MADDAUS
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MANAGEMENT INC.

Technical Memorandum

Prepared for: Rancho Murieta Community Services District

Project Title: Water Supply Assessment – Rancho Murieta North Project

Technical Memorandum

Subject: Final Water Supply Assessment

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TABLE OF CONTENTS

		Page
	Executive Summary	1
1	Introduction	2
	1.1 Purpose and Authorization	2
	1.2 Scope of Investigation	2
	1.3 Documents and Persons Consulted	2
2	Development Project Description	4
	2.1 Description	4
3	Project Water Supply Source	5
	3.1 Service Area Background Information	5
	3.2 Potable Water Treatment and Distribution	5
	3.3 Recycled Water	6
	3.4 Raw Water	6
	3.5 Supply Source and Contractual Provisions	7
	3.6 Water Supply Plan	8
	3.7 District Water Supply Protection	8
	3.8 Water Supply Shortage Contingency	10
	3.9 Projections Under Water Supply Shortage Conditions	11
4	Water Demand Projections	12
	4.1 Future System Potable and Non-Potable Water Demand Projections	12
	4.2 Net Additional Demand from Proposed Project	12
	4.3 Estimated Proposed Project Demands	13
5	Description of Adopted Water Conservation Measures	18
6	Comparison of Supply Allocation vs. Water Demand Projections	19
7	Conclusion	22
8	References	23
Appendix 1 – Acronyms		24
Appendix 2 – Maddaus Water Management Firm Summary		25

EXECUTIVE SUMMARY

The Water Supply Assessment (WSA) provides information for use in the California Environmental Quality Act (CEQA) analysis for the proposed project, Rancho Murieta North PLNP2014-00206. The Rancho Murieta Community Services District (District) has completed the WSA at the County of Sacramento's request based on Board adopted planning documents, recent review of District water demands, and information provided by the County and Project Proponent. One future project, Rancho Murieta North Development Project, on undeveloped land within the District's existing service area is presented in this WSA.

The requirements for the WSA are described in the California Water Code Sections 10910 through 10915, amended by the enactment of Senate Bill 610 (SB 610) in 2002. SB 610 requires an assessment of whether available water supplies are sufficient to serve the demand generated by the new project, as well as the reasonably foreseeable cumulative demand during normal year, single dry year, and multiple dry year conditions over the next 20 years.

While the District is below the Urban Water Management Plan (UWMP) thresholds of 3,000 connections or 3,000 AFY to prepare an UWMP for submission to the California Department of Water Resources, the District Board adopted the Rancho Murieta Community Services District 2010 Integrated Water Master Plan Update (IWMP) on October 18, 2010. This WSA builds on the water demand projections created as part of the IWMP. The IWMP buildout out demand, which is based on 600 gallons per day per equivalent dwelling unit[1] (EDU) for new development, is assumed to occur in year 2035. This is consistent with the 20-year time horizon required by the WSA. The number of residential accounts at buildout was drawn from Sacramento County approved land use projections included in the IWMP.

Since the 2010 IWMP Update was completed, more recent information has been included in the WSA analysis as noted throughout this technical memorandum. When either supply or demand assumptions were required for the assessment, conservative values were selected for the analysis in an effort to estimate "worst case" conditions; meaning demands are projected in the upper portion of the range and available supplies are projected in the lower portion of the range. For example, average and projected residential account water use is based on the District's Summary of Residential Demand Factors Analysis, published June 19, 2013, and was then updated to consider more recent water use trends. This resulted in the finding that large size estate lots have an average indoor use of 60.7 gallons per capita (person) per day (GPCD) and small estate lots have an average indoor use of 57 GPCD. In calculating the proposed project's projected indoor use the WSA uses the large size estate lot average of 60.7 GPCD. This is an example of a conservative assumption in estimating demands; especially when compared to documented indoor use of 45 GPCD for new homes built under current building codes and with more efficient fixtures. Both residential and commercial demands are planned as part of the proposed development included in this WSA.

The supply for the District is described in the 2010 IWMP Update. The source of the Cosumnes River is a precipitation based watershed, not heavily influenced by the snowpack levels (and as a result did not experience the same level of severity as other west slope of the Sierra Nevada watersheds during the 2012-2015 drought). The off-stream reservoirs have a usable storage of 4,723 AFY. This volume is a conservative assumption of available supply because it does not include the amount of water that is directly supplied to residential and commercial customers during the District's permitted diversion season of November through May.

[1] An equivalent dwelling unit(EDU) is a normalizing factor used to assign water demands to different lot (parcel) sizes within the District. A single EDU is based on 600 gallons per day of water used. Some lots may be assigned less than a single EDU and some lots may be assigned multiple EDU's based on their projected daily water demands.

Since the IWMP was approved, average account water use has been reviewed such that the demand calculations for the new projects are included in this report to illustrate a comprehensive overview of system-wide supply and demand. The Rancho Murieta North Development project proposes 827 new residential lots, a small commercial 39-acre parcel development and 382.7 acres of parks, open spaces, trails and other non-residential land uses. The WSA estimates the total project will require approximately 1,326 acre-feet per year (AFY) of additional total potable and non-potable water demand. This project is currently in the County application process. This WSA was developed by Maddaus Water Management, Inc. and District staff independent from the applicant as required by California Code, including a detailed estimate for project water demands.

The number of connections and projected water demand for this proposed project do not exceed the adopted demand projection in the 2010 IWMP Update. As a result, the analysis shows that the District can meet its obligation to serve proposed development within the service area boundary and its existing customers using current supply sources in the 20-year time horizon required by Senate Bill 610 Water Supply Assessment requirements.

1 INTRODUCTION

1.1 Purpose and Authorization

The purpose of the Water Supply Assessment (WSA) is to determine whether there is adequate water supply to meet the water needs of the new proposed project within the Rancho Murieta Community Services District service area. The WSA was developed by the collaborative efforts of the project team consisting of Maddaus Water Management, Inc. (MWM) and Rancho Murieta Community Services District (District). MWM provided estimated calculations for the water demand of the project and assisted to compile the WSA report; the District provided information on this project and also all other development projects and water demands contained in the report.

1.2 Scope of Investigation

This WSA focuses on the proposed Rancho Murieta North Development project. As shown in Figure 1-1 below, the project property is located on private land within the Rancho Murieta Planned Development boundaries.

