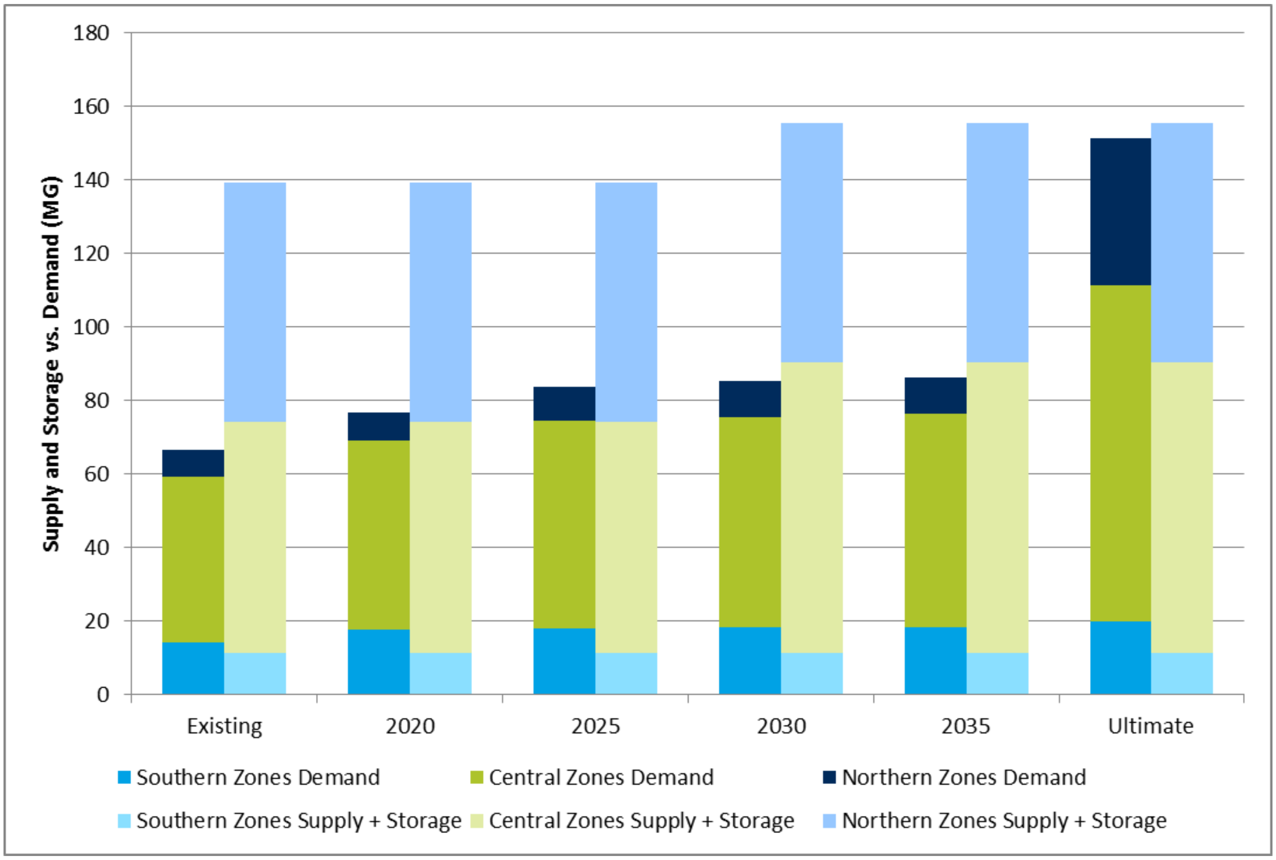


Notes:

- *No SDCWA Aqueduct 2, desalinated water, or OMWD supplies available.*
- *Assumes unplanned shutdown period is 4.5 days, average day demands, and existing storage is 80% full.*

If the District was able to access the desalinated water supply during such a 2nd Aqueduct shutdown, the available supplies and storage would be able to meet users' demands under the same unplanned shutdown condition. Results from this scenario are presented in Figure 5-11. The same assumptions as listed above were applied with the exception of the availability of the desalinated water supply. As shown in this figure, the additional supply provided by the desalinated water connection allows the District to meet all demands during the shutdown period. While this may not be an immediate need for the District, it may be something to consider in the future as the District continues to improve supply diversification and reliability and considers its option for additional desalination supply in the next 10 years. It would also be beneficial much sooner than ultimate conditions if there were an extended unplanned aqueduct outage, such as a major disruption due to a large seismic event.

Figure 5-11 Supply-Storage Evaluation During Unplanned Shutdown of Aqueduct 2, with Desalinated Water Supply



Notes:

- *No SDCWA Aqueduct 2 or OMWD supplies available. Desalinated water is available.*
- *Assumes unplanned shutdown period is 4.5 days, average day demands, and existing storage is 80% full.*

5.5 RECOMMENDED POTABLE WATER SYSTEM IMPROVEMENTS

This section provides recommendations for the Capital Improvement Program (CIP) for operational reservoirs, pump stations, and transmission mains to serve the District at buildout. The facilities shown with CIP project numbers are the proposed future reservoirs, pump stations, and transmission mains that will be planned, funded, and constructed by the District or by developers. These facilities are shown in Figure 5-12 (located at end of Section 5). Additional distribution pipelines and laterals will be required to serve specific customers but will be the responsibility of the individual customer or developer unless deemed otherwise by the District. It should be noted that some of the proposed transmission main alignments may change as development plans are revised or refined in the future. The intent is to align all mains within existing and planned roadways as much as possible. As development projects are proposed, the project proponents will be required to prepare a study that will, at a minimum, define the distribution and storage infrastructure required to serve the development, including the necessary regional CIP facilities.

Recommended CIP projects are divided into several phases or increments of development as defined in Table 5-21. CIP project phasing is based on the land development phasing as discussed in Chapter 2 and meeting the projected water demands presented previously in Chapter 5. Phasing for the recommended CIP projects may be accelerated or deferred as required to account for changes in development project schedules, availability of land or right-of-way for construction, project funding limitations, environmental concerns, and other considerations. Chapter 8 provides a compilation of recommended District CIP projects and costs.

Table 5-21 Planning Phases

PHASE	PLANNING YEARS
1	Existing – 2020
2	2021 – 2025
3	2026 – 2030
4	2031 – 2035
5	2036 – Buildout

5.5.1 Storage Improvements

The following section describes the storage projects needed within the District to meet the criteria set forth in Chapter 3. These projects are listed in Table 5-22, along with the anticipated phase of each project.

Table 5-22 Recommended Storage Improvement Projects

CIP ID	PRESSURE ZONE	RESERVOIR NAME	ADDITIONAL STORAGE CAPACITY (MG)	CIP PHASE
R-1	815	Proposed - Meadowlark #3	2.47	1
R-3	1530	Proposed - Coronado Hills #2	2.60	2
R-4(1)	1235	Proposed - Deer Spring #2	1.00	2
R-5(1)	1608	Proposed - Coggan #2	6.00	3
R-6(1)	1330	Proposed - North Twin Oaks #3	3.60	5
R-7(1)	815	Proposed - Meadowlark #4	3.50	5
R-8(2)	1500	Proposed - Palos Vista Rehab	0.53	5
R-9	1530	Proposed - Coronado Hills #3	7.50	5
R-10	1028	Proposed - Twin Oaks #3	8.00	5
R-11	1608	Proposed - Coggan #3	3.70	5
		TOTAL	**38.90**	

(1) Project includes demolition of existing reservoir.
(2) Project includes rehabilitation of existing reservoir.

5.5.1.1 Meadowlark Zone (815)

Per the District's storage criteria, the 815 Meadowlark Zone requires 5.69 MG of storage capacity under existing demands, and 8.62 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for various southern pressure zones, including the 622, 660, 670, 686, 700, 815 Meadowlark, and 930 Meadowlark Hydro Zones. The existing Meadowlark #1 Reservoir and Meadowlark #2 Reservoir currently provide a combined 4.0 MG of storage, which is insufficient to meet both existing and ultimate in-zone storage capacity needs.

To meet the required storage criteria under ultimate demand conditions, two storage improvements projects are proposed in the 815 Meadowlark Zone (R-1 and R-7). Project R-1 includes the construction of a new Meadowlark #3 Reservoir with a storage capacity of 2.47 MG. This project is scheduled to be completed during Phase 1 to help offset the current storage deficit.

Project R-7 includes the construction of a new Meadowlark #4 Reservoir, as well as the demolition of the existing Meadowlark #1 Reservoir (1.3 MG). The proposed Meadowlark #4 Reservoir will provide 3.5 MG of storage, covering the remaining deficit for the 815 Meadowlark Zone under ultimate conditions. Meadowlark #4 is currently scheduled as a Phase 5 project and it is expected to be completely funded by development, without contribution from the District's capacity fund. It is anticipated that the new reservoirs will be located on the same site as the existing Meadowlark #2 Reservoir.

5.5.1.2 877 Zone

Per the District's storage criteria, the 877 Zone requires 4.77 MG of storage capacity under existing demands, and 6.13 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for the 750 Zone and 877 Zone. The existing Sage Canyon Reservoir currently provides 3.7 MG of storage, which is insufficient to meet both existing and ultimate in-zone storage capacity needs.

Due to space constraints, no storage improvement projects are recommended in the 877 Zone. The projected storage deficit under ultimate demand conditions (2.43 MG) will be met with the 1530 Coronado Hills Zone and 1530 Double Peak Zone planned storage facilities.

5.5.1.3 Tres Amigos Zone (900)

Per the District's storage criteria, the 900 Tres Amigo Zone requires 1.46 MG of storage capacity under existing demands, and 3.27 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for only the 900 Tres Amigos Zone. The existing Mountain Belle Reservoir currently provides 2.5 MG of storage, which is insufficient to meet ultimate in-zone storage capacity needs.

No storage improvement projects are currently recommended in the 900 Tres Amigos Zone. The projected storage deficit under ultimate demand conditions (0.77 MG) will be met with the 1028 Twin Oaks Zone planned storage facilities.

5.5.1.4 Twin Oaks Zone (1028)

Per the District's storage criteria, the 1028 Twin Oaks Zone requires 45.88 MG of storage capacity under existing demands, and 91.9 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for the 855 Zone, the 920 Richland Zone, and the 1028 Twin Oaks Zone. Existing storage facilities (Palomar, Richland #1, Richland #2, Via Vera Cruz, Twin Oaks #1 and Twin Oaks #2 Reservoirs) currently provide 91.0 MG of storage.

The 1028 Twin Oaks Zone also provides storage for neighboring zones with required in-zone storage capacity deficits under ultimate conditions, including the 900 Tres Amigo Zone (0.77 MG deficit), 1235 Deer Springs Zone (2.75 MG deficit), and 1567 Wulff Zone (1.26 MG deficit).

To balance the needs of the 1028 Twin Oaks Zone and other dependent zones and to meet the required storage criteria under ultimate demand conditions, one storage improvements project is proposed in the 1028 Twin Oaks Zone (R-10). Project R-10 includes the construction of a new Twin Oaks #3 Reservoir with a storage capacity of 8.0 MG, providing the required storage capacity for the 1028 Twin Oaks Zone. This project is scheduled to be completed during Phase 5 and is expected to be partially funded from development and partially from District's capacity fund.

5.5.1.5 Schoolhouse Zone (1115)

Per the District's storage criteria, the 1115 Schoolhouse Zone requires 3.01 MG of storage capacity under existing demands, and 3.27 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for only the 1115 Schoolhouse Zone. The existing Schoolhouse Reservoir currently provides 2.4 MG of storage, which is insufficient to meet both existing and ultimate in-zone storage capacity needs.

Due to space constraints, no storage improvement projects are recommended in the 1115 Schoolhouse Zone, which results in a storage deficit of 0.87 MG under ultimate conditions. This storage deficit will be met with the 1530 Coronado Hills Zone and 1530 Double Peak planned storage facilities.

5.5.1.6 Deer Springs Zone (1235)

Per the District's storage criteria, the 1235 Deer Springs Zone requires 0.84 MG of storage capacity under existing demands, and 3.75 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for only the 1235 Deer Springs Zone. The existing Deer Springs Reservoir currently provides 0.6 MG of storage, which is insufficient to meet both existing and ultimate in-zone storage capacity needs.

The 1235 Deer Springs Zone also provides storage capacity for the 1567 Wulff Zone, which requires 1.14 MG of storage capacity under existing demands, and 1.61 MG of storage under ultimate demand conditions. The existing Wulff #2 Reservoir currently provides 0.35 MG of storage, which is insufficient to meet both existing and ultimate in-zone storage capacity needs.

To provide storage capacity for the 1235 Deer Springs and 1567 Wulff Zones under ultimate demand conditions, one storage improvement project is proposed in the 1235 Deer Springs Zone (R-4). The existing Deer Springs Reservoir was constructed in 1961 and is nearing the end of its useful life. In addition, there is limited space available to build a new reservoir. Therefore, Project

R-4 includes the demolition of existing Deer Springs Reservoir and the construction of a new Deer Springs #2 Reservoir with a storage capacity of 1.0 MG. This project is scheduled to be completed during Phase 2 and is anticipated to be completely funded from development. The projected storage deficit under ultimate demand conditions from the 1235 Deer Springs Zone (2.75 MG) and 1567 Wulff Zone (1.26 MG) will be met with the 1028 Twin Oaks Zone planned storage facilities.

5.5.1.7 North Twin Oaks Zone (1330)

Per the District's storage criteria, the 1330 North Twin Oaks Zone requires 1.28 MG of storage capacity under existing demands, and 9.40 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for the 1059 Zone and the 1330 North Twin Oaks Zone. The existing North Twin Oaks #1 Reservoir and North Twin Oaks #2 Reservoir provide a combined 3.8 MG storage, which is insufficient to meet ultimate in-zone storage capacity needs.

To provide storage capacity for the 1330 North Twin Oaks Zone under ultimate demand conditions, one storage improvement project is proposed in the 1330 North Twin Oaks Zone (R-6). The existing North Twin Oaks #1 Reservoir was constructed in 1961 and is nearing the end of its useful life. As part of Project R-6, it is recommended that a new North Twin Oaks #3 Reservoir be constructed on the same site as the existing North Twin Oaks #2 Reservoir. Once complete, the older North Twin Oaks #1 Reservoir may then be taken out of service. This project is scheduled to be completed during Phase 5 and is anticipated to be completely funded from development, without contribution from the District's capacity fund.

With the completion of Project R-6, a storage deficit of 2.3 MG will remain in the 1330 North Twin Oaks Zone under ultimate conditions. This projected deficit will be met with the 1028 Twin Oaks Zone planned storage facilities.

5.5.1.8 Palos Vista Zone (1500)

Per the District's storage criteria, the 1500 Palos Vista Zone requires 1.99 MG of storage capacity under existing demands, and 4.53 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for the 1025 Zone, 1380 Zone, and the 1500 Palos Vista Zone. The existing Palos Vista Reservoir provides 4.0 MG of storage, which is insufficient to meet ultimate in-zone storage capacity needs.

To provide storage capacity for the 1500 Palos Vista Zone under ultimate demand conditions, one storage improvement project is proposed in the 1500 Palos Vista Zone (R-8). As there is no room on the current Palos Vista Reservoir site for a second reservoir, it is recommended that the existing reservoir be rehabilitated and expanded by 0.53 MG. This will bring its total capacity to 4.53 MG, providing the required storage capacity for the 1500 Palos Vista Zone. The proposed rehabilitation is scheduled to occur during Phase 5 and is expected to be funded partially from development and partially from the District's capacity fund.

5.5.1.9 Coronado Hills Zone (1530)

Per the District's storage criteria, the 1530 Coronado Hills Zone requires 1.42 MG of storage capacity under existing demands, and 10.07 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for the 1125 Zone and 1530 Coronado Hills Zone. The existing Coronado Hills Reservoir currently provides 2.6 MG of storage, which is insufficient to meet ultimate in-zone storage capacity needs.

The storage facilities located in the 1530 Coronado Hills Zone are also planned to cover the storage capacity deficits in the 877 and 1115 Schoolhouse Zones. These pressure zones will require approximately 3.31 MG of capacity to meet the storage criteria under ultimate conditions.

To provide storage capacity for the 1530 Coronado Hills Zone under ultimate demand conditions, two storage improvement projects are proposed in the 1530 Coronado Hills Zone (R-3 and R-9). Project R-3 includes the construction of a new Coronado Hills #2 Reservoir with a storage capacity of 2.6 MG on the same site as the existing Coronado Hills #1 Reservoir. This project is scheduled to be completed during Phase 2 to meet the near-term deficits in the neighboring zones. Construction of Coronado Hills #2 Reservoir is expected to be partially funded from development and partially from the District's capacity fund.

Project R-9 includes the construction of a new Coronado Hills #3 Reservoir (7.5 MG), providing the required storage capacity for the 1530 Coronado Hills Zone and neighboring zones under ultimate conditions. The Coronado Hills #3 Reservoir will also be constructed on same site as the existing Coronado Hills #1 Reservoir. This project is scheduled to be completed during Phase 5 and is expected to be completely funded by development, without contribution from the District's capacity fund.

5.5.1.10 Double Peak Zone (1530)

Per the District's storage criteria, the 1530 Double Peak Zone requires 1.85 MG of storage capacity under existing demands, and 3.07 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for the 1320 Zone and 1530 Double Peak Zone. The existing Double Peak Reservoir currently provides 3.9 MG of storage, which meets the ultimate in-zone storage capacity needs. The surplus storage capacity (0.83 MG) in the 1530 Double Peak Zone will help cover the storage capacity deficits in the 877 Zone and 1115 Schoolhouse Zone.

5.5.1.11 Wulff Zone (1567)

Per the District's storage criteria, the 1567 Wulff Zone requires 1.14 MG of storage capacity under existing demands, and 1.61 MG of storage under ultimate demand conditions. These storage capacity requirements include operational storage, fire storage, and emergency storage for only the 1567 Wulff Zone. The existing Wulff #2 Reservoir currently provides 0.35 MG of storage, which is insufficient to meet both existing and ultimate in-zone storage capacity needs.

Due to space constraints, no storage improvement projects are recommended in the 1567 Wulff Zone. The projected storage deficit under ultimate conditions (1.26 MG) will be covered by 1028 Twin Oaks Zone storage facilities.

5.5.1.12 Coggan Zone (1608)

Per the District's storage criteria, the 1608 Coggan Zone requires 1.31 MG of storage capacity under existing demands, and 9.60 MG of storage under ultimate demand conditions. Storage capacity requirements include operational storage, fire storage, and emergency storage for the 1228 North and 1608 Coggan Zones. The existing Coggan Reservoir currently provides 1.3 MG of storage, which is insufficient to meet ultimate in-zone storage capacity needs.

To meet the required storage criteria under ultimate demand conditions, two storage improvements projects are proposed in the 1608 Coggan Zone (R-5 and R-11). Project R-5 includes the construction of a new Coggan #2 Reservoir with a storage capacity of 6.0 MG, as well as the demolition of the existing Coggan #1 Reservoir (1.3 MG). This project is scheduled to be completed during Phase 3 and is expected to be funded partially from development and partially from the District's capacity fund.

Project R-11 includes the construction of a new Coggan #3 Reservoir, which will provide 3.7 MG of storage, covering the remaining deficit for the 1608 Coggan Zone under ultimate conditions. This reservoir may not be able to be accommodated at the existing reservoir site. There appears to be a site at a suitable elevation to the north of the existing site, in a currently undeveloped area. This would require a land purchase by the District and additional piping to reach the new facility. It is recommended that a siting study be conducted to determine if the proposed site is suitable and cost effective. If this site is determined to not be viable then storage capacity could be moved to the 1028 Zone Twin Oaks #3 Reservoir site. The Coggan #3 Reservoir is currently scheduled as a Phase 5 project and it is expected to be completely funded by development, without contribution from the District's capacity fund.

5.5.2 Pump Station Improvements

The recommended pump station projects are summarized in Table 5-23 and described in the sections below. The required capacity includes the capacity needed to accommodate ultimate demands and to pump during off-peak and semi-peak hours only.

Table 5-23 Recommended Pump Station Improvement Projects

CIP ID	PRESSURE ZONE	CIP NAME	EXISTING CAPACITY (GPM)(1)	PROPOSED CAPACITY (GPM) (1)	CIP PHASE
PS-2	1625	High Point Hydropneumatic Pump Station	N/A	1,200	1
PS-3	1235	Deer Springs Pump Station Expansion	1,550	3,400	5
PS-4	1330	Mountain Belle Pump Station	N/A	3,000	2
PS-5	1330	North Twin Oaks Pump Station Expansion	2,000	6,800	5
PS-6	1530	South Lake Pump Station Expansion	2,200	6,500	5
PS-7	1608	Coggan Pump Station Expansion	4,000	5,400	5
PS-8	1115	Schoolhouse Pump Station Expansion	2,100	3,100	2

(1) Pump station capacity listed assumes two duty and one stand-by pumping units.

5.5.2.1 High Point Hydropneumatic Pump Station (PS-2)

This proposed pump station would be located on the same site as the existing Palos Vista Tank and would serve the properties being improved as part of the High Point development that cannot be served by the 1500 Palos Vista Zone. It is anticipated that this pump station would be constructed during Phase 1 and is expected to be completely funded by development, without contribution from the District's capacity fund.

5.5.2.2 Deer Spring Pump Station Expansion (PS-3)

The existing operational capacity of the Deer Springs PS is 1,550 gpm. The pump station currently supplies the 1235 Deer Springs Zone and transfers water to the 1567 Wulff Zone. The required pumping capacity for the Deer Springs PS is 1,602 gpm under existing demand, off-/semi-peak hour conditions, and 3,301 gpm under ultimate demand, off-/semi-peak hour conditions. This results in a pumping deficit of 1,751 gpm under ultimate conditions.

To meet the District's pumping station criteria, it is recommended that the three existing pumps (775 gpm each) be replaced with three 1,700 gpm pumps to increase the operational capacity of the Deer Springs PS to 3,400 gpm, with one standby pumping unit. These pumps would be capable of delivering maximum day build-out demands during off-peak pumping periods. It is anticipated that the new pumps would be located on the same site as the existing Deer Springs PS. This project is currently scheduled for Phase 5 and is expected to be completely funded from development without contribution from the District's capacity fund.

