Integrated Water Master Plan

Rancho Murieta Community Services District

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Glossary of Terms

acre	43,560 feet^2.
acre-foot	1 foot depth over 1 acre; equivalent to 325,830 gallons.
ADWF	Estimated average dry weather flow.
base scenario	Projected medium growth scenario.
cfs	Cubic feet per second.
CDO	Cease and Desist Order No. RS-2006-0001
dead storage	Unusable reservoir volume.
District	Rancho Murieta Community Services District.
drought deficit	Net system deficit in 1:200 drought event.
DU	Dwelling unit.
EDU	Equivalent dwelling unit.
gpd	Gallons per day.
I&I	Inflow and infiltration.
mgd	Million gallons per day; 1 mgd is equivalent to 3.07acre-ft of water.
Project	Integrated Water Master Plan Project.
RMCC	Rancho Murieta Country Club
SWTR	Surface Water Treatment Rule.
TDS	Total dissolved solids.
WDR	Rancho Murieta Community Services District's Waste Discharge Requirements Order No. 5-01-124.

WWRP	Rancho Murieta Wastewater Reclamation Plant.
WWTF	Rancho Murieta Wastewater Treatment Facility.

Executive Summary

The Rancho Murieta Community Services District (District) was formed in 1982 to provide water supply, wastewater, storm drainage and flood control services to the community of Rancho Murieta. The area served by the District encompasses approximately 3,500 acres. Land uses within this service area provide for the development of approximately 2,000 acres for single-family residences, townhouses, apartments, duplexes and manufactured homes.

The District's water supply consists of seasonal diversion from the Cosumnes River that is normally diverted to three storage reservoirs (Calero, Chesbro, and Clementia). In addition to other use limitations, the total amount of water taken from the Cosumnes River cannot exceed 6,368 acre-ft per year. During average rainfall years, diversions provide adequate water supply for consumptive uses and storage reservoir replenishment. However, some Rancho Murieta residents have expressed concern about degraded waterline aesthetics associated with lower water levels at the reservoirs. In addition, the Cosumnes River water supply is subject to drought restrictions. The District has developed a drought ordinance to protect the community against water supply shortages. Since 1989, over 10 studies or exploratory measures have been executed to determine potential water supply alternatives.

The District has initiated this Integrated Water Master Plan Project (Project) to address drought deficits and reservoir waterline aesthetics. The goals of this project are as to:

- Provide a holistic evaluation of the District's water supply, potable water, treated effluent, and recycled water assets.
- Evaluate both water supply and potable/recycled water needs based on three growth scenarios.
- Recommend a comprehensive plan for maximizing the use of District water resources while simultaneously addressing the community's needs in regard to drought conditions and reservoir draw downs.

Existing and Future Conditions

The District currently serves a total of 2,547 residential units and 326 non-residential units. According to the County's approved Planned Unit Development Plan, Rancho Murieta can ultimately represent a potential 5,200 residential units. However, developer growth projections have recently been reduced from 5,200 to 4,345 residential units due to current economic influence, environmental constraints and consumer home-buying trends.

A summary of key information developed for current and future buildout conditions is presented in Table ES-1 pertaining to raw water supply, potable water demand, wastewater production and recycled water disposal.

Table ES-1. Summary of Existing and Future Conditions.

Service and Parameter	Units	Existing Conditions	Buildout Conditions
Raw Water Supply			
Projected Demand	acre-ft per year	2,010	4,430
Available Water Rights	acre-ft per year	6,368	6,368
Water Treatment			
Projected Maximum Demand	mgd	3.1	6.7[a]
Available Capacity	mgd	3.5	7.0
Wastewater Treatment			
Projected Production (ADWF)[b]	mgd	0.5	1.05
Available Capacity (ADWF)[b]	mgd	1.55	1.55
Recycled Water Production			
Projected Peak Month Demand	mgd	1.5	1.5
Available Capacity	mgd	3.0	3.0
Recycled Water Storage			
Projected Storage Needs	acre-ft	430	1,100
Available Storage Volume	acre-ft	720	720
Additional Storage Requirements	acre-ft	none	380
Recycled Water Disposal			
Projected Production	acre-ft per year	565	1,110
Golf Course Irrigation Demands	acre-ft per year	575	575
Excess Recycled Water	acre-ft per year	supplementary water required	535

[a] Based on planning water demand of 750 gpd per equivalent dwelling unit. Actual demands have been approximately 695 gpd per equivalent dwelling unit.
[b] Average dry weather flow (ADWF).

Reservoir Implications and Drought Deficits

A water balance model was developed to estimate reservoir volumes and water levels during both normal and drought conditions. The water balance model estimates these for both existing and future buildout conditions in the community. Figure ES-1 and Figure ES-2 show projected water volumes and levels in Calero Reservoir for existing and future conditions.

The following summarizes key results derived from the reservoir water balance model:

Existing Conditions:

- Calero Reservoir's volume is sufficient to meet the community's water supply needs under normal conditions. Chesbro Reservoir is expected to be full throughout the year since it is replenished throughout the year by Calero. Clementia Reservoir experiences a maximum draw down of five feet due to naturally occurring evaporation and seepage.

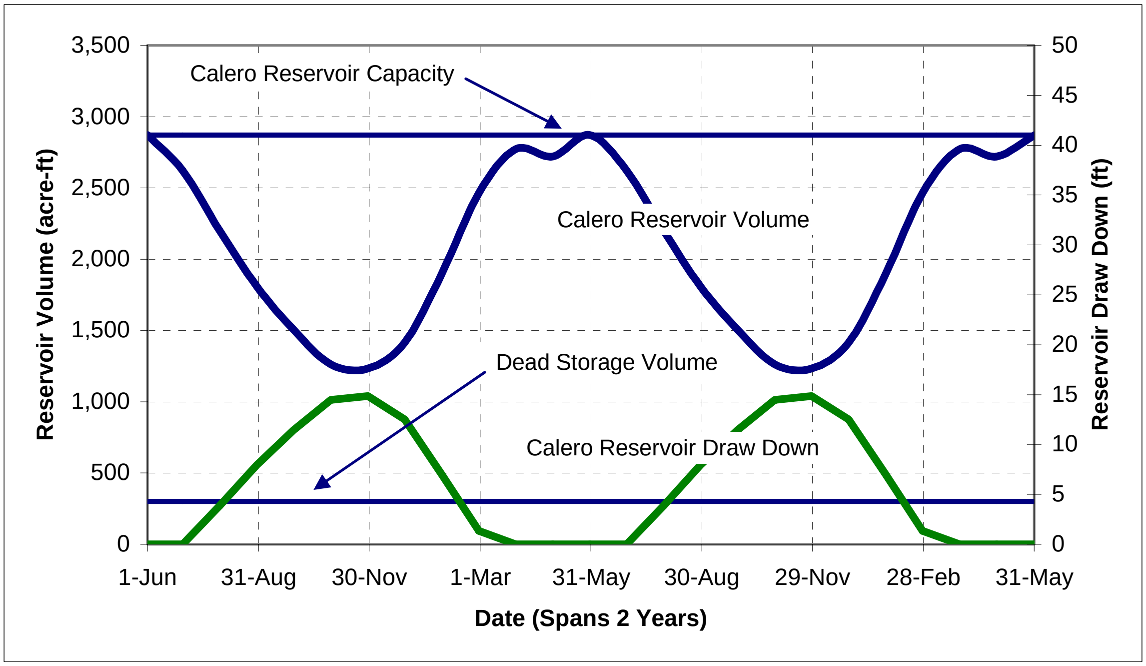

Figure ES-1. Estimated Calero Reservoir Volume and Water Levels – Existing Conditions.

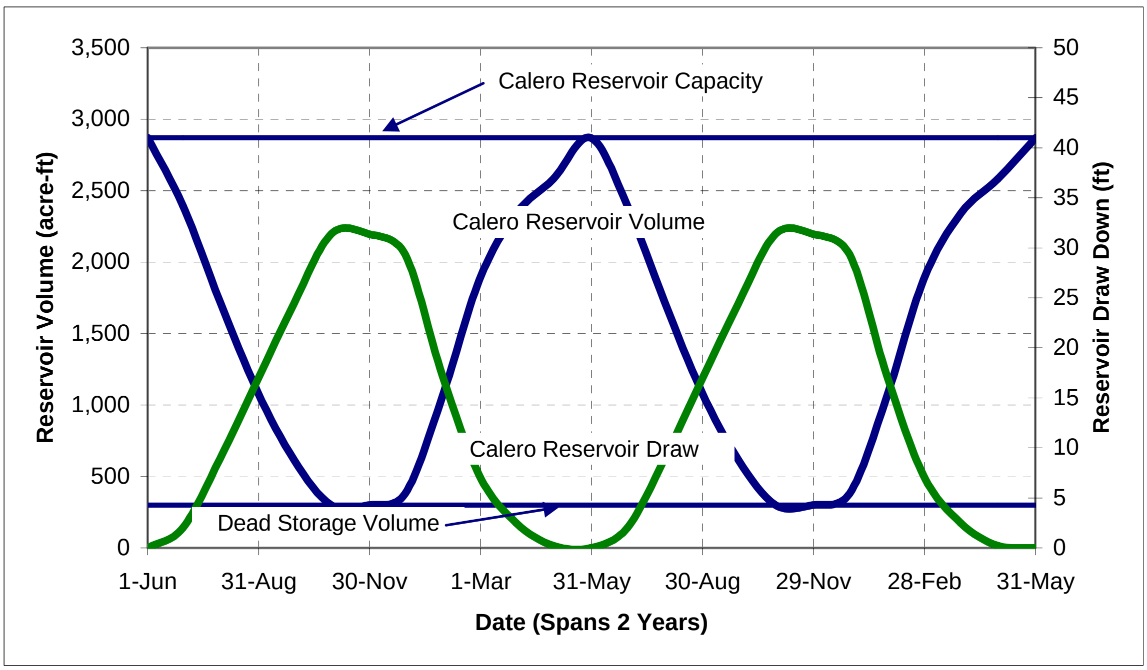

Figure ES-2. Estimated Calero Reservoir Volumes and Water Levels - Future Conditions.

- These three storage reservoirs are capable of meeting the community's water supply needs under severe drought conditions (a 200-year drought event followed by 25-year drought event) provided water use in the community is reduced 50 percent.

Future Buildout Conditions

- Both Calero and Chesbro Reservoirs are needed to meet the community's water needs during normal conditions. Calero is expected to be at dead storage in October and November. The maximum draw down in Chesbro is estimated to be 5 feet. Clementia Reservoir experiences a maximum draw down of 5 feet due to naturally occurring evaporation and seepage.
- An additional water supply of 435 acre-ft is needed in addition to the volume of all three water storage reservoirs under severe drought conditions. Under severe drought conditions all three reservoirs are expected to reach dead storage. The additional 435 acre-ft estimate includes a safety factor approximately equal to one month's water demand in addition to the estimated drought deficit, and also assumes water use in the community is reduced 50 percent.

Potential Integrated Management Components and Strategies

Workshops were held with District staff on May 17 and June 27, 2005 to review preliminary findings and results. Potential components and strategies that could address degraded waterline aesthetics and projected drought deficits were also discussed. A total of 10 strategies/components were reviewed. Of these strategies and components, the following seven were considered viable options and were selected for further consideration:

- **Mandatory Water Reductions (Policy Component):** It is recommended the District implement a formal water use policy pertaining to drought cutbacks. The policy should be based on achieving a 50 percent level of water conservation during severe drought conditions since this was established as the baseline conservation rate in both this and past planning projects.
- **Reduced Water Allocation (Policy Component):** The estimated water savings for this option is 125 acre-ft per year assuming water allocations for all future large estate lots in the community are reduced by 100 gpd per residential unit.
- **Demand Management Pricing (Policy Component):** The estimated water savings for this option is 125 acre-ft per year based on an overall reduction in water use of 3.5 percent and an assumed water price increase of 10 percent.
- **Expand Recycled Water Service (Physical Improvement):** Expansion of the recycled water program is estimated to reduce water demand by 535 acre-ft per year under normal conditions and 420 acre-ft per year under severe drought conditions. Decreased water demand reductions are attributed to increased golf course recycled water demands during drought conditions.

- **Surface Storage (Physical Improvement):** A new surface storage reservoir could be constructed to address drought deficits. District staff has indicated a new reservoir could only be used during droughts and could not be used to reduce reservoir draw downs under normal conditions.
- **Groundwater Supply (Physical Improvement):** Previous studies show that providing new groundwater supply is more cost effective than installing a new off stream storage reservoir. The conjunctive use option could use groundwater during normal and drought conditions in combination with stored surface water provided some type of groundwater recharge process is implemented. This is only one of two options that can significantly reduce reservoir draw downs while simultaneously eliminating drought deficits.
- **Water Exchange — Trading Recycled Water for Groundwater Supply (Physical Improvement):** There are several agricultural operations in close proximity of Rancho Murieta. The District could form agreements with local ranchers or farmers and trade District-produced recycled water for groundwater drawn for agriculture. This is only one of two options that could significantly reduce reservoir draw downs while simultaneously eliminating drought deficits. As the community grows larger and more recycled water is produced, this water exchange option also addresses the District's future need to dispose of excess recycled water.

Recommendations

A multi-faceted and integrated solution is required to reduce reservoir draw downs and eliminate the drought deficit. Figure ES- 3 illustrates the recommended approach for addressing these issues.

The solution is comprised of the four components described below, the first three of which are policy related. The fourth component is comprised of three competing options all of which are physical improvements. These options will be compared as part of the District's upcoming buildout expansion and financing plan project that is expected to be initiated in January 2007. At this time, it is envisioned that a single option would be selected from these three options.

- **Mandatory Water Reductions During Severe Drought:** Policy implementation describes the level of service to be provided during severe drought conditions to the community. The policy should be based on achieving a 50 percent level of water conservation during severe drought conditions, since this was established as the baseline conservation rate in both this and past planning projects.
- **Reduced Water Allocations for Large Estates:** Policy implementation provides the District the ability to influence water demands associated with highest future growth classification. Can be used as the stepping stone to set forth allocations for other lot classifications and promote water conscious landscaping throughout the community. Policy can be used to describe level of service to be provided during normal conditions for specific or all lot classifications.

- **Demand Management Pricing:** Policy implementation provides a mechanism for enforcing mandatory water reductions and reduced water allocations.
- **Effluent Management and Water Supply Augmentation:** Each of the options listed below are physical improvements which maximize the use of all available water resources, provides additional supply for normal, drought, and emergency conditions, and addresses the community's long-term treated effluent disposal needs.
  - Exchange recycled water for local groundwater supply.
  - Expand recycled water service to new residential customers.
  - Convey recycled water to a local rancher. Independently obtain new groundwater supply to address normal and drought water supply needs.

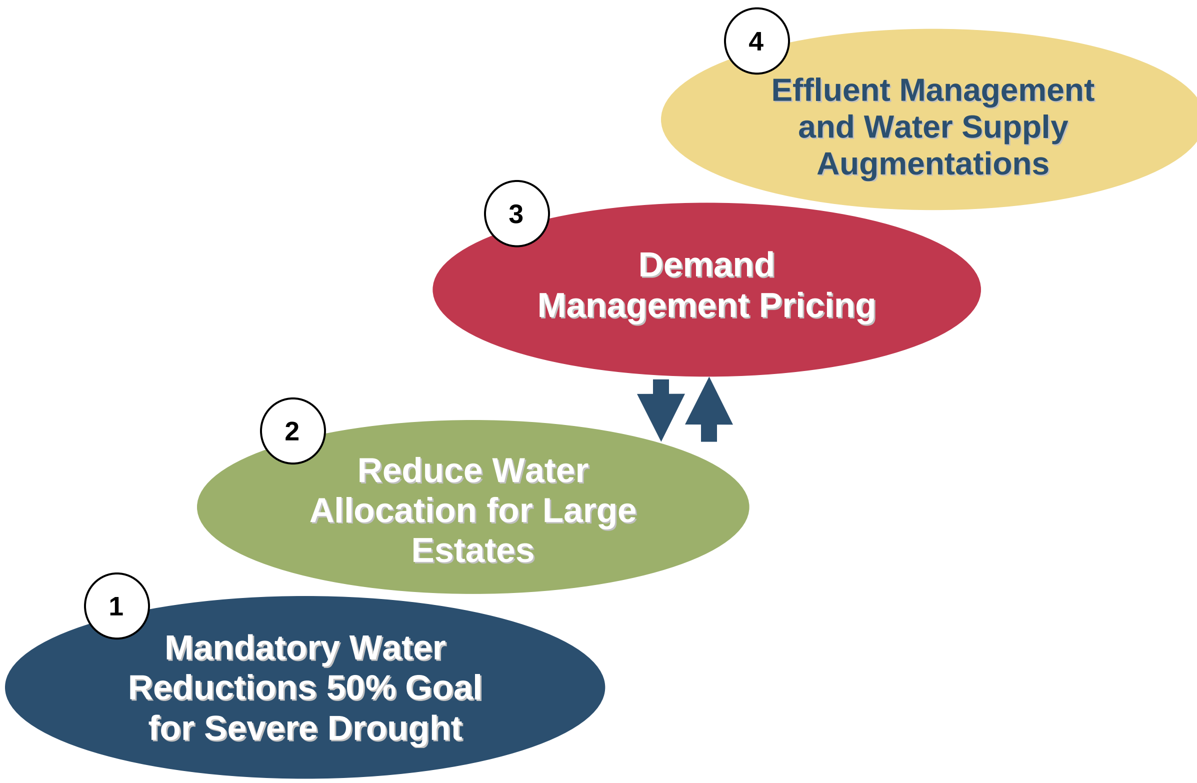

Figure ES- 3. Recommended Policy Components and Physical Improvements

1.0 Introduction

The Rancho Murieta Community Services District (District) was formed in 1982 to provide water supply collection, treatment and distribution; wastewater collection, treatment and reuse; as well as 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. Land uses within this service area show the development of approximately 2,000 acres for single-family residences, townhouses, apartments, duplexes and mobile homes. According to the County's approved Planned Unit Development Plan, the development of this area represents a potential of 5,200 residential units at buildout.

The District's water supply consists of seasonal diversions from the Cosumnes River that are normally diverted to three storage reservoirs (Calero, Chesbro and Clementia). Diversions are limited as follows:

- During periods of high flow in the river and between the dates of November 1 and May 31, surface water can be diverted from Granlees Dam into the District's water storage reservoirs. Diversions are limited as follows:
  - No water may be diverted when river flows are less than 70 cubic feet per second (cfs) at Michigan Bar.
  - For river flow between 70 and 175 cfs, a maximum diversion rate of 6 cfs is allowed provided this diversion does not reduce downstream flow below 70 cfs.
  - When river flows exceed 175 cfs, diversion of 6 cfs is allowed for direct use plus an additional 3,900 acre-ft for storage as follows:
    1. 1,250 acre-ft to Chesbro Reservoir.
    2. 2,610 acre-ft to Calero Reservoir.
    3. 850 acre-ft to Clementia Reservoir.
    4. 40 acre-ft to South Course Lake 10.
  - The combined amount of items 2, 3, and 4 above cannot exceed 2,650 acre-ft.
  - The maximum allowable diversion rate to storage is 46 cfs.