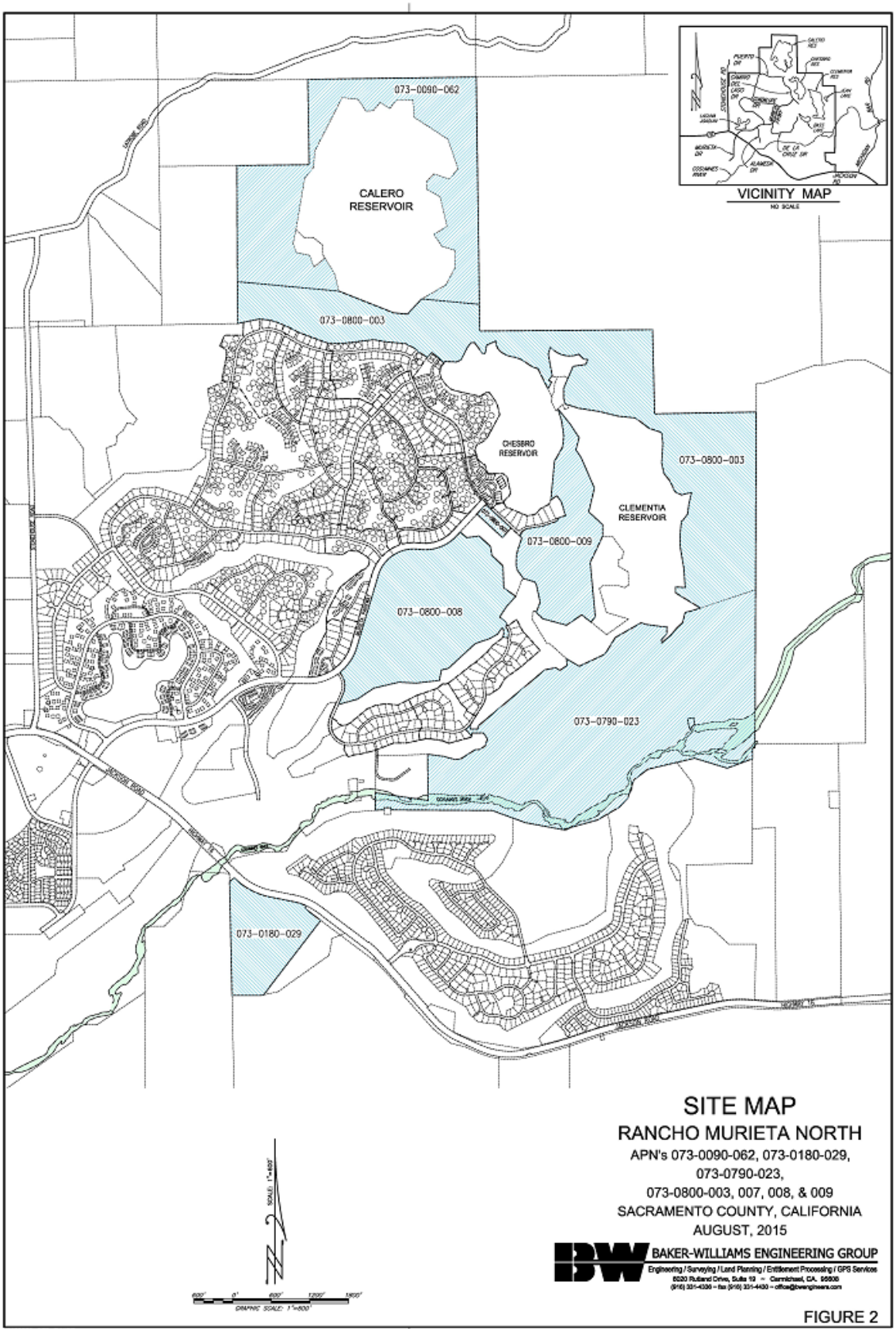
1.3 Documents and Persons Consulted

Water supply source related information in this report is primarily based on the District's 2010 Integrated Water Master Plan Update, Final 2020 Compliance Plan, and 2013 Summary of Residential Demand Factors Analysis, unless more updated information was applicable.

Demand projections were developed independently by the District and MWM based on assumptions using District provided data. The future demand projection to buildout was adopted by the District in the 2010 IWMP Update. The number of connections and projected water demand in the IWMP for this proposed project are not exceeded based on this adopted demand projection.

Some information specific to Rancho Murieta North Development project was provided by District staff and Sacramento County in the August through November 2015 time period.

Figure 1-1. Project Site Vicinity Map



Source: Baker-Williams Engineering Group, Rancho Murieta North Planning with APNs

2 DEVELOPMENT PROJECT DESCRIPTION

2.1 Description

The proposed project elements of the Rancho Murieta North Development project included in this WSA are described below. Key project features and phasing are also presented.

The proposed Rancho Murieta North Development project is on approximately 775 acres of land located in the Rancho Murieta Community Services District. The proposed project includes 827 residential lots in Villages A-H, a 39-acre commercial development, and 215 EDUs of park and additional non-residential land uses. Individual village communities proposed have a combination of three different lot sizes: (1) estate lots of less than 12,000 square feet, (2) estate lots between 12,000 and 24,000 square feet, and (3) estates greater than 24,000 square feet. Lots greater than 9,000 square feet may include an additional accessory dwelling unit or "casita" on the property.

The proposed 39-acre General Commercial (GC) parcel will be located on the south side of Jackson Road (Highway 16) just east of the Cosumnes River. The property was historically used by Operating Engineers Local #3 for heavy equipment training purposes. The intended use for this parcel may include, but is not be limited to, warehousing, light industrial, retail, some residential housing, and/or recreation uses as allowable in a GC zone development.

Table 2-1 presents the proposed sizes of the Rancho Murieta North project non-residential development and residential village lots, as well as the development schedule.

Information associated with the project demands and assumptions are presented in Section 4.

Table 2-1. Proposed Residential, Commercial, and Common Area Sizes – Rancho Murieta North Project

Village	Lot Sizes (square feet)			Total Lots	Development Schedule			
	Less Than 12,000 SF	12,000 to 24,000	More Than 24,000		2020	2025	2030	2035 or later
Village A	91	68	8	167	70%	15%	7%	8%
Village B	45	116	6	167	10%	30%	30%	30%
Village C	85	45	0	130	10%	40%	40%	10%
Village D	0	40	2	42	0%	25%	25%	50%
Village E	0	11	32	43	0%	0%	20%	80%
Village F	40	54	1	95	0%	2%	38%	60%
Village G	7	29	17	53	0%	0%	10%	90%
Village H	24	103	3	130	0%	10%	25%	65%
Non-Residential								
Commercial			4 parcels or 39 acres		15%	30%	30%	25%
Park and Non-Residential EDUs (Lettered Lots/Common Area)				215 EDUs	11%	15%	25%	49%

3 PROJECT WATER SUPPLY SOURCE

The water supply sources for the District are described in detail in the 2010 IWMP Update. This section provides an overview of the District's supply sources. The Rancho Murieta North Development project is within the existing service area of Rancho Murieta Community Services District and is included in past planning efforts to be served by the existing water sources.

3.1 Service Area Background Information

The District was formed in 1982 to provide water supply collection (treatment and distribution), wastewater collection (treatment and reuse), and storm drainage collection, disposal, and flood control services for the community of Rancho Murieta. The area served by the District encompasses approximately 3,500 acres in eastern Sacramento County. The region is similar to a Mediterranean climate, marked by precipitation typically occurring only in winter months.

While the District is below the threshold of 3,000 connections and 3,000 AFY to prepare an Urban Water Management Plan for submission to the California Department of Water Resources, the District's future demand projection to buildout was adopted by the District in the 2010 IWMP Update.

Land uses within the District's service area show the development of approximately 1,920 acres in 2004 for single-family residences, townhouses, duplexes, and mobile homes (MacKay & Somps, 2004).

District water is taken from the Cosumnes River at Granlees Dam and pumped into Calero, Chesbro, and Clementia Reservoirs from November 1st until May 31st of each year; it is subject to provisions in the water rights permit 16762. The stored water is used throughout the year for the needs of the community. These reservoirs work as large settlement basins before the water is transferred to the Water Treatment Plant at the foot of the Chesbro Dam.

3.2 Potable Water Treatment and Distribution

Water is processed by conventional and membrane filtration through two treatment plants, disinfected through chlorine contact chambers, and pumped to storage in the 1.2 million gallon (MG) storage tank on Rio Oso Drive and the 3.0 MG storage tank on Van Vleck Ranch (east of Rancho Murieta). These tanks hold water for distribution and fire protection to the customers of Rancho Murieta Community Services District.

The distribution system is divided into two separate type systems: a pressure system and a gravity feed system. The area north of Guadalupe Drive is the pressure system and its water comes from the booster system at the Rio Oso Drive storage tank. The rest of the system is gravity flow and the water comes from the Van Vleck tank through the south area across the yellow bridge to the area south of the second Guadalupe Drive.

Water Treatment Plant. A retrofit and expansion project to upgrade the existing 1.5 million gallons per day (MGD) conventional water treatment plant (WTP #1) to 4 MGD of ultra-filtration, which is expandable to 6 MGD as needed, is being installed and includes influent piping through new 400-micron auto-strainers as well as modifications to the Plant 1 flash mixer and flocculation basins. This WTP #1 project is scheduled to be completed in early 2016. Also, two new treated water booster pumps have been added to pump the treated water out to the distribution system.

3.3 Recycled Water

The use of recycled water in Rancho Murieta offsets the demand for potable use. The new development is required to use recycled water for outdoor irrigation where economically feasible per District Policy 2011-07, adopted July 20, 2011. It also prevents the need for the District to obtain a National Pollutant Discharge Elimination System (NPDES) permit for disposing of treated wastewater.

Recycled water of the tertiary treated wastewater effluent is currently used exclusively on the two community golf courses. They have a combined irrigation area of approximately 250 acres and annual average demand of 550 AF (179.2 million gallons). The District's tertiary treatment plant typically operates annually from late April through October to produce recycled water for the golf courses' irrigation needs. Should the District have an excess of recycled water, it may be delivered for use on adjacent property located at the Van Vleck Ranch. In the 2010 IWMP Update, the District was projected to have an average annual recycled water production estimated at 1,110 AFY.