5.5.2.3 Mountain Belle Pump Station (PS-4)

A proposed pump station from the 900 Tres Amigos Zone to the 1330 North Twin Oaks Zone is currently in the preliminary stages of development. The station would pump water from the 900 Mountain Belle Reservoir, which receives water from the VAL 8 connection, into the 1330 North Twin Oaks Zone. The significance of this project is the ability to take water from the VAL 8 connection, which could receive water from the Oceanside Robert A. Weese Water Filtration Plant, during a SDCWA shutdown. This station could possibly delay or eliminate the need for the 1330 North Twin Oaks PS expansion. The proposed location of the station is in the northwest corner of the existing Mountain Belle Reservoir site. The Mountain Bell PS is proposed to have an operational capacity of 3,000 gpm and is anticipated to be constructed during Phase 2.

5.5.2.4 North Twin Oaks Pump Station Expansion (PS-5)

The existing operational capacity of the North Twin Oaks PS is 2,000 gpm. It currently supplies the 1059 Zone and 1330 North Twin Oaks Zone. The North Twin Oaks PS may also supply the 900 Tres Amigos Zone when the VAL 8 connection is not in service. The required pumping capacity for the North Twin Oaks PS is 1,560 gpm under existing demand, off-/semi-peak hour conditions, and 6,741 gpm under ultimate demand, off-/semi-peak hour conditions. This results in a pumping deficit of 4,741 gpm under ultimate conditions.

To meet the District's pumping station criteria, it is recommended that the three existing pumps (1,000 gpm each) be replaced with three 3,400 gpm pumps to increase the operational capacity of the North Twin Oaks PS to 6,800 gpm, with one standby pumping unit. These pumps would be capable of delivering maximum day build-out demands during off-peak pumping periods. It is anticipated that the new pumps would be located on the same site as the existing North Twin Oaks PS. This project is currently scheduled for Phase 5 and is expected to be completely funded by development, without contribution from the District's capacity fund.

5.5.2.5 South Lake Pump Station Expansion (PS-6)

The existing operational capacity of the South Lake PS is 2,200 gpm and supplies the 1530 Coronado Hills and 1125 Zones. In the future, it will also supplement supply to the 1320 Zone and 1530 Double Peak Zone, which are also served via the Double Peak PS. The required pumping capacity for the South Lake PS is 1,131 gpm under existing demand, off-/semi-peak hour conditions, and 6,478 gpm under ultimate demand, off-/semi-peak hour conditions. This results in a pumping deficit of 4,278 gpm under ultimate conditions.

To meet the District's pumping station criteria, it is recommended that the three existing pumps (1,100 gpm each) be replaced with three 3,250 gpm pumps to increase the operational capacity of the South Lake PS to 6,500 gpm, with one standby pumping unit. These pumps would be capable of delivering maximum day build-out demands during off-peak pumping periods. It is anticipated that the new pumps would be located on the same site as the existing South Lake PS. This project is currently scheduled for Phase 5 and is expected to be completely funded by development, without contribution from the District's capacity fund.

5.5.2.6 Coggan Pump Station Expansion (PS-7)

The existing operational capacity of the Coggan PS is 4,000 gpm and supplies the 1608 Coggan Zone. The required pumping capacity for the Coggan PS is 893 gpm under existing demand, off-/semi-peak hour conditions, and 5,365 gpm under ultimate demand, off-/semi-peak hour conditions. This results in a pumping deficit of 1,365 gpm under ultimate conditions.

It is expected that by buildout, the Coggan PS will need to be replaced due to age in addition to the need for additional capacity. At this time, it is recommended that the capacity be slightly increased to accommodate the off-/semi-peak pumping schedule. Therefore, it is recommended that the three existing pumps (2,000 gpm each) be replaced with three 2,700 gpm pumps to increase the operational capacity of the Coggan PS to 5,400 gpm, with one standby pumping unit. These pumps would be capable of delivering maximum day build-out demands during off-peak pumping periods. It is anticipated that the new pumps would be located on the same site as the existing Coggan PS. This project is currently scheduled for Phase 5 and is expected to be partially funded through the District's operations and maintenance funds and partially from the District's capacity fund.

5.5.2.7 Schoolhouse Pump Station Expansion (PS-8)

The existing operational capacity of the Schoolhouse PS is 2,100 gpm. The station supplies the 1115 Schoolhouse Zone and transfers water to the 1530 Double Peak Zone. The required pumping capacity for the Schoolhouse PS is 2,941 gpm under existing demand, off-/semi-peak hour conditions, and 3,088 gpm under ultimate demand, off-/semi-peak hour conditions. Currently, operational capacity of the existing Schoolhouse PS cannot meet the pumping criteria under existing demands, and a pumping deficit of 988 gpm is projected under ultimate conditions.

To meet the District's pumping criteria, it is recommended that the three existing pumps (1,050 gpm each) be replaced with three 1,500 gpm pumps to increase the operational capacity of the Schoolhouse PS to 3,100 gpm, with one standby pumping unit.

These pumps would be capable of delivering maximum day build-out demands during off-peak pumping periods. It is anticipated that the new pumps would be located on the same site as the existing Schoolhouse PS. This project is currently scheduled for Phase 2 and is expected to be partially funded through the District's operations and maintenance funds and partially from the District's capacity fund.

5.5.3 Pipeline Improvements

The following section describes the pipeline projects needed within the District to meet the criteria set forth in Chapter 3. These projects are summarized in Table 5-24, along with the anticipated phase of each project.

Table 5-24 Recommended Pipeline Improvement Projects

CIP ID	PRESSURE ZONE	PROJECT NAME	DIAMETER (IN)	LENGTH (FT)	CIP PHASE	TYPE
P-16 and P-56	1235	Deer Springs PS to Deer Springs Reservoir	16	8,700	5	Upsizing
P-30	900	Mountain Belle Reservoir to 1330 North Twin Oaks Zone	16	1,800	2	Emergency
P-42	1228	North Twin Oaks #2 Reservoir to Huckleberry Lane	12	6,400	5	Emergency
P-43	1625	1625 High Point Hydro Zone to 1567 Wulff Zone	12	3,000	1	Developer
P-64	1330	North Twin Oaks PS to North Twin Oaks Reservoir	20	12,600	5	Upsizing
P-100	920	Rock Springs Road-Bennett Avenue to Rees Road	10	1,600	5	Upsizing
P-101	1115	Schoolhouse PS to San Elijo Road	20	600	2	Upsizing
P-300	1530	South Lake PS to San Elijo Road	20	3,900	5	Upsizing
P-301	920	Twin Oaks Valley Road-Village Drive to South Lake PS	20	3,100	5	Upsizing
P-400	920	El Norte Parkway-Rees Road to Woodland Parkway	20	5,300	2	Upsizing
P-600	1608	Coggan PS to Coggan Reservoir	20	8,900	5	Upsizing

5.5.3.1 Upsizing Projects

Timing of replacement projects will be contingent on the condition of the pipe segments recommended for replacement. It is also recommended that these projects take place over several years, replacing segments as they exceed design criteria. It is recommended that the District monitor pipe break and leak reports to schedule timing of these projects.

- **P-16 and P-56: Deer Springs PS to Deer Springs Reservoir.** Approximately 8,700 linear feet (LF) of 16-inch pipeline is proposed to replace existing 10-inch lines that were constructed in

1961. The replacement section is proposed from the Deer Springs PS to the Deer Springs Reservoir. This project is recommended to be completed during Phase 5 to coincide with the proposed Deer Springs PS Expansion project (PS-3) and is expected to be completely funded from development and without contribution from the District's capacity fund.

- **P-64: North Twin Oaks PS to North Twin Oaks Reservoir.** Approximately 12,600 LF of 20-inch pipeline is proposed to replace existing 12-inch lines that were constructed in 1964. The replacement section is proposed from the North Twin Oaks #2 Reservoir south and west to the 1330 North Twin Oaks PS. This project is currently scheduled to be completed during Phase 5 to coincide with the North Twin Oaks PS Expansion project (PS-5) and is expected to be funded partially from development and partially from the District's capacity fund.
- **P-100: Rock Springs Road-Bennett Avenue to Rees Road.** Approximately 1,600 LF of 10-inch pipeline is proposed to replace existing 8-inch lines. The replacement project is proposed to alleviate high velocities through this segment, located in Rock Springs Road between Bennett Avenue and Rees Road. This project is scheduled to be completed during Phase 5 and is expected to be funded partially from development and partially from the District's capacity fund.
- **P-101: Schoolhouse PS to San Elijo Road.** Approximately 600 LF of 20-inch pipeline is proposed to replace the existing 16-inch lines located downstream of the Schoolhouse PS. This project is proposed to alleviate high velocities projected to occur through this segment. It is recommended to be completed during Phase 2, concurrently with the proposed Schoolhouse PS expansion project (PS-8) and is expected to be funded partially through the District's operations and maintenance funds and partially from the District's capacity fund.
- **P-300: South Lake PS to San Elijo Road.** Approximately 3,900 LF of 20-inch pipeline is proposed to replace existing 16-inch lines located downstream of the South Lake PS. This project is proposed to alleviate high velocities projected to occur through this segment. It is recommended to be completed during Phase 5, concurrently with the proposed South Lake PS expansion project (PS-6) and is expected to be completely funded from development and without contribution from the District's capacity fund.
- **P-301: Twin Oaks Valley Road – Village Drive to South Lake PS.** Approximately 3,100 LF of 20-inch pipeline is proposed to replace existing 14-inch lines located upstream of the South Lake PS. This project is proposed to alleviate high velocities projected to occur through this segment. It is recommended to be completed during Phase 5, concurrently with the proposed South Lake PS expansion project (PS-6) and is expected to be completely funded from development and without contribution from the District's capacity fund.
- **P-400: El Norte Parkway-Rees Road to Woodland Parkway.** Approximately 5,300 LF of 20-inch pipeline is proposed to be constructed along El Norte Parkway from Rees Road to Woodland Parkway in the 920 Richland Zone. This pipeline is intended to improve the system's ability to serve demands from the VAL 2 supply connection. This project is scheduled to be completed during Phase 2 and is expected to be completely funded from the District's capacity fund.
- **P-600: Coggan PS to Coggan Reservoir.** Approximately 8,900 LF of 20-inch pipeline is proposed to replace existing 16- and 18-inch lines. The replacement project is proposed to alleviate high velocities through this segment located between the Coggan PS and Coggan Reservoir in the 1608 Coggan Zone. This project is scheduled to be completed during Phase 5 to coincide with the

proposed Coggan PS Expansion project (PS-7) and is expected to be funded partially through the District's operations and maintenance funds and partially from the District's capacity fund.

5.5.3.2 Emergency Service Improvements

Two pipeline projects to improve emergency service were identified during the 2008 Master Plan and are recommended as part of this 2018 Master Plan.

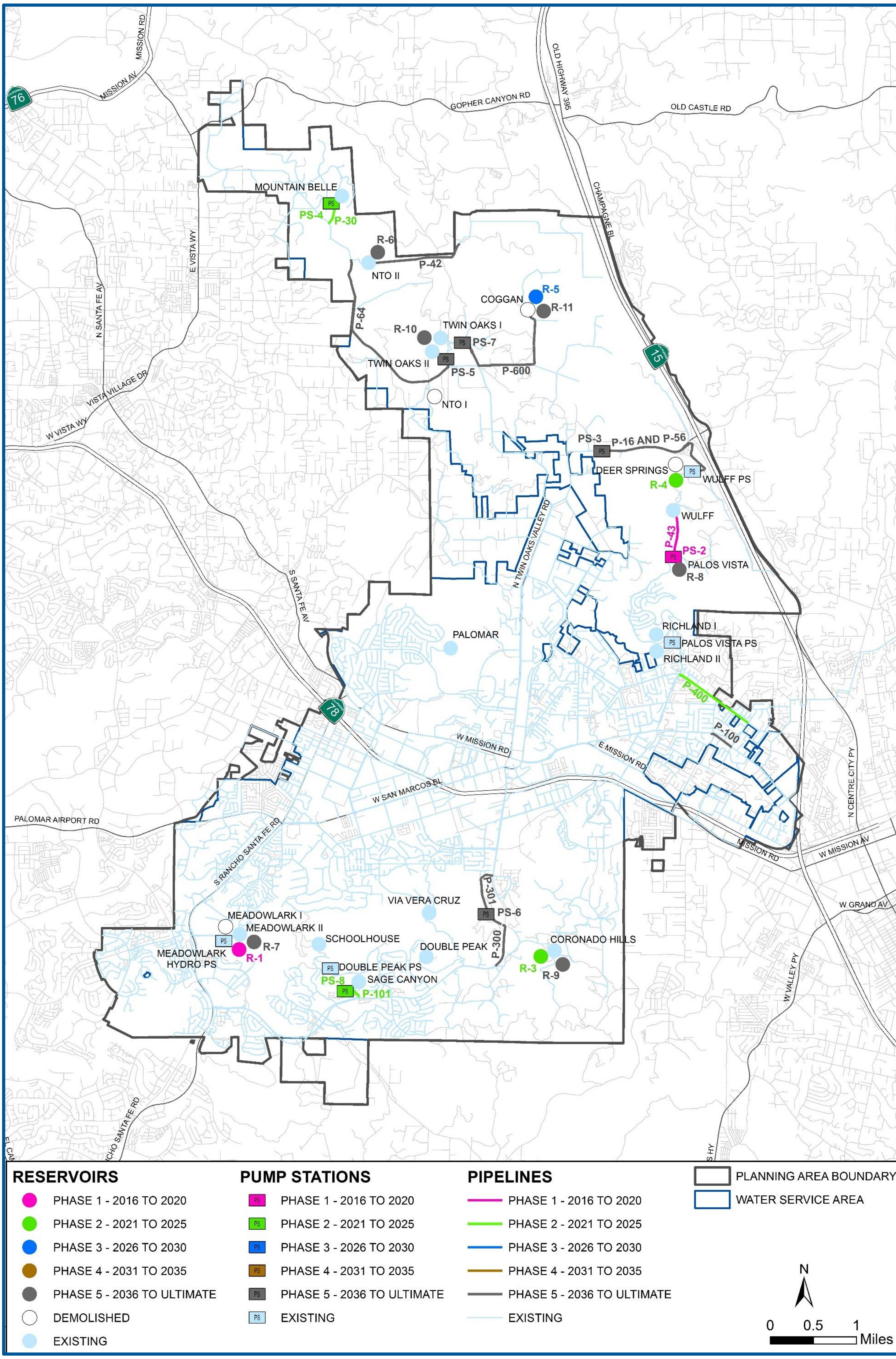
- **P-30: Mountain Belle Reservoir to 1330 North Twin Oaks Zone.** Approximately 1,800 LF of 16-inch line is proposed from the proposed Mountain Belle PS, located at the existing Mountain Belle Reservoir site, south to the connection with the existing 1330 Zone. This project is scheduled for completion during Phase 2 to coincide with the proposed Mountain Belle PS project (PS-4).
- **P-42: North Twin Oaks #2 Reservoir to Huckleberry Lane.** Approximately 6,400 LF of 12-inch line is proposed from the existing 1330 North Twin Oaks #2 Reservoir east to the intersection of El Farra Street and Huckleberry Lane. This pipeline will serve as a redundant supply connection to serve the 1228 North Zone. This project is recommended for construction in Phase 5.

5.5.3.3 Developer-Funded Improvements

Developer-funded improvements are those required to serve either new development or redevelopment. These projects are anticipated to be funded by the developer. Timing of these projects is contingent on the developers' schedule for development.

- **P-43: 1625 High Point Hydro Zone to 1567 Wulff Zone.** Approximately 3,000 LF of 12-inch line is proposed to connect the 1625 High Point Zone to the 1567 Wulff Zone from Woodland Heights Glen north to Rancho Luiseno Road. This line will provide an auxiliary feed from the 1625 High Point Zone to the 1567 Wulff Zone and includes a pressure reducing value to the 1567 Wulff Zone's hydraulic grade line. This project is anticipated to occur in Phase 1, concurrent with the construction of the proposed High Point Hydropneumatic Pump Station (PS-2).

Figure 5-12 Recommended Water System Improvement Projects



6 Wastewater Planning Criteria

This chapter presents unit generation rates, peaking, and planning criteria for the wastewater collection system. The information is used in subsequent sections of this 2018 Master Plan to estimate future wastewater generation, evaluate the existing wastewater collection system and determine what infrastructure improvements are required to serve the existing and future needs. The planning criteria were developed based on the following:

- Review of the District's previous master planning documents
- Review of District's meter data
- Comparison of District criteria to those of other local agencies
- Discussions with District staff to determine applicability to current conditions

6.1 WASTEWATER GENERATION RATES

Wastewater generation rates for various land uses were developed from an assessment of the District's water billing database for fiscal years 2009 to 2014, and wastewater meter data within the District's collection system. The water billing data were compared based on billing codes and used to estimate a typical return to sewer rate for each land use classification. Irrigation and non-permanent use meters, such as temporary construction meters and interim service meters, and unmetered water losses in the system were excluded. Generally, a sewer system experiences between 65 and 85 percent return rates of water use to the sewer, depending on the type of land use and extent of outdoor water use. The return ratio can be as high as 90 percent or more during wet periods.

6.1.1 Calculating Generation Rates for Standard Land Uses

Wastewater generation rates were developed on a per acreage basis based on 2014 flow data, a comparison of the measured values with previous planning study data and local agency standards, and water meter billing data used to develop percent return to sewer. Table 6-1 presents the 2018 Master Plan unit demand factors and the factors used in the previous planning studies. The wastewater generation rates represent average wastewater generation within the District and are used for general planning purposes. The calculation is expressed as:

(Acres of Base Land Use) x (2018 Unit Rate, Table 6-1) = Gallons per Day (gpd)

Table 6-1 Wastewater Unit Generation Rates

LAND USE CATEGORY	1991 MASTER PLAN (GPD/AC)	1997 MASTER PLAN (GPD/AC)	2002 MASTER PLAN (GPD/AC)	2008 MASTER PLAN (GPD/AC)	2018 MASTER PLAN (GPD/AC)
Residential (<1.0 du/ac)(1)	400	300	140	150	150
Residential (1-2 du/ac)	400	500	500	500	500
Residential (2-4 du/ac)	800	800	700	750	750
Residential (4-6 du/ac)	1,250	1,200	1,300	1,100	-
Residential (4-8 du/ac)	1,550	1,400	1,500	1,300	1,300
Residential (8-12 du/ac)	1,900	1,700	1,500	2,100	2,100
Residential (12-15 du/ac)	3,000	2,500	2,100	2,500	2,500
Residential (15-20 du/ac)	3,000	2,500	2,200	3,300	3,300
Residential (20-30 du/ac)	3,700	3,700	4,000	4,500	4,500
Residential (30-40 du/ac)	-	-	-	6,300	6,300
Residential (40-50 du/ac)	-	-	-	8,100	8,100
Intensive Ag./Res. (0.125-0.5 du/ac)	-	300	80	80	80
Agricultural/Res. (0.125-0.5 du/ac)	-	300	80	80	80
Commercial	1,200	1,200	1,500	1,200	1,200
Hotel / Motel	-	-	-	125 gpd/room	125gpd/room
Office Professional	1,800	1,700	1,700	1,200	1,200
Light Industrial	1,200	1,300	1,600	1,500	1,300
Industrial	1,800	2,100	900	900	700
Schools & Public Facilities	820	700	800	800	800
Palomar College	2,075	1,000	1,000	1,000	1,000
San Marcos State University	-	1,000	1,000	1,000	1,000
Parks/Golf Courses	300	300	500	250	250
Solid Waste Management	-	0	0	-	-
Open Space	-	200	40	40	-
Right-of-Way	-	-	0	-	-

Notes:
(1) The 2008 MP Projected acreage includes the total areas from the following 2008 MP Land Use Categories: (a) Hillside Residential (0.05-0.25 du/ac) and (b) Rural Residential (0.125-1.0 du/ac). For the 2018 MP Update, these categories were combined.
(2) Unit generation rates shown in this table represent averages. Actual wastewater generation will vary based on the specific building plans and types of use. All new developments will be required to develop specific wastewater generation estimates to be approved by the District. The District may, at its sole discretion, require higher generation rates once specific development plans are proposed.
(3) See Section 6.1 for calculation of wastewater generation rates for mixed land uses, schools and universities.
(4) For Hotel/Motels with commercial space, wastewater generation will be based on the commercial area-based duty factor for the hotel's/motel's parcel area, plus 125 gpd/room

6.1.2 Calculating Generation Rates for Mixed Land Uses

Mixed use developments are becoming more common in the District and typically blend commercial or office land uses with stacked, high density residential units. For wastewater estimation, the uses are additive. A unit generation rate of 1,000 gpd/ac was determined for mixed land use types based on available water and sewer metering data. The District, at its discretion, may require higher residential unit rates if deemed appropriate.

6.1.3 Calculating Generation Rates for Schools and Hotels

Wastewater generation rates at schools, including Palomar College and California State University – San Marcos, shall initially be calculated using the area-based duty factor given in Table 6-1. These flows shall be compared to wastewater generated based on student capacity at a generation rate of 5 gpd/student. If the wastewater generation estimate based on student count is higher compared to the flow calculated from the area-based duty factor, the District may utilize the higher number and assess the appropriate fees.

For hotels and motels with commercial space, the wastewater flow will use the commercial area-based demand factor for the hotel's/motel's parcel area, plus 125 gpd/room. For those without commercial space, only the 125 gpd/room duty factor applies.