The total amount of water taken from the river cannot exceed 6,368 acre-ft per year. During average rainfall years, diversions provide adequate water supply for consumptive uses and storage reservoir replenishment. However, some Rancho Murieta residents have expressed concern about the degraded waterline aesthetic associated with lower water levels at the reservoirs.

The Cosumnes River water supply is subject to drought restrictions. In 1976 and 1977, California experienced the driest one-year drought span on record. This drought represented a one in 200-year drought event; during the drought, total available river water supply was reduced to 277 acre-ft/year. The District has developed a drought ordinance to protect the community against similar water supply shortages. Since 1989, over 10 studies or exploratory measures have been executed to determine potential water supply alternatives. In addition, other studies have evaluated alternative buildout projections and assessed reclaimed water disposal needs.

1.1 Purpose or Goal

The goal of the Integrated Water Master Plan Project (Project) is to:

- Provide a holistic evaluation of the District's water supply, potable water, treated effluent and recycled water assets.
- Evaluate both water supply and potable/recycled water needs based on three growth scenarios.
- Recommend a comprehensive plan for maximizing the use of District water resources while addressing the community's needs in regard to drought conditions and reservoir draw downs.

Specific tasks conducted for the project include:

- **Characterize Existing Conditions:** Characterize existing conditions within the community in regard to water connections and water supply, raw water treatment, wastewater treatment and treated effluent/reuse needs based on a review of historic data.
- **Project Future Conditions:** Project water supply, raw water treatment, wastewater treatment, treated effluent disposal/reuse needs based on three buildout scenarios and historic growth patterns.
- **Estimate Reservoir Implications and Estimated Drought Deficits:** Estimate reservoir draw down levels and drought deficits based on existing and future conditions.
- **Identify Potential Integrated Management Components and Strategies:** Identify, describe and evaluate potential components/strategies that can be used to address water supply deficits and reservoir levels.
- **Recommend Plan:** Recommend an integrated water management plan consisting of single or multiple components/strategies to address water supply deficits and reservoir levels.

1.2 Chapter Summary

This chapter provided introductory and background information about the District, its water rights, and the goals for the Project.

Project goals are to:

- Provide a holistic evaluation of the District's water resources.
- Evaluate both current and future water supply and potable/recycled water needs.
- Recommend a comprehensive plan for maximizing use of District water resources.
- Address community needs in regard to drought conditions and reservoir drawdowns.

2.0 Existing Conditions

Table 1 summarizes the existing number of lots according to type of unit (residential, commercial, parks, school, etc.) and lot type. As shown in Table 1, the District estimates current service at 2,547 residential lots (units).

Table 1. Summary of Existing Lots.

Lot or User Class	Projected Average Use (gpd/DU)[1]	EDU Conversion Ratio[2]	Number of Lots	Number of EDUs[3]
Residential Units				
Estate > 12,000 sf	750	1.0	752	752
Estate < 12,000 sf	650	0.9	561	486
Circle	550	0.7	457	335
Cottage	500	0.7	281	187
Halfplex	400	0.5	59	31
Townhouse	350	0.5	248	116
Mobile Home	200	0.3	189	50
		Subtotal	2,547	1,958
Non-Residential Units				
Commercial/Industrial	744	~1.0	272	272
Parks	744	1.0	54	54
School	744	1.0	0	0
		Subtotal	326	324
		Total	2,873	2,282

[1]Gallon per day (gpd) per dwelling unit (DU).
[2]Rounded to the nearest tenth.
[3]Equivalent dwelling unit (EDU). Equal to the product of the EDU conversion ratio and the number of lots.

The District projects water demands using equivalent dwelling units (EDUs) and an average unit demand factor of 750 gallons per day (gpd) per EDU. EDU is a unit measure for demand. It is used to equalize demand for various land use classifications and structure types. As shown in Table 1, various types of lots or user classes are assigned a ratio that converts a lot size or user class to a water demand value. For example, a large estate lot greater than 12,000 square feet is expected to have greater water demand than a smaller townhouse lot. A large estate lot is assigned a water demand of 1.0 EDU while the smaller townhouse lot is assigned a demand of 0.5 EDU. EDU value is used to project demands between development units in various lot and user classes.

2.1 Water Supply

The following describes the District's existing raw water supply infrastructure and historic water supply trends.

2.1.1 Raw Water Infrastructure

The District's raw water infrastructure consists of an intake from the Cosumnes River (Granlees Dam and a diversion structure), booster pumps and three primary raw water storage reservoirs (see Figure 1). The three primary storage reservoirs (Chesbro, Calero and Clementia) have an estimated combined storage of 4,723 acre-ft.[1] Although there are three water supply storage reservoirs within the District's system, only two reservoirs, Calero and Chesbro, are needed under normal or wet conditions to supply the community with raw water.

Raw water can be conveyed from Granlees Dam to either Calero or Clementia Reservoirs via 33- or 21-inch raw water pipelines. 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 pipeline to Chesbro Reservoir. Raw water needed to meet the community's needs is routed 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 lakes and ponds within the community. Clementia Reservoir is also used for irrigation supply and recreational uses.

Operation of the raw water system is based on a water balance where supply meets demand. Although this concept may seem simple, the actual implementation of balanced operation becomes complicated because of the District's water rights restrictions and seasonal demands. The basic equation for raw water supply is:

$$\Delta Storage = \sum_{in} Flow - \sum_{out} Flow$$

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 depth increases until they are filled to capacity. The opposite state occurs during the summer-to-fall draw down season; flow out of the system is greater than flow into the system. 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 the system remains greater than flow into the system for most of the drought period including the diversion season.

2.1.2 Historic Water Supply Trends

Volumes of raw water pumped from Granlees Dam to the three storage reservoirs over the past 20 years are presented in Figure 2. This figure also shows the number of customers served by the District and the total amount of potable water produced by the water treatment plant.

[1] Combined volume with flashboards.

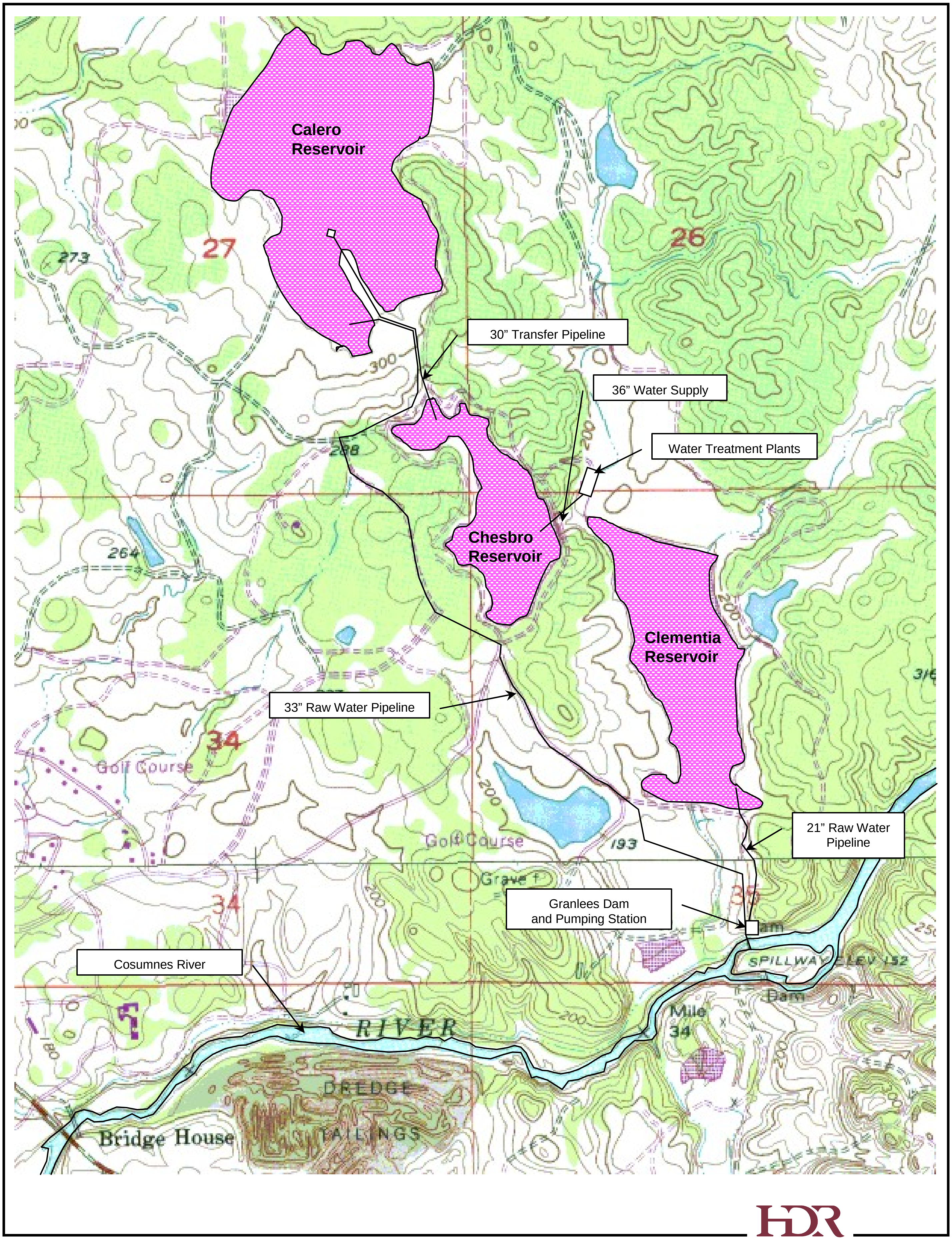

Figure 1. Raw Water Infrastructure.

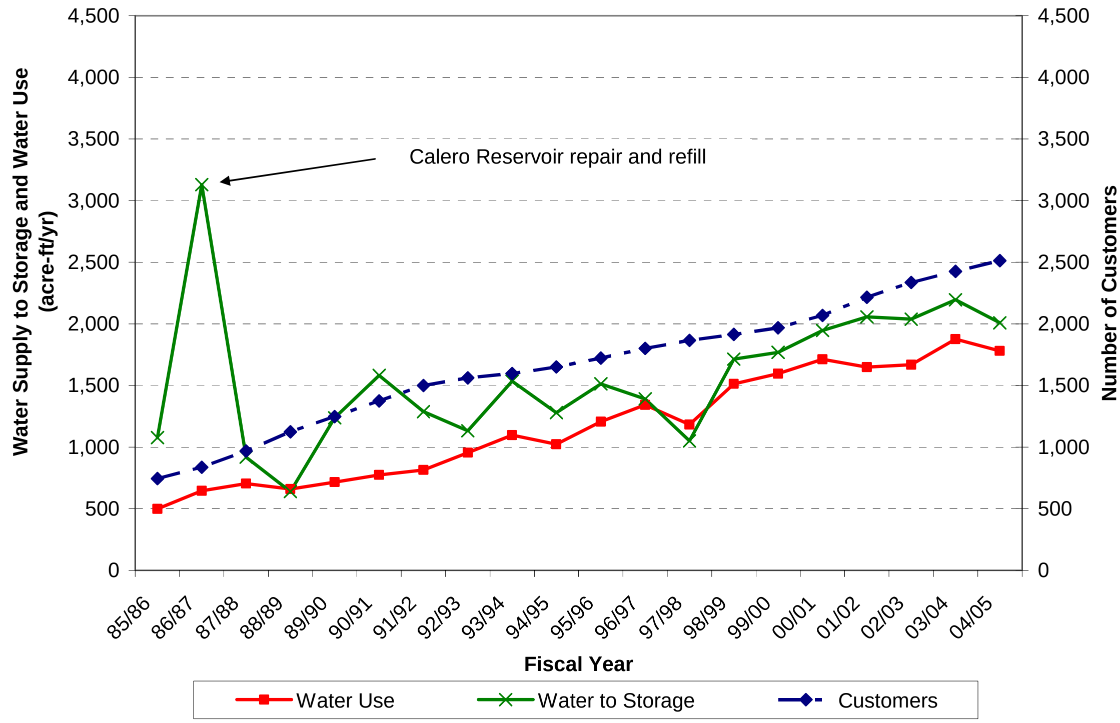

Figure 2. Water Supply and Potable Water Use - Fiscal Year 1985/86 Through 2004/05.

As indicated by similar slopes in water supply (after fiscal year 1989/90), water demands and connection trends, the increase in overall water supply and use is roughly comparable to rates of growth.

2.1.3 Reservoir Losses

Past studies used an assumed reservoir loss of 25 percent to account for evaporation and reservoir seepage. Evaporation rates were estimated using pan evaporation rates and estimated surface areas of the three water supply reservoirs. Losses associated with reservoir seepage were based on a rate of 2.5 feet per year and the interface between water volume and the reservoir's total bottom surface area.

A comparison between the amount of water pumped from Granlees Dam to raw water storage and the amount of water produced at the water treatment plant was prepared. Figure 3 shows the estimated raw water supply and treated water production rates between 1985 and 2003. The solid line in the figure represents no reservoir losses; the volume of water pumped from Granlees Dam to storage is equal to the total amount of water produced. As shown, the best fit line (developed based on a regression analysis of historic values) and all historic values fall on or below the solid line shown in the figure that is associated with no reservoir losses. This result indicates water losses do occur in the reservoir. Reservoir losses vary significantly from year to year and range between 100 and 800 acre-ft per year. Overall, average losses appear to be 20 percent of the total water supply.

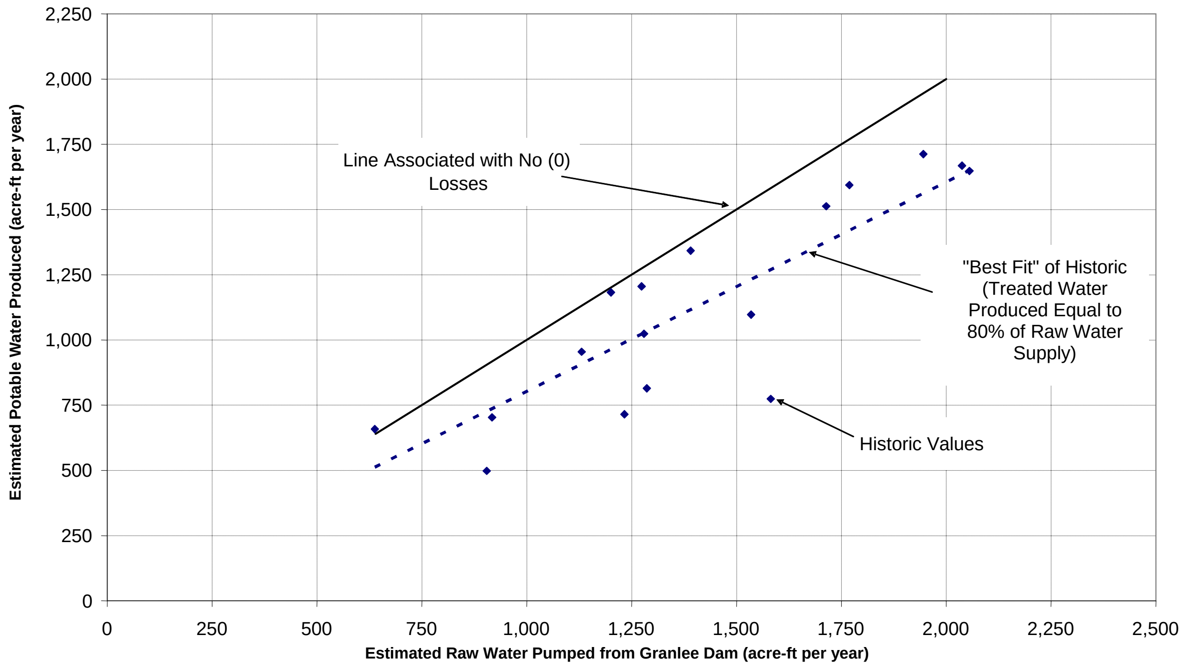

Figure 3. Comparison of Raw Water Supply and Treated Water Produced.

2.2 Water Treatment, Demands and Uses

The following are descriptions of the District's existing water treatment plant and historic potable water demands and characteristics.

2.2.1 Description of Existing Water Treatment Plant and Expansion Plan

The District's first water treatment plant (Plant 1) was constructed in 1975 and had a design capacity of 1.5 million gallons per day (mgd). Plant components and processes include:

- Drum screen
- Flash mixing
- Flocculation
- Sedimentation
- Traveling bridge filter
- Chlorine contact basin
- Booster pumps

The second water treatment plant (Plant 2) was constructed in 1988 with a rated capacity of 2.0 mgd. Plant components and processes for Plant 2 are the same as those in Plant 1. However, Plant 2 can reliably treat 2.0 mgd. Both plants accommodate higher hydraulic flows but cannot reliably meet current treated water quality regulations at higher flows. In 1995, both Plants 1 and 2 were retrofitted to meet the new Surface Water Treatment Rule (SWTR). Since then, the plants have generally operated well and provide a reliable capacity of 1.5 and 2.0 mgd, respectively, resulting in 3.5 mgd total combined capacity. The current maximum day demand is estimated to be 3.1 mgd.

To ensure adequate water supply for future development, the District has initiated the Phase 3 Water Treatment Plant Expansion Project. This project will expand the District's water treatment system. Key objectives of this project include:

- Modifying the existing raw water pipeline to accommodate higher flows to Plant 1 and provide raw water screening upstream of Plant 1.
- Retrofitting Plant 1 with submerged membrane filtration technology and increasing its maximum day capacity from 1.5 to 2.2 mgd in accordance with current and foreseeable future regulations. This replacement is required due to age and regulatory constraints.
- The existing Plant 2 treatment system will remain in service and will not be modified as part of this project.

Following this expansion project, the firm rated capacity of the District's water system will be 4.2 mgd.

A second expansion project (the Phase 4 Water Treatment Plant Expansion Project) will be initiated in the future. The purpose of this future project will be to increase the rated capacity of Plant 2 from 2.0 to 4.75 mgd. Once this project is completed, the firm rated capacity of the District's water system will approximately 7.0 mgd.

2.2.2 Historic Potable Water Demands and Characteristics

Figure 4 provides a breakdown of the total potable water demands by user category. As shown, residential demands account for 72 percent of the total water produced. Of this amount, residential outdoor uses account for 53 percent of total residential demand. The remaining demand (28 percent) is comprised of non-residential uses and system losses. Non-residential uses account for 19 percent of the total water produced and, of that amount, 68 percent of non-residential use is associated with outdoor uses. System losses, which are defined as losses after water treatment (e.g. distribution leaks, water used for fire hydrant testing, etc.), account for the remaining 9 percent of the total water produced.