The District stops supplying recycled water in coordination with the Rancho Murieta Country Club (RMCC) each fall per a Waste Discharge Requirement with the Regional Water Quality Control Board, as well as when supplies are exhausted. RMCC then draws down the levels in their ponds at Holes 10, 11, 16 and 17 on the South Course and partially draws down Bass Lake on the North Course. This is to keep the ponds from violating the minimum of two feet from spillway requirement from the Regional Water Quality Control Board to prevent the ponds from overflowing due to storm water runoff during the rainy season.

Recycled water is distributed in a separate network of pipes that keeps reclaimed water pipes completely separate from potable water pipes. The non-potable reclaimed water is distributed in lavender (light purple) pipes or pipes marked as "RECYCLED WATER" to distinguish it from potable water. Where economically feasible, future development is required to install purple pipe and supply recycled water for residential and common area irrigation purposes.

3.4 Raw Water

The District's raw water infrastructure consists of an intake from the Cosumnes River at its Granlees Dam and diversion structure, diversion pumps, and piping to feed the three primary raw water storage reservoirs. The three primary storage reservoirs, Calero, Chesbro and Clementia have an estimated usable combined storage capacity of 4,608 AF. This value does NOT include the minimum storage volume of 400 AF that cannot be put into use, commonly referred to as dead storage. An additional 115 AF is available supply when the reservoir stop logs or flashboards are in place. Usable reservoir volume (meaning that dead storage is excluded because it is not usable) with stop logs in place is 4,723 AF. The WSA total available storage for the District is assumed to be the reservoir volume with the stop logs installed. During the 2012-2015 drought, the District was able to fill the reservoirs with the stop logs in place.

This 4,723 AFY is a conservative assumption of available supply because it does not include the amount of water that is directly supplied to residential and commercial customers during the District's permitted diversion season of November through May. This "dynamic pumping supply" is continually replaced in the reservoirs throughout the diversion season. The volume of additional "dynamic pumping" varies year to year depending on the flow levels in the river, storage volume in reservoirs, and other operational decisions. Under the District's water right permit 16762 the maximum amount of water allowed to be diverted from the Cosumnes River is 6,368 AFY. The difference between maximum storage and maximum diversion allowed is 1,645 AFY, which would be the maximum amount of "dynamic pumping" volume available to the District. This additional 1,645 AFY volume was not included in the water balance presented in

Sections 4 and 6. The reservoirs are assumed to be filled to full volume at some point during the pumping season, given that was possible during the 2012-2015 drought.

Raw water can be conveyed from Granlees Dam to either Calero or Chesbro Reservoirs via a 33-inch pipeline or to Clementia Reservoir via a 21-inch pipeline. Calero Reservoir is at the highest elevation of the three reservoirs and is the first to be drawn down. It is drawn down by transferring raw water via a 30-inch siphon pipeline to Chesbro Reservoir. Raw water needed to meet the community's needs is drawn from Chesbro Reservoir to the water treatment plants through a gravity-driven 36-inch raw water supply pipeline. In addition to raw water storage, Clementia Reservoir can be used to route water to a number of other areas within the community. Clementia Reservoir is also used for irrigation supply and recreational uses.

For an average rainfall year during the diversion season, flow into the system is greater than flow out of the system. Surplus water is moved to storage and reservoir depths increase until they are filled to capacity. The opposite state occurs during the summer-to-fall draw down season, when flow out of the storage is greater than flow into storage. Reservoirs decrease in volume depth until the minimum allowable reservoir volume is reached (dead storage) or until the diversion season starts once again. Typically, the District enters into the draw down period with all three reservoirs filled to capacity. During severe drought conditions, flow out of storage to the water treatment plant facility remains greater than flow into the system for most of the drought period, including the diversion season. Under shortage conditions, including droughts, the District is preparing to diversify supply sources by potentially using groundwater wells and expanded use of recycled water.

3.5 Supply Source and Contractual Provisions

As summarized in the District's 2010 IWMP Update, the District's water supply consists of seasonal diversions and diversions under Permit 16762 from the Cosumnes River that are normally diverted to three storage reservoirs (Calero, Chesbro, and Clementia). More details on the District's diversion limitations can be found in their 2010 IWMP Update.

Water right permit 16762 was issued in 1969, amended in 1980, 2000, and again in 2006. In 2006, the permit was renewed and extended with no new permit requirements through 2020 in consideration that the community was not at full build-out. It now appears likely that in 2020, the community will not have reached full build-out and the District will request another extension of the permit.

The Cosumnes River water supply is subject to drought restrictions. In 1976 and 1977, the District experienced the driest one-year drought span on record. The most recent drought of 2012-2015 did not impact the District's ability to divert water from the river, which did occur under 1977 river hydrology conditions. The first District drought resolution was adopted in 1990 as Policy 90-2. In February 2012 the District adopted Chapter 14 of the Water Code with updates and enhancements to water use efficiency, wasteful use of water and drought response regulations. The District continues to maintain a drought ordinance to mitigate community impacts in time of water supply shortages. Since 1989, many studies and exploratory measures have been executed to determine potential water supply alternatives. In addition, other studies have evaluated alternative build-out projections and assessed reclaimed water disposal needs and offsets to potable water use.

3.6 Water Supply Plan

According to the District's IWMP, previous studies show that providing new groundwater supply is more cost-effective than other alternatives to increasing supply reliability in times of water shortage. Preliminary well field explorations show that potential well fields exist within close proximity of Rancho Murieta. Early findings indicate an individual well could provide a potential of up to 500 gpm (Dunn, 2013) and identified two potential groundwater well sites. However, a capacity of approximately 400 gpm would be required if this option were used to eliminate drought deficit only. A detailed description of the infrastructure required for this option was presented in the evaluation of the 2006 IWMP (HDR, 2006).

Also, there are several agricultural fields in close proximity of Rancho Murieta. Potentially, the District could form an agreement with a local rancher or farmer to trade recycled water for groundwater. This option requires installation of pipeline and conveyance infrastructure to route raw water from the groundwater well to Chesbro Reservoir and recycled water from the storage reservoir to the agricultural application area. However, this alternative does not provide any off-set or reduction to potable water demand within the District.

3.7 District Water Supply Projections

The following table presents the District's projected water supplies from the Cosumnes River that are normally diverted to the three storage reservoirs (Calero, Chesbro, and Clementia). In addition to other use limitations as presented in the previous sections (water treatment plant capacities, etc.), the total amount of water taken from the Cosumnes River cannot exceed 6,368 AFY.

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Table 3-1. District Potable Supply Sources

Water Supply Source	2015	2020	2025	2030	2035	Notes
Seasonal Diversion Allotment from the Cosumnes River, AFY	6,368	6,368	6,368	6,368	6,368	Total amount of water taken from the Cosumnes River cannot exceed 6,368 AFY.
Water Treatment Capacity, MGD	4.0	6.0	6.0	6.0	6.0	Water treatment capacity is 3.5 MGD (2010 IWMP Update). Expansion to 4.0 MGD by year-end 2015, and expansion to 6.0 MGD when needed.
Water Treatment Capacity, AFY	4,481	6,721	6,721	6,721	6,721	
Total Useable Water Storage Capacity with Stop Logs, AFY	4,723	4,723	4,723	4,723	4,723	Three primary storage reservoirs Calero, Chesbro and Clementia have an estimated usable reservoir volume with stop logs in place of 4,723 AF. This value does NOT include water that is directly supplied to customers during the pumping season (up to a max of 1,645 AFY) or dead storage volume of 400 AF.
Additional Recycled Water Supply, AFY				280	560	Offset on potable irrigation demand for new development. 2010 IWMP Update: Table 3-5. Available at buildout as "credit" towards potable water supplies (versus lower potable demands). Assume 50% of buildout by 2030.
Projected Accessible Supply, AFY[1]	4,481	4,723	4,723	5,003	5,283	This represents a “worst case” minimum of diversion, treatment, and storage capacity (the most limiting element) without dynamic pumping supply plus available additional recycled water supplies with the project.

[1]The projected available supply is conservative on the basis of:
(a) The District is currently planning augmentation of the water supply for drought and emergency needs with the drilling of two groundwater wells with a combined production capacity of approximately 400 gpm. Assuming average ongoing well production, this equates to approximately 645 AF per year (Dunn, 2013). This additional supply is not included in the Table 3-1 potable supply.
(b) Maximum direct diversions (or dynamic pumping supply) on the order of 1,645 AFY are not included in this water balance.