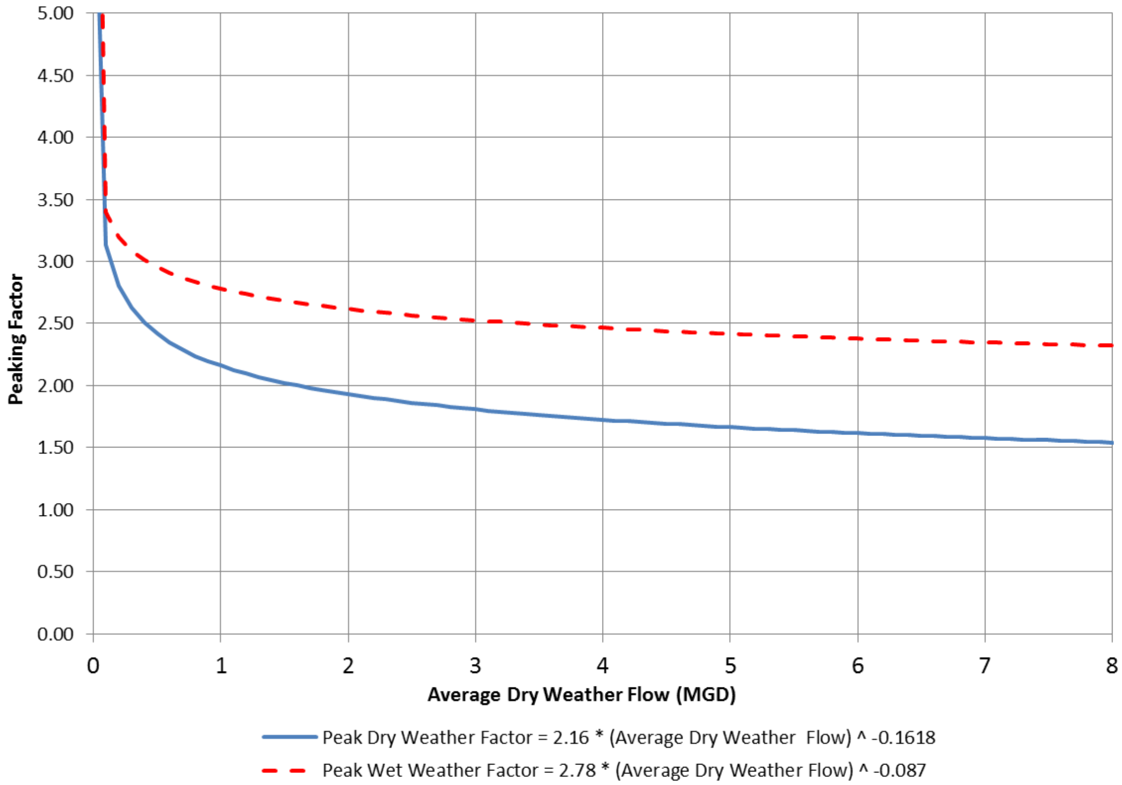
6.2 WASTEWATER SYSTEM PEAKING

Wastewater flows vary depending on the size of the tributary area, which generally means the larger the area, the lower the peaking. Figure 6-1 displays peaking curves used in this 2018 Master Plan. The figure also shows the peaking curves for wet weather flows, which includes allowances for inflow and infiltration (see Chapter 7 for more on inflow and infiltration). The peaking curves were developed by comparing flow meter data from June 2014 (dry weather) and December 2010 (wet weather) with previously recorded data.

6.2.1 Peaking Factors for Individual Projects/Developments

Efforts involving a portion of the District's wastewater system, such as development studies and localized analyses, may require using higher peaking factors appropriate for smaller tributary areas. Peaking factors for these applications are also determined based on the average annual daily dry weather flows of the area served multiplied by the appropriate peaking curve factor, as shown in Figure 6-1. Determination of the appropriate peaking factors will be at the District's discretion.

Figure 6-1 Peaking Curves for Wastewater Flows



6.3 WASTEWATER COLLECTION SYSTEM CRITERIA

The District's wastewater system includes gravity sewer mains, force mains, siphons, lift stations, and metering facilities. Table 6-2 and the information below summarize the wastewater system planning criteria. Additional details about specific facility design requirements can be obtained from the District.

Table 6-2 Wastewater Infrastructure Criteria

ITEM	CRITERIA
Gravity Main Criteria	
Minimum Pipe Diameter	8-inches
Minimum Velocity	2 fps at peak flow rate
Maximum Velocity	10 fps at peak flow rate
Manning's Roughness Coefficient	0.013
Maximum Peak d/D Design Ratio (for wet weather)	0.50 for dia. ≤ 12-inches
	0.75 for dia. > 12-inches
Minimum Slope	0.40% for dia. ≤ 8-inches
	Project Specific for diameters > 8-inches

ITEM	CRITERIA
Force Main Criteria	
Minimum Pipe Diameter	4-inches
Minimum Velocity	3 fps
Maximum Velocity	5 fps
Maximum Allowable Headloss per Thousand Feet	10 feet
Maximum Desirable Headloss per Thousand Feet	5 feet
Hazen-Williams C-factor	120
Siphon Criteria	
Minimum Velocity	3 fps
Maximum Velocity	5 fps
Maximum Allowable Headloss per Thousand Feet	10 feet
Maximum Desirable Headloss per Thousand Feet	5 feet
Hazen-Williams C-factor	120
Lift Station Criteria	
Minimum Number of Pumps	3, each with variable frequency drives (VFDs)
Minimum Pump Capacity	Duty pumps each capable of handling ultimate wet weather capacity
Standby Capacity	100% of largest pump capacity
Emergency Power	Required for full load, Permanent
Emergency Storage Capacity	4 hours of ultimate peak wet weather flow

6.3.1 Easements

Ordinance 200, adopted in August 2016, updated the District's easement policy. The District prefers that pipelines be placed within an existing dedicated street or right-of-way and that open space areas are avoided. Pipelines (and certain facilities) may be located within an easement if no other reasonable alternate alignment exists. The minimum easement width has been established at 20 feet and the pipeline should be placed toward the center of the easement, but in no case closer than five feet to the edge of the easement. District easements shall be exclusive and for District facilities only. Easements shall be located along one parcel, adjacent to the property line, so that the pipeline alignment does not straddle two properties and should impact the fewest number of parcels as possible. Access easements must be provided for all facilities, including reservoirs and pump stations, and also main appurtenances.

6.3.2 Gravity Mains and Siphons

Table 6-2 includes criteria for gravity mains and siphons. Gravity mains shall be sized at a minimum of 8-inches in diameter with a minimum slope of 0.4 percent and provide a cleansing (minimum) velocity of 2 feet per second under peak dry weather flow. Larger mains may be allowed smaller slopes at the District's discretion. Gravity mains 12-inches in diameter and smaller shall be sized to convey peak wet weather flows with a depth-to-diameter (d/D) ratio no greater than 0.5. Gravity mains larger than 12-inches in diameter shall be sized to convey peak wet weather flows with a d/D ratio no greater than 0.75. Siphon mains shall be sized with a minimum of 4-inch diameter to ensure the pipeline can pass solids and provide a cleansing (minimum) velocity of 3 feet per second under peak dry weather flow.

6.3.3 Lift Stations and Force Mains

Table 6-2 includes lift station criteria. Lift stations shall utilize cast-in-place concrete construction materials instead of pre-cast material, have a separate wet-well/dry-well configuration with an above ground control room, and be designed for ultimate peak wet weather conditions. Permanent backup power is required to power peak wet weather operation. Lift stations shall be installed with grinders and shall include four (4) hours of emergency peak wet weather storage in addition to typical operational storage. Pumps shall be designed to meet District pump cycling limits (pump starts shall not exceed six times per hour) and a redundant pump shall be included equal in size to the largest pump in the facility. Odor control may be required depending on site conditions. The force main shall include bypass connections and the District may require redundant force mains in certain cases.

6.3.4 District's Discretionary Authority

The Vallecitos Water District reserves the right to modify any criteria as appropriate to address project-specific considerations or issues. All design criteria established in the 2018 Master Plan are minimums and may be adjusted at the District's discretion.

7 Wastewater System Evaluation

This chapter reviews the District's existing wastewater collection, treatment, and disposal system, evaluates the system's ability to serve existing and projected future wastewater flows, and identifies necessary system improvements.

This chapter builds on information presented in previous chapters. The land use and unit demand factors developed in Chapter 2 (Land Use, Population, and Projection) form the basis for the wastewater flow projections presented here. The system planning criteria presented in Chapter 6 (Wastewater Planning Criteria) define the system performance requirements used to evaluate the adequacy and improvement needs of the District's wastewater system.

The remainder of this chapter is organized into the following sections:

- 7.1 Wastewater System Facilities
- 7.2 Existing and Future Wastewater Flows
- 7.3 Hydraulic Model Development and Calibration
- 7.4 Wastewater System Analysis
- 7.5 Recommended Wastewater System Improvements

7.1 WASTEWATER SYSTEM FACILITIES

The District's sewer service area is divided between two principal drainage basins which are named based on the treatment facility which serves it. The treatment facilities used by the District are the Encina Water Pollution Control Facility (EWPCF) and the Meadowlark Water Reclamation Facility (MRF). A third drainage basin, referred to as the Northern Tributary Area (NTA), is located in the northern part of the District which naturally drains away from the District's existing collection system. The NTA is entirely made up of rural residential and agricultural land uses and is served by on-site septic systems or by a neighboring agency. Land uses within the NTA are not planned to change and as such it is assumed that on-site septic systems will continue to service this area in the future.

The existing wastewater collection system includes treatment facilities, major conveyance facilities, gravity mains, trunk sewers, lift stations, siphons and force mains. Figure 7-1 displays the existing wastewater collection system, including the major basins, treatment facilities, and lift stations. Figure 7-2 presents a flow schematic of the District's wastewater collection system.

This section provides a description of the main components of the wastewater collection system, including:

- Sewer gravity mains
- Lift stations and force mains
- Flow meters

Figure 7-1 Wastewater System

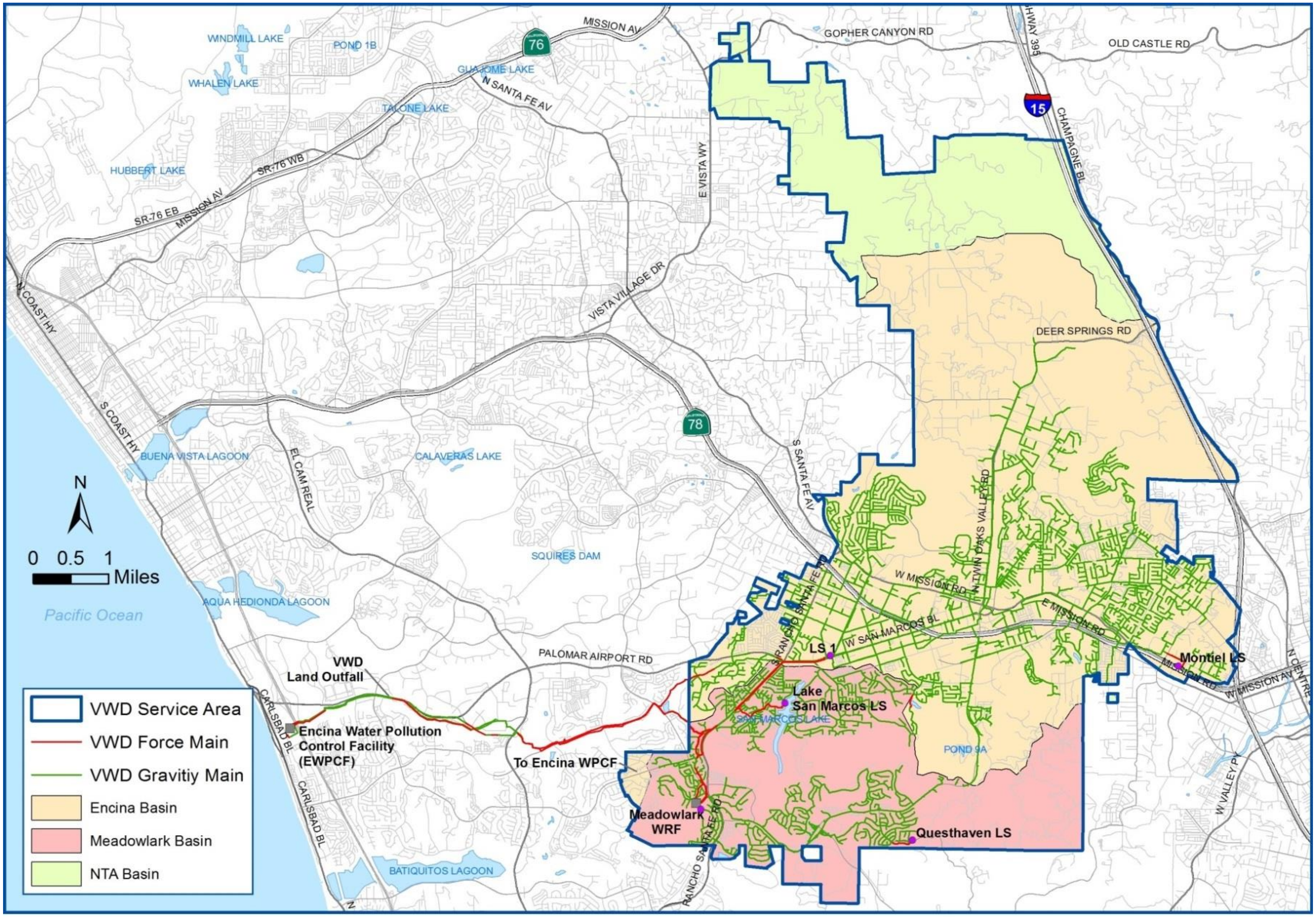
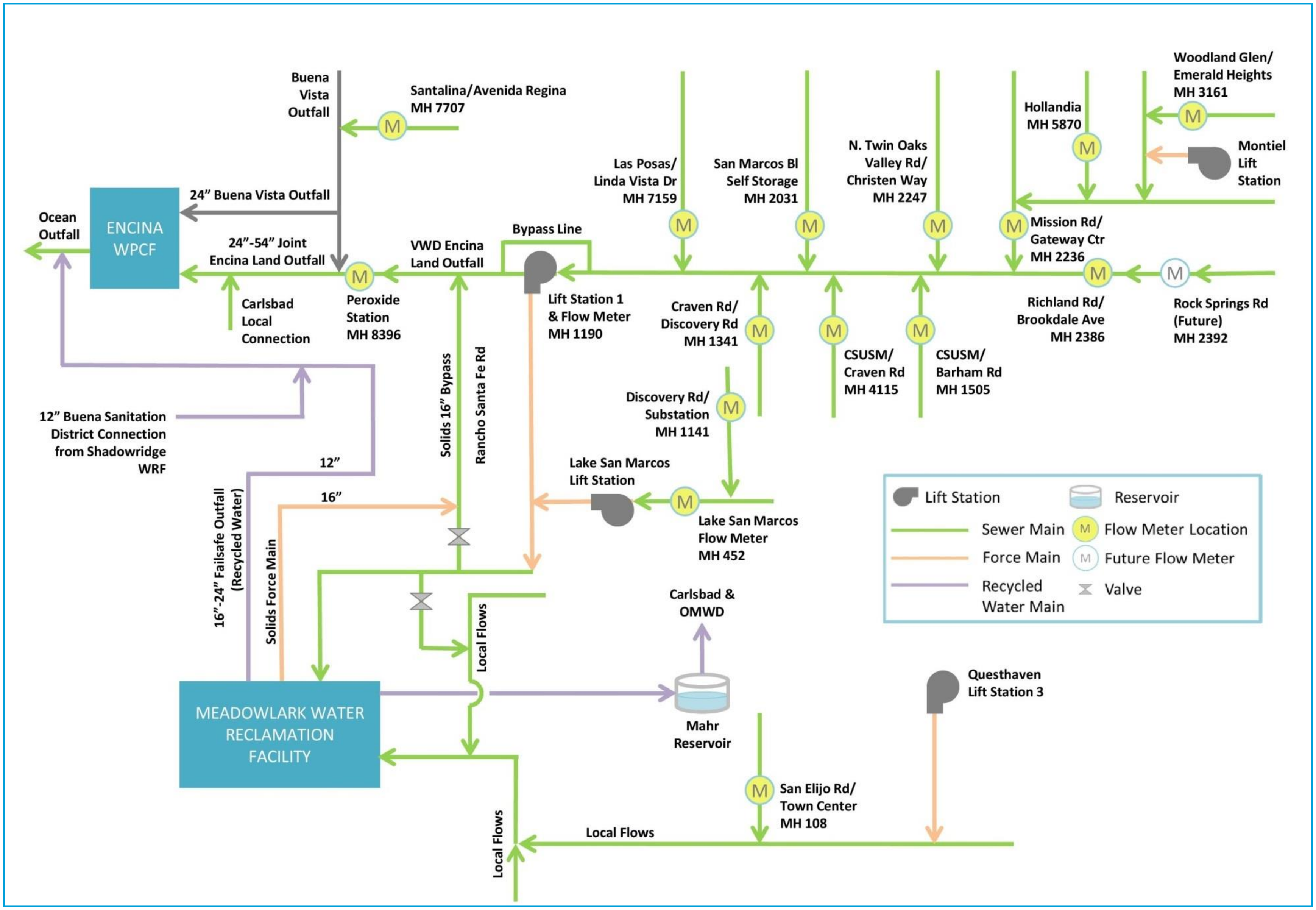


Figure 7-2 Wastewater System Schematic



7.1.1 Collection System Facilities

Sewer Gravity Mains

The District has approximately 1.35 million feet (255 miles) of gravity sewer mains ranging in size from 4-inches to 42-inches in diameter. Table 7-1 includes an inventory of pipeline types, sizes and material age. The oldest pipelines were installed in 1956. Sixty-seven (67) percent of the sewer mains are vitrified clay pipe (VCP), and 25 percent are poly-vinyl chloride (PVC) pipe.

Table 7-1 Sewer Gravity Main Inventory

PIPE TYPE	LENGTH (FEET)	DIAMETER		LINEAR FEET BY DECADE INSTALLED						
		Min	Max	1950s	1960s	1970s	1980s	1990s	2000s	2010s
ACP	2,907	8	12	245	1,249	811	0	350	252	0
CIP	776	8	30	0	73	662	0	0	41	0
CMLC	95	8	8	0	10	0	85	0	0	0
DIP	80,822	6	30	0	538	2,820	26,682	30,678	20,104	0
HDPE	1,922	36	36	0	116	0	0	0	1,806	0
PVC	338,887	6	36	0	654	0	1,318	567	301,220	35,128
RPM	13,190	16	24	0	13,190	0	0	0	0	0
STL	17	8	8	0	17	0	0	0	0	0
VCP	910,623	4	42	55,812	145,093	215,274	229,188	216,612	48,554	90
Unknown	130	10	10	130	0	0	0	0	0	0
Total	**1,349,369**	--	--	**56,187**	**160,940**	**219,567**	**257,273**	**248,207**	**371,977**	**35,218**

Source: Vallecitos Water District GIS wastewater collection system inventory data, dated 4/24/2014.

Lift Stations

There are currently four wastewater lift stations in operation, as shown on Figure 7-1 and in the flow schematic in Figure 7-2. The lift stations are all dry-well/wet well facilities. Table 7-2 summarizes the lift stations currently operating within the District.

Table 7-2 Lift Station Summary

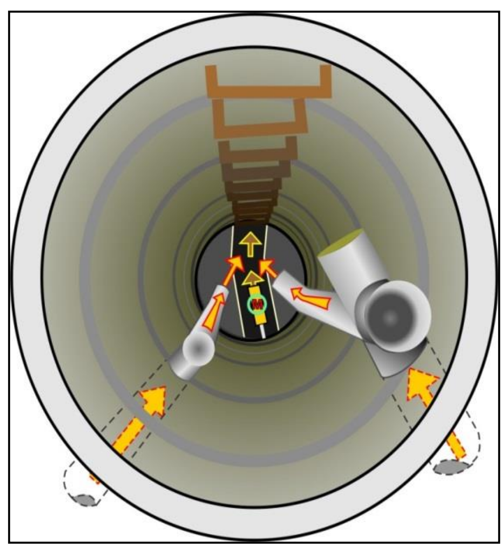
NAME	NO. OF PUMPS	PUMP CAPACITY (GPM)	FIRM CAPACITY (GPM)	HEAD (FEET)	HORSEPOWER	EMERGENCY GENERATOR
Lift Station 1	4	3,100	3,100	158	2 - 50 hp Variable 2 – 125 hp Variable	On Site
Lake San Marcos Lift Station	3	896	1,792	148	100 hp Variable	On Site
Questhaven Lift Station	2	600	600	85	30 hp Constant	On Site
Montiel Lift Station	2	100	100	63	7.5 hp Constant	Portable connection

Source: Vallecitos Water District As-built records and information.

Lift Station 1

Lift Station 1 is located in the Encina Basin along San Marcos Boulevard. Lift Station 1 is designed to divert wastewater from entering the land outfall by pumping to the MRF. The station includes two grinders and four variable speed pumps. The lift station also includes a chemical feed system that injects trioxyn to the forcemain and sulfend to the diversion bypass. The facility currently operates at a capacity of 3,100 gpm. Two manually operated sluice gate valves are located in the bypass vault. The normally open valve allows flows into Lift Station 1. A second valve can be opened to relieve flows into the Land Outfall during high flows.

In the long term, pumping at Lift Station 1 will be reduced as the San Elijo Hills Development and the tributary areas to the Questhaven Lift Station builds out, resulting in less wastewater to be diverted from Lift Station 1. Lift Station 1 normally pumps flows via a 7,700 foot, 16-inch diameter RPM force main (reinforced with Insituform lining in 1993) to Rancho Santa Fe Road and Lake Ridge Drive where flows join the pumped flows from the Lake San Marcos Lift Station. The combined pumped flows from the two lift stations are conveyed southerly down Rancho Santa Fe Road to the MRF via a combination of dedicated gravity and pressure mains. Lift Station 1 also has the ability to pump flows through a parallel 8-inch diameter ACP force main. However, this force main is not currently utilized.



The Lake San Marcos flow meter does not capture all the inflow to the lift station, only those flows that are conveyed under Lake San Marcos, as shown.

Lake San Marcos Lift Station

The Lake San Marcos Lift Station is located in the Meadowlark Basin and serves the Lake San Marcos community area. This facility is important because it serves the natural drainage areas of Lake San Marcos and must reliably convey all flows from the lake-front community. The influent manhole at the facility is deep (due to the influent gravity main under the lake) and includes a flow meter. The flow meter does an adequate job capturing flow data from the gravity main coming from underneath Lake San Marcos but doesn't capture the inflow from the smaller collection pipes conveying local flows at higher elevations in the manhole. Lake San Marcos Lift Station pumps flows via a 4,100 foot, 12-inch diameter DIP force main to Rancho Santa Fe Road and Lake Ridge Drive where flows join the pumped flows from the Lift Station 1. The combined pumped flows from the two lift stations are conveyed southerly down Rancho Santa Fe Road to the MRF via a combination of dedicated gravity and pressure mains.

Questhaven Lift Station

The Questhaven Lift Station is located in the Meadowlark Basin adjacent to the San Elijo Hills Development and is the newest lift station in the District. The facility was built to serve a small development east of San Elijo Hills and eventually the southeast portion of the District. Two pumps are currently installed, leaving a third pump slot vacant for a future pump. The two existing pumps will be upsized at the same time that the third pump is installed. Questhaven Lift Station pumps flows via a 1,250 foot, 8-inch diameter PVC force main in Questhaven Road to Grain Mill Road where flows are then conveyed via gravity to the MRF. The station was sized based upon the results of the 2002 Master Plan and the Southeastern Area Sewershed Study. Pump selection was based on the assumption that the future southeastern area would drain to the station via a series of local pumping stations.