Annual and running five year average water uses over the past 20 years are presented in Figure 5. As shown, annual average water uses have varied between 485 and 738 gpd per connection. In general, the lowest water uses occurred in the late 1980's and early 1990's and some of the

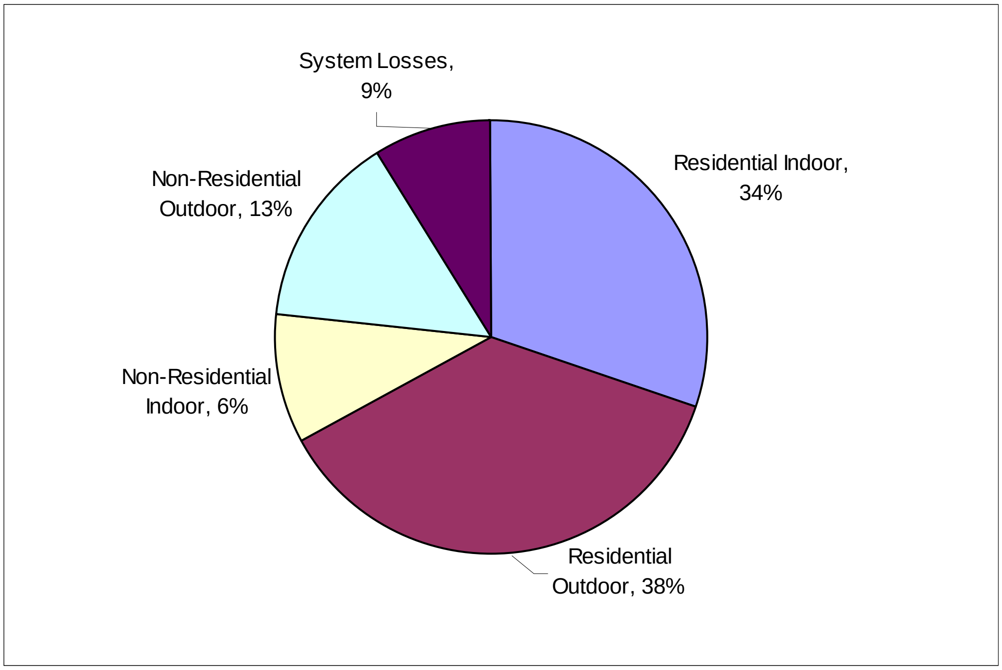

Figure 4. Water Use by Category.

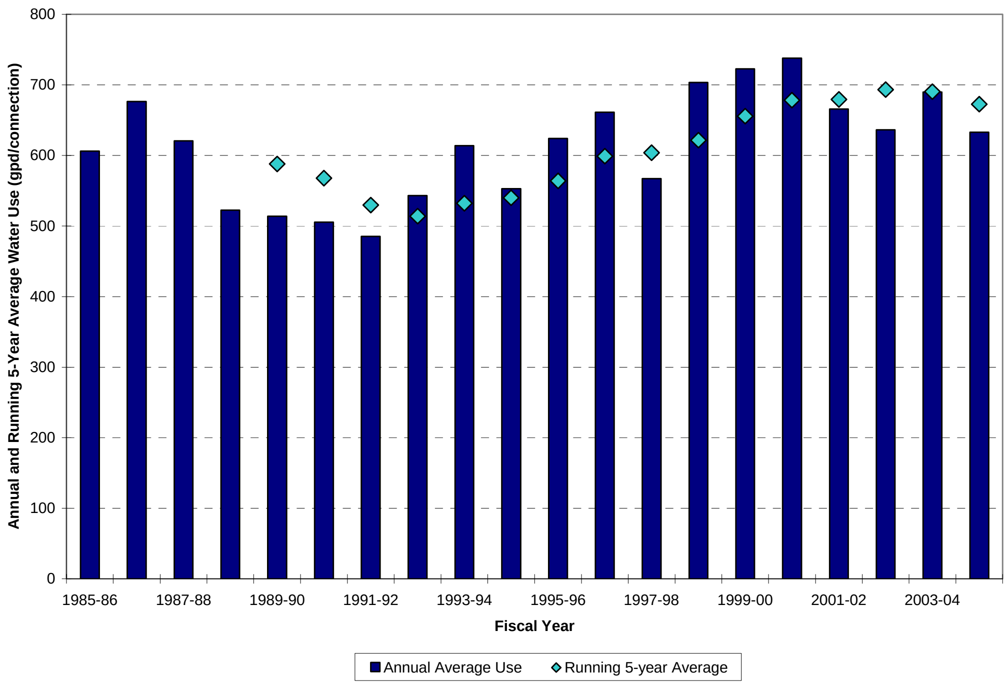

Figure 5. Annual and Running Five Year Average Water Use in the District's Service Area.

highest demands have occurred in the last seven years. The highest five year average use of 693 gpd per connection occurred in 2002/03.

2.2.2.1 Indoor and Outdoor Water Use Characteristics

Estimates for indoor and outdoor water uses were developed from historical seasonal patterns. Figure 6 shows all types of estimated uses over the past 20 years. Currently, residential and non-residential indoor use averages about 300 gpd per connection, while outdoor uses are currently between 350 and 400 gpd per connection. Outdoor water use has increased by 50 to 100 gpd per connection since 1992.

Figure 6. Estimated Indoor and Outdoor Water Use.

2.2.2.2 Seasonal Characteristics

Another factor that influences current and future water demands are seasonal variances between indoor and outdoor uses. Figure 7 shows seasonal indoor, outdoor and total water demands. As shown, the months of January, February and December have significantly lower water demand than the remaining months of the year due to lower outdoor water use. Overall, average demand during these months is approximately 315 gpd per connection, compared to 735 gpd per connection in the remaining nine months of the year. The difference between these two demands is primarily attributed to outdoor use (e.g., landscape irrigation).

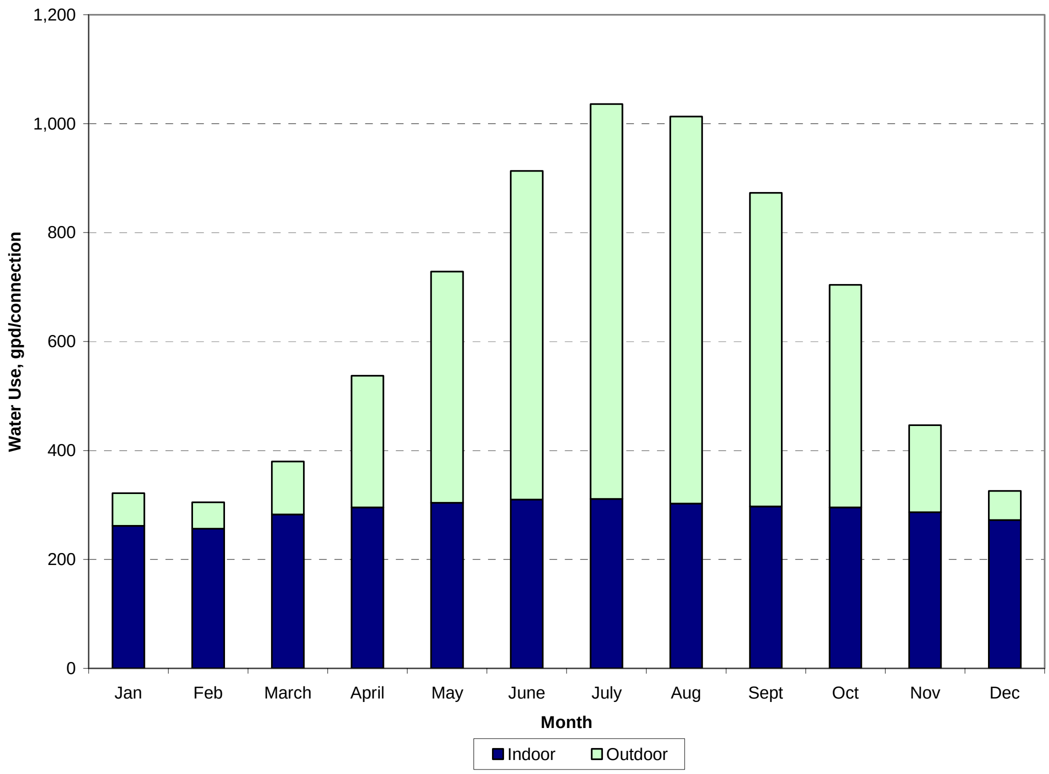

Figure 7. Average Monthly Water Demands.

2.3 Wastewater Treatment and Recycling

The District operates the Rancho Murieta Wastewater Reclamation Plant (WWRP) which provides wastewater treatment for the entire Rancho Murieta community. Raw wastewater sources are residential homes in the Rancho Murieta community and commercial facilities such as stores and restaurants which serve the community. There are no industrial dischargers to the WWRP.

The collection system consists of gravity sewer lines which flow to nine lift stations located throughout the community. Six of the lift stations are located on the north side of the Cosumnes River and three are located south of the river. Ultimately, wastewater is conveyed to the WWRP by three lift stations: Main Lift North, Main Lift South and Lift Station 6B. The volume of influent flow entering the WWRP is calculated by totaling flow readings from these three lift stations.

The WWRP consists of a secondary wastewater treatment facility and a tertiary treatment plant. Wastewater receives secondary treatment through five aerated facultative ponds that are operated in series. Treated effluent is stored in two storage reservoirs before receiving tertiary treatment. The tertiary treatment facilities consist of two dissolved air flotation units, two rapid sand filters, a chlorine contact chamber and a concrete lined equalization basin.

The tertiary treatment plant is operated each year from April through November. During the winter period, secondary treated effluent is stored in the WWRP's two storage reservoirs. After receiving tertiary treatment, reclaimed water is pumped to the golf courses and stored in five reservoirs (Lake 10, Lake 11, Lake 16, Lake 17 and Bass Lake) situated around the golf courses. Depending on irrigation demands, recycled water stored in Lake 10, Lake 11 and Bass Lake may be supplemented with water from the Cosumnes River. At buildout, all water used for golf course irrigation is expected to be reclaimed wastewater.

Residual biosolids produced at the WWRP are collected and treated prior to landfill disposal. On-site biosolids treatment consists of two sludge drying bed trains.

Historically, treated effluent disposal through spray irrigation on 250 acres of land used for Rancho Murieta North and South golf courses has been the only method for effluent disposal. However, the District has recently initiated two projects to increase the number of effluent disposal methods and the overall treated effluent disposal capacity. Both of these projects were initiated to address Cease and Desist Order No. R5-2006-0001 (CDO).

2.3.1 January 2006 Cease and Desist Order

The CDO was issued by the Regional Water Quality Control Board (RWQCB) in January 2006 to the District and the Rancho Murieta Country Club (RMCC). The primary issues described in the CDO were overflows of the golf course lakes, odor complaints related to golf course irrigation, groundwater degradation, and storage and recycled water disposal. Of these four issues, only storage and recycled water disposal and golf course lake overflows impact this Project.

2.3.1.1 Golf Course Lake Overflows

The RMCC, in conjunction with the District and the RWQCB developed a feasibility study and cost evaluation of potential alternatives for achieving golf course lake overflow compliance. The results, along with the preliminary recommendations (implementation of storm water drainage modifications in conjunction with a NPDES permit) were described in a letter submitted to the report on June 27, 2006.

2.3.1.2 Storage and Recycled Water Disposal

Water balance updates have been prepared for this Project to identify a potential range of storage and disposal requirements associated with existing and future conditions. Final storage and disposal requirements for the selected growth scenario will be prepared as part of the District's upcoming facilities and financial plan. According to the CDO, this plan must be submitted to the RWQCB by June 30, 2007 to address the storage and recycled water disposal issue described in the CDO.

The RWQCB has imposed the following influent flow limitations in the CDO until 280 acre-ft of excess secondary effluent is properly disposed of:

- Monthly average daily dry weather influent flow of 0.52 mgd
- Total annual influent flow shall not exceed 198 million gallons per year as measured from July 1 to June 30 of each year[2]

The monthly average daily dry weather influent flow and total annual influent flow shall be limited to 0.67 mgd and 256 million gallons per year, respectively, once the District has demonstrated that the excess water has been properly disposed of.

The District has initiated the evaporative system and is investigating and analyzing the recycled water irrigation project.

- **Evaporative System:** The District has installed an evaporative system for disposing of excess stored water. This system is comprised of large volume evaporative fountains and sprinklers designed to increase the amount of treated effluent which naturally evaporators from the District's two treated effluent storage reservoir. This project has been completed and is operational.
- **Recycled Water Irrigation Project:** The District has initiated a recycled water project to irrigate three grazing pastures on private land south of the WWTF. The project consists of installing temporary reclaimed water conveyance pipelines to deliver treated effluent to grazing pastures. The proposed project would result in spray irrigation of approximately 90 acres of traditional flood-irrigated pastures.

2.3.2 Historic Wastewater and Recycled Water Production

Figure 8 shows total wastewater production at the WWRP, estimated average dry weather flows (ADWFs) and customer contributions (acre-ft/year per connection) for the past 20 years. ADWFs shown in this figure are based on the average historical flow during the dry season (June through September). As shown, wastewater contributions have decreased from approximately 0.30 acre-ft/year per connection (late 1980's) to 0.22 acre-ft/year per connection (current). For comparison purposes, the current average annual wastewater contribution rate of 0.22 acre-ft/year per connection equates to an average annual wastewater contribution of approximately 195 gpd per EDU. As described in the next chapter, the District uses a unit wastewater average dry weather production rate of 210 gpd per EDU for planning purposes. Wastewater contributions, on an ac-ft/year per connection basis, have remained relatively constant over the past 15 years. This infers total wastewater generation has increased proportionally with community growth.

Total wastewater generation has steadily increased by a rate of 3 percent between 1986 and 2003. Currently, annual wastewater production at 565 acre-ft/year equates to an average daily flow of approximately 0.50 mgd. The estimated ADWF for the last three years has been approximately 0.47 mgd, which is significantly lower than the WWRP's rated capacity as

[2] This volume is equivalent to an average annual flow of 0.54 mgd.

described below. In general, recycled water production is considered equal to wastewater generation less minor (i.e., less than 3 percent) losses through the WWTF and WWRP. These losses do not include distribution or evaporation losses downstream of the WWRP or any rainfall contributions entering the recycled water storage reservoirs.

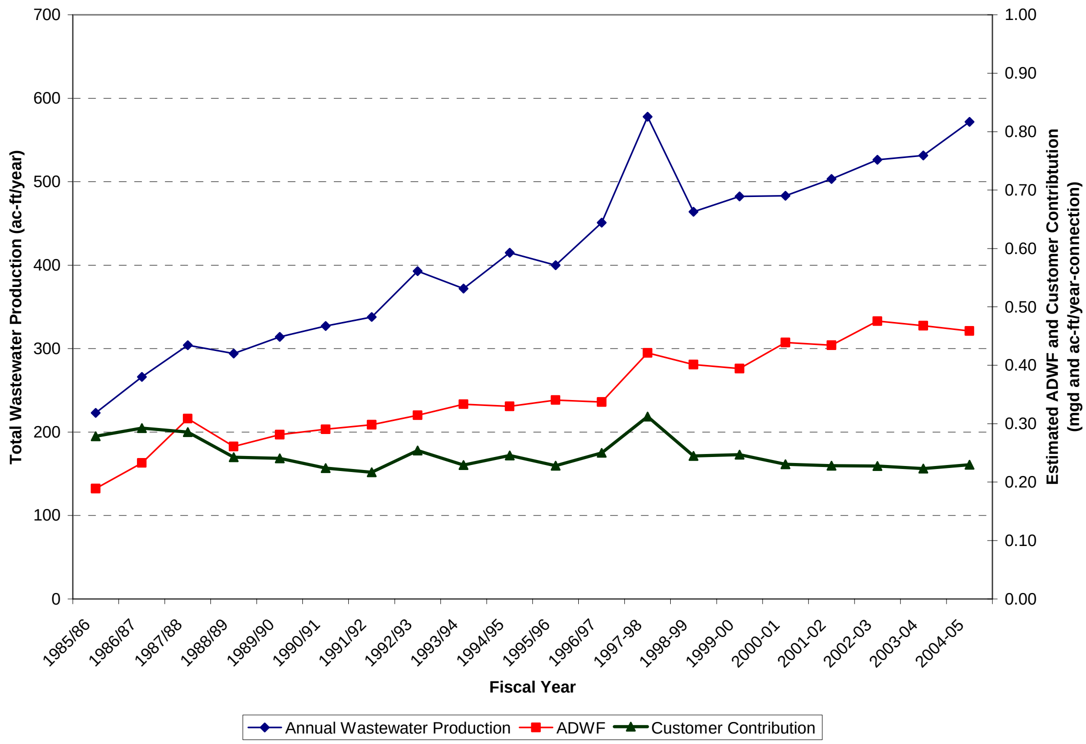

Figure 8. Annual Wastewater Production and Estimated ADWFs.

2.3.3 Secondary and Tertiary Treatment Capacities

The secondary treatment portion of the WWRP was designed to accommodate complete buildout of the community. The secondary treatment facility average dry weather and peak flow capacities are 1.55 and 2.0 mgd, respectively. As described above, current ADWF routed to the WWRP is estimated at approximately 0.47 mgd.

The design flow rate for the tertiary portion of the WWRP is 3.0 mgd. According to the District's WDR, the maximum 30 day ADWF shall not exceed 3.0 mgd. As described below, the maximum 30 day average limitation is associated with peak month irrigation demands as opposed to peak daily or weekly needs.

2.3.4 Effluent Storage and Reuse

The WWRP has two large storage reservoirs for secondary effluent storage. These reservoirs provide seasonal storage of secondary effluent during the winter when tertiary treatment is not employed at the WWRP. Current operating protocols prevent golf course irrigation with reclaimed water after October 15. Typically, golf course irrigation with recycled water does not resume until March 15.

The two secondary effluent storage reservoirs were constructed with a 3-foot thick clay liner and are connected in series. Together they have a combined capacity of approximately 720 ac-ft while maintaining a minimum two feet of freeboard in each reservoir. According to the *Comprehensive Technical Evaluation Report* (February 2004), and the *Updated Water Balances Technical Memorandum* (March 2005) these storage reservoirs have adequate capacity to contain secondary effluent throughout the winter months beyond 2015. The District submitted water balances to the Regional Water Quality Control Board which show the storage reservoirs have sufficient capacity to contain allowable wastewater flow, inflow and infiltration and all flows from seasonal precipitation using a 100-year annual precipitation return period.

Following tertiary treatment, recycled water is pumped to the Rancho Murieta North and South golf courses. As previously described, a total of five storage reservoirs are located around the golf courses. The storage reservoirs are clay lined and were installed to provide operational flexibility rather than reliable seasonal storage. According to District staff, the total surface area of these storage reservoirs is 45 acres, including side slopes. Recycled water is disposed through computer-controlled spray irrigation on each golf course. The irrigation controller uses evapotranspiration rates to determine daily water requirements. Golf course irrigation demands are estimated according to the most recent water balance updates (August 2006) for normal years and the *Infrastructure Program Update Water Supply and Wastewater Disposal Report* (January 2004) for the 200-year drought condition. These values represent total water demand and do not include evaporation or direct rainfall amounts.