The following table presents the District’s estimated annual supply allocations for a single dry year and multiple consecutive dry years. An average supply year of 2020 (which includes the expanded water treatment plant supply) is used. As shown, the dry year conditions presented in Table 3-2 illustrate a progressive 10% cutback per year down to a total of 50% in compliance with California Water Code 10632.

The District’s supply reliability under any shortage condition is dependent on future climate conditions and was thoroughly evaluated during the development of the 2010 IWMP Update. There were adequate supplies to serve the projected demands and the District adopted the plan with a recommended alternative to improve supply reliability in times of water shortages through the future addition of groundwater supplies and the expansion of the recycled water systems to serve new homes using less water than existing homes for outdoor irrigation.

Table 3-2. District Projected Annual Supply Allocations for a Single and Multiple Dry Years

Water Supply Source	Normal Year Supply (2020)	Single Year Year 1	Year 2	Year 3	Year 4	Year 5
Supply, AFY	4,723	4,251	3,778	3,306	2,834	2,362
% Reduction	0%	10%	20%	30%	40%	50%

Notes:

1. Normal year supply is based on the usable storage capacity, which is more limiting than the Cosumnes River diversion allotment of 6,368 AF in a normal year per Table 3-1.
2. Reduction percentages are conservative based on the supply reliability analyzed in the 2010 IWMP Update. The up-to-50% cutback is for illustration; the 50% value is based on state planning requirements in Section 10632 of the California Water Code. In other words, based on the 2010 IWMP Update analysis, these levels of cutbacks are more extreme than is projected to actually occur in the District service area.

3.8 Water Supply Shortage Contingency

The District Water Shortage Contingency Plan (WSCP) was adopted September 14, 2012 in line with the California Water Code and industry best practices to provide direction on specific actions to be taken by District staff and customers in response to increasingly severe water supply shortage conditions. In case of water system failure or water quality issues requiring immediate response and action, refer to the District's Emergency Operations Procedures. The District intends to use this WSCP to meet the requirements of the California Water Code, Section 10632. A water shortage contingency analysis based on the historic driest three-years on record was previously prepared as part of the Integrated Water Master Plan Update (Brown and Caldwell, 2010) (the IWMP).

The current IWMP presents water supply demands and drought responses for the available supply. In an effort to provide a uniform basis for requesting cutbacks in consumption due to reductions in supply from minor to emergency conditions, the District has a program of four levels of actions based on the severity of the water shortage. The District previously adopted shortage mitigation measures, which are included in District Code Chapter 14 - Water Code, updated most recently in 2012. This WSCP is consistent with District policies, District codes, and the District's 2010 Integrated Water Master Plan. The names for stages in this Plan are consistent with other water purveyors in the Sacramento region.

"Normal" – Normal Water Supply and On-going Conservation: The District's supply or distribution system is able to meet all water demands of its customers in the immediate future. All customers are encouraged to use water for beneficial and reasonable uses. District customer demands are being monitored for meeting 20% reduction by 2020 in compliance with state law, Senate Bill SB X7-7.

Stage One – Water Alert: There is a probability that the District's supply or distribution system will not be able to meet all the water demands of its customers and the District's ability to pump to reservoir systems may be impacted.

Stage Two – Water Warning: The District's supply or distribution system is forecasted to not be able to meet all the water demands of its customers and District's ability to pump to reservoir systems is forecasted to be, or is actively being, impacted.

Stage Three – Water Crisis: The District's supply or distribution system is projected to not be able to meet all the water demands of its customers under Stage 2 - Water Warning requirements and the District's ability to pump to reservoir systems is predicted to be, or is actually being, impacted.

Stage Four – Water Emergency: The District is projecting an imminent failure of a water supply, storage, or distribution facility based on an estimate of remaining supply.

Information about water shortage stage determination and declaration as well as WSCP implementation and drought monitoring can be found in the Water Shortage Contingency Plan. The following section discusses the supply reliability for the District.

3.9 Projections under Water Supply Shortage Conditions

The Cosumnes River water supply is subject to drought restrictions under low flow conditions, given the District can be curtailed during its pumping season to the storage reservoirs. A wide range of drought and climate change scenarios were evaluated during the 2010 IWMP Update. The conclusion was that the District had sufficient supplies to serve the community at buildout under the medium growth scenario, provided the District maintained its adopted lower planning assumption from 750 gpd/EDU to 600 gpd/EDU, which is a 20% reduction in line with the 20x2020 conservation target mandated by the state (SB X7-7). It should be noted however, that these targets are not currently applicable to the District until connections are higher than 3,000 or more than 3,000 AFY is supplied.

In 1976 and 1977, California experienced the driest single-year drought span on record that would have a direct impact on District supply availability. In the 2010 IWMP Update, the historical river flow also represented the driest three-year sequence drought event (1976, 1977, and 1978) impact on the District. In this historical drought period, the District's water withdrawals were significantly curtailed or ceased all together in 1977. The river hydrology of 1976, 1977, and 1978 is still the worst case planning scenario for the District, given pumping was permissible in 2014 and 2015 and the District was able to fill the three storage reservoirs to capacity.

As presented in the 2010 IWMP Update, the Shared Vision Model (SVM) analyzed several different multi-year drought scenarios including climate change. As published in the 2010 IWMP Update, annual river diversions for the driest three-year sequence (1976, 1977, and 1978) are 1,440 AFY, 0 AFY, and 3,596 AFY, respectively. To this date, the 1976-1978 drought remains the driest three years in relation to District water supply operations. During the drought conditions of 2012-2015, river diversion pumping levels to the District's reservoirs were sufficient to fill to capacity.

Additional information is presented in Section 6, Table 6-2, where the five-year estimated minimum water supply is presented as a five-year worst case supply projection (e.g., in a case of drought or other causes of reduced water supply) based on the 2010 IWMP Update. A five-year reduction to 50% cutback is more extreme than was modeled in the 2010 IWMP Update, which only assumed a 40% cutback from a combined drought curtailment from existing customers and meeting the 20x2020 demand reduction mandated in SB X7-7.

In the 2010 IWMP, the calculated supply under shortage conditions would meet the projected demand in any single dry year from 2015-2035 under the medium growth scenario at buildout. A contingency supply by groundwater or other sources was recommended as an emergency supply in the event of an outage or other system emergency (i.e., water quality issue in the river or storage reservoirs). In the case of the District anticipating being unable to meet a possible dry year demand, it is assumed the District would implement additional measures to equitably reduce consumption, as described in the Water Shortage Contingency Plan, for all District customers (existing and future) to the extent that the climatic conditions and operational needs demonstrated the need for curtailment.

4 WATER DEMAND PROJECTIONS

4.1 Future System Potable and Non-Potable Water Demand Projections

In addition to existing year 2015 demand for the District and the Rancho Murieta North Development project proposed demand, the following residential and commercial developments have been approved: The Retreats, Murieta Gardens Extended Stay, Murieta Gardens Residential, Murieta Gardens II-Commercial, and Murieta Inn (all with a projected year of completion of 2020); and Riverview, Lakeview, Residences-East, and Residences-West (all with a projected completion year of 2025). The following table presents projected District demands. The proposed project demands are further described in Section 4.3.

Table 4-1. Future System Potable and Non-Potable Water Demand Projections (AFY)

	2015	2020	2025	2030	2035
Existing Demand, AFY[1]	1,711	1,711	1,711	1,711	1,711
Approved Projected Demand, AFY	-	126	391	391	391
Subtotal Future System Demand (without proposed projects)	1,711	1,837	2,102	2,102	2,102
Proposed Rancho Murieta North Project Demand, AFY[2]	-	204	429	752	1,326
Total Future Demand (with Project), AFY	**1,711**	**2,041**	**2,532**	**2,854**	**3,428**

[1] Existing demand is based on average production from 2009-2013 (not including drought year 2014). Excluding 2014 makes this a conservative number given that the actual water demand in 2014 was reduced due to drought response by District customers.
[2] The Rancho Murieta North Project Demands are presented in Table 4-5 and Table 4-7.

The following Table 4-2 presents the adopted total demand forecast in the 2010 IWMP Update for future connections and EDUs based on 600 gpd per EDU compared to future proposed projects with recycled water supplied to support outdoor irrigation. The analysis illustrates that the use of non-potable irrigation for new residential connections is projected to use less than the previously adopted demand forecast using reservoir supplies to meet potable irrigation demand. The recycled water is also needed for the District's wastewater disposal requirements. The use of recycled water therefore is intended to also assist with increasing the supply reliability for the District when buildout occurs (2035).