Montiel Lift Station

Montiel Lift Station is located in the Encina Basin along State Route 78 just east of Nordahl Road. The downstream sewers in the shopping center east of Nordahl toward Bennett Avenue continue to have frequent odor issues, which the District attributes to the nightly low flows and long retention times at the Montiel Lift Station. The District has the ability to connect a portable generator during power failures. Emergency storage would be a benefit here, but the pump station site is wedged between the freeway and a shopping center and space is limited. Montiel Lift Station pumps flows via an 1,850 foot, 6-inch diameter DIP force main in Montiel Road to Nordahl Road where flows are then conveyed via gravity to Lift Station 1. Removal of this pump station may be feasible if tributary flows are diverted to the City of Escondido via a new pipeline under Highway 78.

The Montiel Lift Station is the District's smallest lift station.

Flow Meters

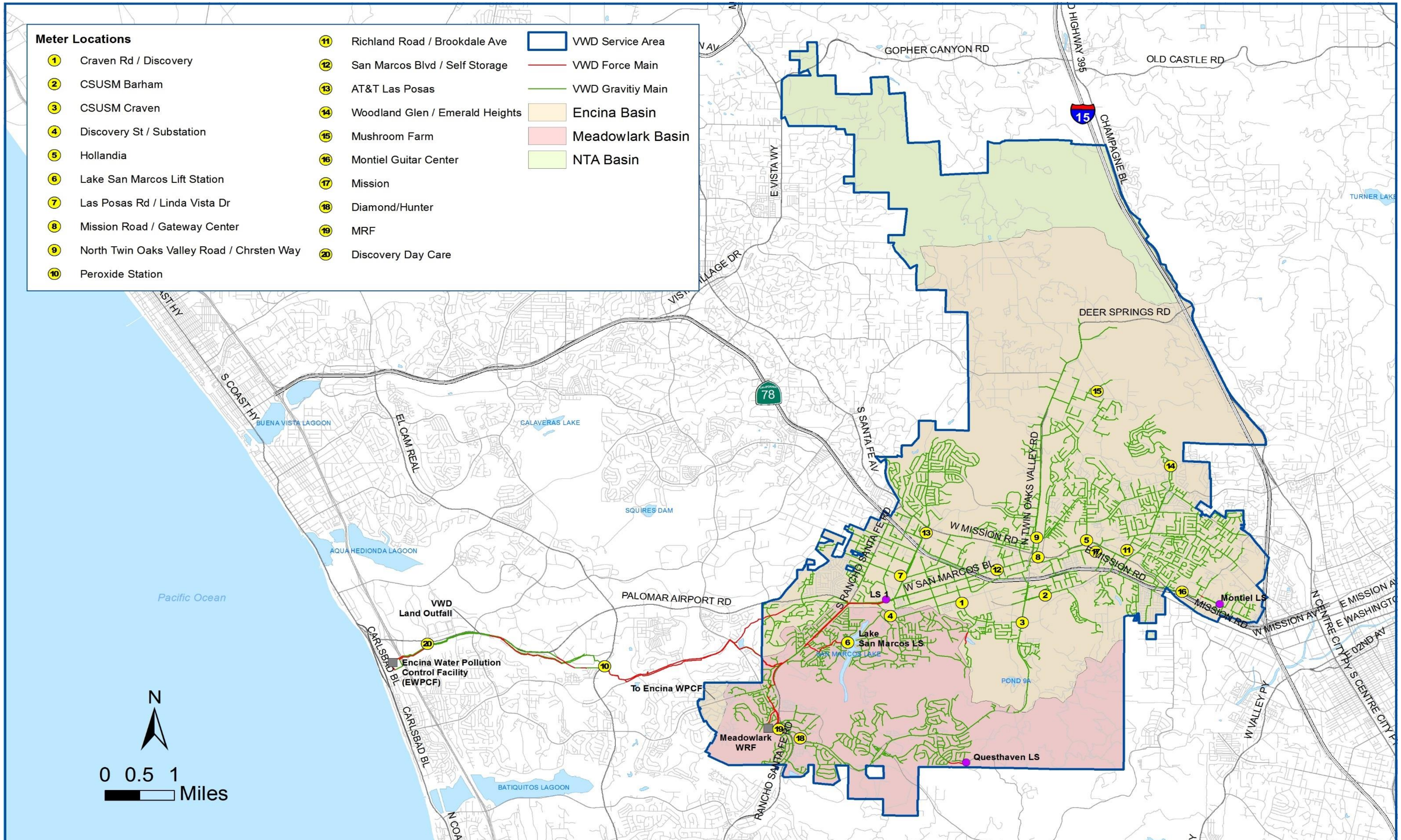
The District currently meters its wastewater collection system at 20 locations distributed throughout the collection system. Figure 7-3 displays the locations of the existing and proposed flow meters.

Sewer flow meters provide critical data on wastewater flows and help pinpoint sources of inflow and infiltration within individual sewer basins. The flow meters also assist with hydraulic modeling, calibration of the hydraulic model and development of CIP projects. All the District's flow meters are connected to its SCADA system, which allows the District to be alerted when high flows or depths are being experienced. This allows the District to determine blockages and avoid sanitary sewer overflows. Each meter is calibrated annually by operations staff. Meters that are used for billing purposes only, such as those metering CSU San Marcos, are calibrated and certified annually by a third party to ensure accuracy.

The flow meters are also being used by the District to aid in their smoke testing program by assisting in identifying locations of high inflow and infiltration, or "hot-spots." If the flow meter shows signs of significant inflow, the area of influence or concern can be determined and scheduled for smoke testing. In general, the District's metering program provides sufficient coverage of the sewer collection system.

The District generally observes a residential- type flow pattern with low flows occurring in the early hours of the day, peak flows occurring in the early morning, average flows occurring in the mid-afternoon and peaking again in the evening. The historical flow meter data was utilized in the VWD sewer model calibration, discussed in further detail in Section 7.3.2.

Figure 7-3 Existing Wastewater System Meter Locations



7.1.2 Wastewater Treatment Facilities

The District utilizes two wastewater treatment facilities, a land outfall, and a sludge pipeline to failsafe pipeline to treat and convey wastewater flows. Exhibit 7-1 displays these major facilities, including the Encina Water Pollution Control Facility and interconnections with other agencies.

Encina Water Pollution Control Facility

The Encina Wastewater Authority (EWA) is the primary wastewater treatment provider utilized by the District. The Encina Water Pollution Control Facility (EWPCF) also serves the City of Carlsbad, City of Encinitas (Encinitas Sanitary Division), Leucadia Wastewater District and Buena Sanitation District (City of Vista). The EWA was established to provide for the day-to-day operation of the EWPCF. Key milestones for the EWA include:

- 1961 Joint Powers Authority (JPA) formed
- 1965 Vallecitos Water District joins JPA
- 1971 Phase I Expansion to 6.75 MGD
- 1975 Phase II Expansion to 13.75 MGD
- 1988 Phase III Expansion to 22.5 MGD
- 1988 Basic Agreement modified in Revised Basic Agreement, including formation of independent Encina Administration Agency (EAA)
- 1991 EAA changes to the Encina Wastewater Authority (EWA)
- 1992 Phase IV expansion to 36 MGD (liquids capacity) and 38 MGD (solids capacity)
- 2008 Phase V expansion to 40.51 MGD (liquids capacity) and 43.31 MGD (solids and outfall capacity)

EWPCF (Ocean) Outfall

EWMPCF’s ocean outfall consists of approximately 1,000 feet on land and extends approximately 7,900 feet into the Pacific Ocean. The outfall components include:

- Surge tower and an effluent pump station (required for high flows or high tides), located at the west side of the EWPCF near the main entrance along Avenida Encinas.
- 200 feet of 84-inch diameter reinforced concrete pipeline (RCP) from the surge tower to just east of the railroad tracks.
- 6,400 feet of 48-inch diameter RCP. This original outfall segment was built in 1965 and starts at the 84-inch pipeline and continues west to a depth of approximately 80-feet in the Pacific Ocean.
- 2,300 feet of 72-inch diameter RCP. This outfall extension was constructed in 1974. It includes an 800-foot, 138-point diffuser located at depths ranging from 135 feet to 168 feet below mean lower low water (MLLW) levels.

EWPCF Peak Flow Management

Managing peak flows is an important operational consideration. The EWPCF employs peak flow management procedures and has constructed facilities to manage peak flows. The facilities were based on the 1999 PFMP. The PFMP evaluated outfall and onsite regulatory storage alternatives as a means of managing temporary peak wet weather flows. The hydraulic analysis evaluated alternatives for adding capacity at different stages of the treatment process and made recommendations based on cost, staging suitability, flexibility for multiple uses, construction impacts, and ease of implementation. The ability to build a storage facility in stages was a particularly important factor; therefore, the onsite storage alternative was selected.

The EWPCF peak flow facilities include an existing 8 million gallon (MG) open, rectangular storage tank for holding secondary effluent and a pump station allowing the secondary effluent to be diverted to the basin. The plant has provisions to incrementally increase capacity by adding two more 8 MG basins in the future, for a maximum storage capacity of 24 MG. The member agencies' ability to manage inflow and infiltration into the sewer system is a major factor in deferring additional peak flow facilities or future outfall upgrades at the EWPCF.

EWPCF Capacity Rights

The District's Unit I capacity rights were set forth in the 1998 Revised Basic Agreement and included 7.54 MGD of liquids treatment capacity and 7.54 MGD of solids treatment capacity. The most recently completed Phase V Expansion of the EWPCF was primarily solids driven. With that expansion, VWD maintained its 7.54 MGD of liquids treatment capacity, and increased its solids treatment capacity to 10.47 MGD. In 2014, EWA re-rated the EWPCF capacity and a "true-up" calculation was performed, which adjusted the District's liquid capacity to 7.67 MGD. Table 7-3 presents capacity rights at the EWPCF for the member agencies based on the latest true-up calculation.

Table 7-3 EWPCF Phase V Projected Capacity Rights

AGENCY	TREATMENT CAPACITY		OCEAN OUTFALL CAPACITY	
	Liquids (MGD)	Solids (MGD)	MGD	(%)
Buena Sanitation District	3.00	3.00	3.00	6.93%
City of Carlsbad	10.26	10.26	10.26	23.69%
City of Encinitas	1.80	1.80	1.80	4.16%
Leucadia Wastewater District	7.11	7.11	7.11	16.42%
Vallecitos Water District	**7.67**	**10.47**	**10.47**	**24.17%**
City of Vista	10.67	10.67	10.67	24.64%
Total	**40.51**	**43.31**	**43.31**	**100%**

Source: Encina Wastewater Authority, January 2009 Management Report; VWD Liquids capacity adjusted post-Phase V per the EWPCF capacity true-up calculations

Meadowlark Water Reclamation Facility

The District owns and operates the Meadowlark Water Reclamation Facility (MRF). The MRF treats wastewater to meet recycled water standards in accordance with State of California Title 22 requirements and under the provisions of Waste Discharge Permit R9-2007-0018 issued by the State of California Regional Water Quality Control Board for Region 9. The treatment process includes tertiary treatment with disinfection. A majority of the existing flows that MRF treats are diversions via Lift Station 1 along San Marcos Boulevard and Rancho Santa Fe Road, and via Lake San Marcos Lift Station along Rancho Santa Fe Road. Ultimately, the southern portions of the District will build out and contribute additional wastewater flows to the MRF, reducing the diversion from the EWPCF basin via Lift Station 1.

The MRF was recently upgraded to a capacity of 5 MGD, with a peak wet weather capacity of 8.0 MGD. It is anticipated that at buildout, approximately 3.5 MGD and 1.5 MGD of source wastewater will come from the San Elijo area (including flows from the Questhaven Lift Station) and the Lake San Marcos Lift Station, respectively, requiring little to no "make-up" wastewater during dry weather conditions from Lift Station 1. The plant does not have solids treatment capability. Solids are pumped from the MRF through a sludge pipeline to the land outfall, and subsequently treated at the EWPCF. Therefore, the District requires a higher capacity of solids treatment than liquid treatment at EWPCF. When combined with the 7.67 MGD treatment capacity of the EWPCF, the District currently has a total liquids treatment capacity of 12.67 MGD.

The District utilizes the MRF to produce recycled water for two wholesale customers – the Carlsbad Municipal Water District (MWD) and the Olivenhain Municipal Water District (OMWD). Table 7-4 summarizes the agreement conditions.

Table 7-4 MRF Wholesale Recycled Water Customer Agreement Conditions

AGREEMENT COMPONENTS	CARLSBAD MWD		OMWD
Capacity	*Apr-Nov* 3.0 MGD	*Dec-Mar* 2.0 MGD	1.5 MGD
Agreement Type	Take or Pay		Take or Pay
Mahr Reservoir Capacity[(1)]	32 MG		16 MG
TDS[(2)]	1,000 ppm		1,000 ppm
Chlorine Residual[(3)]	10 ppm		10 ppm

(1) Mahr Reservoir total capacity is 54 million gallons.
(2) TDS of 1,200 ppm is acceptable during drought conditions as designated by the Metropolitan Water District of Southern California or the San Diego County Water Authority.
(3) Chlorine residual measured over 24 hours

Carlsbad MWD Recycled Water Agreement

A portion of the recycled water produced at the MRF is currently wholesaled to the Carlsbad Municipal Water District (CMWD) for non-potable reuse (landscaping, industry and agriculture). Terms of this arrangement are defined in the original June 13, 1991 agreement between the District and CMWD, and more recently, the "Agreement for Sale of Recycled Water and Use of Mahr

Reservoir between the Vallecitos Water District and the Carlsbad Municipal Water District" dated August 20, 2003. The "take-or-pay" agreement requires Carlsbad to purchase a minimum of 2 MGD from December to March, and a minimum of 3 MGD from April to November. The agreement also summarizes water quality limits including a maximum total dissolved solids (TDS) content of 1,000 parts per million (ppm) (except in specific drought conditions where 1,200 ppm is acceptable) and a 10 ppm chlorine residual averaged over 24 hours. The agreement also allocates 32 MG of the Mahr Reservoir (which has a total capacity of 54 MG) for use by CMWD, provided certain improvements are completed by Carlsbad. These improvements are complete.

OMWD Recycled Water Agreement

A portion of the recycled water produced at the MRF is currently wholesaled to the Olivenhain Municipal Water District (OMWD) for non-potable reuse (landscaping, industry and agriculture). Terms of this arrangement are defined in an October 24, 2003 agreement between the District and OMWD, the "Agreement for Sale of Recycled Water and Use of Mahr Reservoir between the Vallecitos Water District and the Olivenhain Municipal Water District." The "take-or-pay" agreement requires Olivenhain to purchase a minimum of 1.5 MGD. The agreement also summarizes water quality limits including a maximum total dissolved solids (TDS) content of 1,000 parts per million (ppm) (except in specific drought conditions where 1,200 ppm is acceptable). The agreement also allocates 16 MG of the Mahr Reservoir (which has a total capacity of 54 MG) for use by OMWD.

7.1.3 Wastewater Outfall Facilities

Recycled Water Failsafe Pipeline

A recycled water failsafe pipeline, ranging in diameter from 12-inches to 24-inches in diameter, extends from MRF to the EWPCF ocean outfall. The failsafe pipeline is primarily used to dispose of either secondary or tertiary effluent from MRF that is not pumped to the Mahr Reservoir or treated effluent that cannot be sold as tertiary. Westerly portions of the failsafe line have been oversized to accommodate BSD and CMWD flows from existing and planned reclamation plants in their service areas. The BSD's Shadowridge WRP also connects to this pipeline. Capacity rights in the failsafe pipeline were defined in the "San Marcos County Water District, Buena Sanitation District, and The City of Carlsbad Agreement for the Operation and Maintenance of an Ocean Failsafe Treated Effluent Outfall Pipeline," dated October 26, 1981. The agreement divided the failsafe pipeline into three reaches, (VWD, Buena and Carlsbad) for the purposes of allocating capacity rights. Table 7-5 describes each reach and the respective capacity rights for each agency. The location of the failsafe pipeline is presented in Exhibit 7-1.

Table 7-5 Failsafe Pipeline Capacity Rights

PIPELINE	DIA. (INCHES)	LENGTH (FEET)	CAPACITY (%)		
			VWD	BSD	Carlsbad MWD
VWD Reach	12	26,000	100.0%	0.0%	0.0%
Buena Reach	16	7,200	50.0%	50.0%	0.0%
Carlsbad Reach	24	7,200	16.3%	16.3%	67.4%

In the 2003 Recycled Water Agreement with CMWD, it is acknowledged that under certain operational scenarios, the full production of MRF may exceed the failsafe pipeline capacity of 3 MGD, and the Mahr Reservoir may be at capacity with no additional storage available. To accommodate this event, CMWD will provide adequate facilities and operational flexibility to allow the District to dispose of additional flow into the Carlsbad recycled water distribution system. Disposal is subject to the availability of adequate capacity at the EWPCF flow equalization facility.

Land Outfall

A majority of the District's wastewater is conveyed to the EWPCF using the District's maintained Land Outfall. The Land Outfall is approximately 8 miles long and conveys flow by gravity as well as pressure through siphon sections. These sections are numbered alphabetically from east to west. The eastern portions of the Land Outfall (Gravity Section A and Siphon Section A) are owned and operated wholly by the District. The westerly facilities (Gravity Section B, Siphon Section B, Gravity Section C, Siphon Section C, Gravity Section D, and Siphon Section D) are owned by the District, with shared capacity with the City of Vista and the City of Carlsbad. Table 7-6 provides physical details for each section and estimates the physical flow capacity (MGD) based on the hydraulic model and supplemental calculations performed using a spreadsheet model.

The Land Outfall is a critical component of the District's infrastructure. The alignment includes narrow easements along environmentally sensitive corridors and major streets.

Gravity Section A includes 36-inch and 30-inch VCP sewer mains. The alignment includes a 50-foot deep tunnel segment followed by 30-inch gravity mains that generally traverse open space just south of West San Marcos Boulevard. These segments were built in 1984 as part of the Land Outfall Interceptor (VWD Drawing 1691).

Siphon Section A generally runs along a stream course and cross-country south of West San Marcos Boulevard and Palomar Airport Road, starting just west of Acacia Drive and continuing westerly under Poinsettia Drive and terminating at El Camino Real. Siphon A consists of three main pipeline segments, including: a 24-inch diameter PVC forcemain east of Melrose Avenue; a 24-inch diameter ductile iron pipe forcemain west of Melrose Avenue; and approximately 400 feet of 20-inch diameter ductile iron pipe at the siphon terminus just east of El Camino Real. When the 24-inch diameter PVC section was installed in 2005 (the section from Melrose Drive heading east), the existing ductile iron pipe was abandoned in place and may still be serviceable with rehabilitation and slip-lining. Other facilities connected to Siphon A include the 16-inch Rancho Santa Fe Road bypass (which includes solids from the solids pipeline from MRF); and a 10-inch emergency bypass from the siphon to a City of Carlsbad force main (in Bressi Ranch). Odor control for Siphon A is provided by the Poinsettia Bioxide Station adjacent to Poinsettia Avenue. The facility went into operation in 2009 and replaced a peroxide station adjacent to El Camino Real. Flow meter VA-1 was located at the former peroxide station along El Camino Real and continues to operate.

Table 7-6 Land Outfall Summary

FACILITY	DRAWING	DIAMETER (INCHES)	LENGTH (FEET)	MATERIAL
Lift Station 1 to Tunnel	1691 Sheets 36-37	36	1,470	VCP
Tunnel Transition	1691 Sheet 35	36	350	VCP
Tunnel Section	1691 Sheet 33A-35	36	3,460	VCP
Tunnel Exit to Siphon A	1691 Sheets 32 – 33A	30	1,700	VCP
Siphon A West of Melrose	2500	24	6,000	PVC
Siphon A East of Melrose	2111; 2131	24	10,770	DIP
Siphon A Outlet	1691 Sheet 19A	20	380	DIP
21" Gravity Segment	1691 Sheet 19A	21	150	VCP
30" Gravity Segment	1691 Sheets 18 - 19	30	1,440	VCP
Siphon B	1691 Sheet 18	30	400	DIP
Gravity Section	1691 Sheets 17 - 18	30	460	VCP
Siphon C Upstream Section	1691 Sheet 17	30	760	DIP/CMLC
Siphon C Downstream Section	1691 Sheets 16-17	24	830	CMLC
30" Segment	1691 Sheets 9-16	30	10,150	VCP
36" West Segment	1691 Sheets 8-9	36	770	VCP
33" Segment	1691 Sheet 8	33	560	VCP
36" West Segment	1691 Sheet 8	36	300	VCP
39" Segment	1691 Sheets 7-8	39	1,260	VCP
Siphon Section D (Freeway Crossing)	1691 Sheet 6	48 (Slip-lined)	770	Slip-lined DIP

Joint Capacity Land Outfall Facilities

From El Camino Real to the EWPCF, the District owns the Land Outfall, but shares capacity with Carlsbad and BSD. Capacity rights in the Land Outfall were defined in the "Palomar Joint Land Outfall Interceptor Interagency Agreement," dated January 8, 1985. Table 7-7 summarizes the capacity rights for each agency in the land outfall. The facilities include three siphons, and gravity pipelines ranging from 21-inches to 39-inches in diameter. The pipeline conveys flows westerly and is generally aligned south of, or with, Camino Vida Roble and Palomar Airport Road.

Table 7-7 Land Outfall Capacity Rights

AGENCY	CAPACITY (MGD)	PERCENTAGE (%)
City of Carlsbad	5.00	23.98
Vallecitos Water District	12.10	58.03
Buena Sanitation District	3.75	17.99
Total	**20.85**	**100.00**

Source: Palomar Joint Land Outfall Interceptor Interagency Agreement, dated January 1985. Capacity shown based on design capacity, not peak flow capacities shown on previous table.

Gravity Section B consists of 30-inch diameter VCP pipeline, with the exception of approximately a 150-foot section of 21-inch diameter VCP pipeline which conveys wastewater flows from Siphon A at El Camino Real. This section conveys District flow from Siphon A through the Peroxide Metering Station, south along El Camino Real where it joins flows from the City of Carlsbad, and then westerly across El Camino Real to Siphon Section B south of Camino Vida Roble.