- **Normal Year:** 575 ac-ft per year; this value is used for all subsequent analysis. Peak month demands associated with this condition occur in July when average daily demands are approximately 1.5 mgd, which is significantly lower than the rated capacity of the tertiary treatment plant.
- **200-yr Drought Condition:** 600 to 700 ac-ft per year. A value of 690 ac-ft per year is used for all subsequent analysis. Peak month demands associated with this condition occur in June, July and August when average daily demands are approximately 1.6 mgd, which is significantly lower than the rated capacity of the tertiary treatment plant.

Table 2 estimates monthly golf course irrigation demands. Values shown in this table are based on the annual demands described above and monthly distributions described in the *Updated Water Balances Technical Memorandum* (May 2005) for normal years and *Infrastructure Program Update Water Supply and Wastewater Disposal Report* for drought conditions.

Table 2. Monthly Golf Course Irrigation Demands.

Month	Monthly Golf Course Demands (ac-ft)	
	Normal Year	200-yr Drought
January	0.0	0.0
February	0.0	0.0
March	0.0	10.0
April	0.0	24.5
May	89.4	95.9
June	132.1	137.1
July	143.7	149.2
August	119.5	125.0
September	82.7	87.7
October	10.4	50.2
November	0.0	10.0
December	0.0	0.0
Total (Rounded)	575	690

2.4 Chapter Summary

This chapter presented statistics pertaining to the District's existing service area and water supply, potable water, and wastewater production rates and recycled water production demands. A summary of the key information presented in this chapter is provided below:

- **Service Area:** The District currently serves a total of 2,547 residential and 326 non-residential units, which represents 2,282 EDUs.
- **Water Supply** (fiscal year 2004/05):
  - Water supply: 2,010 acre-ft
  - Average reservoir losses: 20 percent of water supply
- **Water Treatment:**
  - Current maximum day demand 3.1 mgd
  - Current treatment capacity: 3.5 mgd
  - Capacity following upgrades:
    - Phase 3 Project: 4.2 mgd
    - Phase 4 Project: 7.0 mgd (approximately)
- **Potable Water Production and Uses** (fiscal year 2004/05):
  - Treated water production: 1,780 acre-ft
  - Overall demand (actual): 695 gpd per EDU

- Residential Demand: 576 gpd per connection
- Use Patterns:
  1. Residential: 72 percent of total water produced
     a. Outdoor residential use: 53 percent of residential use
     b. Outdoor water use has increased by 50 to 100 gpd per connection since 1992.
  2. Non-Residential: 19 percent
  3. System losses: 9 percent

- **Wastewater Treatment:**
  - Secondary plant capacity: 1.55 mgd
    1. The current average dry weather flow is estimated to be 0.47 mgd which is lower than the rated secondary treatment plant capacity.
  - Tertiary plant capacity: 3.0 mgd
    1. The current peak recycled water demand is estimated to be 1.5 mgd which is lower than the rated tertiary treatment plant capacity.
- **Effluent Storage:**
  - Required storage volume: 432 acre-ft
  - Available storage capacity: 720 acre-ft (approximately)
  - Existing storage reservoirs have adequate capacity to serve existing conditions.
- **Effluent Disposal:**
  - Available recycled water: 565 acre-ft/year
  - Effluent disposal:
    1. Golf course irrigation demands:
       a. Normal year: 575 acre-ft/year
          i. Demands are greater than production, thus requiring supplementary water.
       b. 200-year drought condition: 600 to 700 acre-ft/year
    2. Pasture irrigation:
       a. Normal year: 280 acre-ft/year
       b. 200 year-drought condition: Not applicable; short term solution
    3. Total combined capacity:

a.	Normal year:	855 acre-ft/year[3] (short term)
		575 acre-ft/year (long-term)
b.	200-year drought condition:	600 to 700 acre-ft/year

[3] After pasture irrigation system has been commissioned.

3.0 Future Conditions

The District's original master plan projected a total of 5,189 DUs at buildout and 779 EDUs for related commercial and industrial uses, making a total of 5,244 EDUs. However, due to economic influences, environmental constraints and consumer home-buying trends, developers propose to reduce buildout projections from 5,244 to 4,230 EDUs. This decrease represents an overall EDU reduction of approximately 20 percent at buildout. Details regarding the 4,230 EDU count are included in Appendix A.

Three projected growth scenarios were developed for estimating future water, wastewater and recycled water production. The medium density projected growth scenario was based on the current 4,230 EDU count provided by the developers. As described later in this report, this projected growth scenario will serve as the basis for developing the recommended integrated water management plan. Reservoir impacts and drought deficits for the other two projected growth scenarios have been prepared to help the District develop a different course of action if lower population growth occurs or if the community elects to pursue full buildout potential of approximately 5,200 DUs. In addition, Appendix B presents projected water supply, treated water, wastewater treatment, effluent storage, and recycled water needs and productions based on the low and high growth scenarios. The following summarizes the three projected growth scenarios. A summary of the total number of existing and future connections and EDUs for the three projected growth scenarios is presented in Table 3.

- **Medium Growth Scenario (Base Case):** Future connections and EDUs based on the information provided by the developers and the breakdown of future units provided by the District. As shown in Table 3, this scenario is associated with a total of 4,346 DUs and a total of 4,230 EDUs at buildout, which includes both residential and non-residential units. As shown in Table 3, the number and type of future non-residential connections are the same for all three projected growth scenarios.
- **Low Growth Scenario:** This scenario is based on the future connections associated with the Medium Growth Scenario above less 500 residential units. All future connections are assumed to be estate lots greater than 12,000 square feet (equal to 1 EDU). As shown in Table 3, this scenario shows a total of 3,846 residential units and a total of 3,921 EDUs at buildout.
- **High Growth Scenario:** This scenario is based on a total of 5,200 residential units at buildout. All future connections are assumed to be estate lots greater than 12,000 square feet (equal to 1 EDU). As shown in Table 3, this scenario shows a total of 5,275 EDUs at buildout, which is approximately equal to the total EDU count projected in the original master plan.

Table 3. Projected Number of Connections and EDUs at Buildout.

Lot or User Class	Existing Service Area		Medium Growth Scenario[1]		Low Growth Scenario		High Growth Scenario	
	Number of Units (Connections)	Number of EDUs (EDUs)	Number of Units (Connections)	Number of EDUs (EDUs)	Number of Units (Connections)	Number of EDUs (EDUs)	Number of Units (Connections)	Number of EDUs (EDUs)
Residential Units								
Estate > 12,000 sf	752	752	1,884	1,884	2,051	2,051	3,405	3,405
Estate < 12,000 sf	561	486	832	721	561	486	561	486
Circle	457	335	565	414	457	335	457	335
Cottage	281	187	389	259	281	187	281	187
Halfplex	59	31	149	79	59	31	59	31
Townhouse	248	116	338	158	248	116	248	116
Mobile Home	189	50	189	50	189	50	189	50
Subtotal	2,547	1,958	4,346	3,566	3,846	3,257	5,200	4,611
Non-Residential Units								
Commercial	272	270	374	371	374	371	374	371
Park	54	54	271	269	271	269	271	269
School	0	0	24	24	24	24	24	24
Subtotal	326	324	669	664	669	664	669	664
TOTAL	2,873	2,282	5,015	4,230	4,515	3,921	5,869	5,275

[1] Base scenario.

3.1 Projected Water Supply Needs

Annual water supply needs for current and buildout conditions during normal rainfall years were estimated based on annual water demands. These estimates took into account system losses, direct rainfall and runoff and reservoir evaporation and seepage losses as described below.

- **Water Demands:** Based on the current and projected EDU count and a demand of 750 gpd/EDU.
- **System Losses:** As previously shown in Figure 4, system losses are estimated to make up 9 percent of the overall water demand. As described, this component is comprised of un-metered uses such as distribution leaks, flows required for fire hydrant testing, etc. This same percentage is used to estimate system losses for the future scenarios.
- **Direct Rainfall and Runoff:** The mean annual rainfall for Rancho Murieta is approximately 21 inches per year. Typically the District operates the storage reservoirs such that raw water is withdrawn from Calero Reservoir until dead storage is reached. The District then withdraws raw water from Chesbro Reservoir until dead storage is reached or the non-diversion season ends. If additional water is needed, the District withdraws raw water from Clementia Reservoir. As previously described, and under normal circumstances, Calero and Chesbro Reservoirs have adequate storage capacity to serve the community throughout the non-diversion season and raw water is not withdrawn from Clementia Reservoir. This same operating strategy is expected to be employed under buildout conditions. Because Clementia Reservoir does not typically contribute to raw water supply under normal conditions, rainfall contributions to the raw water supply are based on surface and runoff areas associated with Calero and Chesbro Reservoirs only.
- **Reservoir Losses (Evaporation and Seepage):** As described in previous studies and reports, evaporation and seepage represent a significant portion of the overall raw water demand. These two components are collectively referred to as reservoir losses since this volume of water is lost specifically as a consequence of open area surface water storage and seepage into the groundwater table. As previously described in Figure 3, reservoir losses constitute about 20 percent of overall raw water demand. This percentage is used for projecting buildout raw water needs.

A comparison of actual and theoretical water supply needs was prepared to verify the parameters described above. Based on historical data, actual demands over the last few years have been on the order of 655 gpd per EDU. Using this rate for this comparison instead of the planning value of 750 gpd per EDU lowers treated water production and raw water supply needs to 1,840 and 2,300 acre-ft per year for existing conditions, respectively. These values were compared to historic data for fiscal years 2003/04 and 2004/05 to determine whether these estimates reflected actual values. As described below, using actual water demands as opposed to planning values of 750 gpd per EDU and considering lower reservoir losses between 2003 and 2005, projections reflect:

- **Treated Water Production**: Total estimated treated water produced based on historic data was 1,874 acre-ft in fiscal year 2003/04, and 1,778 acre-ft in fiscal year 2004-05. The average of these two production rates is 1,826 acre-ft per year, approximately equal to the estimated value of 1,840 acre-ft per year.
- **Raw Water Supplied:** Total estimated raw water supplied based on historic data was 2,195 acre-ft in fiscal year 2003/04 and 2,008 acre-ft in fiscal year 2004/05. The average of these two is 2,101 acre-ft per year, approximately 10 percent less than the estimated value of 2,300 acre-ft per year. The most likely cause for this discrepancy is lower reservoir losses, which were significantly lower than the 20 percent value used in the projections. During 2003/04 and 2004/05, reservoir losses were respectively estimated at 14 and 11 percent.

Table 4 summarizes estimated treated water production and raw water supply needs for the three growth scenarios.

Table 4. Estimated Treated and Raw Water Needs.

Raw Water Demand Component	Existing Conditions (ac-ft per year)	Projected Buildout Scenarios (ac-ft per year)		
		Low Growth	Medium Growth	High Growth
Residential and Non-Residential Demands	1,917	3,295	3,554	4,432
System Losses	190	326	351	438
Estimated Treated Water Production	**2,107**	**3,621**	**3,905**	**4,870**
Direct Rainfall and Runoff	(287)	(287)	(287)	(287)
Reservoir Losses	813	813	813	813
Total Estimated Water Supply Need	**2,633**	**4,145**	**4,430**	**5,395**

3.2 Projected Water Treatment Needs

Maximum day potable water demands were developed as part of the *Phases 3 and 4 Water Treatment Plant Expansion Basis of Design Report* (August 2003). Table 5 of this document shows projected average and maximum day flow requirements of 3.24 and 6.8 mgd respectively, which implies an average to maximum day peaking factor of approximately 2.1.

As previously described, the District has initiated expansion to the water treatment's firm capacity to approximately 7.0 mgd. As shown in Table 5, this capacity upgrade is adequate to serve both the projected low and projected medium growth scenarios. Additional capacity may be required if the community begins to expand beyond the number of units described in the projected medium growth scenario.

Table 5. Projected Maximum Day Potable Water Demands.

Raw Water Demand Component	Units	Buildout Scenarios		
		Low Growth	Medium Growth	High Growth
Treated Water Production [a]	ac-ft/year	3,621	3,905	4,870
Equivalent Average Day Demand[b]	mgd	2.9	3.2	4.0
Peaking Factor (Max to Ave Day)	--	2.1	2.1	2.1
Estimated Maximum Day Demand	mgd	6.2	6.7	8.3

[a] From Table 4

[b] Without system losses.

3.3 Projected Wastewater Production and Treatment Needs

The same methodology used in the *Updated Water Balances Technical Memorandum* (May 2005) was used to project future wastewater flows at buildout. A system average ADWF unit production rate of 210 gpd per DU was used to estimate future ADWFs.

To estimate ADWF at buildout for a particular growth scenario, a system average ADWF unit wastewater production rate of 210 gpd per residential DU was applied to the projected number of residential DUs at buildout (see Table 6). Average annual flows were estimated by adding inflow and infiltration (I&I) rates equal to 5 percent of projected ADWF. The 5 percent I&I rate was developed in the *Wastewater Disposal Study* (October 2003) to reflect normal-year rainfall conditions and was based on an assessment of WWRP influent data from 1986 through 2002.

Table 6. Projected Average Dry Weather and Annual Average Flows.

Wastewater Component	Units	Buildout Scenarios		
		Low Growth	Medium Growth	High Growth
Projected Number of Connections at Buildout	number of units	4,515	5,015	5,869
Wastewater Flow Contribution	gpd per unit	210	210	210
Projected ADWF	mgd	0.95	1.05	1.23
Inflow and Infiltration Contribution	mgd	0.05	0.05	0.06
Projected Average Annual Flow	mgd	1.00	1.11	1.29

3.4 Recycled Water and Effluent Disposal Implications

Water balances were developed for each of the projected growth scenarios (including current conditions) to estimate storage requirements and irrigation needs under normal precipitation conditions. The water balances estimated monthly net reclaimed water generated for irrigation at the golf courses along with change in storage volume in the tertiary effluent equalization basin. Changes in storage volume are the difference between total inflow (ADWF, I&I and rainfall) less total outflow (evaporation and irrigation flows).

Table 7 summarizes estimated recycled water storage volume requirements and estimated amounts of reclaimed water available for golf course irrigation. As previously described, the secondary effluent storage reservoirs have a total combined capacity of approximately 720 acre-ft. As shown in the table, additional storage will be required in the future for each of the buildout scenarios. Supplementary water is needed to satisfy overall golf course irrigation needs under current conditions as recycled water production is less than the amount required annually. In the future, reclaimed water production will surpass golf course irrigation needs and an additional means of effluent disposal will be needed.

Table 7. Estimated Storage Volume and Disposal Area Requirements.

Component	Units	Growth Scenario			
		Current	Low	Medium	High
Storage Requirements	acre-ft/yr	430[a]	1,000	1,100[a]	1,250
Additional Storage Requirements	acre-ft/yr	none	280	380	530
Recycled Water Production[b]	acre-ft/yr	565	1,005	1,110	1,290
Golf Course Needs	acre-ft/yr	575	575	575	575
Supplementation	acre-ft/yr	10	0	0	0
Excess Recycled Water	acre-ft/yr	0	430	535	715

[a] Based on storage requirements shown in the *Updated Water Balances Technical Memorandum* (May 2005).
[b] Includes precipitation and evaporation.

3.5 Chapter Summary

This chapter used known and collected data presented in the previous chapters to project future water supply and treated water needs and recycled water production. Implications associated with these projections are also discussed. A summary of the key information presented in this chapter along with key implications are provided below:

- **Buildout Growth Projections:** Developer growth projections have been reduced from 5,200 to 4,345 residential units due to economic influences, environmental constraints and consumer home-buying trends.
- **Growth Scenarios:** Three growth scenarios were developed. The medium density scenario was based on the developer growth projections of 4,346 residential units. This scenario will serve as the basis for developing the integrated water management plan.
- **Water Supply** (medium growth scenario):
  - Projected Water Supply Needs: 4,430 acre-ft per year
  - Current Water Rights (maximum): 6,368 acre-ft per year
- **Treated Water** (medium growth scenario):
  - Projected Average Day Demand: 3.5 mgd
  - Projected Maximum Day Demand: 6.7 mgd
  - Production Capacity: 7.0 mgd[4]

[4] Capacity after completion of the Phase 3 and 4 water treatment plant improvements.

- **Wastewater Treatment** (medium growth scenario):
  - Projected Average Dry Weather Flow: 1.05 mgd
  - Projected Average Annual Flow: 1.11 mgd
  - Treatment Plant Capacity: 1.55 mgd (ADWF)
- **Effluent Storage** (medium growth scenario):
  - Required Storage Volume: 1,100 acre-ft
  - Available Storage Capacity: 720 acre-ft
  - Additional Capacity Required: 380 acre-ft (minimum)
- **Recycled Water** (medium growth scenario):
  - Projected Recycled Water Production: 1,110 acre-ft per year
  - Golf Course Irrigation Demands: 575 acre-ft per year

    1. Excess Recycled Water: 535 acre-ft per year

4.0 Reservoir Implications and Drought Deficits

The 1990 Giberson drought report used a water balance model to estimate the magnitude of drought deficits, and was based on three primary components: supply, demand and storage. This model was analyzed and re-created as part of the *Infrastructure Program Update Water Supply and Wastewater Disposal Project* to estimate the drought deficit associated with alternative projected buildout scenarios. The re-created model followed the general format of the original Giberson model. Subsequent analyses of the models for past District projects focused on the 200-year drought event at buildout and a 50 percent level of water conservation. For the 200-year drought analysis, the Giberson model simulated a two-year duration from the beginning of the draw down season (June 1) through an average summer draw down, a 200-year drought winter, a drought summer, and followed with a 25-year drought ending May 31. This extreme drought condition in conjunction with a 50 percent level of water conservation serves as the criteria to estimate drought deficits and compare alternative solutions.

The re-created Giberson model was used as a starting point to develop water balance models for the District's water supply system. These water balance models were then used to estimate reservoir water levels during normal and drought conditions and drought deficits. Adjustments were made to the re-created model to reflect existing and future EDU estimates with criteria and model inputs described below.

4.1 Supply

Water balances considered all major available raw water supplies which include river diversions, direct rainfall and runoff as described below.

4.1.1 Annual River Diversions

Annual river diversions were based on the following equation for normal conditions:

$$= \sum_{i=1}^{12} ConsumptiveUse + \sum_{i=1}^{12} Storage\ Requirement + \sum_{i=1}^{12} Seepage + \sum_{i=1}^{12} Evaporation - \sum_{i=1}^{12} Rain - \sum_{i=1}^{12} Runoff$$

where:
i = $Month_1$, $Month_2$, ……. $Month_{12}$

Monthly diversions for normal conditions were based on typical diversion percentages obtained from an analysis of historical data.

Monthly river diversions for the 200-year and 25-year drought conditions are shown in Table 8. These values were obtained from the Giberson report. As described in the *Evaluation of Water Supply Augmentation Alternatives Technical Memorandum*, Giberson used regression analyses to determine available diversions for specific drought conditions. As shown in Table 8, it is estimated 277 and 4,485 acre-ft of water will be available during 200-year or 25-year drought events respectively.