Table 4-2. Future Proposed Demands Comparison (normal conditions)

	2015	2020	2025	2030	2035
2010 IWMP Update Demand Projection (using 600 gpd/EDU)	1,525	1,992	2,460	2,928	2,928
Total Future Demand (with Project), AFY	1,711	2,041	2,532	2,854	3,428
Total Estimated Recycled Water	-	-	-	280	560
Total Potable Demand (Reservoir Supplied), AFY	**1,711**	**2,041**	**2,532**	**2,574**	**2,868**

4.2 Net Additional Demand from Proposed Projects

The following table presents the future system demand projections and the difference (estimated remaining supply) until 2035. As shown, available supplies are sufficient to meet system demands under normal conditions.

Table 4-3. Current System Demands (normal conditions without proposed projects)

	2015	2020	2025	2030	2035
Supply, AFY*	4,481	4,723	4,723	4,723	4,723
Current and Approved Demand, AFY	1,711	1,837	2,102	2,102	2,102
Annual Estimated Supply Remaining, AFY	2,770	2,886	2,621	2,621	2,621
Percent Remaining	61.8%	61.1%	55.5%	55.5%	55.5%

*Does not include additional recycled water supplies.

The following table presents the future system demand projections INCLUDING the proposed Rancho Murieta North project demand and the difference (estimated remaining supply) until 2035. As shown, available supplies are sufficient to meet system demand projections.

Table 4-4. Future System Demand Projections (with proposed project)*

	2015	2020	2025	2030	2035
Supply, AFY*	4,481	4,723	4,723	5,003	5,283
Current, Approved and Proposed Demand, AFY*	1,711	2,041	2,532	2,854	3,428
Annual Estimated Supply Remaining, AFY	2,770	2,682	2,191	2,149	1,855
Percent Supply Remaining (normal conditions)	61.8%	56.8%	46.4%	43.0%	35.1%

*All water demands were estimated by District staff except for Rancho Murieta North Development demands, which were calculated by Maddaus Water Management staff. Supplies include recycled water in 2030 and 2035, after the irrigation needs of the Rancho Murieta Country Club have been met.

4.3 Estimated Proposed Project Demands

The following Table 4-5 presents the various analysis input parameters and assumptions.

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Table 4-5. Analysis Input Parameters and Assumptions*

Analysis Input Parameter		Input Value	Notes/Source
Indoor Water Use, gpcd		60.7	Indoor water use based on the minimum of 2010-2015 average low month account water use and 3 persons per lot (ppl) per account. Smaller estate lots less than 12,000 SF have average lowest month water use of 57 gpcd. This is a conservative assumption given new homes have been documented to use as low as 45 gpd per person under the more recent building codes with more efficient fixtures.
Persons per Lot		3.0	Persons per lot (ppl) is based on 2020 compliance assumptions of 3 ppl per household. This is conservative given it's higher than the 2010 census 2.25 people per household (pph). Though this value may seem low for estates >24,000 SF which may have casitas, the assumption is that the additional ppl per casita water use is equivalent or lower to the irrigated square footage for that area should there NOT be a casita. Again, we assume more landscaped area for larger lots in lieu of casitas (a more conservative approach than adding more people per lot for a casita).
Applied Water Estimate (feet/year)		4.18	Applied Water Estimate is based on the applied water from 100% of the 2010-2015 five-year historical average reference evapotranspiration (watering requirements for healthy cool season turf grass 4-7 inches tall in full sun) from the California Irrigation Management Information System (CIMIS) for the Fair Oaks station no. 131. Outdoor irrigation demand was based on an applied water rate of 4.2 feet (30-year average reference evapotranspiration for the Fair Oaks CIMIS). The outdoor water demand is assumed to meet County ordinance requirements for the Maximum Applied Water Allowance (compliant with the most recent state adopted ordinance requirements as of December 1, 2015). A long term average irrigation efficiency of 55% is also conservatively assumed (compared to ordinance levels of 0.75 for overhead spray and 0.81 for drip systems). Existing homes are using approximately 5.5 to 7.0 feet of water per year as published in the 2013 District Demand Factors Technical Memorandum.
Irrigated Area	Estate >24,000 SF	33,000	Irrigated area (per square foot) is based on Project Proponent provided information related to the assumed irrigated area for the lot types.
	Estate 12,000-24,000 SF	11,250	
	Estate <12,000 SF	8,000	
Commercial Water Use per Acre (MG/Acre)		0.56	Using the normal year 2013 water use of a local commercial area of approximately 9 acres, an annual commercial water use factor of 0.56 MG/acre was determined. Some of the commercial water use contained in this sample area includes a Chinese restaurant, post office, parking lot, dentist, country store, and landscape area.
Park and Non-Residential (Common Area)		215 EDUs	Total allocation in 2010 IWMP Update buildout demands is 269 EDUs and historical use has been 54 EDUs, leaving 215 EDUs for parks and other non-residential uses.
		600	600 gpd per lettered lot EDU

***Table acronyms:**

GPCD – gallons per capita (person) per day
SF – square feet
MG – million gallons
EDU – equivalent dwelling unit
gpd – gallons per day
ppl – persons per lot
pph – people per household
CIMIS – California Irrigation Management Information System

Table 4-7 presents the Rancho Murieta North Development project buildout population and water use. This estimate was prepared using the assumptions shown above in Table 4-5.

To calculate the total **residential indoor water demand**, the estimate is based on gallons per day of 60.7 multiplied by average of 3 persons per lot for every day of the year. A sample calculation is as follows:

Total indoor Demand = (60.7 gallons used indoors per person per day) x (3 people per household) x (827 total lots) x (365 days) / 325,851 gallons =* ***169 acre-feet per year (AFY)***

(an acre foot is equal to 325,851 gallons)*

The total **residential outdoor water demand of 946 AFY** was estimated based on the calculation for water budgets per the County Ordinance; assuming less irrigation efficiency (more water required) of 4.18 feet per year of applied water multiplied by the estimated irrigated square footage provided for each lot multiplied by the number of lots. A sample calculation is as follows:

Outdoor Demand for lot type Estate >24,000 SF is:

*(69 Estate >24,000 SF lots) * (33,000 irrigated square feet per Estate >24,000 SF lot) x (4.18 feet per year applied water estimate) x (7.48 gallons / 1 cubic foot) / 325,851 gallons* = 218 AFY*

(an acre foot is equal to 325,851 gallons)

The following table shows the other lot type outdoor water demand calculation inputs. Unit conversion factors are NOT shown in the table below but are presented in the previous sample calculation.

Table 4-6. Residential Outdoor Water Demand – Rancho Murieta North Project

Lot Type	Number of Lots	Irrigated Square Feet Per Lot	Applied Water Estimate, feet/year*	Outdoor Water Demand, AFY
Estate >24,000 SF	*69*	*33,000*	*4.18*	*218*
Estate 12,000-24,000 SF	*466*	*11,250*	*4.18*	*503*
Estate <12,000 SF	*292*	*8,000*	*4.18*	*225*
Total Residential	***827***	*N/A*	*N/A*	***946***

**The 4.18 feet per year applied water estimate is based on the "depth of water" applied to landscapes on a "per square foot" basis. The 4.18 feet per year applied water estimate is equivalent to 31.2 gallons per square-feet applied water. Per the new State Model Water Efficient Landscape Ordinance (pending County adoption), this is taken as 55% of the 2010-2015 five-year historical average reference evapotranspiration. The reference evapotranspiration (ETo[1] is the watering requirements for healthy cool season turf grass 4-7 inches tall in full sun for the California Irrigation Management Information System (CIMIS) for the Fair Oaks station no. 131. The reference ETo is 4.2 feet per year the 30-year average Reference Evapotranspiration for the Fair Oaks CIMIS station. For distribution uniformity, a conservative average of 55% irrigation efficiency was assumed per site; this value is 16% less than the State's default irrigation efficiency estimate for new systems of 0.75 (75%) for newly installed spray and 0.81 (81%) for drip systems. This value of 55% is also an average of the 50-60% efficiency default value used by the California Urban Water Conservation Council. Assumptions for lower irrigation efficiency is conservative, given it means more water needs to be applied to meet plant water needs resulting in higher project estimated water demands for outdoor watering. More information can be found related to Landscape Ordinance requirements for new construction on the California Department of Water Resources web site: http://www.water.ca.gov/wateruseefficiency/landscapeordinance/*