Siphon Section B is approximately 400 feet of 30-inch diameter ductile iron pipe, which conveys wastewater flows by pressure to avoid utility conflicts from Gravity B to Gravity C, south of Camino Vida Roble.

Gravity Section C is an approximate 500-foot section of 30-inch diameter VCP pipeline, which conveys wastewater flows from Siphon B to Siphon C, south of Camino Vida Roble.

Siphon Section C is approximately 1,600 feet in length and consists of 30-inch forcemain constructed of both ductile iron pipe and cement mortar lined and coated (CML&C) steel pipe; and 24-inch diameter CMLC steel pipe forcemain. Siphon C conveys wastewater flows from Gravity C by pressure underneath a low elevation point to connect to Gravity D in Palomar Oaks Way.

Gravity Section D is approximately 13,000 feet in length of VCP pipe, which ranges in diameter from 30-inch to 39-inch. Gravity D conveys wastewater flows from Palomar Oaks Way westerly along Palomar Airport Road to Armada Road, where the pipeline heads south-westerly in the canyon to Interstate 5. Numerous connections to the Land Outfall from the City of Carlsbad occur along this alignment. BSD's connection to the outfall is within this segment, however, BSD has not used their contracted capacity and a new planned outfall may permanently divert their flows out of the outfall.

Siphon Section D is an approximately 800 feet of 48-inch slip-lined ductile iron force main (the original pipeline prior to slip-lining was 54-inches in diameter). Siphon D conveys wastewater flows from Gravity D by pressure underneath Interstate-5 to the EWPCF inlet structure.

7.2 EXISTING AND FUTURE WASTEWATER FLOWS

This section summarizes the existing and projected average, peak dry and peak wet weather wastewater flows to be used for sewer system evaluation and design.

7.2.1 Existing Wastewater Flows

From 2010 through 2014 the District conveyed average annual wastewater flows of approximately 3.42 MGD to the EWPCF (including solids from the MRF) and 3.65 MGD to the MRF. The total average annual (2010-2014) wastewater flow amounts to 6.76 MGD. This average annual total is nearly identical (slightly higher) than the 6.71 MGD cited in the previous master plan, indicating that growth has been offset by conservation and water use efficiency. The wet weather maximum day flow for the Encina Basin between 2010 and June 2014 occurred during a series of storms culminating on December 22, 2010. This storm event resulted in a flow of 13.92 MGD to the EWPCF (including 0.60 MGD of solids from the MRF) and a peak flow at the MRF of 5.83 MGD. The total wet weather maximum day flow was 19.15 MGD. Table 7-8 summarizes the average annual and peak wet weather wastewater flows for the District.

Table 7-8 Existing Wastewater Flow Summary

TRIBUTARY	AVERAGE ANNUAL FLOW (MGD)	WET WEATHER MAXIMUM DAY FLOW (MGD) (2010 STORM)
Peroxide Meter	3.42	13.92
Less Solids from Meadowlark	(0.32)	(0.60)
Subtotal Encina Basin (without solids)	**3.11**	**13.32**
Lift Station 1 & Lake San Marcos LS	2.74	4.00
Meadowlark Gravity	0.91	1.83
Subtotal Meadowlark Basin	**3.65**	**5.83**
Total District	**6.76**	**19.15**

Notes:
Average flows are based on District's January 2010 to June 2014 metered flow data.
Peak Wet Weather based on December 22, 2010 storm event and is the peak hour flow during the storm event.
Lift Station 1 and Lake San Marcos LS flows are combined since they operate together to divert flows to MRF.

Wet Weather Considerations

Peak (instantaneous) flows within a wastewater collection system occur under two general conditions: dry weather and wet weather. Dry weather peak flows are defined as peak instantaneous wastewater flows that occur on a daily basis without the influence of a storm event. Peak wet weather flows are defined as peak instantaneous wastewater flows that occur as a result of inflow and/or infiltration occurring during one or multiple storm events during the rainy season. Inflows include large flows over a short duration coming from specific point sources (such as illicit connections to the sewer system from storm drains or roof drains). Infiltration includes flows coming from seepage into the sewer system (such as cracked sewer pipes or seepage at pipeline joints). Controlling wet weather peaking is important to avoid costly sewer system oversizing.

Inflow – The District previously conducted smoke testing in 2006 to identify inflows into the sewer system. The District's ongoing program has allowed the District to identify areas of high infiltration. Per the Wastewater Discharge Requirements, the District smoke tests three times a year and has found a number of illegal rain gutters and irrigation drain connections. The program has also allowed the District to identify missing and/or broken clean-out caps on customers' properties. All these issues put together will allow unauthorized rain or irrigation water into the system and sometimes cause the pipe capacity to reach its limits. This program has helped limit inflows into the sewer collection system.

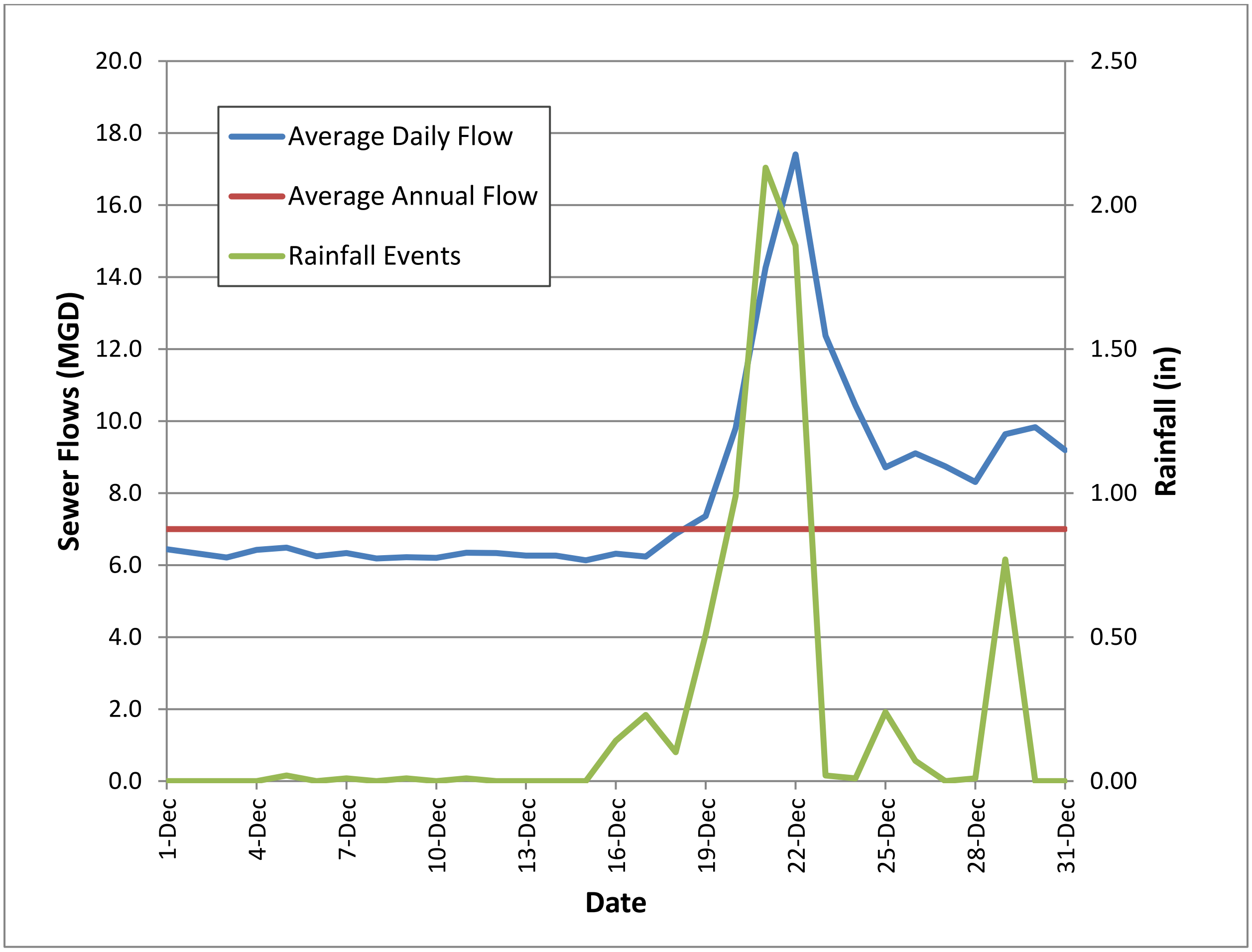
Infiltration – The District uses the sewer basin meter stations to determine areas influenced by infiltration by comparing the difference between dry-weather and wet-weather flows.

A general assessment of the inflow and infiltration to the District's collection system was made by evaluating flow records collected at the Peroxide Station and the MRF. The metering period included a large storm event in December 20-22, 2010 for consideration. This event produced the most strenuous test of the system's capacity over the evaluation period. In all, the metering period observed approximately 5.5 inches of precipitation over a 3-day period which corresponds closely to a 10-year return period storm. Metered flows were compared to the average annual flow to estimate the rainfall dependent inflow and infiltration that made it into the wastewater system.

Figure 7-4 illustrates the wastewater flows and rainfall that occurred in December 2010. The impacts of inflow and infiltration on wastewater flows can be directly correlated to the magnitude of the rainfall events. The largest increase in wastewater flows occurred on December 20-22 and resulted in a cumulative increase over the average daily flow of up to 10 MGD.

The District recognizes that as sewer pipelines age, there is more potential for inflow and infiltration to occur. The location of these aging sewers can also play a significant role in the amount of inflow and infiltration experienced. As such, the District will continue to assess aging infrastructure on an ongoing basis. The District also plans to enhance their asset management efforts in the coming years.

Figure 7-4 Inflow and Infiltration Analysis



7.2.2 Future Wastewater Flow Projections

To develop flow projections, the ultimate wastewater flow was first calculated. The ultimate wastewater flow was calculated based on the established unit rates (presented in Chapter 6) and the approved planned land use data (presented in Chapter 2). The steps used to calculate the ultimate flows are summarized below.

- The planned land use coverage was provided to the land use agencies for comment and the land use agencies provided their approved zoning maps and comments to the planned land use, as discussed in Chapter 2.
- All parcels were attributed with their approved planned land use and zoning. Approved redevelopment projects were then identified as discussed in Chapter 2. The land use database now represents the ultimate land use condition with the maximum potential development of existing and future parcels.
- Areas outside the existing sewer service area, but within the planning area, were examined in more detail. The District assisted in identifying which of these areas outside the existing service area may be served by the District in the future. The Northern Tributary Area (NTA) was assumed not to be served by the District's wastewater collection system, since it would likely sewer to a neighboring agency basin. However, wastewater collected in the NTA basin would likely be treated at the EWPCF, so ultimate flows from the NTA were considered when evaluating the District's treatment and disposal capacity needs.
- The established unit rates were applied to all parcels that indicated growth, or where the existing land use differed from the ultimate planned land use.
- For areas where there is no projected change in land use, the actual existing flow was assumed to be the same as the future ultimate flow for that parcel.
- Ultimate flows for the approved Special Project Areas, identified in Chapter 2, were calculated individually based on the most recent information provided to the District.
- Flow projections for the interim planning years were calculated by using the population increase as the basis of wastewater flow increases from one planning period to the next. Details regarding the population projection and growth summary can be found in Chapter 2.

Table 7-9 and

Figure 7-5 present the existing and projected future average wastewater flows for the District at 5-year increments from the basis year of 2014 to 2035 and ultimate buildout conditions. Peak flows were estimated by applying the District's peaking factors, presented in Chapter 6, to the average flows. Projected wastewater flows for interim years 2020, 2025, 2030, and 2035 are also provided in Table 7-9. These interim flow projections were estimated based upon SANDAG's growth forecasts for the District, described in Chapter 2.

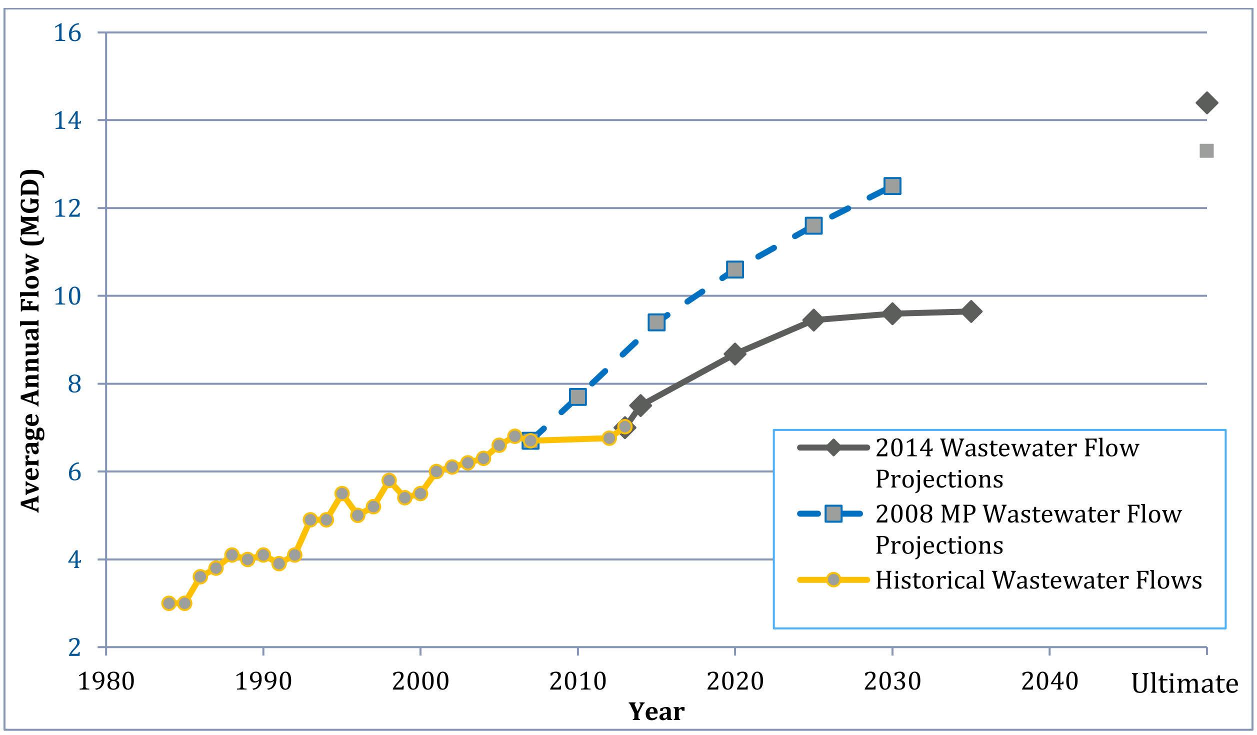
The average annual flow projection for the ultimate condition is 14.4 MGD. This total is greater than the 2008 Master Plan's ultimate flow projection of 13.3 MGD. This is due primarily to recently approved densification projects within the City of San Marcos. This total represents the maximum potential flow based on allowable land uses and existing flows. While the ultimate flow is potentially higher, continued conservation and water use efficiency would delay reaching ultimate conditions.

Table 7-9 Projected Wastewater Flows

YEAR	AVERAGE ANNUAL FLOWS (MGD)	PEAK DRY WEATHER FLOWS (MGD) (1)	PEAK WET WEATHER FLOWS (MGD) (1)
Existing 2014	7.5	11.7	17.5
2020	8.7	13.2	20.0
2025	9.5	14.2	21.6
2030	9.6	14.4	21.9
2035	9.6	14.4	22.0
Ultimate	14.4	20.2	31.7
Ultimate w/ NTA (2)	15.2	21.2	33.4

Notes:
(1) Peak Flows were estimated by applying District Peaking Curves as presented in Chapter 6.
(2) NTA flows were estimated and would need further evaluation if this area is to be connected into VWD's sewer system.

Figure 7-5 Historical and Projected Average Annual Wastewater Flows



Notes:

1. Historical Flows were derived from 2002 and 2008 Master Plans
2. 2008 MP wastewater flow projections is from 2008 MP Table 7-9

3. Existing flows derived from District's 2014 Meter Data.

7.3 HYDRAULIC COMPUTER MODEL DEVELOPMENT AND CALIBRATION

A hydraulic model of the existing wastewater system was provided by the District for this Master Plan. The District developed the model internally using SewerGEMS software by Bentley. The basis year (FY2013-2014) wastewater flows were input into the model by the District. Ultimate wastewater flows were estimated based on approved land use planning information. Major facilities were added and sized to accommodate future flows. Smaller facilities, such as local wastewater collection systems for subdivision projects, will be addressed during the land use agency approval process for each planned development, and were not included in the District-wide hydraulic model. Estimated wastewater flows from the NTA were not considered in the collection system analysis but were considered in the EWPCF capacity requirements analysis.

7.3.1 Existing System Computer Model Development

A detailed hydraulic computer model is required to analyze the complex operation of the District's wastewater system. The District developed a model of the existing collection system by obtaining the system's physical data, translating the physical data into a network of nodes and links, delineating existing wastewater drainage areas (sub-basins) and estimating the existing sewer flows.

7.3.2 Model Calibration

The sewer model was calibrated to meter data by comparing the simulated flow hydrographs to actual meter data at nine existing metered sites, where flow data was available and not highly variable. Table 7-10 summarizes the metered sewer flows for the basis data in June 2014. The purpose of the comparison was to refine the model parameters so that the simulated flow conditions reasonably approximated the measured flow conditions at each meter. These parameters generally include the dry weather diurnal curve patterns, and peak to average flow ratios (peaking factors). Calibration was achieved by assigning a specific diurnal curve to the inflow manholes in each meter basin.

Weekend flows are known to be somewhat higher, so observations made on the weekday were expected to be slightly lower than indicated by the model.

The District's Land Outfall was not calibrated for use in the model. However, the model and a spreadsheet analysis tool were used to project the flows and capacity constraints in the outfall.

7.3.3 Future System Computer Model Development

Future system dry weather and wet weather models were developed for the interim years 2020, 2025, 2030, 2035 and ultimate conditions. Projected flows were input into the model for these conditions and the models were used to assess the capacity of the existing collection system to convey projected flows.

Table 7-10 Metered Sewer Flows

NAME	MANHOLE LABEL	AVERAGE FLOW (MGD)	PEAK FLOW (MGD)
Craven Road / Discovery	1341	0.11	0.25
CSUSM Barham	1505	0.02	0.11
CSUSM Craven	4115	0.01	0.07
Discovery Street / Substation	1141	0.12	0.29
Hollandia	5870	0.03	0.10
Lake San Marcos Lift Station	452	0.23	0.61
Las Posas Rd / Linda Vista Dr	7159	0.20	0.39
Mission Road / Gateway Center	2236	1.37	2.30
NTOV Road / Christen Way	2247	0.07	0.11
Peroxide Station (Land Outfall)	8396	2.78	6.16
Richland Road / Brookdale Avenue	2386	1.39	2.24
San Marcos Blvd / Self Storage	2031	0.14	0.44
Santalina / Avenida Rd	7707	0.01	0.11
Woodland Glen / Emerald Heights	3161	0.16	0.31

Note: All metered data is from June 2014 except Richland Road/Brookdale and Woodland Glen/Emerald Heights metered data are from May 2014 due to metered data error.

7.3.4 District Planned Projects

There are two District planned projects that were completed in and after 2014 that are not in the existing system model and not in capital improvement program projects. These planned projects are considered in the future system models beginning in the first interim year 2020 through ultimate.

- Linda Vista East Sewer Upsizing and Realignment Project (as-builts approved August 2015)
- Interceptor Replacement – Phase I Project (as-builts approved April 2014): a new 36-inch diameter pipeline that runs west along the San Marcos Creek from Johnston Lane to Travelers Way before it bends south to cross the SR 78 Highway and connects back to the existing 39-inch diameter interceptor.

7.4 WASTEWATER SYSTEM ANALYSIS

The District sewer model and wastewater flow projections were used to analyze the existing system, interim systems, and ultimate wastewater system. Lift station capacity requirements were analyzed based on model flow projections and the District's lift station and force main design criteria. The pipeline capacity assessment was based on hydraulic modeling. The results of these analyses are compiled below. The resulting projects are consolidated and described in the Capital Improvement Program (CIP) section, Chapter 8.

7.4.1 Lift Station Capacity Assessment

Table 7-11 summarizes the existing and ultimate projected flows for the District's lift stations. Capacity limitations for Lift Station 1 are not applicable because this lift station operates as a scalping station providing supplemental wastewater to the MRF. This station is operated at or near capacity during low flow periods to supplement flows to the MRF and during wet weather when up to 3 MGD needs to be diverted to the MRF to relieve capacity in the Land Outfall. Over time, as flows from the San Elijo area increase, the need to divert during low-flow periods via Lift Station 1 will diminish. However, the local flows at ultimate conditions are now projected to be less than 5 MGD, in which case Lift Station 1 would be required to operate long-term to divert flows to MRF.

Table 7-11 List Station Capacity Requirements

NAME	FIRM CAPACITY (GPM)	EXISTING CONDITION		ULTIMATE CONDITION		DEFICIENCY CONDITION (CAPACITY NEEDED TO MEET ULTIMATE WW FLOWS)
		DRY WEATHER PEAK FLOW (GPM)	WET WEATHER PEAK FLOW (GPM)	DRY WEATHER PEAK FLOW (GPM)	WET WEATHER PEAK FLOW (GPM)	
Lake San Marcos Lift Station	1,792	828	965	1,227	1,337	--
Questhaven Lift Station	600	26	33	76	83	--
Montiel Lift Station	100	48	103	224	275	176 gpm

Note: The District and the City of Escondido have conceptualized a gravity pipeline alternative to the Montiel Pump Station.

No deficiency in capacity is evident at the Lake San Marcos Lift Station nor at the Questhaven Lift Station, which includes wastewater flows from future development in the southeast portion of the basin. The Montiel Lift Station was shown as deficient under the Ultimate Dry and Wet Weather Conditions. This station will require an additional 175 gpm of capacity to accommodate Ultimate Peak Wet Weather Flows. The District has also experienced odor issues from this lift station, likely caused by low velocities in the force main and nightly retention in the wet well. These factors may warrant replacement of the existing pump station rather than rehabilitation. Another alternative is to re-investigate a gravity flow option under State Route 78 and an interagency agreement with the City of Escondido.