Table 8. Monthly Diversions for Drought Conditions.

Month	River Diversion (acre-ft)	
	200-year Drought Diversion	25-year Drought Condition
November	4	59
December	0	122
January	24	457
February	231	1,030
March	0	318
April	0	1,250
May	18	1,250
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
Total	277	4,485

4.1.2 Direct Rainfall and Runoff

A secondary minor supply source is from rainfall and watershed runoff. The following summarizes the criteria used to estimate direct rainfall water supply contributions in the water balance model.

4.1.2.1 Normal Conditions

- Direct rainfall contributions were based on the total combined reservoir surface area of 234 acres. This value is equal to the estimated surface area when all three reservoirs are completely full.
- Rainfall contributions were based on an annual precipitation level of 21 inches, which is Rancho Murieta's mean annual rainfall. Estimated annual contributions from direct rainfall are 410 acre-ft.
- Monthly rainfall contributions were based on the 30-year average monthly precipitation pattern for the Sacramento area.

4.1.2.2 Drought Conditions

- Total direct rainfall contributions were based on the values provided in the Giberson report for 200-year and 25-year drought conditions of 184 and 392 acre-ft per year, respectively.

- Monthly rainfall contributions were based on the 30-year average monthly precipitation pattern for the Sacramento area.

Calero and Chesbro Reservoirs' estimated combined water supply contribution associated with runoff from the Calero and Chesbro watersheds is less than 100 acre-ft per year under normal conditions and less than 40 acre-ft under a 200-year drought event. These contributions are considered negligible compared to overall community water supply needs. By comparison, Clementia has a relatively large watershed encompassing approximately 1,150 acres, which is a significant water supply contribution. Similar to the Giberson report, runoff contributions from the Clementia watershed were added to the overall water supply budget based on annual rainfall totals, monthly precipitation patterns and a runoff coefficient of 0.3.

4.2 Storage Capacity and Operation

As shown in Table 9, three primary storage reservoirs have an estimated total combined storage capacity of 5,123 acre-ft. Each reservoir has a minimum storage volume that cannot be put into use. This minimum storage level is called dead storage. Dead storage volume for the Calero, Chesbro and Clementia Reservoirs are 300, 50, and 50 acre-ft, respectively. Usable reservoir volume is limited to 4,723 acre-ft; this is total combined storage capacity minus dead storage.

Table 9. Reservoir Storage Capacity.

Description	Units	Reservoirs			Total Combined
		Calero	Chesbro	Clementia	
Total Volume without freeboard[a]	ac-ft	2,872	1,244	1,007	5,123
Surface Area When Full	acres	118	46	70	234
Dead Storage	ac-ft	300	50	50	400
Useable Volume[b]	ac-ft	2,572	1,194	957	4,723

[a] Estimated volume with flashboards.
[b] Total volume minus dead storage.

4.2.1 Reservoir Operation

The following assumptions, similar to assumptions made in previous projects, were used to form the basis of the water balance model:

- All three reservoirs were assumed to be at capacity at the beginning of each model run.
- The reservoirs were drawn down in the following sequence: Calero, Chesbro and Clementia.
- Each reservoir was drawn down until the water reached the dead storage level. Supply then came from the next hierarchical reservoir or directly from river diversion when available.

- At the beginning of each model run, Calero Reservoir was used to supply consumptive use and any reservoir losses associated with Chesbro such that Chesbro was kept full and at capacity.
- While Clementia was not being used to supply consumptive use, Clementia sustained monthly reservoir losses without supply from Calero or Chesbro.
- Once the reservoir reached dead storage level, it continued to experience losses the following months.
- Once Clementia reaches dead storage, a net system deficit (otherwise known as drought deficit) is calculated from monthly consumptive use rates. A running total deficit is calculated until monthly direct diversions can meet monthly consumptive use rates.

4.2.2 Operating Considerations

Currently, only Calero and Chesbro Reservoirs are used for residential and municipal supply. Calero is at the highest elevation; it is the first to drain and last to fill. Water is routed from Calero to Chesbro and is withdrawn. From Chesbro, water is directed to the water treatment plants for subsequent treatment and distribution.

Clementia is open to the residents for recreational use, including body contact activities such as swimming. However, Clementia's water level is projected to be five feet below the maximum water level by the end of the summer season due to natural evaporation and seepage. At this level, the swimming area becomes unusable because it is relatively shallow compared to other parts of the reservoir. Under current operating practice, water can be routed from Clementia to smaller irrigation holding lakes and ponds. Raw water stored in Clementia is not currently drawn for consumptive uses during years when the community's water needs can be met from direct diversion and storage from Calero and Chesbro. In the future, use of Clementia for raw water supply is dependent on growth. Table 10 poses questions about the future operation of Clementia:

Table 10. Projected Clementia Reservoir Use During Normal and Drought Conditions.

Question	Projected Growth Scenario		
	Low Growth	Medium Growth	High Growth
1: Will Clementia Reservoir be required to satisfy raw water demands under normal conditions in the future? In other words, is dead storage reached in Chesbro Reservoir under normal conditions?	No[a]	No[a]	No[a]
2: Under what drought condition will Clementia Reservoir be required to satisfy raw water demands? In other words, under what drought conditions is dead storage reached in Chesbro Reservoir?	> 100-yr[b]	~ 25-yr[b]	≥ Normal Conditions[c]

[a] Clementia Reservoir will not be completely filled throughout the year. The water level will fluctuate based on evaporation, rainfall, runoff and the amount of water available to refill Clementia Reservoir.
[b] Based on drought conditions and monthly distributions described in the 1990 Giberson report. Estimates based on a one year drought followed by normal diversions, rainfall and runoff totals. Second year demands based on 50 percent conservation level.
[c] Chesbro is projected to be within 150 acre-ft of reaching dead storage under normal conditions at buildout. Calero is projected to reach dead storage under this condition.

4.3 Demands

Demands consist of consumptive and non-consumptive uses. Residential and non-residential demands were included collectively as consumptive use based on projected EDU count and a unit demand of 750 gpd/EDU as previously described. Non-consumptive uses consisted of distribution (system) and reservoir losses from evaporation and seepage. The following is a summary of the criteria used to estimate demands associated with non-consumptive uses:

- **System Losses:** A 9 percent system loss was used in the water balance model to account for system losses.
- **Reservoir Losses:**
  - **Evaporation**: Monthly evaporation rates were based on an annual evaporation rate of 52.4 inches distributed according to historic monthly records. The previous month's net volume was used as a surrogate to estimate the individual reservoir's open surface area based on fill and draw curves.
  - **Seepage**: Monthly seepage rates were based on regression analyses of the seepage curves developed for previous reports. These curves show seepage as a function of storage reservoir volume.

4.4 Reservoir Implications - Normal Conditions

One of the objectives of the reservoirs' water balance model is to estimate water levels under normal conditions. Water balance models were developed for two conditions, existing and future, and for the three projected growth scenarios previously described. Table 11 summarizes key model results. If the District desires, this information can be used to make policy decisions and/or to evaluate/form the basis of specific management components and strategy recommendations. As an example, the District could use model results to identify a maximum draw down level for each reservoir and address community concerns over increasing reservoir draw downs.

Table 11. Summary of Water Balance Results -- Normal Conditions.

Condition and Scenario	Maximum Draw Down[a] – Normal Conditions (ft)		
	Calero	Chesbro	Clementia
Existing Conditions	14.8	0	5.3[b]
Future Conditions			
Low Growth Scenario	31.3	0	5.3[b]
Medium Growth Scenario	31.4	3.8	5.3[b]
High Growth Scenario	31.5	29.5	5.3[b]

[a] Draw down relative to vertical height below reservoir spillway. The maximum depths of Calero, Chesbro, and Clementia are estimated to be 50, 56, and 28 feet, respectively.
[b] Draw down is due to naturally occurring evaporation and seepage, not water supply.

Figure 9 and Figure 10 show existing volumes and draw down levels for each individual reservoir under existing and future conditions based on the medium projected growth scenario. Copies of similar figures for the low and high growth scenarios are in Appendix B.

Figure 9 and Figure 10 can be used to predict reservoir volumes and draw down levels throughout the year under normal precipitation conditions. An example for estimating Calero volume and draw down values for September 15 is presented below:

- A vertical line associated with September 15 is drawn in the Calero Curve.
- A horizontal line is drawn at the intersection of the September 15 line and the reservoir draw down curves. From this intersection, a horizontal line is drawn to the right until it intersects the reservoir draw down axis. The value located at the intersection of the horizontal line and the reservoir draw down axis is the estimated draw down level on September 15. For this example, the value is approximately 10 feet.
- A second horizontal line is drawn at the intersection of the September 15 line and the reservoir volume curve. From this intersection, a horizontal line is drawn to the left until it intersects the Calero volume axis. The value located at the intersection of the horizontal line and the Calero volume axis is the estimated Calero volume on September 15. For this example, the value is 1,600 acre-ft.

A review of historic reservoir levels from 2000 to 2005 was conducted to validate projections shown in Figure 9. The following summarizes historic reservoir draw down data.

- Maximum Calero draw downs ranging between 12 and 14 feet have occurred in either October or November.
- Maximum Chesbro draw downs range between 1 and 5 feet and can occur throughout the year.
- Maximum draw downs in Clementia range between 6 and 7 feet and typically occur in fall.

Comparison of these historical values to projections in Figure 9 indicates the following results:

- Overall, draw down projections in Figure 9 correlate well with historic values in regard to draw down magnitude and timing.
- Reservoir draw down projections are based on a planning level water demand of 750 gpd per EDU. Projected draw downs are expected to be greater than historic values because actual water demands (approximately 655 gpd per EDU) are less than the 750 gpd per EDU used for planning purposes.
- Reservoir draw down projections are based on assumed operating conditions. Actual operating conditions may vary from the assumed conditions presented in the water balance projections. For example, Chesbro may have been used to supply the

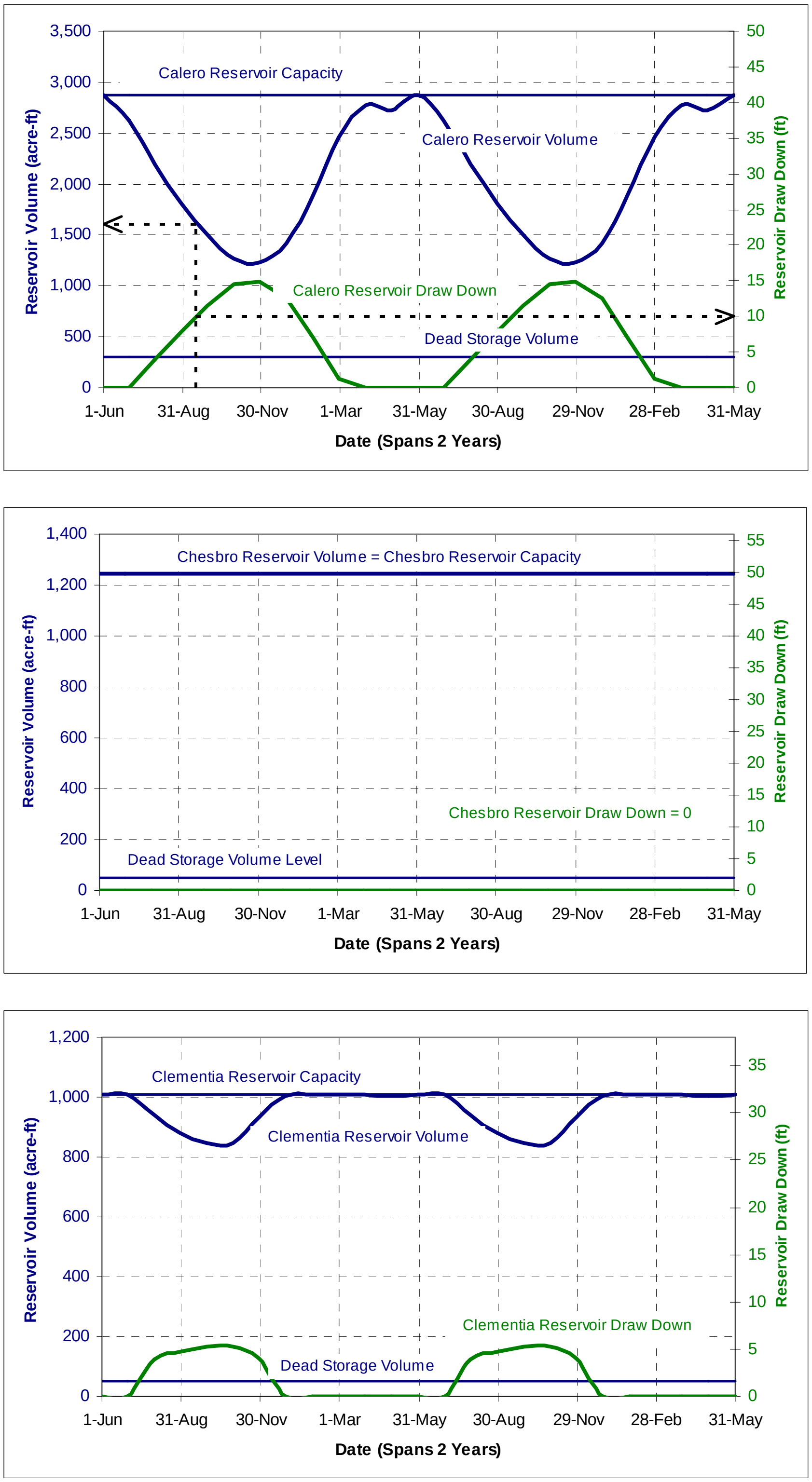

Figure 9. Estimated Reservoir Volumes and Draw Down Levels--Existing Conditions.

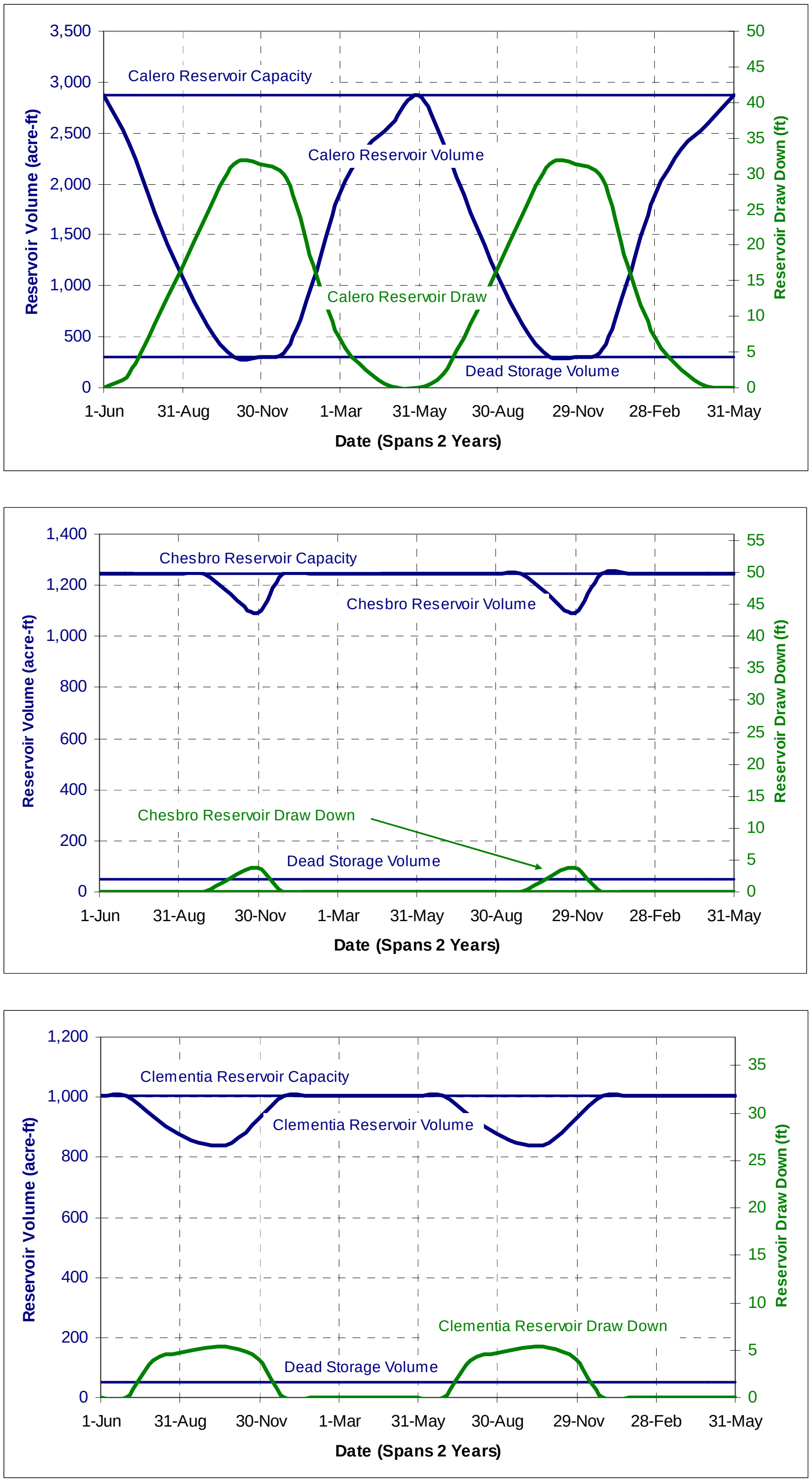

Figure 10. Estimated Reservoir Levels and Draw Downs -- Future Conditions (Medium Growth Scenario).

community's water for a portion of the year, increasing its draw down while reducing Calero's draw down.

As shown in Figure 9, Calero is the only reservoir required to meet the community's water supply needs under existing conditions. Operating the reservoirs in a hierarchical fashion (Calero, Chesbro, Clementia) is expected to result in a 15 foot draw down of Calero occurring in November of each year. Chesbro is projected to be full throughout the year due to replenishment from Calero. As shown in Figure 9, Clementia does experience volume and draw down fluctuation throughout the year. However, these fluctuations are attributed to natural reservoir losses (evaporation and seepage) and are *not* associated with meeting the community's water supply needs.

In the future, Calero is expected to reach dead storage level in October and November which corresponds to the maximum draw down level of approximately 31.5 feet. Additional water supply is needed from Chesbro to meet anticipated water demands. The volume of Chesbro will have to be reduced by approximately 155 acre-ft to provide additional water, which corresponds to a maximum draw down of approximately four feet in November. Similar to existing conditions, Clementia experiences volume and draw down fluctuations throughout the year due to natural causes.

4.5 Estimated Drought Deficits

Figure 11 shows projected available water volumes in the three reservoirs during a severe drought event (i.e., a 200-yr drought event followed by 25-year drought event) for the medium growth scenario. As shown, all three reservoirs are required to meet the community's water needs. The estimated drought deficit associated with this scenario is 210 ac-ft based on a 50 percent level of water conservation.