[1] http://wwwcimis.water.ca.gov/Resources.aspx

The **commercial demand** estimate was based on a similar mixed commercial use demand factor developed from the existing commercial uses in the District's service area. Using the normal year 2013 water use of a local commercial area of approximately 9 acres, an annual commercial water use factor per acre of 0.56 MG/acre was determined. Some of the commercial water use included in this sample area includes a Chinese restaurant, post office, parking lot, dentist, country store, and general landscape area. A sample calculation is as follows:

Total Commercial Demand = (39 acres of commercial area) x (560,000 gallons)/ 325,851 gallons = **66 acre-feet per year***

**(an acre foot is equal to 325,851 gallons)*

The **park and common area demands** were based on a water use factor of 600 gallons per day per EDU for the estimated 215 equivalent dwelling units the park and common areas equate to, yielding an estimated volume of outdoor irrigation water demand. At this time the projected 382.7 acres of parks, trails, open spaces, and other non-residential land uses are equivalent to 215 EDUs. A sample calculation is as follows:

Park, Common Area, and Other Non-Residential Total Demand = (215 Total EDUs) x (600 gallons per day per EDU) x (365 days per year) / 325,851 gallons = **145 acre-feet per year***

**(an acre foot is equal to 325,851 gallons)*

Please note that the **bolded and underlined** values in the previous sample calculations sum to the total 1,326 AFY demand shown in the bottom right and corner of the following table. A sample calculation is as follows:

Total Proposed Project Demand = (169 AFY Residential Indoor Water Use) + (946 AFY Residential Outdoor Water Use) + (66 AFY Commercial Water Use) + (145 AFY Park and Other Water Use) = 1,326 AFY.

Table 4-7. Proposed Water Demand Analysis – Rancho Murieta North Project

Water Using Type	No. of Lots	Population	Indoor Water Use (AFY)	Outdoor Water Use (AFY)	Average Annual Water Use (AFY)
Village A	167	501	34	169	203
Village B	167	501	34	179	213
Village C	130	390	27	114	140
Village D	42	126	9	50	58
Village E	43	129	9	113	122
Village F	95	285	19	92	112
Village G	53	159	11	91	101
Village H	130	390	27	139	166
Subtotal Villages	**827**	**2,481**	**169**	**946**	**1,115**
Commercial Mixed Use	4 parcels or 39 acres	N/A	N/A	N/A	66
Park/Common Area	215 EDUs	N/A	N/A	N/A	145
Total	N/A	**2,481**	N/A	N/A	**1,326**

The following table 4-8 presents the Rancho Murieta North Project proposed development water use in five-year increments.

Table 4-8. Proposed Potable and Non-Potable Water Demand Growth – Rancho Murieta North Project*

Lot Type	Cumulative Potable and Non-Potable Water Demand, AFY*			
	2020	2025	2030	2035
Estate >24,000 SF	21	34	75	233
Estate 12,000-24,000 SF	82	190	343	598
Estate <12,000 SF	75	137	211	284
Total Residential	177	361	628	1,115
Commercial Mixed Use	10	30	50	66
Park/Common Area	16	38	74	145
Total	**204**	**429**	**752**	**1,326**

* The project supply estimate includes the use of recycled water estimated at 560 AFY projected to offset potable irrigation demands at buildout. As a result, the table above presents the combined potable and recycled water use planned for the development.

5 DESCRIPTION OF ADOPTED WATER CONSERVATION MEASURES

Over the years, the District has implemented demand management measures in an effort to reduce the overall demand for water. Water conservation helpful tips are available online and in brochures to educate customers. Furthermore, the District has actively used non-potable water for meeting golf course irrigation demands since the courses were built and switched over to recycled water in 1988 with raw water augmenting supply. Over time it is the District's intent to supply 100% of the golf course's irrigation demand with recycled water, even in drought and low water years. Also, in July 2011 the District adopted Policy #2011-07 mandating the use of recycled water for all new development where economically and physically reasonable.

The District is currently and has historically been engaged in promoting water conservation awareness to its customers, which includes the following activities:

- Continue to designate ongoing conservation program funding in yearly budget planning
- Provide new home Welcome Packets, which include copies of water conservation water code and a copy of the River Friendly Landscaping Guidelines
- Assist Rancho Murieta Association (home owner association) with landscape plan reviews related to water efficient landscaping and work to incorporate the new Sacramento County Landscaping Ordinance requirements into future plan reviews
- Participate in the Regional Water Efficiency Program public outreach and rebate programs for high efficiency toilets and washers started in 2010
- Host web pages focused on water conservation education and awareness
- Support active water waste reporting and follow-up: staff notifications given if seen and anonymous reporting via the District web site. Through October 2015, the District issued 342 notices of violation and levied 5 fines.
- Added additional conservation incentives in October 2015 for Drought Irrigation Efficiencies through participation with the Regional Water Authority and the Proposition 84 Drought Grant Irrigation Efficiency Project

In September 2014, the District implemented mandatory outside irrigation restrictions to include limiting outside watering to two days per week. Year-to-date through October 2015, the District has achieved a 32% reduction in residential water demand as compared to 2013.

The proposed project development is scheduled to begin just prior to year 2020 and all the latest applicable Sacramento County building and landscape codes and ordinances will apply to this development per County's approval.

6 COMPARISON OF SUPPLY ALLOCATION VS. WATER DEMAND PROJECTIONS

As shown in the following table, there will continue to be sufficient supplies to meet all projected demand, including the net additional demand generated from the proposed projects in all conditions until year 2035. This conclusion is dependent on the District implementing the mandatory demand reduction as outlined in the District's Water Shortage Contingency Plan.

Table 6-1. Total System Demand with Added Rancho Murieta North Project*

System Demand, No Drought, AFY	2015	2020	2025	2030	2035
District Demand Projection (assumes water conservation achieved and approved lots included)	1,711	1,837	2,102	2,102	2,102
Net Demand from Additional Project Rancho Murieta North, AFY	-	204	429	752	1,326
Total System Demand, AFY	1,711	2,041	2,532	2,854	3,428
Total Projected Supply Availability, AFY	4,481	4,723	4,723	5,003	5,283
Estimated Remaining Supply, AFY	2,770	2,682	2,191	2,149	1,855
Est. Remaining Supply Reliability, %	62%	57%	46%	43%	35%

*All water demands were estimated by District staff except for Rancho Murieta North Development project demands, which were calculated by Maddaus Water Management staff based on information provided and/or industry standards. The estimate of Total Projected Supply Availability includes recycled water in 2030 and 2035 and it does not include any estimated groundwater supplies.

In the event of prolonged drought conditions, the District would implement their Water Shortage Contingency Plan (WSCP). The Plan provides a framework to address demand curtailment of up to 50% within the service area. Per California Water Code, the District has complied with preparing a WSCP down to an assumed 50% reduction in supply.

Therefore, the water demand associated with the proposed project and all foreseeable development could be accommodated during multiple dry years through implementation of the voluntary and possibly mandatory demand reductions.