7.4.2 Pipeline Capacity Assessment

The existing and ultimate system hydraulic computer models were used to assess pipeline capacity utilizing the design criteria presented in Chapter 6. Gravity main capacity deficiencies were identified as those pipelines which could not convey peak wet weather wastewater flows at acceptable depth-to-diameter ratios (d/D) of less than 75 percent for pipes larger than 12-inches in diameter, and less than 50 percent for pipes 12-inches and smaller in diameter. An extended period simulation using diurnal flow patterns was used to determine peak operating conditions. Deficiencies identified in the model were reviewed as a guide to develop phased recommended improvement projects. The pipeline capacity assessment identified approximately 13 miles (not including a parallel land outfall) of existing sewers requiring improvement by ultimate conditions. These projects are listed with more detail in Section 7.5.

7.4.3 Regional Conveyance and Treatment System Assessment

In January 2010 through June 2014, the District conveyed approximately 3.11 MGD and 3.65 MGD (6.76 MGD total) of annual average wastewater flow to the EWPCF and MRF, respectively, for treatment and disposal, based upon flow metering records. The total of these flows is anticipated to increase to 14.4 MGD (15.2 MGD if the NTA is included) by ultimate conditions. This section assesses the available capacity in the regional conveyance and treatment system, previously described in Section 7.1, through 2050.

Recycled Water Failsafe Pipeline

The MRF has recently been upgraded to 5.0 MGD with a wet weather treatment capacity of 8.0 MGD. The treated effluent is delivered to the Mahr Reservoir and then to CMWD and OMWD. Sludge is pumped to the land outfall via the 6-inch diameter solids line. Under dry weather conditions, up to 1.0 MGD is conveyed through the failsafe pipeline to the Ocean Outfall. VWD can discharge up to 3 MGD into the failsafe outfall in cases of emergency or when the Mahr Reservoir is full. Under wet weather conditions the District can operate the MRF at 8.0 MGD by managing flows in the Mahr Reservoir prior to a wet weather event so up to 2.0 MGD can be stored in Mahr. The District's flows to the Failsafe Pipeline are limited by its contractual capacity of approximately 3 MGD.

Encina Water Pollution Control Facility

On December 22, 2010, the District experienced its maximum day of the year and conveyed approximately 13.6 MGD of wastewater flow to the EWPCF. The District currently has excess liquids capacity at the EWPCF but will require additional treatment capacity when its average weather wastewater flows exceed 12.67 MGD (5 MGD at MRF and 7.67 MGD at EWPCF Capacity Rights). Ultimately the District will need to acquire an additional 1.73 MGD of liquids treatment capacity in the EWPCF. If the NTA ultimately sewers to the EWPCF, the District will need to acquire a total of 2.53 MGD of liquids treatment capacity in the EWPCF.

For the existing average flows, the District currently has excess solids handling capacity at the EWPCF. MRF does not provide solids handling capacity. Therefore, all solids must be processed at EWPCF. Ultimately, the District will need to acquire an additional 3.93 MGD of solids handling capacity. If the NTA ultimately sewers to the EWPCF, the District will need to acquire a total of 4.73 MGD of solids handling capacity.

The District has a total ocean outfall capacity of 10.47 MGD at EWPCF. However, the District is also able to maximize its use of the MRF treatment capacity (5.0 MGD) through the use of the Mahr Reservoir via its agreement with the City of Carlsbad. This effectively gives the District a total disposal capacity of 15.47 MGD. Therefore, no additional ocean outfall capacity needs are anticipated based on current projections.

Land Outfall Capacity Assessment

The land outfall is one of the most important District facilities to assess in this master plan. It conveys a majority of the District's wastewater a long distance through multiple jurisdictions along and within canyons, residential areas, and major business corridors. The outfall also employs a more complex hydraulic siphon/gravity operation including one pressure siphon over three miles long. Much of the land outfall is also in narrow easements, which will likely require replacement versus parallel improvements and higher construction and mitigation costs.

As noted previously, the land outfall facilities consist of four gravity and four siphon sections and convey a wide range of peak flows. Gravity Section A conveys wet weather peak flows from the District (See Table 7-9) less the flows being treated at the MRF (8.0 MGD). Siphon Section A conveys flows from Gravity Section A plus the MRF solids. The rest of the land outfall facilities convey flows from Siphon A along with tributary flows from BSD and the Carlsbad MWD. For this analysis, the tributary flows from BSD and Carlsbad MWD have been assumed at their contract capacities of 3.75 MGD and 5.0 MGD, respectively. Both the BSD and Carlsbad capacities are also assumed to enter the land outfall at their most upstream connection (the potential interconnect at Camino Vida Roble and Palomar Airport Road for BSD and El Camino Real for Carlsbad). Table 7-12 summarizes the peak wet weather flow conditions estimated using the hydraulic model.

Table 7-12 Land Outfall Peak Wet Weather Flow Conditions

YEAR	GRAVITY SECTION A (MGD)	SIPHON SECTION A (MGD)	GRAVITY SECTION B TO EWPCF (MGD)
2014	14.81	15.38	24.92
2020	16.61	17.30	26.21
2025	16.84	17.57	26.74
2030	16.89	17.62	26.41
2035	16.82	17.53	26.86
Ultimate	25.72	26.65	32.78

Contractually, the District owns approximately 12.10 MGD of capacity in the shared portions of the land outfall and, with existing peak wet weather flows of 15.38 MGD (including solids return from MRF as shown in Table 7-12 under Siphon Section A), currently has 3.28 MGD of deficit capacity. The District will have a projected deficit of 14.55 MGD by ultimate buildout.

Estimating the capacity of the land outfall presents several challenges as there are two major siphons that create backwater conditions, segments with very steep slopes, as well as uncertainties in the exact locations and amounts of flow being contributed by the City of Carlsbad which has several connection points. A conservative approach was used in assuming the contribution for these flows. In addition, the return solid flows from the MRF are also accounted for in estimating the flow into the land outfall. As the outfall was constructed with varying pipe sizes and slopes, a segment by segment analysis was conducted to compare the capacity with the projected flows.

Improvement needs were identified where the ultimate wet-weather flow (Maximum Flow) exceeds the estimated full flow capacity for each segment. Because of the siphons, some pipe segment must be surcharged in order to convey flows. In these cases, the pipe capacities are based on keeping the surcharged levels to below the manhole rim elevation by at least three feet where possible. The District should conduct regular physical condition assessments of these surcharged segments.

There are also some segments where the projected velocity is exceeding the District's velocity criteria. In most of these cases, this is a result of the segment being constructed on a steep slope, which cannot be mitigated with a larger pipe size. The District should consider implementing a regular inspection program of these segments to ensure the condition of the pipes are not deteriorating and to consider taking proactive measures in critical segments.

Table 7-13 summarizes the results of the outfall analysis and the estimated timing of the deficiency. For segments requiring capacity improvements, the timing of the deficiency was determined by considering the maximum capacity versus the projected flow for each planning period. Note that the final recommended pipe sizes and lengths of proposed improvement projects may differ from the need identified by the hydraulic analysis as some sections may not need replacing hydraulically, but replacement is recommended due to age and/or to avoid changes in pipe sizes in short reaches and to provide a more uniform pipe size through each major segment. Also, a 30-inch parallel line for Siphon A is recommended so that the existing line can be taken out of service for rehabilitation without jeopardizing the peak flow capacity of the segment.

Deferment of land outfall improvements may be possible based on peak flow mitigation measures, which also include maximizing the MRF wet weather capacity and diversions from Lift Station 1. However, based on the recorded flow of 15.38 MGD some sections of the land outfall have reached their capacity and improvements should be started in Phase 1.

Table 7-13 Land Outfall Capacity and Flow Summary

SEGMENT	EXISTING PIPE SIZE (IN)	LENGTH (FT)	MAXIMUM FLOW (GPM)	CAPACITY AT FULL FLOW (GPM)	HYDRAULIC LIMITATION	PROPOSED IMPROVEMENT			ESTIMATED TIMING OF DEFICIENCY
						NEED	SIZE (IN)	LENGTH (FT)	
Gravity A	24-36	6,909	18,514	8,246	Capacity, high velocities	Replace existing pipe	42	1,514	Phase 2
Siphon A	20-24	18,230	19,072	10,400	Capacity	New parallel line	30	18,230	Phase 3
Gravity B	21-30	1,507	22,548	7,850	Capacity, high velocities	Replace existing pipe	36	1,507	Phase 3
Siphon B	30	401	22,548	26,947	-	-	-	-	-
Gravity C	30	373	22,549	22,184	-	-	-	-	-
Siphon C	24-30	1,647	22,551	20,393	-	-	-	-	-
Gravity D	30	12,838	25,178	12,169	Capacity, high velocities	Replace existing pipe	36	1,238	Phase 1
	30-36				Capacity, high velocities	Replace existing pipe	42	5,367	Phase 1
	39				Capacity	Replace existing pipe	48	1,319	Phase 1
	30				Capacity	Replace existing pipe	36	1,233	Phase 5
	30-36				Capacity	Replace existing pipe	42	3,681	Phase 5
Siphon D	48	715	25,179	65,489	-	-	-	-	-
Gravity E	48	25	25,179	78,429	-	-	-	-	-
Total		**42,645**						**34,089**	

7.5 RECOMMENDED WASTEWATER SYSTEM IMPROVEMENTS

This section provides a recommended Capital Improvement Program (CIP) project plan for the wastewater collection and outfall systems to serve the District through buildout. The facilities shown with CIP project numbers are the proposed improvements that will be planned, funded, and constructed by the District or by developers. Additional collection system pipelines will be required to serve specific customers but will be the responsibility of the individual customers/developers. This 2018 Master Plan does not include developments that were not approved prior to June 30, 2014. As development projects are proposed, the project proponents will be required to prepare a study that will, at a minimum, define the location and size of the sewer facilities required to serve the development, including the necessary regional collection, transfer and treatment infrastructure.

Recommended CIP projects are divided into several construction phases or increments of development as defined in Table 7-14. Phase 1 includes those projects that are currently under construction or will be constructed in 2016 to 2020. Categorizing CIP projects to each phase is based on land development phasing as discussed in Chapter 2, discussion with District engineering and operations staff, and meeting the projected wastewater flows presented in Section 7.2.2. Phasing for the recommended CIP projects may be accelerated or deferred as required to account for changes in development project schedules, availability of land or right-of-way for construction, project funding limitations, environmental concerns, and other considerations.

Table 7-14 CIP Phasing - Planning Years

PHASE	PLANNING YEARS
1	2016-2020
2	2021-2025
3	2026-2030
4	2031-2035
5	2036-Ultimate

7.5.1 Lift Station Improvements

Only one lift station improvement project is recommended and described in the paragraph below. Lift stations and force mains associated with future developer-driven projects are not addressed in this master plan.

Montiel Lift Station Upgrade

To accommodate ultimate peak wet weather flows, the Montiel Lift Station requires upgrading of the existing 100 gpm pumps. The ultimate condition wet weather firm capacity required was estimated at 300 gpm. The District has also experienced odor issues from this lift station, likely caused by low velocities in the force main and nightly retention in the wet well. These factors warrant replacement of the existing pump station rather than rehabilitation. Alternatively, to avoid the need for the pump station, diversion of tributary flows to the City of Escondido sewer collection system has been proposed in the past, requiring 1,000 feet of open trench sewer and 300 feet of tunneling beneath SR-78. The District is currently assessing this alternative. Table 7-15, below, assumes the existing lift station will be replaced.

Table 7-15 Recommended Sewer Pump Station Improvements

CIP ID #	DESCRIPTION	PHASE
SB-01	Montiel Lift Station Replacement	1

7.5.2 Sewer Improvements

The 2002 and 2008 Master Plans identified a number of pipelines as CIP projects. A review of the existing wastewater system model as received from the District (facilities prior to June 2014) showed that many of these pipelines have been constructed. The remaining pipeline segments are replacement projects for either over capacity pipe segments, emergency service improvements, developer-driven improvements, or pipelines that have been deferred beyond the 2035 planning horizon.

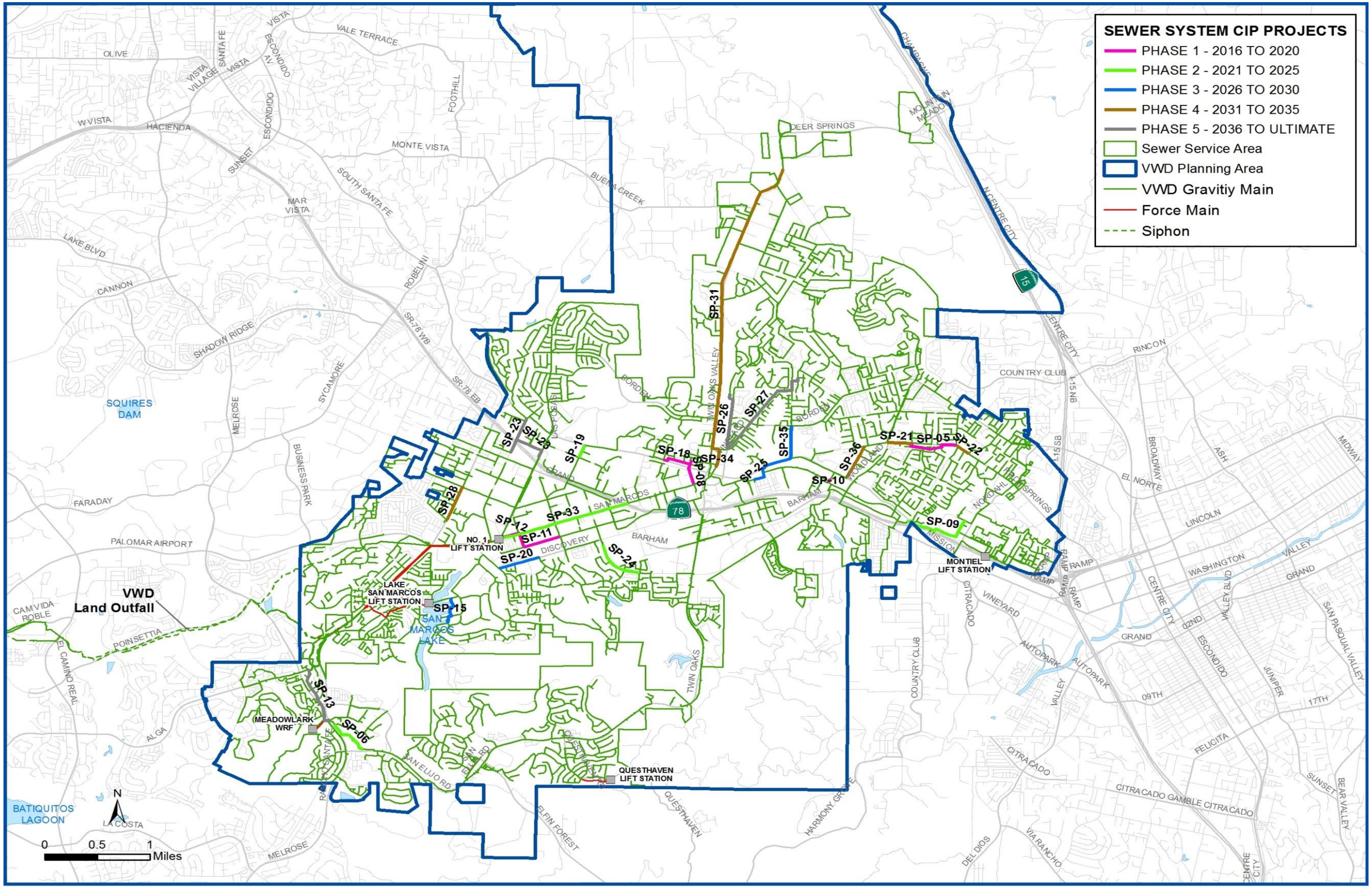
The proposed pipeline projects are listed in Table 7-16 and are described below. Proposed phasing of these projects is provided but could change depending on the physical condition of lines recommended for replacement and changes in development. Figure 7-6 shows the proposed sewer pipeline improvements.

Table 7-16 Proposed Sewer Pipeline Improvements

PHASE	CIP ID #	PIPELINE PROJECT NAME	DIAMETER (IN)	LENGTH (FT)
1	SP-05	Rock Springs Road Sewer Pipeline Replacement	12 15	1,700 900
1	SP-08	Pico Ave. Sewer Pipeline Replacement	12	1,400
1	SP-10	Diamond Siphon Replacement	15	200
1	SP-11	San Marcos Interceptor Phase 2	42	1,900
1	SP-12	San Marcos Interceptor Phase 3	42	1,800
1	SP-18	Mission Alley Pipeline Replacement	12	1,500
2	SP-06	Old Questhaven Road Pipeline	36	2,100
2	SP-09	Nordahl Shopping Center Pipeline Replacement	12 15	700 3100
2	SP-19	Bingham Sewer Pipeline Replacement	12	700
2	SP-24	Craven Road Pipeline Replacement	12	2,700
2	SP-33	San Marcos Blvd West Sewer Replacement Project	12	6,600
3	SP-15	San Pablo Walkway Sewer Pipeline Replacement	12	1,800
3	SP-20	Discovery Street East Pipeline Replacement	12	2,100
3	SP-25	San Marcos Interceptor East Pipeline Replacement	24	800

PHASE	CIP ID #	PIPELINE PROJECT NAME	DIAMETER (IN)	LENGTH (FT)
3	SP-35	Mission Road & Mulberry Drive Sewer Pipeline Replacement	12	3,600
4	SP-21	Rock Springs Road West Sewer Pipeline Replacement	15	1,300
4	SP-22	Rock Springs Road East Sewer Pipeline Replacement	12	800
4	SP-28	Linda Vista / Rancho Santa Fe Intersection Sewer Pipeline Replacement	12	2,000
4	SP-31	N. Twin Oaks Valley Road Pipeline Replacement	18	16,700
4	SP-34	San Marcos Creek North of Mission Rd Sewer Pipeline Replacement	24	1,000
4	SP-36	Richland Rd Sewer Pipeline Replacement	18	2,000
5	SP-13	Camino De Amigos Sewer Pipeline Replacement	12	3,500
5	SP-23	Pacific Street & Descanso Avenue Pipeline Replacement	12 15	2,100 1,800
5	SP-26	Woodward Street Pipeline Replacement	12	3,200
5	SP-27	Vineyard Road Sewer Pipeline Replacement	12 15	2,800 3,100

Figure 7-6 Proposed Sewer Pipeline Improvements



SP-5 Rock Springs Road Sewer Pipeline Replacement Project

Replace approximately 2,600 feet of existing 8-inch gravity main along Rock Springs Road and within an adjacent greenbelt area from Lancers Park Avenue east to Bennett Avenue with 2,600 feet of 12-inch diameter pipe. This project is included in Phase 1.

SP-6 Old Questhaven Road Pipeline Replacement Project

Replace approximately 2,100 feet of existing temporary 21 -inch gravity main located within the abandoned Questhaven right-of-way next to San Elijo and Rancho Santa Fe Roads with 36-inch diameter pipe. This project is included in Phase 2.

SP-8 Pico Ave Sewer Pipeline Replacement Project

Replace approximately 1,400 feet of existing 8-inch gravity main with 12-inch diameter in Pico Avenue from San Marcos Boulevard to the alleyway north of West Mission Road. This project is included in Phase 1. This project is expected to be completely funded by development without contribution from the District's capacity fund.

SP-9 Nordahl Shopping Center Pipeline Replacement Project

Replace approximately 3,800 feet of existing 8-inch gravity main, in the Nordahl Shopping Center, with 700 feet of 12-inch diameter and 3,100 feet of 15-inch diameter pipe. This project is included in Phase 2.

SP-10 Diamond Siphon Replacement Project

Replace the existing 85 feet of 10-inch siphon sewer with construction of new 200 feet of 15-inch siphon from the Diamond Environmental Services parking lot south to Mission Road. This project is included in Phase 1.

SP-11 San Marcos Interceptor Phase 2 Replacement Project

Replace approximately 1,900 feet of existing 21-inch gravity main, north of Discovery Street, along San Marcos Creek from South Bent Avenue to McMahr Road, with 42-inch diameter. This project also includes approximately 800 feet of a new 8-inch diameter diversion pipeline in Cribbage Lane that will alleviate capacity in the 8-inch gravity main along San Marcos Boulevard, by diverting flows to the new interceptor sewer. This project is included in Phase 1.

SP-12 San Marcos Interceptor Phase 3 Replacement Project

Replace approximately 1,800 feet of existing 21-inch gravity main in McMahr Road to San Marcos Boulevard and then westerly along San Marcos Boulevard to the existing 42-inch diameter pipeline located just west of Pacific Street, with 42-inch diameter pipeline. This project is included in Phase 1.

SP-13 Camino De Amigos Sewer Pipeline Replacement Project

Replace approximately 3,500 feet of existing 8-inch gravity main in Camino de Amigos from Alga Road south to La Costa Meadows Drive with 12-inch diameter pipe. This project is included in Phase 5.

SP-15 San Pablo Walkway Sewer Pipeline Replacement Project

Replace approximately 1,800 feet of existing 8-inch gravity main in San Pablo Walkway with 12-inch diameter pipe. This project is included in Phase 3.

SP-18 Mission Alley Pipeline Replacement Project

Replace approximately 1,500 feet of existing 8-inch gravity main in Mission Alley, between Pico Avenue and Marcos Street, with 12-inch diameter pipe. This project is included in Phase 1. This project is expected to be completely funded by development without contribution from the District's capacity fund.

SP-19 Bingham Sewer Pipeline Replacement Project

Replace approximately 700 feet of existing 8-inch gravity main north of SR-78 in Bingham Drive with 12-inch diameter pipe. This project is included in Phase 2. This project is expected to be completely funded by development without contribution from the District's capacity fund.

SP-20 Discovery Street East Pipeline Replacement Project

Replace approximately 2,100 feet of existing 8-inch gravity main in Discovery Street from La Sombra Drive east to McMahr Road with 12-inch diameter pipe. This project is included in Phase 3.

SP-21 Rock Springs Road West Sewer Pipeline Replacement Project

Replace approximately 1,300 feet of existing 12-inch gravity main in Rock Springs Road from Woodland Parkway east to Lancer Park Avenue with 15-inch diameter pipe. This project is included in Phase 4.

SP-22 Rock Springs Road East Sewer Pipeline Replacement Project

Replace approximately 800 feet of existing 8-inch gravity main in Rock Springs Road from Bennett Avenue east to Rock Springs Hollow with 12-inch diameter pipe. This project is included in Phase 4.