Table 12 summarizes maximum draw downs and storage deficits associated with drought conditions and future buildout scenarios. Each of the projected growth scenarios require supply from all three reservoirs under severe drought conditions. Clementia is projected to reach a minimum volume of 90 acre-ft (very close to the 50 acre-ft dead storage) under the projected low growth scenario. However, this growth scenario is not projected to experience drought deficit. Both Calero and Chesbro are projected to reach dead storage under all three projected growth scenarios. The varying maximum draw down levels shown for Chesbro and Clementia are associated with the time when dead storage volume is reached and continued evaporation and seepage.

In keeping with the recommendations of past studies and reports, HDR recommends that a safety factor approximately equal to one month's water demand is added to the estimated drought deficit. A volume of 435 acre-ft will be used to evaluate and compare integrated water management strategies and components described in the next chapter which includes a 225 acre-ft safety contingency.

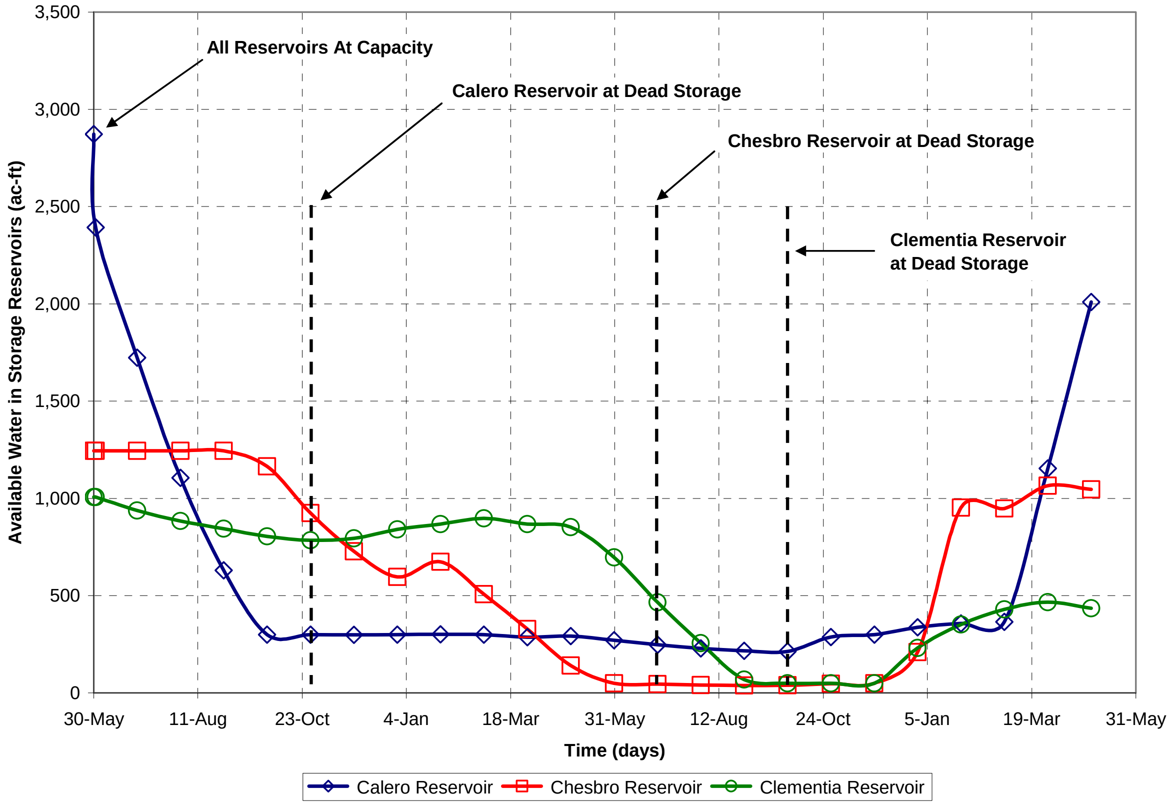

Figure 11. Drought Condition Reservoir Draw Down Curves – Medium Growth Scenario and 50 Percent Level of Water Conservation.

Table 12. Estimated Draw Down and Deficits -- Drought Conditions.

Projected Growth Scenario	Maximum Draw Down[a] – Normal Conditions (ft)			Estimated Drought Deficits[b] (acre-ft)	Drought Deficit Plus Contingency[c] (acre-ft)
	Calero	Chesbro	Clementia		
Low Growth	33.9	38.9	22.2	None	185
Medium Growth	33.9	39.2	24.1	210	435
High Growth	33.9	39.8	26.3	1,830	2,055

[a] Draw down relative to vertical height below reservoir spillway. The maximum working depths of Calero, Chesbro, and Clementia are estimated to be 50, 56, and 28 feet, respectively.

[b] Deficits based on the three existing reservoirs only. If an additional reservoir were to be built to satisfy a projected deficit, additional capacity would be required to compensate for evaporation and seepage.

[C] Values equal to estimated drought deficit plus 225 acre-ft (one month contingency).

4.6 Water Rights and Normal Condition Draw Down Considerations

According to District staff, the District’s water rights permit currently provides an allotment for aesthetics and environmental purposes. Moreover, California is currently in need of identifying additional water supplies to meet its future projected water demands. Given those two results, it is unlikely that modifications to the District's existing water rights or the addition of a new surface water storage reservoir used to lessen the community's reservoir draw down levels will be permitted for aesthetic or environmental conditions. However, the addition of a new surface water storage reservoir to address the drought deficit may be possible.

4.7 Reservoir Draw Down Constraints

It is understood that the District is not held to a specific maximum draw down level. Therefore, this report assumes that the District can operate the water supply reservoirs in accordance with the standard operation procedures and requirements. As such, fluctuations in reservoir depth and volume are acceptable and expected to occur to accommodate water demands and annual replenishment needs, and are supported by the water rights diversions and storage replenishment allotments.

4.8 Chapter Summary

A reservoir water balance model was developed to estimate reservoir volumes and water levels during normal and drought conditions. Adjustments were made to the model to reflect existing and future (buildout) conditions. The model output was compared to historic monthly reservoir data. Overall, draw down projections were found to correlate well with historic values in regard to draw down magnitude and timing. The following assumptions were used to form the basis for reservoir operation:

- The model assumed that the reservoirs were drawn down in the following sequence: Calero, Chesbro, and Clementia.
- Each reservoir was drawn down until the water level reached dead storage or diversion began. Supply then came from the next hierarchical reservoir or directly from river diversion when available.
- At the beginning, Calero was used to supply consumptive use and any reservoir losses associated with Chesbro such that Chesbro was kept at capacity.
- While Clementia was not being used to supply consumptive use, Clementia sustained monthly reservoir losses, due to naturally occurring evaporation and seepage, without supply from Calero or Chesbro.
- If Clementia reached dead storage, a net system deficit (otherwise known as drought deficit) was calculated from monthly consumptive uses. A running total deficit was calculated until monthly diversions can meet monthly consumptive use rates.

The following is a summary of model results for current conditions and normal levels of precipitation:

- Calero's volume is sufficient to meets the community's water supply needs. Calero's maximum draw down is estimated to be approximately 15 feet and is expected to occur in October or November.
- Chesbro is expected to be full throughout the year.

- Clementia experiences a maximum draw down of approximately 5 feet due to naturally occurring evaporation and seepage. Clementia is not needed for water supply under this condition.

The following is a summary of model results based on buildout conditions and normal levels of precipitation (medium growth scenario):

- Both Calero and Chesbro will be needed to meet the community's water supply needs.
- Calero is expected to be at dead storage between October and November.
- Chesbro is required to supply water once Calero reaches dead storage. Its maximum draw down is projected to be approximately 4 feet.
- Clementia experiences a maximum draw down of approximately 5 feet due to naturally occurring evaporation and seepage. Clementia is not needed for water supply under this condition.

An additional water supply of 435 acre-ft will be needed under severe drought conditions. Under these conditions all three reservoirs are expected to reach dead storage. The 435 acre-ft supply includes a safety factor approximately equal to one month's water demand in addition to the estimated drought deficit.

5.0 Potential Integrated Management Components and Strategies

Workshops were held with District staff on May 17, June 27, October 27, 2005 and September 20, 2006 to present preliminary project results and obtain public input. The workshops were also used to identify, describe and evaluate potential components and strategies that could be used to address drought deficits and fluctuating reservoir water levels. Table 13 presents a summary of potential integrated management components and strategies discussed during the initial workshop. This information is based on projected medium growth scenario (base scenario) and an estimated drought deficit of 435 acre-ft. This table also describes relative advantages and disadvantages and describes the options the District chose not to consider further during the workshop.

Each of the components or strategies described in Table 13 can be grouped into potential policy components or physical improvements categories. In general, policy components would be implemented to address fluctuating reservoir levels, whereas physical improvements would be implemented to address drought deficits. In some cases however, policy components would provide added benefit since they address a portion of the anticipated drought deficit. More detailed descriptions are presented later in this chapter regarding potential management strategies and components the District elected to pursue.

5.1 Potential Policy Components

Policy components are described below which could be adopted by the District. Except for the mandatory water reduction option, these components could be implemented to address reservoir draw downs under normal conditions.

5.1.1 Mandatory Water Reductions

During droughts, demands tend to decrease temporarily in response to water shortages. Therefore, annual average water use rates cannot be used to predict total water consumption during periods of drought. A 50 percent level of water conservation has been the base line used in this and past projects to estimate drought deficits. Accordingly it is recommended that the District implement a formal policy pertaining to drought cutbacks. This policy could include a collective series of initial voluntary and subsequently mandatory demand management measures as described in Table 14. There are several potential demand reduction measures that have been commonly implemented by various water agencies during normal and period of water shortages. A list of potential measures is provided in Table 15. As shown in listed Table 15, most of the measures pertain to outdoor uses.

Table 13. Potential Integrated Management Components and Strategies.

Management Strategy or Component Title and Description	Policy Component or Physical Improvement	Estimated Water Supply Increase or Savings (acre-ft/yr)	Projected Impact (%)		Order of Magnitude Cost	Relative Advantages	Relative Disadvantages	Decision[c]
			Calero Draw Down[a]	Drought Deficit[b]				
Surface Storage: Provide additional surface water storage capacity to address projected drought deficit. Discussions with District staff indicate added supply could only be used to eliminate or reduce drought deficits.	Physical Improvement	435	0[d]	100	$5 to 13.5 million[e]	▪ Completely addresses drought deficit ▪ Visible to the community	▪ Most costly option ▪ Potential for siting and land acquisition constraints ▪ Lowest cost to benefit ratio due operating constraints and projected deficit.	Consider for further analysis
Mandatory Water Reductions: Implement policies which become effective when drought conditions are projected or occur.	Policy Component	Not applicable	0	50% level conservation level included in drought deficit calculations	$25,000 to 50,000	▪ Promotes greater understanding of water uses within the community ▪ May promote water conscious landscaping	▪ Adverse economic impact on users ▪ Alone this is not adequate to address 200-year drought deficit ▪ Reduced monthly fees	Consider for further analysis
Groundwater Supply: Install groundwater wells with suitable capacity to address projected drought deficit. Discussions with District staff indicate added supply could only be used to eliminate or reduce drought deficits if groundwater recharge is not provided.	Physical Improvement	435	0[d]	100	$1 to 2.5 million	▪ Completely addresses drought deficit ▪ Visible to the community ▪ Can provide back up supply if WTP is out of service.	▪ Costly option ▪ Potential siting and water right constraints ▪ Low cost to benefit ratio due to operating constraints and projected costs	Consider for further analysis
Reduced Water Allocation: Reduce water allocations for all or specific lot classifications. It is assumed reduced allocations would be enacted for future customers only.	Policy Component	65 to 125	0[g]	15 to 30	$25,000 to 50,000	▪ No impact on existing customers ▪ Could be initiated throughout the community to reduce reservoir draw downs ▪ Promotes water conscious landscaping	▪ Difficult to monitor to verify reduced usage ▪ Reduced monthly fees ▪ Water allocation discrepancy between existing and future customers in same user lot class	Consider for further analysis
Demand Management Pricing: Conserve water by implementing management demand pricing control measures. Control measures would be in continuous effect to reduce water demand in all conditions.	Policy Component	0 to 125	0[g]	0 to 60	$50,000 to 100,000	▪ Low cost option ▪ Enhances community perception ▪ Likely to result in increased monthly fees	▪ No assurance pricing will effect dry season demands ▪ Typically too little too late for addressing droughts ▪ Requires ongoing public outreach and involvement to maximize effectiveness	Consider for further analysis
Aquifer Recharge: Fully utilize diversion rights. Maximize water production during diversion season. Percolate excess water into the local aquifer. Bank any excess diversion water to storage, lower reservoir draw downs during the summer season and eliminate drought deficits.	Physical Improvement	0 to 1,940[h]	0 to 40	100	$4 to 7 million	▪ Banking provides for recovery from drought conditions	▪ Higher treatment may be required based on perceived beneficial uses ▪ Aquifer may not need replenishment ▪ Likely requires regional implementation and coordination ▪ Potential water rights issues ▪ Regulatory hurdles	Eliminate; not considered further

Management Strategy or Component Title and Description	Policy Component or Physical Improvement	Estimated Water Supply Increase or Savings (acre-ft/yr)	Projected Impact (%)		Order of Magnitude Cost	Relative Advantages	Relative Disadvantages	Decision[c]
			Calero Draw Down[a]	Drought Deficit[b]				
Expand Recycled Water Service: Use future recycled water surplus to offset potable water demands within the community and install additional recycled water storage.	Physical Improvement	535	20	100	$5 to 7.5 million	▪ Maximizes beneficial uses of resource ▪ Addresses future effluent disposal concerns ▪ Potentially reduces water treatment plant expansions after Phase 4 due to reduced potable water demand for outdoor irrigation.	▪ Potential need for infrastructure reconstruction and retrofitting ▪ Administration services associated with on-going system management ▪ Install new recycled water storage reservoir	Consider for further analysis
Exchange Recycled Water For Surface Water Rights Exchange excess recycled for surface water rights. Draw down and drought deficit reductions are based on a one to one exchange.	Policy Component	535	20	0	$1.5 to 2.5 million	▪ Maximizes beneficial uses of resource ▪ Addresses future effluent disposal concerns ▪ Use of beneficial recycled water nutrients if applied in agricultural use ▪ Increases water supply reliability	▪ New surface water source likely to be impacted by drought conditions ▪ Potential for varying effluent demand ▪ Long term viability for disposal of excess recycled water ▪ Infrastructure needs: new delivery and storage systems	Eliminate; not considered further
Exchange Recycled Water For Ground Water Rights: Exchange excess recycled for ground water rights. Draw down and drought deficit reductions are based on a one to one exchange. Assume groundwater would be conveyed directly to one of the existing storage reservoirs for subsequent treatment.	Policy Component and Physical Improvement	535	20	100	$2 to 4 million	▪ Maximizes beneficial uses of resource ▪ Addresses future effluent disposal concerns ▪ Use of beneficial recycled water nutrients if applied in agricultural use	▪ Potential for varying effluent demand ▪ Long term viability for disposal of excess recycled water ▪ Infrastructure needs: new delivery and storage systems	Consider for further analysis
Recycled Water Aquifer Recharge: Recharge local aquifer with excess recycled water for potential future use. This strategy only addresses future treated effluent disposal needs and does not address draw down or drought deficits.	Policy Component	Not Applicable	Not Applicable	Not Applicable	Unknown – dependent upon regulatory requirements	▪ Maximizes beneficial uses of resource ▪ Addresses future effluent disposal concerns	▪ Aquifer may not need replenishment ▪ Aquifer contamination ▪ Public perception ▪ Regional implementation and concerns ▪ Water rights ▪ May require a higher degree of treatment ▪ Regulatory hurdles	Eliminate; not considered further

[a] Percent of projected draw down reduced.
[b] Percent of drought deficit reduced.
[c] Strategy or component eliminated or considered for further analysis.
[d] Based on discussions with District staff, the added water supply associated with a new reservoir and groundwater (without some type of groundwater recharge) source could not be used to address the fluctuating reservoirs levels within the existing reservoirs. It could only be used to address drought deficits.
[e] Updated order of magnitude cost based on meeting 435 acre-ft drought deficit. Unit costs developed previously in the *Evaluation of the Full Buildout Water Supply Augmentation Alternatives Technical Memorandum* were used as the basis for cost estimate. This unit cost was adjusted to reflect 2005 dollars based on an inflation rate of 5 percent. It is estimated that the minimum volume of a new reservoir would be approximately 620 acre-ft based on estimated evaporation and seepage rates associated with the three existing reservoirs.
[f] Based on minimum and maximum water allocation reductions or 50 and 100 gpd/sf for all future estate lots greater than 12,000 sf.
[g] Savings used to decrease minimum draw downs in Chesbro.
[h] Maximum value represents the difference between current water rights and buildout diversion needs.

Table 14. Potential Target Levels of Water Conservation.

Target Conservation Level	Potential Drought Condition[a]	Demand Management Measures	Potential Reduction Targets (%)
I	All Conditions	Voluntary	8 to 10
II	10-year	Voluntary	15 to 20
III	25-year	Voluntary	20 to 30
IV	50-year	Major restrictions	30 to 35
V	100-year	Mandatory shutoffs required for outdoor uses	35 to 40
VI	200-year	Enforced – no outdoor uses throughout drought	50

[a] Describes drought conditions during which the District may elect to implement various levels of water conservation.

Table 15. Potential Demand Management Measures.

Description	Potential Reduction in Water Use
Potential Indoor Measures	
Plumbing-Related	10-25 Percent of Overall Indoor Use
Low Flush Toilets	2-3 gallons/flush (10-15 gpd/home unit)
Toilet Displacement Devices	0.5-1 gallon/flush (3-5 gpd/home unit)
Low Flow Showerheads	5-7 gallons/shower (10-15 gpd/home unit)
Faucet Aerators	2-10 gpd/home unit
Pressure Reduction	1-5 gpd per 5 psi decrease reported
Low-Load Laundry/Wash Cycles	5-10 gpd/home unit
Grey Water System	20-30 gpd/unit potential offset in outdoor use
Reduced Garbage Grinder Use	1-2 gpd/home unit
Hot Water Pipe Insulation	5-10 gpd/home unit
Outdoor Measures - Landscaping	
Landscaping	25-40 Percent of Overall Outdoor Use
More Efficient Irrigation Practices:	10-100 gpd/home unit
Reduced/Adjusted Watering Times	site dependent
Modified Watering Schedules	site dependent
Adjusted Sprinkler Head Patterns	site dependent
Drain Evaporative Coolers to Landscape	10-20 gpd/home unit
Redesign for Lower Maintenance/Water Use (Xeriscape)	50-200 gpd/home unit
Cutback in Typical Over Watering	25-100 gpd/home unit
Outdoor Measures – Pools and Spas	
Covering When Not in Use	50-500 gallons/month
Adjusted Filtering/Backwash Schedules	10-100 gallons/month
Pool Backwash to Landscape	20-50 gpd/home unit w/ pool
Outdoor Measures - Other	
Use Broom/Blower to Clean Walks/Driveway	10-50 gallons/occurrence
Use Bucket to Wash Car/Boat	50-125 gallons/occurrence
Wash Pets/Cool off Children on Landscaped Areas	10-80 gallons/occurrence

Sizable reductions in overall water demand are a necessity during periods of extreme drought. As previously shown in Figure 4, approximately 50 percent of the community's overall water demand is for outdoor uses; these can be significantly reduced during severe drought conditions. Under such conditions the District's potential total usage should be cut back by 50 percent. Table 16 shows the potential percentage targets by which each water use component could be cut back to attain the 50 percent goal. As shown, outdoor residential and non-residential uses are expected to encounter the largest cutbacks at 70 and 75 percent respectively. Lower reduction levels, especially for outdoor use, may also be required as best management practices during times of less extreme water shortages and/or emergencies.