Table 6-2. Annual Supply Allocation vs. Multiple Dry Years Demand (AFY)[1]

Year		Allocation AFY	Single Dry Year	Year 2	Year 3	Year 4	Year 5
			Supply and Demand Reduction %				
			10%	20%	30%	40%	50%
2015	Supply	4,481	4,033	3,584	3,136	2,688	2,240
	Demand (With approved projects, and NOT including proposed projects)	1,711	1,540	1,369	1,198	1,027	856
	Demand (including proposed projects)	1,711	1,540	1,369	1,198	1,027	856
	Supply Remaining (NOT including proposed projects)	2,770	2,493	2,216	1,939	1,662	1,385
	Supply Remaining (including proposed projects)	**2,770**	**2,493**	**2,216**	**1,939**	**1,662**	**1,385**
2020	Supply	4,723	4,251	3,778	3,306	2,834	2,362
	Demand (NOT including proposed projects)	1,837	1,654	1,470	1,286	1,102	919
	Demand (including proposed projects)	2,041	1,837	1,633	1,429	1,225	1,020
	Supply Remaining (NOT including proposed projects)	2,886	2,597	2,309	2,020	1,731	1,443
	Supply Remaining (including proposed projects)	**2,682**	**2,414**	**2,146**	**1,877**	**1,609**	**1,341**
2025	Supply	4,723	4,251	3,778	3,306	2,834	2,362
	Demand (NOT including proposed projects)	2,102	1,892	1,682	1,472	1,261	1,051
	Demand (including proposed projects)	2,532	2,278	2,025	1,772	1,519	1,266
	Supply Remaining (NOT including proposed projects)	2,621	2,359	2,097	1,835	1,572	1,310
	Supply Remaining (including proposed projects)	**2,191**	**1,972**	**1,753**	**1,534**	**1,315**	**1,096**
2030	Supply[2]	5,003	4,503	4,002	3,502	3,002	2,502
	Demand (NOT including proposed projects)	2,102	1,892	1,682	1,472	1,261	1,051
	Demand (including proposed projects)	2,854	2,569	2,283	1,998	1,712	1,427
	Supply Remaining (NOT including proposed projects)	2,901	2,611	2,321	2,031	1,740	1,450
	Supply Remaining (including proposed projects)	**2,149**	**1,934**	**1,719**	**1,504**	**1,289**	**1,074**
2035	Supply[2]	5,283	4,755	4,226	3,698	3,170	2,642
	Demand (NOT including proposed projects)	2,102	1,892	1,682	1,472	1,261	1,051
	Demand (including proposed projects)	3,428	3,085	2,743	2,400	2,057	1,714
	Supply Remaining (NOT including proposed projects)	3,181	2,863	2,545	2,227	1,908	1,590
	Supply Remaining (including proposed projects)	**1,855**	**1,669**	**1,484**	**1,298**	**1,113**	**927**

[1]Year 2030 and 2035 supplies include projected new recycled water supplies, anticipated to partially come online in 2030 (50%) and fully by buildout (2035). New recycled water supplies are anticipated to be modestly reduced in dry years as customers seek to cut back on indoor potable water demands that would reduce wastewater generation and as a result recycled water availability.

[2]Without groundwater supplies included to augment multi-year drought supplies. Without added direct diversions of up to 1,645 AFY and assuming the reservoirs are filled during the diversion season as occurred in the 2014-2015 drought years.

Using full buildout conditions in year 2035 the District's water supply, under critically dry conditions and limited to full storage capacity in the first year, is capable of supplying water for a 3 year period under extreme drought conditions (meaning no river diversions possible) as documented below:

Beginning Supply 5,283 AF (full reservoir capacity and recycled water) / 1,714 AF (50% demand cutback at full buildout) = 3.08 years of estimated supply.

7 CONCLUSION

Currently, the District has conservatively estimated available supplies of 5,283 AFY in 2035, which includes the reservoir storage capacity as a limiting factor without additional dynamic pumping supply up to the permit limits and including an estimated 560 AFY of recycled water to meet projected buildout demands. In addition, there is a contingency supply planned for additional groundwater resources for emergency shortage conditions, including droughts, of 645 AFY. Given the groundwater wells have been tested but not yet constructed, this supply was not included in this WSA (which would further improve the water supply reliability in times of emergency).

The District's estimated future demand through buildout is forecasted to be 2,928 AFY per the 2010 IWMP Update (using 600 gpd per EDU). The future demand projection developed within this WSA presents that, with the proposed project included, future demands are estimated at 3,428 AFY (Table 4-2). Numerous conservative assumptions were made when independently estimating the project demands (Section 4.3). By accounting for the added recycled water supplies generated from the project, estimated at 560 AFY, there is an offset to potable water demands within the District; however that off-set is included in the assessment as additional supply. The District is requiring the use of recycled water where economically feasible to meet outdoor irrigation demands and as a wastewater disposal alternative.

It is important to note that the District has an obligation to have supply capacity available beyond the Rancho Murieta North Project to serve one remaining 17.8 acre parcel to be developed within the District's service area. With no additional information available associated with this parcel, it is conservatively assumed that 4 acre-ft per acre demand factor[2] would equate to a less than 100 AFY annual demand under normal conditions, which is about 5.4% of the supply remaining of 1,855 AFY under normal conditions.

The Water Supply Assessment, prepared per the requirements of California Water Code and SB 610, finds the proposed project would result in a less-than-significant impact upon potable water supply by not exceeding the demand forecast previously adopted by the District. In other words, the projected demands include sufficient water to serve the Rancho Murieta North Project with excess capacity remaining of 1,855 AFY under normal conditions.

[2] The Murieta North Project has an average of 1.71 acre-ft per acre demand factor (1326 AFY divided by 775 acres) and the 9.34 acre commercial property currently served by the District is 1.7 acre-ft per acre.

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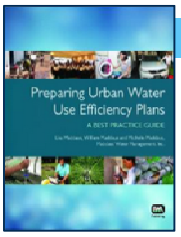
ACRONYMS AND OTHER ABBREVIATIONS

AF	acre-foot or acre-feet
AFY	acre-feet per year
CEQA	California Environmental Quality Act
District	Rancho Murieta Community Services District
EDU	Equivalent Dwelling Unit
GC	General Commercial
gpcd	gallons per capita (person) per day
gpd	gallons per day
gpm	gallons per minute
IWMP	Integrated Water Master Plan
MGD	million gallons per day
MG	million gallons
MWM	Maddaus Water Management, Inc.
NPDES	National Pollutant Discharge Elimination System
ppl	people per lot
pph	people per household
RMCC	Rancho Murieta Country Club
RMCSD	Rancho Murieta Community Services District
SB	Senate Bill
SF	square feet
SVM	Shared Vision Model
WSA	Water Supply Assessment
WSCP	Water Shortage Contingency Plan
WTP	Water Treatment Plant

FIRM SUMMARY

- Extensive knowledge of demand analysis and water conservation
  - MWM is an internationally recognized water conservation authority
  - We have completed over 325 projects in 20 years
  - We provide an unparalleled combination of water conservation, climate change and drought preparedness planning expertise
  - More than 20 years ago, MWM's first project was supporting the water conservation planning needs of Bangkok, Thailand. Our team continues to support both publications and training workshops for the International Water Association and American Water Works Association
- Innovative contributions in advancing demand management technology and integrated water resources planning
  - In 1999, William Maddaus, our company's founder, developed the first water conservation model, the Least Cost Planning Decision Support System (DSS Model), has been used in over 25 states across the nation and internationally in Canada, New Zealand, and Australia, representing a population of over 30 million people
  - Lisa Maddaus develops custom models for drought and climate change planning analyses.
  - MS Excel based software is available for customer water surveys and an iPad app is currently in development by our software developer, Chris Matyas.
- Unparalleled expertise and recognition in our field
  - 90% of our clients are municipal agencies or governmental entities
  - Approximately 85% of our work comes from repeat clients seeking to expand our services into other planning areas or, after a number of years, revisit design of their conservation programs

RECENT PUBLICATIONS WITH LEAD AUTHORSHIP BY MWM STAFF



PREPARING URBAN WATER USE EFFICIENCY PLANS: A BEST PRACTICE GUIDE

Guidebook with more than 25 international case studies on preparing WUE Plans.

Maddaus, L., Maddaus, W., Maddaus, M. Published by the International Water Association in 2013.
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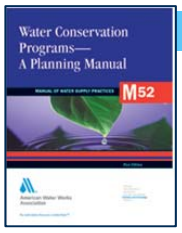

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PROJECT STAFF BIOGRAPHIES

Lisa Maddaus, P.E., is a senior water resources engineer with over 20 years of experience preparing water resources planning studies for water suppliers across the country. Her passion is integrated water resources planning, and her specialty is in conservation, drought, and climate change planning. Lisa is serves as a Special Advisor to the Board of Directors for the California Urban Water Conservation Council and was formerly on staff as a Technical Adviser. Lisa has presented numerous papers on integrated water resource planning, water conservation, demand management, and drought preparedness at AWWA National and International Water Association conferences and for the United Nations. Lisa is also the co-author of the American Water Works Association, Manual of Water Supply Practices, M52, "Water Conservation Programs - A Planning Manual." She was on the team to update M52 in 2014. In 2013, she led the MWM team in authoring "Preparing Urban Water Efficiency Plans – A Best Practice Guide" published by the International Water Association.