SP-23 Pacific Street & Descanso Avenue Pipeline Replacement Project

Replace approximately 2,100 feet of existing 8-inch gravity main with 12-inch diameter pipe and 1,800 feet of existing 8-inch with 15-inch diameter pipe. This project is included in Phase 5.

SP-24 Craven Road Pipeline Replacement Project

Replace approximately 2,700 feet of existing 8-inch pipe gravity main in Craven Road, south of San Marcos Creek to Santa Barbara Drive, with 2,700 feet of 12-inch diameter pipe. This project is included in Phase 2. This project is expected to be completely funded by development without contribution from the District's capacity fund.

SP-25 San Marcos Interceptor East Pipeline Replacement Project

Replace approximately 800 feet of existing 18-inch gravity main with 24-inch diameter pipe. This proposed replacement would occur primarily within the Twin Oaks Valley Park residential community. This project is included in Phase 3.

SP-26 Woodward Street Pipeline Replacement Project

Replace approximately 3,200 feet of existing 8-inch gravity main in Woodward Street, north from Vineyard Road, with 12-inch diameter pipe. This project is included in Phase 5 and is expected to be funded partially from development and partially from District's replacement fund.

SP-27 Vineyard Road Sewer Pipeline Replacement Project

Replace approximately 2,800 feet of existing 8-inch gravity main in Vineyard Road with 12-inch diameter pipe and 2,000 feet of existing 8-inch gravity main with 15-inch diameter pipe. This project is included in Phase 5 and is expected to be funded partially from development and partially from District's replacement fund.

SP-28 Linda Vista / Rancho Santa Fe Intersection Sewer Pipeline Replacement Project

Replace approximately 2,000 feet of existing 8-inch gravity main with 12-inch diameter pipe at the Linda Vista Drive and Rancho Santa Fe Road intersection. This project is included in Phase 4.

SP-31 North Twin Oaks Valley Road Pipeline Replacement Project

Replace approximately 16,700 feet of existing 8-inch gravity main with 18-inch diameter pipe from Deer Springs Road south to North Twin Oaks Valley Road and in North Twin Oaks Valley Road. This project is included in Phase 4. This project is expected to be completely funded by development without contribution from the District's capacity fund.

SP-33 San Marcos Blvd West Sewer Replacement Project

Replace approximately 6,600 feet of existing 8-inch gravity main with 12-inch diameter pipe along San Marcos Blvd. due to wet weather capacity constraints. This project is included in Phase 2.

SP-34 San Marcos Creek North of Mission Road Pipeline Replacement Project

Replace approximately 1,000 feet of existing 18-inch gravity main with 24-inch diameter pipe along San Marcos Creek north of Mission Road. This project is included in Phase 4.

SP-35 Mission Road & Mulberry Road Pipeline Replacement Project

Replace approximately 13,600 feet of existing 8-inch gravity main with 12-inch diameter pipe near and along Mission Road and Mulberry Road. This project is included in Phase 3.

SP-36 Richland Road Pipeline Replacement Project

Replace approximately 2,000 feet of existing 15-inch gravity main with 18-inch diameter pipe on Richland Road. This project is included in Phase 4.

7.5.3 Regional Facility Improvements

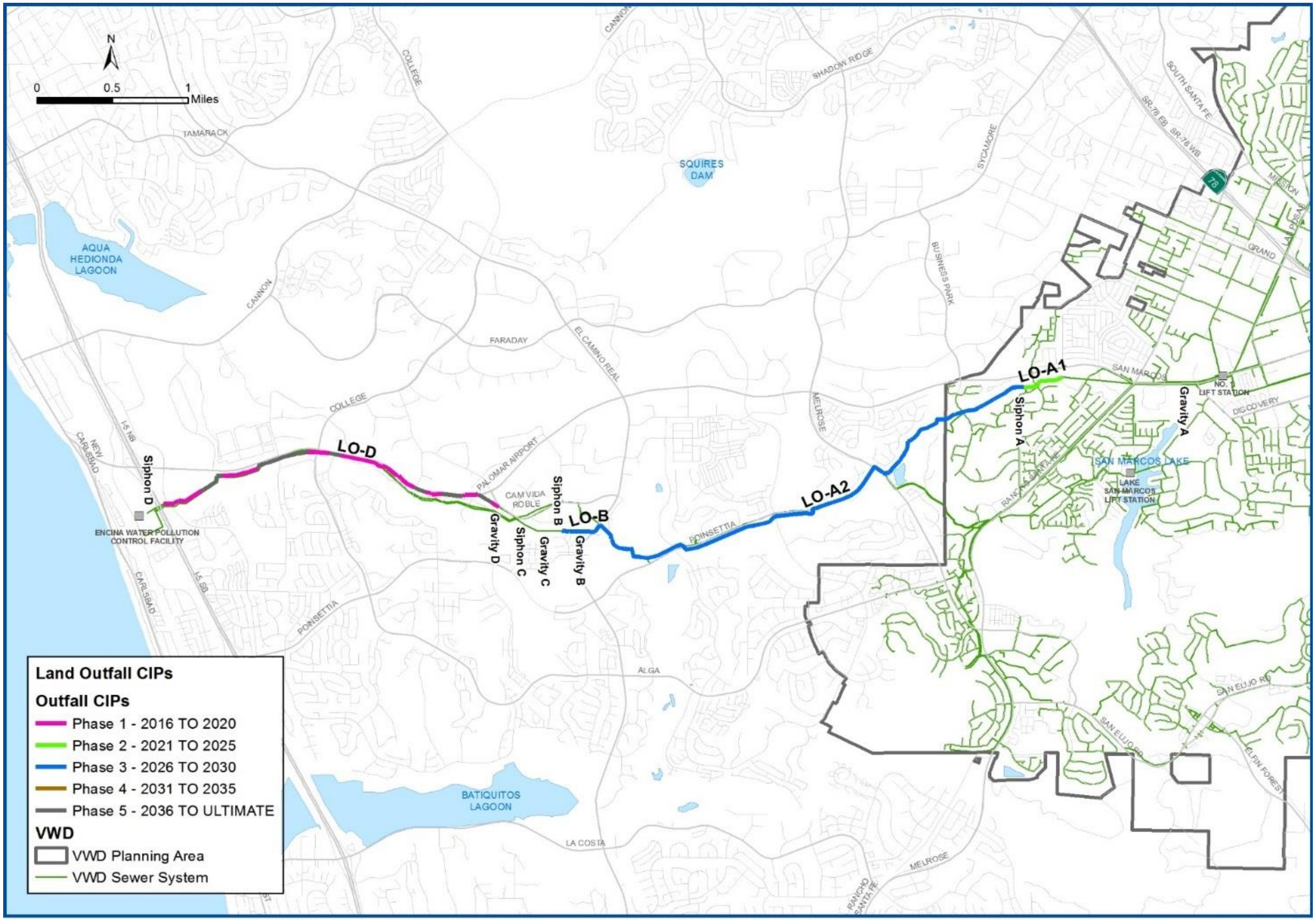
The Land Outfall is maintained by the District and conveys a majority of the District's wastewater to the EWPCF along with wastewater from the City of Carlsbad and Buena Sanitation District. The District's existing Land Outfall was identified in the capacity analysis as being deficient under peak wet weather conditions in the existing and ultimate scenarios. For CIP purposes, four improvement projects were established to consolidate the various improvement needs by outfall segment and timing of need. In the future, these improvements can be broken into smaller packages based on contractor capabilities, preferred project sizes, timing, length of construction, or other factors. Such a phasing plan is recommended to be developed as part of a more detailed condition assessment and hydraulic evaluation of the outfall.

Table 7-17 shows the recommended outfall improvement projects. Replacement of the existing outfall line is recommended in sections where there is limited working space due to the existing constricted easement and where numerous underground utilities exist. In other sections, a parallel pipeline is recommended as it will provide some level of redundancy for non-peak flow conditions and would help to avoid the need for bypass pumping during construction. In some area, tunneling of the line may be necessary due to the depth of the line. These sections were not identified as part of this Master Plan and should be further developed as part of a more detailed pre-design study. The improvement sizes listed are for the recommend replacement or parallel line. Figure 7-7 shows the proposed outfall improvements projects.

Table 7-17 Proposed Land Outfall Improvements

CIP ID	SEGMENT	ESTIMATED TIMING OF DEFICIENCY	IMPROVEMENT RECOMMENDATION	IMPROVEMENT PIPE SIZE (IN)	ESTIMATED LENGTH (FT)
LO-A1	Gravity A	Phase 2	Replace existing pipe	42	1,500
LO-A2	Siphon A	Phase 3	New parallel line	30	18,200
LO-B	Gravity B	Phase 3	Replace existing pipe	36	1,500
LO-D1	Gravity D	Phase 1	Replace existing pipe	36	1,200
	Gravity D	Phase 1	Replace existing pipe	42	5,400
	Gravity D	Phase 1	Replace existing pipe	48	1,300
LO-D2	Gravity D	Phase 5	Replace existing pipe	36	1,200
	Gravity D	Phase 5	Replace existing pipe	42	3,700

Figure 7-7 Proposed Land Outfall Improvements



8 Proposed Capital Improvement Program

This chapter presents the proposed Capital Improvement Program (CIP) for the District based on the findings of this Master Plan. The CIP includes both near-term and long-term future capacity needs for the water distribution and wastewater collection systems. There are a number of cases where it will be in the best interest of the District to conduct feasibility or preliminary engineering evaluations before embarking on a major capital investment. Costs for these planning or feasibility studies are also included in the CIP.

CIP projects developed for the District's water and wastewater systems are prioritized capacity or reliability improvements to the existing system. Phase 1 projects represent projects that are underway or expected to be completed by 2020. Phase 2 (2021-2025) projects represent high priority projects that should be planned or constructed over the next five years. Lower priority projects are identified as Phase 3 and Phase 4 projects that would be phased over the following ten years (2026-2035). Phase 5 projects identified in this Master Plan are projects that would be required to meet the projected build-out, or ultimate demand conditions.

This Master Plan CIP does not include specific rehabilitation or replacement projects due to age or condition of facilities. Rehabilitation and replacement projects will be addressed as part of the District's upcoming Asset Management Plan.

8.1 DEVELOPMENT OF UNIT COSTS

The unit cost estimates reflect full project costs (or capital costs) including planning, engineering design, environmental, permitting or regulatory compliance, legal, construction, construction management and contract administration.

Unit costs were developed based in part on input from District staff on recent construction projects in the community, comparison with local bid documents for similar projects and unit costs used by other local agencies. Many of the District projects, especially pipelines, require public involvement, traffic control, utility re-locations, and paving replacement, and accordingly have fairly high unit costs. Since some of the pipeline projects are relatively short in distance, a scaling factor has been included to address the economy of scale of constructing smaller scale projects.

To develop unit costs for the various project components, the historical cost data must be converted to current price levels to develop project cost estimates. The best available barometer of these changes is the Engineering News Record's (ENR) Construction Cost Index (CCI). This index is computed from prices of construction materials and labor and is based on a value of 100 in year 1913. Cost indices vary geographically and are dependent upon multiple variables, including labor and material markets. For this Master Plan, all costs brought up to the July 2015 ENR CCI for the Los Angeles Area, which is 10981.02. These cost estimates are based on representative available data at the time of this report. However, since prices of materials and labor fluctuate over time, new estimates should be obtained at or near the time of construction of proposed facilities.

The CIP has been divided into five phases as follows:

- Phase 1 – 2020

- Phase 2 – 2021-2025
- Phase 3 – 2026-2030
- Phase 4 – 2031-2035
- Phase 5 – Ultimate

8.1.1 Pipelines

Base unit costs for pipeline projects are presented in Table 8-1 and include the costs for material, installation, repaving, and system appurtenances that collectively constitute the principal elements of the water distribution and wastewater collection system facilities. A base unit cost has been provided for potable water mains, gravity sewers, and sewer force mains.

Table 8-1 Pipeline Unit Capital Costs

DIAMETER (IN)	POTABLE WATER ($/LF)	SEWER, GRAVITY ($/LF)	SEWER, FORCEMAIN ($/LF)
6	$170	$155	$220
8	$220	$200	$285
10	$255	$255	$330
12	$290	$310	$375
15	N/A	$375	N/A
16	$400	N/A	$520
18	$465	$495	$605
20	$520	N/A	$680
24	$660	$670	$860
30	$950	$770	$1,230
36	$1,150	$880	$1,490
42	$1,450	$1,020	$1,800
48	$1,920	$1,200	N/A

The unit costs shown above reflect an average capital cost for typical pipeline projects. Special circumstances (e.g., jacking, trenchless installations, tunnels, etc.) are considered separately on a case-by-case basis. A scaling factor was applied to each project to account for project specific issues such as difficult conditions, constrained access, congested areas, etc. For the land outfall, a scaling factor of 1.5 is applied to account for limited easement space, the need for bypassing in some sections, potential need for tunneling, and a difficult construction environment.

8.1.2 Pump Stations

Pump station capital costs for upgrades are based on the specific upgrade proposed. Specific elements typical for pump station or lift station projects would include the pump station building, landscaping, pumps and motors, miscellaneous piping and valving, instrumentation and controls, and electrical systems.

Unit capital costs for new pump station or lift station projects were estimated to be approximately $1,100 per gpm. Unit capital costs for pump stations that simply required pump replacements and small electrical or control upgrades were estimated to be $150,000 per pump. This assumes no retrofit of the building itself is required, no major electrical upgrades, and no other costs to accommodate the new pumps.

8.1.3 Reservoirs

The costs for reservoirs are based on the total capacity of storage needed. Specific elements typical for reservoirs projects include the material and installation of the tank/reservoir, limited site work, yard piping, valving, fencing, and landscaping. Based on District costs for recent reservoir projects, the unit capital cost for a new reservoir is assumed to be $1.39 per gallon.

8.2 RECOMMENDED CIP PROGRAM

The CIP projects identify facilities to meet existing system needs based on the District's design criteria for the water and wastewater systems. As previously discussed, the CIP projects are presented in five major phases of work based on priority needs.

8.2.1 Water Supply

Since the previous Master Plan, the reliability of the District's water supply has benefitted significantly from the recently completed connection to the 50 MGD Claude "Bud" Lewis Carlsbad Desalination Plant and the purchase agreement with the Olivenhain Municipal Water District. In Chapter 4 of this Master Plan, additional opportunities to expand or diversify the District's water supply were presented. In Chapter 5, additional analysis was conducted to consider increasing the use of the desalination supply in the future. This could require a new pump station to be able to utilize the full amount of water. Another option would be for the District to adjust the terms of the desalination water agreement such that the District could take less desalination supply, without penalty or cost, during low demands periods to avoid the additional capital improvement costs. At this time, it is anticipated that the District will continue to monitor its use and purchase of desalination supply and work with the SDCWA in determining the best options for future increases in using the desalination water. Additional investment in any of the other proposed water supply alternatives is not anticipated at this time.

8.2.2 Water Distribution System

Proposed CIP projects recommended for the District's water system are shown on Figure 8-1 and summarized in the sections below. Table 8-2 provides a summary of all water system CIPs and planning level cost opinions for each project by phase.

8.2.2.1 Reservoir Projects

Ten storage projects are proposed in this CIP. Combined, these projects would increase the District's storage capacity by approximately 38.9 MG. Capacity of the new reservoirs would total 42.9 MG as the Palos Vistas Tank is proposed to be retrofitted to expand its capacity from 4.0 MG to 4.53 MG. It is anticipated that at least 7 of the 10 proposed reservoirs will be new above-ground steel tanks adjacent to or in place of existing tanks on padded sites. The 8.0 MG Twin Oaks #3 Tank is assumed to be a pre-stressed concrete tank. The cost opinion presented in Table 8-2 considers this assumption.

8.2.2.2 Pump Station Projects

Seven water pump station projects are proposed in this CIP. Two new pump stations are proposed as part of this CIP. The 1625 High Point Hydropneumatic PS (PS-2) is intended to serve new customers in a new pressure zone. The Mountain Belle PS (PS-4) is proposed to increase system reliability and operational flexibility. It is anticipated that the Schoolhouse PS expansion project (PS-8) will require replacement of only the pumping units and not a new pump station. Based on the projected phasing, it is assumed that the remaining proposed pump station projects will require a new station to be constructed. The cost opinion presented in Table 8-2 considers these assumptions.

8.2.2.3 Pipeline Projects

Eleven water pipeline projects are proposed in this CIP. A total of approximately 55,900 feet of pipeline is estimated to be constructed or replaced.

Figure 8-1 Water System CIPs

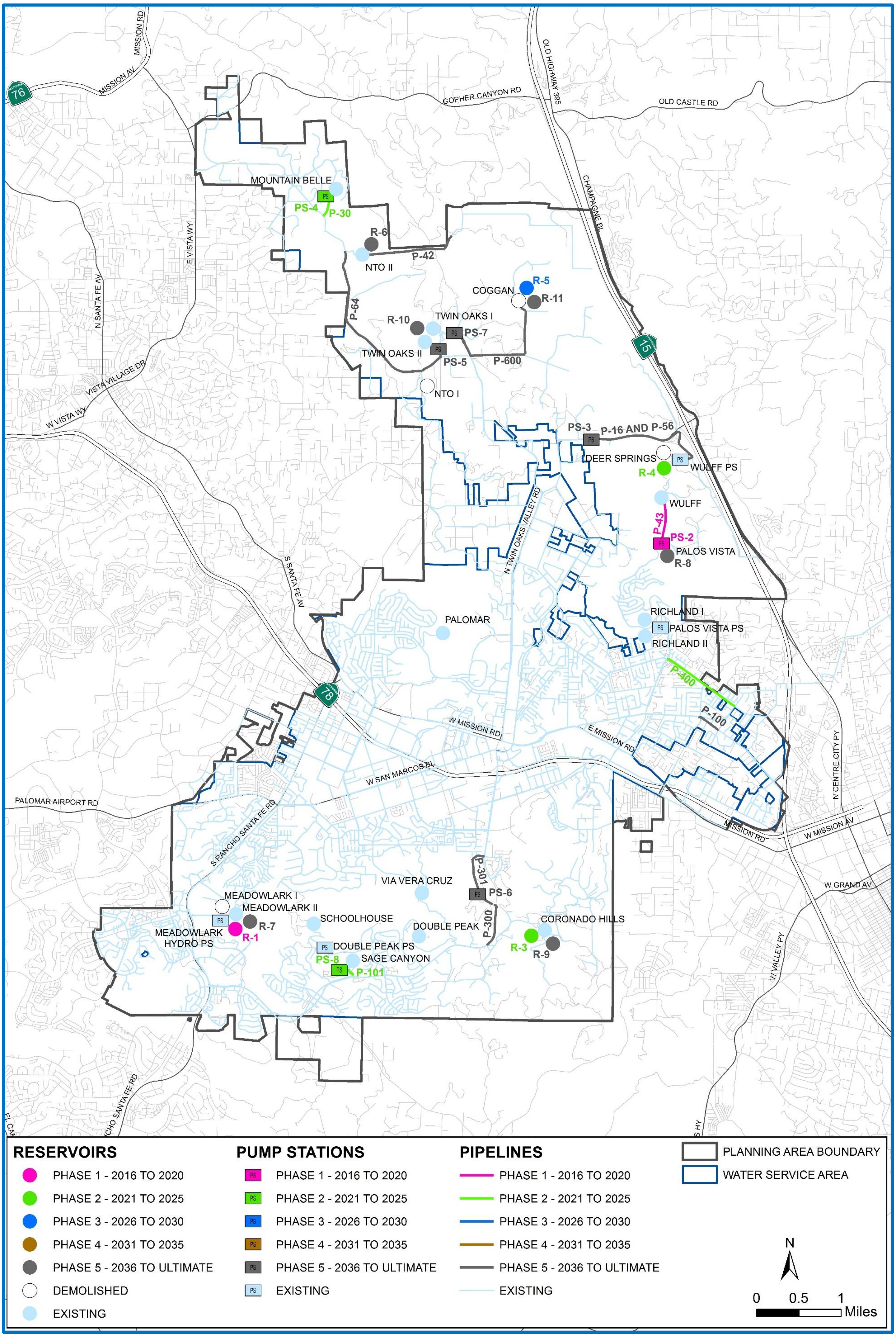


Table 8-2 Summary of Water System Capital Improvement Projects

CIP ID	TYPE	PROJECT NAME	DESCRIPTION	BASE UNIT COST	SCALING FACTOR	CIP COST	ESTIMATED COST BY PHASE				
							1	2	3	4	5
R-1	Reservoir	MEADOWLARK III	2.47 MG	$1.39	1.0	$3,400,000	$3,400,000				
R-3	Reservoir	CORONADO HILLS II	2.60 MG	$1.39	1.0	$3,600,000		$3,600,000			
R-4	Reservoir	DEER SPRINGS II; DEMOLITION OF DEER SPRINGS I	1.00 MG	$1.39	1.0	$1,400,000		$1,400,000			
R-5	Reservoir	COGGAN II; DEMOLITION OF COGGAN I	6.00 MG	$1.39	1.0	$8,300,000			$8,300,000		
R-6	Reservoir	NORTH TWIN OAKS III; DEMOLITION OF NORTH TWIN OAKS I	3.60 MG	$1.39	0.8	$4,000,000					$4,000,000
R-7	Reservoir	MEADOWLARK IV; DEMOLITION OF MEADOWLARK I	3.50 MG	$1.39	1.2	$5,800,000					$5,800,000
R-8	Reservoir	PALOS VISTA REHABILITATION & EXPANSION	0.53 MG	$1.39	1.5	$1,100,000					$1,100,000
R-9	Reservoir	CORONADO HILLS III	7.50 MG	$1.39	1.0	$10,400,000					$10,400,000
R-10	Reservoir	TWIN OAKS III	8.00 MG	$1.39	1.0	$11,100,000					$11,100,000
R-11	Reservoir	COGGAN III	3.70 MG	$1.39	1.0	$5,100,000					$5,100,000
PS-2	Pump Station	HIGH POINT HYDROPNEUMATIC PUMP STATION	1200 gpm, Firm 1800 gpm, Total	$1,100	0.5	$700,000	$700,000				
PS-3	Pump Station	DEER SPRINGS PUMP STATION EXPANSION	3400 gpm, Firm 5100 gpm, Total	$1,100	1.0	$3,700,000					$3,700,000
PS-4	Pump Station	MOUNTAIN BELLE PUMP STATION	3000 gpm, Firm 4500 gpm, Total	$1,100	1.0	$3,300,000		$3,300,000			
PS-5	Pump Station	NORTH TWIN OAKS PUMP STATION EXPANSION	6800 gpm, Firm 10200 gpm, Total	$1,100	1.0	$7,500,000					$7,500,000
PS-6	Pump Station	SOUTH LAKE PUMP STATION EXPANSION	6500 gpm, Firm 9750 gpm, Total	$1,100	1.0	$7,200,000					$7,200,000
PS-7	Pump Station	COGGAN PUMP STATION EXPANSION	5400 gpm, Firm 8100 gpm, Total	$1,100	1.0	$5,900,000					$5,900,000
PS-8	Pump Station	SCHOOLHOUSE PUMP STATION EXPANSION (NEW PUMPS)	3100 gpm, Firm 4650 gpm, Total	$150,000	1.0	$500,000		$500,000			
P-16 and P-56	Pipeline	DEER SPRINGS PS TO DEER SPRINGS RESERVOIR	8700 LF of 16-inch pipe	$400	1.0	$3,500,000					$3,500,000
P-30	Pipeline	MOUNTAIN BELLE RESERVOIR TO 1330 ZONE	1800 LF of 16-inch pipe	$400	1.0	$700,000		$700,000			