Table 16. Potential Water Cutbacks for Several Drought Events for a 50 Percent Reduction Goal.

Water Use Category and Components	Normal Conditions		Several Drought Conditions	
	Percent of Total	Demand (gpd/unit)	Percent of Total	Demand (gpd/unit)
Residential	72	485	51	246
Indoor	34	229	26	169
Outdoor	38	256	70	77
Non-Residential	19	127	44	56
Indoor	6	40	15	34
Outdoor	13	87	75	22
Total Demand	91	612	49	302
System Losses	9	61	45	33
Total	100	673	50	336
Indoor Subtotal	40	269	61	204
Outdoor Subtotal	51	343	29	99

5.1.2 Reduced Water Allocation

The relative impact on managing water demands by reducing water allocation for a specific lot or user classification has been evaluated. According to Table 3, approximately 53 percent of all future growth within the community will be large estate lots greater than 12,000 sf. As previously described, these units have a projected water use of 750 gpd per unit since these units represent one equivalent dwelling unit. If these new estates were allowed the same water allocation as existing large estates, their demand alone would represent 950 of the total 1,635 acre-ft demand increase (58 percent of total increase). According to District staff, several dwelling units within this classification have demands in excess of the 750 gpd allotment. If this demand were to occur with the new estates, the District would experience higher water demands than currently projected.

One potential water management strategy reduces water allocated for all future large estates. Figure 12 shows projected water demand and savings associated with future estate lots. If this strategy were implemented, it may be possible to reduce water allocations to the next lower water allocation, or 650 gpd per large estate. In this scenario, both large and small estates are allocated the same amount of water. Estimated water savings associated with this scenario are 125 acre-ft per year as shown in Figure 12. These water savings will not impact draw down levels at Calero since it is less than the volume required to be withdrawn from Chesbro annually under buildout conditions. However, this is expected to decrease the maximum draw down in Chesbro by 50 percent (reduced from four to two feet).

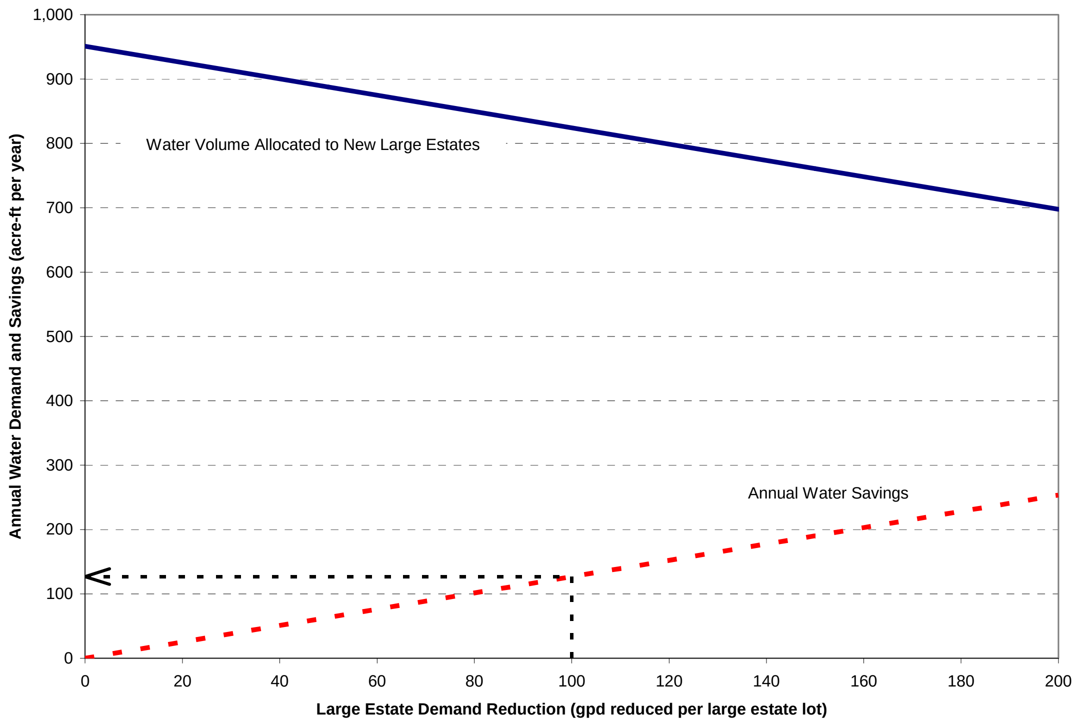

Figure 12. Water Allocation Reduction - Water Demand and Savings.

5.1.3 Demand Management Pricing

The demand for water is inelastic. In other words, when the price of water increases, the expected reaction is smaller than the price increase. Table 17 summarizes the results of HDR's review of several reports and studies regarding demand management pricing; the price increase for each source was 10 percent. The corresponding demand reduction ranged from 1 to 7 percent. The overall estimated demand reduction was estimated at 3.5 percent. This degree of reduction was assumed to evaluate this particular management strategy for Rancho Murieta.

The potential water savings for this strategy is estimated at 125 acre-ft per year, equal to the savings shown for the reduced water allocation example. Similarly, savings will not impact Calero draw down levels, but will decrease the maximum draw down in Chesbro by 50 percent.

Table 17. Water Pricing Increases and Corresponding Demand Reductions.

Water Price Increase (%)	Measured Demand Reduction	Source
10	1.6	*Measuring the Price Responsiveness of Residential Water Demand in California's Urban Areas* (California Department of Water Resources. May 1998).
10	7	*How to Conserve Water and Use It Effectively* (EPA, April 1995)
10	2 to 4	*Conservation Pricing of Water and Wastewater* (Stallworth, April 2000)
10	1 to 5	*Orange Water and Sewer Authority Conservation Pricing Study* (January, 2003)
Estimated Average	3.5	Approximately equal to the arithmetic average.

5.2 Potential Physical Improvements

The following describes the physical improvements which could be adopted by the District to address the projected 435 acre-ft drought deficit.

5.2.1 Expand Recycled Water Service

This and past reports have shown that an additional means for wastewater effluent disposal will be needed in the future because treated effluent production will surpass golf course irrigation needs. Expansion of the District's recycled water program within the community is one way to address this issue along with reduced draw down levels and drought deficits. The estimated annual treated effluent surpluses for normal and drought conditions are estimated at 535 and 420 acre-ft, respectively.[5]

One of the most cost effective means for expanding the recycled water program is installing the required infrastructure for new customers during construction. The total annual treated water demand for new customers is projected to be 1,635 acre-ft per year. Of this, approximately 835 acre-ft per year is projected for outdoor use. Comparison of this 835 acre-ft demand with the projected recycled water surpluses indicate all of the excess recycled water could be utilized for outdoor irrigation, assuming all outdoor water use is supplied by recycled water. However, implementing this alternative would require additional recycled water storage. This strategy is expected to eliminate draw down in Chesbro altogether and reduce Calero draw down by approximately 6.5 feet (20 percent) under normal conditions.

During drought conditions, outdoor annual use is projected to decrease from 1,810 to 515 acre-ft/yr based on the water use cutbacks shown in Table 16 and the medium growth scenario. If this strategy were implemented, one benefit for new customers is that an additional 420 acre-ft would be available for outdoor irrigation during drought conditions. If this surplus was dedicated to new residences, outdoor allocation would only have to be reduced by 50 percent

[5] The 390 acre-ft drought recycled water surplus is based on the average of the values presented in the *Wastewater Disposal Study* (Table 20). Buildout projections used to prepare these estimates are within 1 percent of the medium growth projections described in this report.

instead of the 70 percent previously described. In addition, this strategy could reduce water treatment plant expansion needs after Phase 4 due to reduced potable water demands from outdoor irrigation.

One drawback associated with this strategy is the need for the District to manage and oversee the recycled water program to ensure it is in compliance with recycled water regulations for residential use. Potential managerial and administrative tasks include verifying that lawn and landscaping runoff does not enter the storm drain system, that distribution systems are properly labeled and marked accordingly, and initiating and maintaining a cross-connection prevention program.

5.2.2 Surface Storage

Previous studies evaluated and compared potential reservoirs sites. The total estimated amount of water diverted to storage reservoirs is estimated to be 2,840 acre-ft for normal buildout conditions. Based on this review, it appears the new reservoir could be supplied with diverted river water provided the new reservoir is added to the existing permit.

As previously described, the new reservoir could only be used during droughts. This strategy would have no impact on reservoir draw down levels during normal conditions.

5.2.3 Groundwater (Conjunctive) Supply

Previous studies show that providing new groundwater supply is more cost effective than installing a new off stream storage reservoir. Preliminary well field explorations show that potential well fields exist within close proximity of Rancho Murieta. Preliminary findings indicate an individual well could provide up to 600 gpm. However, a capacity of only 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 Full Buildout Water Supply Augmentation Alternatives Technical Memorandum*.

This conjunctive option could use groundwater during both normal and drought conditions along with stored surface water, as well as during emergency conditions. This is only one of the two options that could potentially be used to significantly reduce reservoir draw down while eliminating drought deficits.

5.2.4 Water Exchange: Trade Recycled Water for Ground Water Supply

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.

This option provides the most benefits relative to other options; it could address the issues of reservoir draw down under normal conditions, drought deficits and future treated effluent disposal needs. Similar to the previous option, it also uses groundwater during normal and drought conditions to significantly reduce reservoir draw down while eliminating drought deficits. The primary drawback of this option is District reliance on a rancher or farmer to dispose of excess recycled water. If the District elects to pursue this option, HDR recommends the District pursue long-term contracts with more than one rancher or farmer if possible.

5.3 Chapter Summary

Workshops were held with District staff on May 17, June 27, October 27, 2005, and September 20, 2006 to present preliminary findings and project results. Potential components and strategies that could be used to address the degraded waterline aesthetics and projected drought deficits were also discussed during the workshops. Of the potential components and strategies discussed, the following were considered as viable options. In general the viable options can be grouped into potential policy components or physical improvements as described below.

- **Mandatory Water Reductions** (Policy Component): A 50 percent level of water conservation has been the base line used in this and past projects to estimate drought deficits. Accordingly it is recommended that the District implement a formal policy pertaining to drought cutbacks.
- **Reduced Water Allocation** (Policy Component): Over half of all future growth within the community is from large estates which have the highest projected water use. One potential management strategy is to reduce water allocation for all future large estates. The following is a summary of potential water savings for this alternative based on reducing water allocations for large estates by 100 gpd per dwelling unit:
  - Impacted Condition (drought or normal): Normal
  - Estimated Water Savings: 125 acre-ft per year
  - Draw Down Impact (Normal Conditions):
    1. Calero Reservoir: None
    2. Chesbro Reservoir: 50 percent (reduce from 4 to 2 ft)
    3. Clementia Reservoir: None
  - Projected Drought Deficit at Buildout: 435 acre-ft
- **Demand Management Pricing** (Policy Component): The demand for water is inelastic; when the price of water increased, the expected reaction is smaller than the price increase. The following is a summary of potential water savings for this alternative:
  - Impacted Condition (drought or normal): Normal
  - Estimated Water Savings: 125 acre-ft per year
  - Draw Down Impact (Normal Conditions):
    1. Calero Reservoir: None

2. Chesbro Reservoir: 50 percent (reduce from 4 to 2 ft)
3. Clementia Reservoir: None

- Projected Drought Deficit at Buildout: 435 acre-ft

- **Expand Recycled Water Service** (Policy and Physical Improvement): Expansion of the District's recycled water program is one way to reduce reservoir draw downs and drought deficits as well as disposing of excess recycled water in the future. The following is a summary of potential water savings for this alternative:
  - Impacted Condition (drought or normal): Normal and Drought
  - Estimated Water Savings: 535[6] and 420 acre-ft per year
  - Draw Down Impact (Normal Conditions):
    1. Calero Reservoir: 6.5 ft reduction
    2. Chesbro Reservoir: 100 percent (reduce from 4 to 0 ft)
    3. Clementia Reservoir: None
  - Projected Drought Deficit at Buildout: 15 acre-ft

- **Surface Storage** (Physical Improvement): A new surface storage reservoir could be constructed to address the drought deficits. The following is a summary of potential water savings for this alternative:
  - Impacted Condition (drought or normal): Drought
  - Estimated Water Savings: None
  - Draw Down Impact (Normal Conditions):
    1. Calero Reservoir: None
    2. Chesbro Reservoir: None
    3. Clementia Reservoir: None
  - Projected Drought Deficit at Buildout: None

- **Groundwater Supply** (Physical Improvement): Of all of the options discussed, this is only one of the two options that could potentially be used to significantly reduce reservoir draw down while eliminating drought deficits. The following is a summary of potential water savings for this alternative:
  - Impacted Condition (drought or normal): Normal and Drought
  - Estimated Water Savings: None
  - Draw Down Impact (Normal Conditions):

[6] Projected residential outdoor water demand for new customers is estimated to be 690 acre-ft/yr.

1. Calero Reservoir: 100 percent reduction
2. Chesbro Reservoir: 100 percent reduction
3. Clementia Reservoir: None

- Projected Drought Deficit at Buildout: None

- **Water Exchange: Trade Recycled Water for Ground Water Supply** (Policy and Physical Improvement): Of all the options discussed, this is only one of the two options that could potentially be used to significantly reduce reservoir draw down while eliminating drought deficits. In addition, this option addresses the District's concerns regarding excess recycled water in the future. The following is a summary of potential water savings for this alternative:
  - Impacted Condition (drought or normal): Normal and Drought
  - Estimated Water Savings: None
  - Draw Down Impact (Normal Conditions):
    1. Calero Reservoir: 100 percent reduction
    2. Chesbro Reservoir: 100 percent reduction
    3. Clementia Reservoir: None
  - Projected Drought Deficit at Buildout: None

6.0 Recommendations

A multi-faceted and integrated solution is required to reduce reservoir draw downs and eliminate the drought deficit. Figure 13 illustrates the recommended approach for addressing these issues.

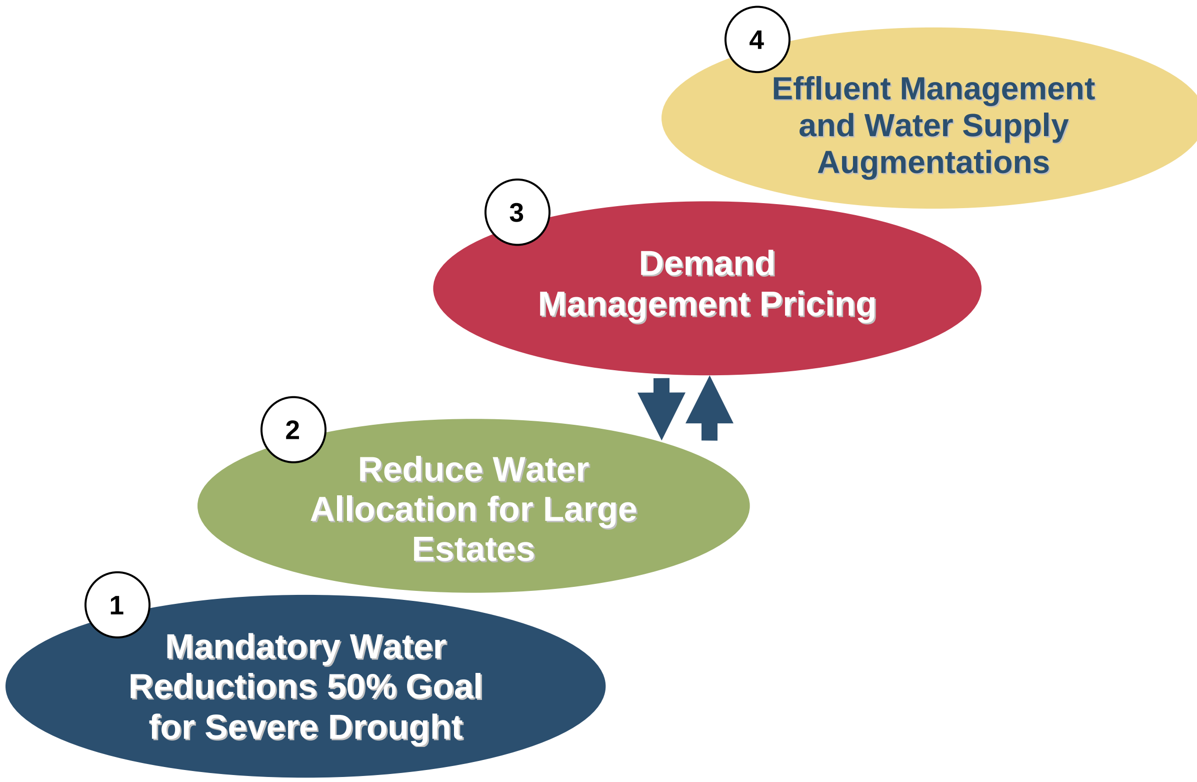

Figure 13. Recommended Policy Components and Physical Improvements.

The solution is comprised of the four components described below, the first three of which are policy related. The fourth component is comprised of three competing options all of which are physical improvements. These options will be compared as part of the District's upcoming buildout expansion and financing plan project that is expected to be initiated in January 2007. At this time, it is envisioned that a single option would be selected from these three options.

- **Mandatory Water Reductions During Severe Drought:** Policy implementation describes the level of service to be provided during severe drought conditions to the community. The policy should be based on achieving a 50 percent level of water conservation during severe drought conditions, since this was established as the baseline conservation rate in both this and past planning projects.
- **Reduced Water Allocations for Large Estates:** Policy implementation provides the District the ability to influence water demands associated with highest future growth

classification. Can be used as the stepping stone to set forth allocations for other lot classifications and promote water conscious landscaping throughout the community. Policy can be used to describe level of service to be provided during normal conditions for specific or all lot classifications.

- **Demand Management Pricing:** Policy implementation provides a mechanism for enforcing mandatory water reductions and reduced water allocations.
- **Effluent Management and Water Supply Augmentation:** Each of the options listed below are physical improvements which maximize the use of all available water resources, provides additional supply for normal, drought, and emergency conditions, and addresses the community's long-term treated effluent disposal needs.
  - Exchange recycled water for local groundwater supply.
  - Expand recycled water service to new residential customers.
  - Convey recycled water to a local rancher. Independently obtain new groundwater supply to address normal and drought water supply needs.