Lisa is the AWWA California-Nevada Section instructor for the Water Use Efficiency Practitioner workshops for exam preparation. She has completed more than 100 conservation planning studies and takes an especially pragmatic approach given her more than three years' experience with managing the Regional Water Authority's (RWA) Water Efficiency Program in the Sacramento region in Northern California. At RWA, Lisa helped the 22 water provider members fulfill best management practices for water conservation and was responsible for the daily management of a $2 million budget. Lisa has a B.S. and M.S. in Civil and Environmental Engineering from UC Davis.

Tess Kretschmann, E.I.T. is a water resources engineer with over 10 years project management experience in community, nationally, and internationally based environments. She has 10 years of experience preparing water resources planning studies for urban water suppliers. Recently, Tess was part of the team that worked on a thirty-year water demand forecast for the wholesale customers of the Sonoma County Water Agency (nine different water agencies), which included working on the development of nine individual water demand forecasting DSS Models. She is experienced in preparing water efficiency and master planning studies for water systems which include water demand projections and cost effectiveness evaluations. She has prepared urban water management plans for multiple water systems throughout California. Tess participated in the numerous modeling efforts for regional clients

Tess has created strategic visioning models representing regional water supplies and demands, simulating various drought, supply, demand, and climate change scenarios, analyzing water system reliability, potential system conservation savings, and system drought reliability and vulnerability. She has participated in competitive grant writing efforts, helping applicants receive awards of over $8 million on behalf of regional consortiums. In 2014, she was part of the team awarded a Regional Water Authority grant for 2.5 million. She has led workshops on drought management, master planning, and urban water management planning and has managed permitting efforts for local, state, and federal infrastructure facilities (water tanks, pump stations, etc). As past vice chairperson of the Utilities Rate Advisory Commission in Sacramento, California, Tess reviewed and commented on proposed changes to utility service rates for water, sewer, garbage, recycling, yard waste, and street sweeping services. Tess has a B.S. in Civil and Environmental Engineering from Duke University.

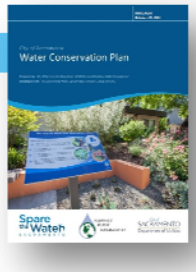
We believe our projects listed below reflect our in-depth knowledge of technical, regulatory, and stakeholder challenges facing agencies, and our willingness to listen and respond to each client's needs.

INTREGRATED WATER MASTER PLAN, WATER SHORTAGE CONTIGENCY PLAN AND WATER SUPPLY ASSESSMENT PROJECTS, RANCHO MURIETA, CALIFORNIA

Project Manager: Lisa Maddaus
Project Completed: 2011, Ongoing
Contact: Darlene Gillum, (916) 354-3700, dgillum@ranchomurietacsd.com
The purpose of the Integrated Water Master Plan (IWMP) was to build a Shared Vision Model to determine future reliability of water supplies at buildout for the community. Model included climate change simulations using historical hydrology data sets modified based on Global Circulation Models as part of the water balance approach. Water Shortage Contingency Plan with a Drought Tracking Tool was completed in 2013. The 2010 IWMP formed the basis for the recently completed Water Supply Assessment (WSA). The WSA was prepared to determine whether there was adequate water supply to meet the needs of a new proposed development project within the service area. MWM provided calculations for the estimated water demand of the project compared to available supplies for the WSA report to be appended with Project Environmental Impact Report.
Weblinks: Integrated Water Master Plan Update:
http://ranchomurietacsd.com/water/water_publications_archive.php

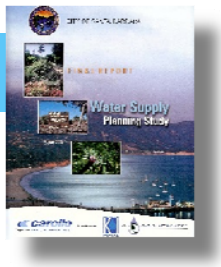
WATER CONSERVATION MASTER PLAN, CITY OF SANTA CRUZ, CALIFORNIA

Project Manager: Lisa Maddaus
Project Completed: 2013-Ongoing
Contact: Toby Goddard, (831) 420-5232, tgoddard@cityofsantacruz.com
MWM provided a master measure database to the City, who then used it to share more than 90 conservation measure ideas with the public. A total of 50 measures to-date have been modeled in the City's DSS Model. The prior work through the master planning effort is currently helping to inform how much conservation savings are estimated to be available in the future.
Weblink: http://cityofsantacruz.com/departments/water/conservation/more-information/water-conservation-master-plan



WATER CONSERVATION PLAN, CITY OF SACRAMENTO, CALIFORNIA

Project Manager: Lisa Maddaus
Project Completed: 2013
Contact: Terrance Davis, (916) 808-4949, tcdavis@cityofsacramento.org
MWM completed a technical analysis and created a plan to replace the Interim Water Conservation Plan that was included as part of the 2010 Urban Water Management Plan. The technical analysis was conducted using the DSS Model.
Weblink: http://portal.cityofsacramento.org/Utilities/Resources/Reports

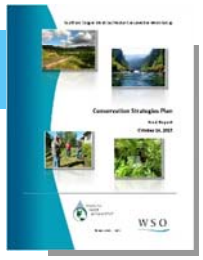


CONSERVATION ANALYSIS FOR LONG-TERM WATER SUPPLY PLAN, CITY OF SANTA BARBARA, CALIFORNIA

Project Manager: Michelle Maddaus
Project Completed: 2010, revised in 2014
Contact: Cathie Pare, (805) 564-5593, cpare@SantaBarbaraCA.gov
MWM assessed the City's water use patterns and trends and the conservation potential; reviewed its water conservation program; in conjunction with another firm, prepared

a water conservation chapter in the overall water supply study report; and recommended an approach to developing a water conservation plan for the City. Later, MWM detailed evaluation of water savings, costs, and benefits from additional water conservation programs.
Weblink: http://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=34152

CONSERVATION STRATEGIES PLAN, SOUTHERN OREGON MUNICIPAL WATER CONSERVATION WORK GROUP, MEDFORD, OREGON



Project Manager: Michelle Maddaus
Project Completed: 2014
Contact: Laura Hodnett, (541) 774-2436, laura.hodnett@cityofmedford.org
MWM developed a Conservation Strategies Plan for Southern Oregon Municipal Water Conservation Work Group (SOMWCWG) that included analyzing conservation measures and programs using MWM's DSS Model. Three programs were developed to evaluate the net effect of running multiple measures together over time and were put forward for review and selection by the SOMWCWG. Based on the implementation of conservation Program B, approximately 3.7 million gallons of water per average day could be saved by 2025 (and 6.4 MGD by 2040).

REGIONAL WATER DEMAND AND CONSERVATIONS PROJECTIONS, BAY AREA WATER SUPPLY AND CONSERVATION AGENCY, SAN MATEO, CALIFORNIA

Project Manager: Michelle Maddaus
Project Completed: 2014
Contact: Nicole M. Sandkulla, (650) 349-3000, nsandkulla@BAWSCA.org
MWM worked with BAWSCA agencies to determine the status of current conservation plans; used Survey Monkey tool to gather BAWSCA member agency preferences on new conservation measures to be included in the DSS Model (25 measures were selected for analysis); modified current and provided final demand projections; developed alternative implementation schedules for BAWSCA to meet conservation goals; prepared three technical memorandums documenting results of analysis; provided three workshops for BAWSCA member agencies; and prepared a Final Report with combined information from all 26 member agencies.
Weblink:
http://www.bawsca.org/docs/BAWSCA%20Demand%20and%20Conservation%20Projection%20FINAL%20REPORT.pdf

DEMAND AND CONSERVATION EVALUATION, 2010 UWMP SUPPORT, CONSERVATION MASTER PLAN, MARIN MUNICIPAL WATER DISTRICT, CALIFORNIA

Project Manager: Michelle Maddaus
Project Completed: 2011
Contact: Daniel Carney, (415) 945-1522, dcarney@marinwater.org
In 2007, MWM conducted a Water Conservation Evaluation for Marin Municipal Water District, using the DSS Model, that was included in their Water Conservation Master Plan. In 2009, MWM completed a study of three additional conservation options that provided detailed cost and projected water saving information, allowing the MMWD's Board to select a higher level of conservation than in the 2007 Master Plan. In February 2011, MWM completed a water demand and conservation update in support of MMWD's 2010 Urban Water Management Plan, which included new demand forecast to 2035.
Weblinks: Conservation Master Plan: https://ca-marinwater.civicplus.com/DocumentCenter/View/57
Follow on 2009 study: https://ca-marinwater.civicplus.com/DocumentCenter/View/56
2010 UWMP Demand Study, Apdx E: https://ca-marinwater.civicplus.com/DocumentCenter/View/533