CIP ID	TYPE	PROJECT NAME	DESCRIPTION	BASE UNIT COST	SCALING FACTOR	CIP COST	ESTIMATED COST BY PHASE				
							1	2	3	4	5
P-42	Pipeline	NORTH TWIN OAKS II TO HUCKLEBERRY LANE	6400 LF of 12-inch pipe	$290	1.0	$1,900,000					$1,900,000
P-43	Pipeline	1625 HIGH POINT HYDRO ZONE TO 1567 WULFF ZONE	3000 LF of 12-inch pipe	$290	1.0	$900,000	$900,000				
P-64	Pipeline	NORTH TWIN OAKS PS TO NORTH TWIN OAKS RESERVOIR	12600 LF of 20-inch pipe	$520	1.0	$6,600,000					$6,600,000
P-100	Pipeline	ROCK SPRINGS ROAD-BENNETT AVENUE TO REES ROAD	1600 LF of 10-inch pipe	$255	1.0	$400,000					$400,000
P-101	Pipeline	SCHOOLHOUSE PS TO SAN ELIJO RD	600 LF of 20-inch pipe	$520	1.0	$300,000		$300,000			
P-300	Pipeline	SOUTH LAKE PS TO SAN ELIJO ROAD	3900 LF of 20-inch pipe	$520	1.3	$2,600,000					$2,600,000
P-301	Pipeline	TWIN OAKS VALLEY ROAD - VILLAGE DRIVE TO SOUTH LAKE PS	3100 LF of 20-inch pipe	$520	1.3	$2,100,000					$2,100,000
P-400	Pipeline	EL NORTE PARKWAY - REES ROAD TO WOODLAND PARKWAY	5300 LF of 20-inch pipe	$520	1.5	$4,100,000		$4,100,000			
P-600	Pipeline	COGGAN PS TO COGGAN RESERVOIR	8900 LF of 20-inch pipe	$520	1.3	$6,000,000					$6,000,000
					Subtotal Reservoirs	$54,200,000	$3,400,000	$5,000,000	$8,300,000	$0	$37,500,000
					Subtotal Pump Stations	$28,800,000	$700,000	$3,800,000	$0	$0	$24,300,000
					Subtotal Pipelines	$29,100,000	$900,000	$5,100,000	$0	$0	$23,100,000
					TOTAL	$112,100,000	$5,000,000	$13,900,000	$8,300,000	$0	$84,900,000

8.2.3 Wastewater System

Proposed CIP projects recommended for the District's wastewater collection and disposal system are shown on Figure 8-2 and summarized in the sections below. Table 8-3 provides a summary of all wastewater system CIPs and planning level cost opinions for each project by phase.

8.2.3.1 Sewer Pipeline Projects

There are 24 proposed sewer pipeline projects, with a total of approximately 74,000 feet of gravity sewer to be constructed or replaced as part of this CIP. Projects are identified from Phase 1 through Phase 5.

8.2.3.2 Lift Station Projects

Only one lift station improvement project is proposed as part of this Master Plan. The current improvement project is to replace the Montiel LS to accommodate ultimate peak wet weather flows and odor issues. However, the District is currently exploring an alternative to divert the flow to the City of Escondido's sewer system and thus eliminate the Montiel LS. This CIP assumes the replacement of this lift station.

8.2.3.3 Land Outfall Projects

The District's Land Outfall was identified in the capacity analysis as being deficient in several sections. A parallel land outfall was recommended in some sections and replacement of the existing line was recommended in other sections due to easement space restrictions. The Land Outfall is maintained by the District and conveys a majority of the District's wastewater to the EWPCF along with wastewater from Carlsbad and Buena Sanitation District. The Land Outfall is approximately 8 miles long and conveys flow by gravity pipelines as well as pressure through siphon sections.

For CIP purposes, four improvement projects were established to consolidate the various improvement needs by outfall segment and timing of need. In the future, these improvements can be broken into smaller packages based on contractor capabilities, preferred project sizes, timing, length of construction, or other factors. Such a phasing plan is recommended to be developed as part of a more detailed condition assessment and hydraulic evaluation of the outfall.

Due to the total length of the land outfall and the anticipated timing of needed improvements for each section, the land outfall project has been divided into four distinct improvement projects. Costs to upgrade some of these facilities may be shared by Carlsbad and Buena Sanitation District, depending on their need for additional capacity. The cost for the outfall capacity improvements is estimated to be $45 million.

Figure 8-2 Wastewater System CIPs

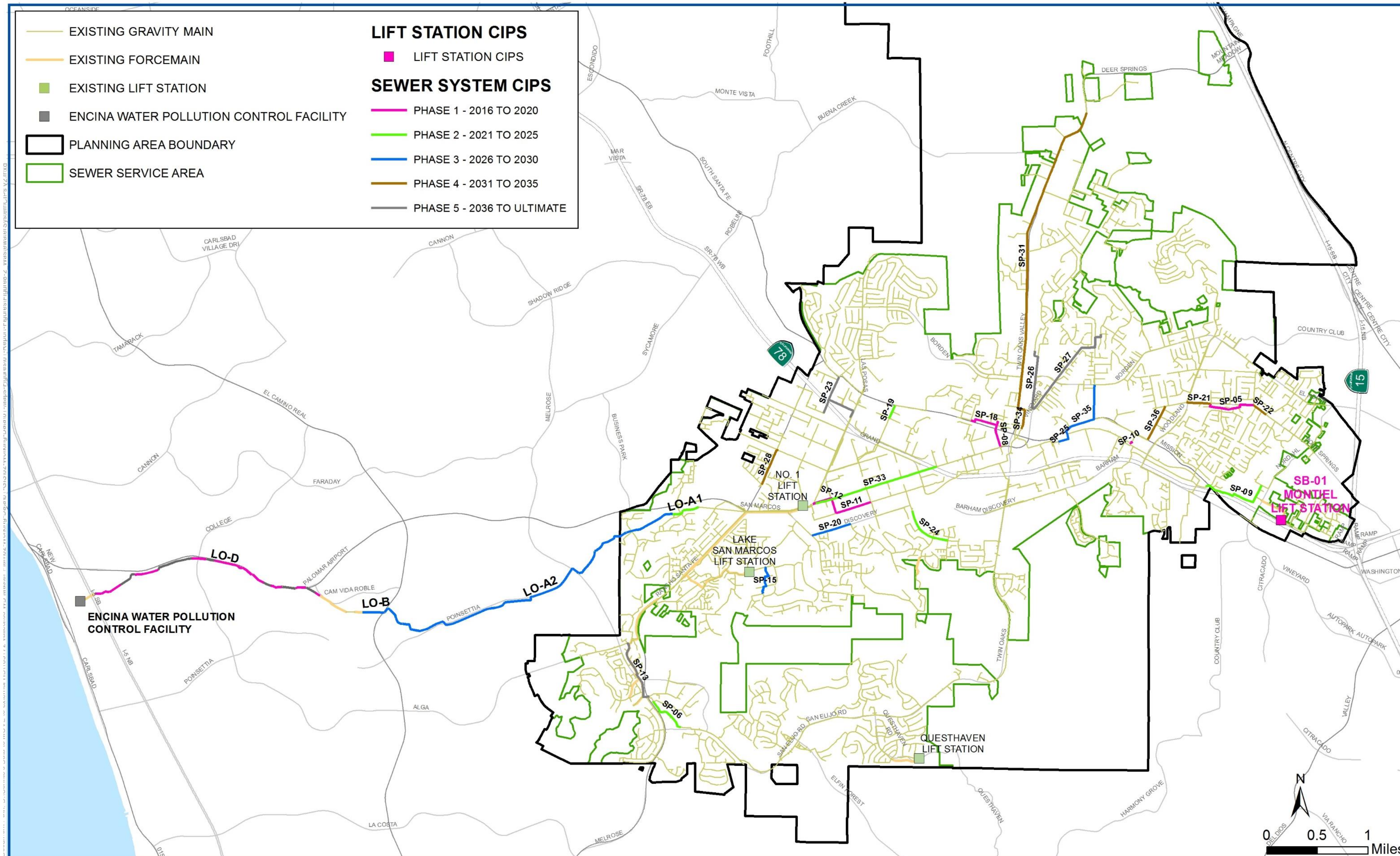


Table 8-3 Summary of Wastewater System Capital Improvement Projects

CIP ID	TYPE	PROJECT NAME	PROJECT DESCRIPTION	UNITS	BASE UNIT COST	SCALING FACTOR	CIP COST	ESTIMATED COST BY PHASE				
								1	2	3	4	5
SP-05	Pipeline	ROCK SPRINGS ROAD SEWER REPLACEMENT PROJECT	Replace 1,700 feet of 8-inch gravity main with 12-inch diameter pipe.	1,700 LF	$310	4	$3,500,000	$3,500,000				
			Replace 900 feet of 8-inch gravity main with 15-inch diameter pipe.	900 LF	$375							
SP-06	Pipeline	OLD QUESTHAVEN ROAD SEWER REPLACEMENT PROJECT	Replace 2,100 feet of 21-inch gravity main with 36-inch diameter pipe.	2,100 LF	$880	1	$1,800,000		$1,800,000			
SP-08	Pipeline	PICO AVENUE SEWER REPLACEMENT PROJECT	Replace 1,400 feet of 8-inch gravity main with 12-inch diameter pipe.	1,400 LF	$310	1.1	$500,000	$500,000				
SP-09	Pipeline	NORDAHL SHOPPING CENTER SEWER REPLACEMENT PROJECT	Replace 700 feet of 8-inch gravity main with 12-inch diameter pipes.	700 LF	$310	1.5	$2,100,000		$2,100,000			
			Replace 3,100 feet of 8-inch gravity main with 15-inch diameter pipes.	3,100 LF	$375							
SP-10	Pipeline	DIAMOND SIPHON REPLACEMENT PROJECT	Replace 85 feet of 10-inch siphon with 200 feet of 15-inch gravity main and new siphon.	200 LF	$375	10	$800,000	$800,000				
SP-11	Pipeline	SAN MARCOS INTERCEPTOR PHASE 2 REPLACEMENT PROJECT	Replace 1,900 feet of 21-inch gravity main with 42-inch diameter pipe.	1,900 LF	$1,020	3	$5,800,000	$5,800,000				
SP-12	Pipeline	SAN MARCOS INTERCEPTOR PHASE 3 REPLACEMENT PROJECT	Replace 1,800 feet of existing 21-inch of gravity main with 42-inch diameter pipe.	1,800 LF	$1,020	3	$5,500,000	$5,500,000				
SP-13	Pipeline	CAMINO DE AMIGOS SEWER REPLACEMENT PROJECT	Replace 3,500 feet of 8-inch gravity main with 12-inch diameter pipe.	3,500 LF	$310	1	$1,100,000					$1,100,000
SP-15	Pipeline	SAN PABLO WALKWAY SEWER REPLACEMENT PROJECT	Replace 1,800 feet of 8-inch gravity main with 12-inch diameter pipe.	1,800 LF	$310	3	$1,700,000			$1,700,000		
SP-18	Pipeline	MISSION ALLEY SEWER REPLACEMENT PROJECT	Replace 1,500 feet of 8-inch gravity main with 12-inch diameter pipe.	1,500 LF	$310	1	$500,000	$500,000				
SP-19	Pipeline	BINGHAM SEWER REPLACEMENT PROJECT	Replace 700 feet of 8-inch gravity main with 12-inch diameter pipe.	700 LF	$310	1.1	$200,000		$200,000			
SP-20	Pipeline	DISCOVERY STREET EAST SEWER REPLACEMENT PROJECT	Replace 2,100 feet of 8-inch gravity main with 12-inch diameter pipe.	2,100 LF	$310	1	$700,000			$700,000		
SP-21	Pipeline	ROCK SPRINGS WEST SEWER REPLACEMENT PROJECT	Replace 1,300 feet of 12-inch gravity main with 15-inch diameter pipe.	1,300 LF	$375	1	$500,000				$500,000	

CIP ID	TYPE	PROJECT NAME	PROJECT DESCRIPTION	UNITS	BASE UNIT COST	SCALING FACTOR	CIP COST	ESTIMATED COST BY PHASE				
								1	2	3	4	5
SP-22	Pipeline	ROCK SPRINGS EAST SEWER REPLACEMENT PROJECT	Replace 800 feet of 8-inch gravity main with 12-inch diameter pipe.	800 LF	$310	1	$200,000				$200,000	
SP-23	Pipeline	PACIFIC ST & DESCONSO SEWER REPLACEMENT PROJECT	Replace 2,100 feet of 8-inch gravity main with 12-inch diameter pipe.	2,100 LF	$310	1.1	$1,500,000					$1,500,000
			Replace 1,800 feet of 8-inch gravity main with 15-inch diameter pipe.	1,800 LF	$375							
SP-24	Pipeline	CRAVEN ROAD SEWER REPLACEMENT PROJECT	Replace 2,700 feet of 8-inch gravity main with 12-inch diameter pipe.	2,700 LF	$310	1	$800,000		$800,000			
SP-25	Pipeline	SAN MARCOS INTERCEPTOR EAST SEWER REPLACEMENT PROJECT	Replace 800 feet of 18-inch gravity main with 24-inch diameter pipe.	800 LF	$670	1.5	$800,000			$800,000		
SP-26	Pipeline	WOODWARD STREET SEWER REPLACEMENT PROJECT	Replace 3,200 feet of 8-inch gravity main with 12-inch diameter pipe.	3,200 LF	$310	1	$1,000,000					$1,000,000
SP-27	Pipeline	VINEYARD ROAD SEWER REPLACEMENT PROJECT	Replace 2,800 feet of 8-inch gravity main with 12-inch diameter pipe.	2,800 LF	$310	1	$2,000,000					$2,000,000
			Replace 3,100 feet of 8-inch gravity main with 15-inch diameter pipe.	3,100 LF	$375							
SP-28	Pipeline	LINDA VISTA & RANCHO SANTA FE INTERSECTION REPLACEMENT PROJECT	Replace 2,000 feet of 8-inch gravity main with 12-inch diameter pipe.	2,000 LF	$310	2	$1,200,000				$1,200,000	
SP-31	Pipeline	NORTH TWIN OAKS VALLEY SEWER REPLACEMENT PROJECT	Replace 16,700 feet of 8-inch gravity main with 18-inch diameter pipe.	16,700 LF	$495	1	$8,300,000				$8,300,000	
SP-33	Pipeline	SAN MARCOS BLVD WEST SEWER REPLACEMENT PROJECT	Replace 6,600 feet of 8-inch gravity main with 12-inch diameter pipe.	6,600 LF	$310	2	$4,100,000		$4,100,000			
SP-34	Pipeline	SAN MARCOS CREEK NORTH OF MISSION RD SEWER REPLACEMENT PROJECT	Replace 1,000 feet of 18-inch with 24-inch diameter pipe.	1,000 LF	$670	2	$1,300,000				$1,300,000	
SP-35	Pipeline	MISSION ROAD & MULBERRY DRIVE SEWER REPLACEMENT PROJECT	Replace 3,600 feet of 8-inch with 12-inch diameter pipe.	3,600 LF	$310	1.5	$1,700,000			$1,700,000		
SP-36	Pipeline	RICHLAND ROAD SEWER REPLACEMENT PROJECT	Replace 2,000 feet of 15-inch gravity main with 18-inch diameter pipe.	2,000 LF	$495	1	$1,000,000				$1,000,000	

CIP ID	TYPE	PROJECT NAME	PROJECT DESCRIPTION	UNITS	BASE UNIT COST	SCALING FACTOR	CIP COST	ESTIMATED COST BY PHASE				
								1	2	3	4	5
LO-A1	Pipeline	OUTFALL SECTION GRAVITY A IMPROVEMENT PROJECT	Replace existing 1,500 feet of gravity sewer sections with 42-inch diameter pipe.	1,500 LF	$1,020	1.5	$2,300,000		$2,300,000			
LO-A2	Pipeline	OUTFALL SECTION SIPHON A IMPROVEMENT PROJECT	Parallel 18,200 feet of siphon sewer with 30-inch diameter pipe.	18,200 LF	$770		$21,000,000			$21,000,000		
LO-B	Pipeline	OUTFALL SECTION GRAVITY B REPLACEMENT SEGMENTS	Replace existing 1,500 feet of gravity sewer sections with 36-inch diameter pipe.	1,500 LF	$880	1.5	$2,000,000			$2,000,000		
LO-D1	Pipeline	OUTFALL SECTION GRAVITY D REPLACEMENT SEGMENTS	Replace existing 1,200 feet of gravity sewer sections with 36-inch diameter pipe.	1,200 LF	$880	1.5	$1,600,000	$1,600,000				
			Replace existing 5,400 feet of gravity sewer sections with 42-inch diameter pipe.	5,400 LF	$1,020		$8,300,000	$8,300,000				
			Replace existing 1,300 feet of gravity sewer sections with 48-inch diameter pipe.	1,300 LF	$1,200		$2,300,000	$2,300,000				
LO-D2	Pipeline	OUTFALL SECTION GRAVITY D REPLACEMENT SEGMENTS	Replace existing 1,200 feet of gravity sewer sections with 36-inch diameter pipe.	1,200 LF	$880	1.5	$1,600,000					$1,600,000
			Replace existing 3,700 feet of gravity sewer sections with 42-inch diameter pipe.	3,700 LF	$1,020		$5,700,000					$5,700,000
LS-1	Lift Station	MONTIEL LIFT STATION REPLACEMENT	Upgrade the existing 100 gpm pumps with two new 200 gpm pumps. Alternatively, construct new 1,000 feet open trench sewer and 300 feet of tunneling beneath SR-78.	400 gpm	$1,100	3.5	$1,500,000	$1,500,000				
Subtotal Sewer Pipelines							**$48,600,000**	**$16,600,000**	**$9,000,000**	**$4,900,000**	**$12,500,000**	**$5,600,000**
Subtotal Land Outfall Pipelines							**$44,800,000**	**$12,200,000**	**$2,300,000**	**$23,000,000**	**$0**	**$7,300,000**
Subtotal Lift Stations							**$1,500,000**	**$1,500,000**				
Total							**$94,900,000**	**$30,300,000**	**$11,300,000**	**$27,900,000**	**$12,500,000**	**$12,900,000**

8.2.3.4 Wastewater Treatment Capacity Needs

Budgetary CIP costs for expanding the EWPCF were estimated consistent with previous VWD efforts using construction costs for the EWPCF Phase IV and Phase V expansions. Phase V costs were updated to include audited totals based on information provided by EWA. The estimated costs are shown in Table 8-4

Table 8-4. It is important to note that actual costs will likely require 1) buying existing capacity from other EWA member agencies or 2) constructing new facilities at the site where the actual sizes and thus costs for new facilities at the EWPCF may vary based on additional capacity needs of other agencies as well as how the existing facility would be modified and/or expanded to meet the increased capacity needs. Therefore, actual costs may be lower or higher than the methodology used. The methodology herein provides a reasonable estimate for master planning purposes.

8.2.4 CIP Summary

The District's total CIP costs for both water and sewer system improvements is estimated to be $207 million and $253 million when the wastewater treatment costs are included. These costs are shown by phase and system in Figure 8-3.

Table 8-4 Summary of Wastewater Treatment Capital Improvement Needs

ELEMENT	LIQUIDS COST	SOLIDS COST	DISPOSAL COST	SOURCE	ENR CCI LA BASIS
PHASE IV					
Phase IV Costs (2004 Muni Report)	$18,521,000	$16,105,000	$5,939,000	EWA: Table 26A *2004 Muni Financial Report*	7543.00
Phase IV Costs (ENR Adjusted to CIP Basis)	$26,963,000	$23,445,000	$8,646,000	Totals from above adjusted to CIP ENR Basis	10981.02
PHASE V					
Phase V Costs (Total all EWA Members)	$9,816,000	$53,484,000	$0	EWA: Table 3; file: Phase V Ownership Calc-OM Final (2/10/14); provided by EWA at 6/20/18 meeting (updated and escalated from previous files provided as part of EWA Board presentation to VWD in 2013)	10306.93
Phase V VWD Ownership	18.93%	24.17%	24.17%	EWPCF Ownership Allocation, file: Ownership Capacity rev3.xls; 10/16/2012; provided by EWA at 6/20/18 meeting	-
Phase V Costs (VWD portion)	$1,858,000	$12,927,000	$0	Phase V costs above times ownership percentage above	10306.93
Phase V Costs (ENR Adjusted to CIP Basis)	**$1,980,000**	**$13,772,000**	**$0**	Totals from above adjusted to CIP ENR Basis	10981.02
PHASES IV and V					
Total Phase IV and V	$28,943,000	$37,217,000	$8,646,000	Summation of data in this table	10981.02
Capacity Gained Phase IV and Phase V	2,670,000	5,280,000	2,350,000	Capacities are determined based on the EWA *Revised Basic Agreement for Ownership, Operation, and Maintenance of a Joint Sewage System* (RBA)	-
$/gallon	$10.84	$7.05	$3.68	Total costs above divided by capacities above	10981.02
Capacity Gap (gallons)	1,700,000	3,900,000	-	VWD 2018 Master Plan Calculation	-
Estimate of Capacity Cost	**$18,428,000**	**$27,490,000**	**$0**	$/gallon cost above times capacity gap above	10981.02

Figure 8-3 CIP Cost Estimate per Phase