Appendix A

Projected EDUs and Water Supply Needs

TYPE OF LOT	STD USAGE (gpd)	EDU CONV RATIO	EST NUMBER OF CONNECTION (Current)	EST NUMBER OF EDUs (Current)	COMMENTS
NORTH, SOUTH, AND ADDITIONAL RESIDENTIAL AREAS					
Cottage	500	0.7	281	187	Number of connections derived from south/north residential info
Circle	550	0.7	457	335	Number of connections derived from south/north residential info
Estate >12000SF	750	1.0	752	752	Number of connections derived from south/north residential info
Estate <12000SF	650	0.9	561	486	Number of connections derived from south/north residential info
Townhouse	350	0.5	248	116	Number of connections derived from south/north residential info
Halfplex	400	0.5	59	31	Number of connections derived from south/north residential info
Moble home	200	0.3	189	50	Number of connections derived from south/north residential info
Subtotal			**2,547**	**1,958**	March 15, 2005 EDU Count indicates 2,437 connections
MISCELLANEOUS AREAS					
Commercial/Industrial	744	0.99	272	270	Obtained from March 15, 2005 EDU Count
Parks	744	0.99	54	54	Obtained from March 15, 2005 EDU Count
School	744	0.99		0	
Subtotal			**326**	**324**	
TOTAL			**2,873**	**2,282**	

Notes:

1. Existing number of connections to be based on approved connections shown on the March 15, 2005 EDU Count Sheet.
2. Breakdown of residential units provided by Ed Crouse totals 2,537 residential units whereas March 15, 2005 EDU Count shows a total of 2,547 units
3. Difference of 10 units allocated evenly between cottages, circle, Estate > 12,000 sf, Estate < 12,000 SF, and townhous lots

Difference Between Medium and Low/High Density Scenarios = 500

CURRENT AND INCREASED CONNECTIONS

TYPE OF LOT	STD USAGE (gpd)	EDU CONV RATIO	GROWTH SCENARIO = LOW DENSITY INCREASE (Future Connections)	GROWTH SCENARIO = LOW DENSITY EDU INCREASE (Future)	GROWTH SCENARIO = MEDIUM DENSITY (BASELINE) INCREASE (Future Connections)	GROWTH SCENARIO = MEDIUM DENSITY (BASELINE) EDU INCREASE (Future)	GROWTH SCENARIO = HIGH DENSITY INCREASE (Future Connections)	GROWTH SCENARIO = HIGH DENSITY EDU INCREASE (Future)
NORTH, SOUTH, AND ADDITIONAL RESIDENTIAL AREAS								
Cottage	500	0.7			108	72		
Circle	550	0.7			108	79		
Estate >12000SF	750	1.0	1,299	1,299	1,132	1,132	2,653	2653
Estate <12000SF	650	0.9			271	235		
Townhouse	350	0.5			90	42		
Halfplex	400	0.5			90	48		
Moble home	200	0.3				0		
Subtotal			**1,299**	**1,299**	**1,799**	**1,608**		
MISCELLANEOUS AREAS								
Commercial/Industrial	744	0.99	102	101	102	101	102	101
Parks	744	0.99	217	215	217	215	217	215
School	744	0.99	24	24	24	24	24	24
Subtotal			**343**	**340**	**343**	**340**	**343**	**340**
TOTAL								

Breakdown Provided by Ed Crouse on July 25, 2005 for Future Proposed Medium Scenario Only

	STD USAGE (gpd)	EDU CONV RATIO	INCREASE (Future Connections)	EDU INCREASE (Future)
North Area				
MBA	750	1	1,093	1,093
Apt. Size	375	0.5	180	90
River West	750	1	39	39
South Area				
Riverview	675	0.9	154	139
Lakeview	675	0.9	117	105
South of Highway				
Murieta Gardens	525	0.7	216	151
Total Future			1,799	1,617

CURRENT AND INCREASED CONNECTIONS

TYPE OF LOT	STD USAGE (gpd)	EDU CONV RATIO	GROWTH SCENARIO = LOW DENSITY INCREASE (Future Connections)	GROWTH SCENARIO = LOW DENSITY EDU INCREASE (Future)	GROWTH SCENARIO = MEDIUM DENSITY (BASELINE) INCREASE (Future Connections)	GROWTH SCENARIO = MEDIUM DENSITY (BASELINE) EDU INCREASE (Future)	GROWTH SCENARIO = HIGH DENSITY INCREASE (Future Connections)	GROWTH SCENARIO = HIGH DENSITY EDU INCREASE (Future)
NORTH, SOUTH, AND ADDITIONAL RESIDENTIAL AREAS								
Cottage	500	0.7	281	187	389	259	281	187
Circle	550	0.7	457	335	565	414	457	335
Estate >12000SF	750	1.0	2,051	2,051	1,884	1,884	3,405	3,405
Estate <12000SF	650	0.9	561	486	832	721	561	486
Townhouse	350	0.5	248	116	338	158	248	116
Halfplex	400	0.5	59	31	149	79	59	31
Moble home	200	0.3	189	50	189	50	189	50
Subtotal			**3,846**	**3,257**	**4,346**	**3,566.3**	**5,200**	**4,611**
MISCELLANEOUS AREAS								
Commercial/Industrial	744	0.99	374	371	374	371	374	371
Parks	744	0.99	271	269	271	269	271	269
School	744	0.99	24	24	24	24	24	24
Subtotal			**669**	**664**	**669**	**664**	**669**	**664**
TOTAL			**4,515**	**3,921**	**5,015**	**4,230**	**5,869**	**5,275**

TYPE OF LOT	EST NUMBER OF EDUs				AVE DAY WATER DEMAND (GPD)				ANNUAL WATER DEMAND (AFY)			
	Current	Future - Low	Future - Med	Future - High	Current	Future - Low	Future - Med	Future - High	Current	Future - Low	Future - Med	Future - High
NORTH, SOUTH, AND ADDITIONAL RESIDENTIAL AREAS												
Cottage	187	187	259	187	140,500	140,500	194,500	140,500	157	157	218	157
Circle	335	335	414	335	251,350	251,350	310,750	251,350	282	282	348	282
Estate >12000SF	752	2,051	1,884	3,405	564,000	1,538,250	1,413,000	2,553,750	632	1,723	1,583	2,861
Estate <12000SF	486	486	721	486	364,650	364,650	540,800	364,650	408	408	606	408
Townhouse	116	116	158	116	86,800	86,800	118,300	86,800	97	97	133	97
Halfplex	31	31	79	31	23,600	23,600	59,600	23,600	26	26	67	26
Moble home	50	50	50	50	37,800	37,800	37,800	37,800	42	42	42	42
Subtotal	**1,958**	**3,257**	**3,566**	**4,611**	**1,468,700**	**2,442,950**	**2,674,750**	**3,458,450**	**1,645**	**2,737**	**2,996**	**3,874**
MISCELLANEOUS AREAS												
Commercial/Industrial	270	371	371	371	202,475	278,404	278,404	278,404	227	312	312	312
Parks	54	269	269	269	40,197	201,731	201,731	201,731	45	226	226	226
School	0	24	24	24	0	17,865	17,865	17,865	0	20	20	20
Subtotal	**324**	**664**	**664**	**664**	**242,673**	**498,000**	**498,000**	**498,000**	**272**	**558**	**558**	**558**
TOTAL	**2,282**	**3,921**	**4,230**	**5,275**	**1,711,373**	**2,940,950**	**3,172,750**	**3,956,450**	**1,917**	**3,295**	**3,554**	**4,432**

Appendix B

High and Low Growth Scenario Results

Low Growth Scenario Results

The following is a summary of key implications based on the Low Growth Scenario described in the report. This scenario is based on the future connections associated with the Medium Growth Scenario less 500 residential units. All future connections are assumed to be estate lots greater than 12,000 square feet (equal to 1 EDU). This scenario shows a total of 3,846 residential units and a total of 3,921 EDUs at buildout.

- **Water Supply** (low growth scenario):
  - Projected Water Supply Needs: 4,145 acre-ft per year
  - Current Water Rights (maximum): 6,368 acre-ft per year
- **Treated Water** (low growth scenario):
  - Projected Average Day Demand: 2.9 mgd
  - Projected Maximum Day Demand: 6.2 mgd
  - Production Capacity: 7.0 mgd[1]
- **Wastewater Treatment** (low growth scenario):
  - Projected Average Dry Weather Flow: 0.95 mgd
  - Projected Average Annual Flow: 1.00 mgd
  - Treatment Plant Capacity: 1.55 mgd (ADWF)
- **Effluent Storage** (low growth scenario):
  - Required Storage Volume: 1,000 acre-ft
  - Available Storage Capacity: 720 acre-ft
  - Additional Capacity Required: 280 acre-ft (minimum)
- **Recycled Water** (low growth scenario):
  - Projected Recycled Water Production: 1,005 acre-ft per year
  - Golf Course Irrigation Demands: 575 acre-ft per year
    1. Excess Recycled Water: 430 acre-ft per year

Figure B-1 shows the estimated volumes and draw downs for each individual reservoir based on the low growth scenario and buildout conditions. The results of this growth scenario are not expected to modify or alter the recommendations presented in Chapter 6.

[1] Capacity after completion of the Phase 3 and 4 water treatment plant improvements.

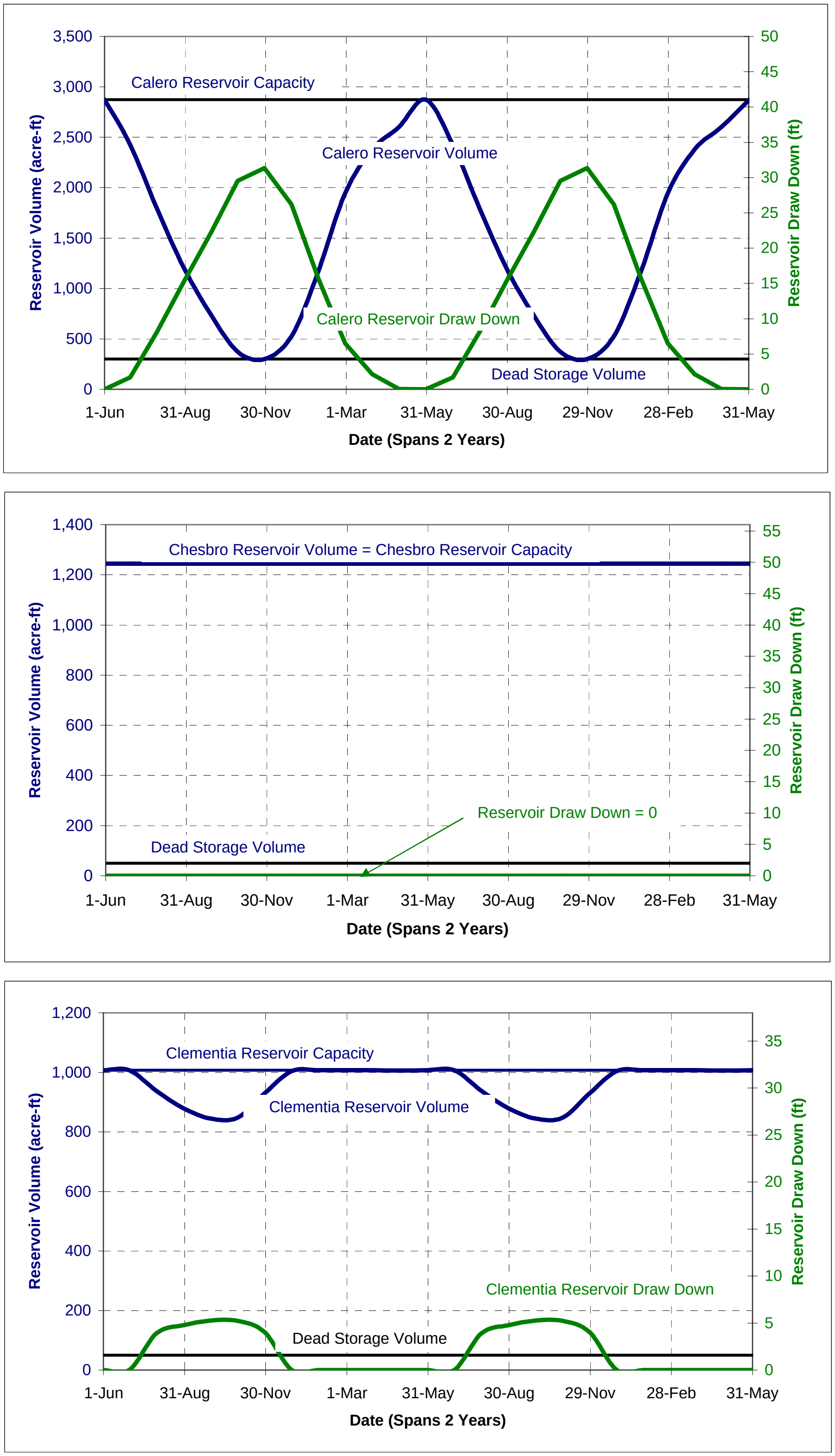

Figure B1. Estimated Reservoir Volumes and Draw Down Levels - Buildout Conditions, Low Growth Scenario

High Growth Scenario Results

The following is a summary of key implications based on the High Growth Scenario described in the report. This scenario is based on a total of 5,200 residential units at buildout. All future connections are assumed to be estate lots greater than 12,000 square feet (equal to 1 EDU). This scenario shows a total of 5,200 residential units and a total of 5,275 EDUs at buildout.

- **Water Supply** (high growth scenario):
  - Projected Water Supply Needs: 5,395 acre-ft per year
  - Current Water Rights (maximum): 6,368 acre-ft per year
- **Treated Water** (high growth scenario):
  - Projected Average Day Demand: 4.0 mgd
  - Projected Maximum Day Demand: 8.3 mgd
  - Production Capacity: 7.0 mgd[2]
- **Wastewater Treatment** (low growth scenario):
  - Projected Average Dry Weather Flow: 1.23 mgd
  - Projected Average Annual Flow: 1.29 mgd
  - Treatment Plant Capacity: 1.55 mgd (ADWF)
- **Effluent Storage** (low growth scenario):
  - Required Storage Volume: 1,250 acre-ft
  - Available Storage Capacity: 720 acre-ft
  - Additional Capacity Required: 530 acre-ft (minimum)
- **Recycled Water** (low growth scenario):
  - Projected Recycled Water Production: 1,290 acre-ft per year
  - Golf Course Irrigation Demands: 575 acre-ft per year
  - 2. Excess Recycled Water: 715 acre-ft per year

Figure B-2 shows the estimated volumes and draw downs for each individual reservoir based on the high growth scenario and buildout conditions. The results of this growth scenario are not expected to modify or alter the recommendations presented in Chapter 6.

[2] This growth scenario requires that the capacity upgrade assocaited with the Phase 3 and 4 water treatment expansion be increased from 7.0 to 8.3 mgd.

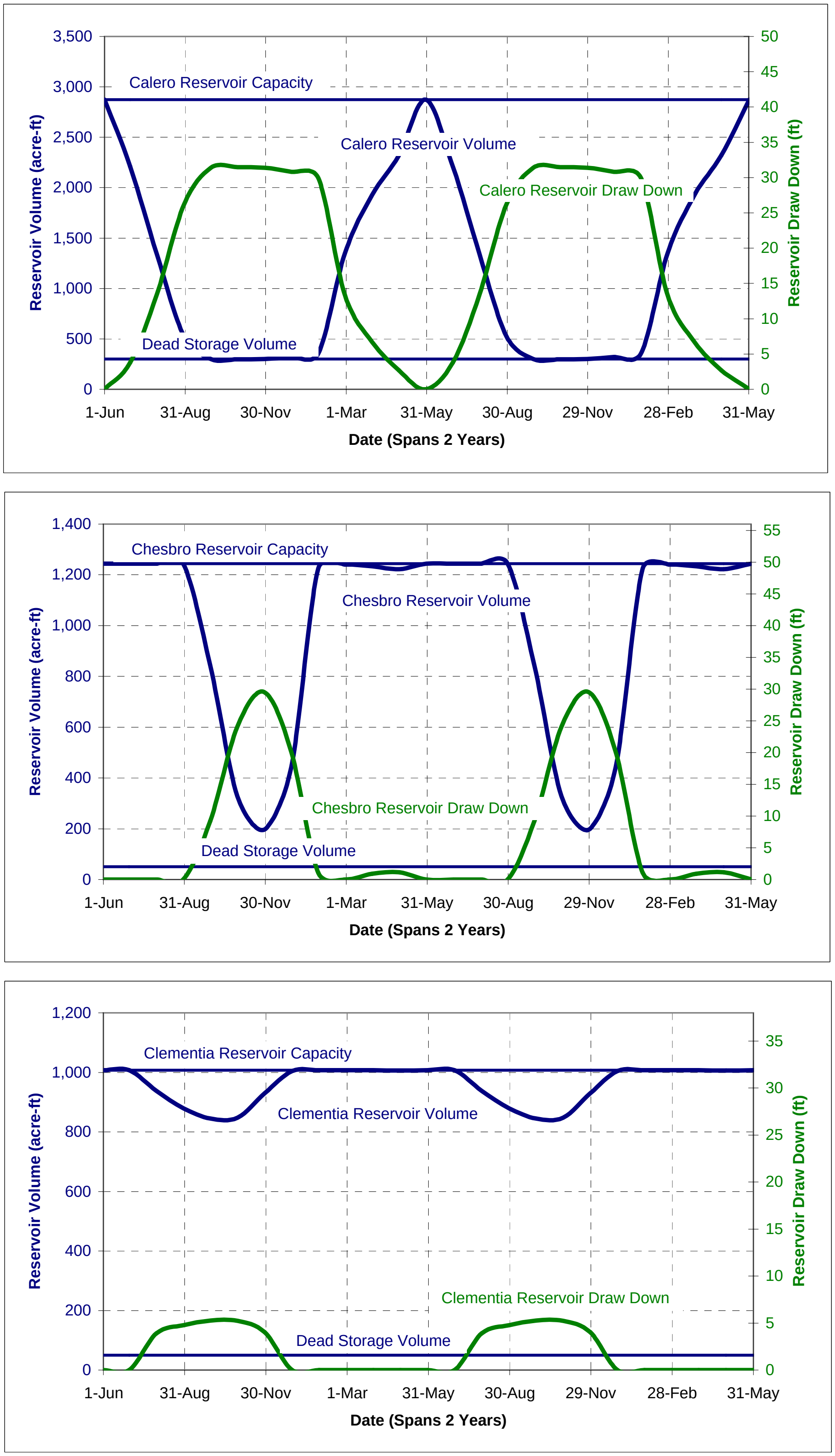

Figure B2. Estimated Reservoir Volumes and Draw Down Levels - Buildout Conditions, High Growth Scenario