# Appendix B – Agency Profiles
# Table of Contents


**Calexico, City of** **6**
- Summary 6
- Background Information 7
- Water Sources 8
- Marginal Water Supply 8
- Water Demand 9
- System Infrastructure and Operations 9
- Energy Profiles 11
- Current Infrastructure Related Energy Efficiency Projects 18
- Sources 19

**California American Water – Monterey District** **20**
- Summary 20
- Background Information 21
- Water Sources 22
- Marginal Water Supply 24
- Water Demand 26
- System Infrastructure and Operations 27
- System-wide Operation Strategy 28
- Energy Profiles 28
- Current Infrastructure Related Energy Efficiency Projects 36
- Sources 37

**Coachella Valley Water District (CVWD)** **38**
- Summary 38
- Background Information 39
- Water Sources 40
- Water Demand 43
- System Infrastructure and Operations 45
- System-wide Operation Strategy 49
- Energy Profiles 49
- Current Infrastructure Related Energy Efficiency Projects 57
- Sources 57

**Contra Costa Water District (CCWD)** **58**
- Summary 58
- Background Information 59
- Water Sources 60

Water Demand 62
System Infrastructure and Operations 63
Energy Profiles 68
Current Infrastructure Related Energy Efficiency Projects 77
Sources 78

**East Bay Municipal Utility District – Water (EBMUD) 79**
Summary 79
Background Information 80
Water Sources 81
Water Demand 84
System Infrastructure and Operations 84
Energy Profiles 88
Current Infrastructure Related Energy Efficiency Projects 96
Sources 97

**Glenn-Colusa Irrigation District (GCID) 98**
Summary 98
Background Information 99
Water Sources 102
Water Demand 104
System Infrastructure and Operations 105
Energy Profiles 108
Current Infrastructure Related Energy Efficiency Projects 116
Sources 116

**Inland Empire Utilities Agency (IEUA) 117**
Summary 117
Background Information 118
Water Sources 119
Water Demand 122
System Infrastructure and Operations 123
Energy Profiles 129
Current Infrastructure Related Energy Efficiency Projects 133
Sources 133

**Los Angeles County Sanitation Districts (LACSD) 134**
Summary 134
Background Information 135
Wastewater Sources 136
System Infrastructure and Operations 138
Energy Profiles 142
Current Infrastructure Related Energy Efficiency Projects 151
Sources 152

**Marin Municipal Water District (MMWD)** **153**
Summary 153
Background Information 154
Water Sources 155
Water Demand 157
System Infrastructure and Operations 158
Energy Profiles 160
Current Infrastructure Related Energy Efficiency Projects 168
Sources 169

**Monterey Regional Water Pollution Control Agency (MRWPCA)** **170**
Summary 170
Background Information 171
Energy Profiles 175
Current Infrastructure Related Energy Efficiency Projects 183
Sources 184

**Natomas Central Mutual Water Company (NCMWC)** **185**
Summary 185
Background Information 186
Water Sources 187
Water Demand 188
System Infrastructure and Operations 189
Energy Profiles 192
Current Infrastructure Related Energy Efficiency Projects 200
Sources 201

**Oceanside, City of** **202**
Summary 202
Background Information 203
Water Sources 204
Water Demand 206
System Infrastructure and Operations 207
Energy Profiles 209
Current Infrastructure Related Energy Efficiency Projects 217
Sources 218

**Orange County Sanitation District (OCSD)** **219**
Summary 219
Background Information 220
Wastewater Sources 220
System Infrastructure and Operations 221
System-wide Operation Strategy 224
Energy Profiles 225
Current Infrastructure Related Energy Efficiency Projects 232

| | |
|---|---|
| Sources | 233 |
| **Orange County Water District (OCWD)** | **234** |
| Summary | 234 |
| Background Information | 235 |
| Water Sources | 236 |
| Water Demand | 238 |
| System Infrastructure and Operations | 239 |
| Energy Profiles | 242 |
| Current Infrastructure Related Energy Efficiency Projects | 245 |
| Sources | 245 |
| **Rancho California Water District** | **246** |
| Summary | 246 |
| Background Information | 247 |
| Water Sources | 249 |
| Water Demand | 253 |
| System Infrastructure and Operations | 253 |
| System-wide Operation Strategy | 254 |
| Energy Profiles | 255 |
| Current Infrastructure Related Energy Efficiency Projects | 263 |
| Sources | 264 |
| **San Gabriel Valley Water Company (SGVWC)** | **265** |
| Summary | 265 |
| Background Information | 266 |
| Water Sources | 266 |
| Water Demand | 268 |
| Energy Profiles | 270 |
| Current Infrastructure Related Energy Efficiency Projects | 278 |
| Sources | 279 |
| **San Jose Water Company (SJWC)** | **280** |
| Summary | 280 |
| Background Information | 281 |
| Water Sources | 282 |
| Water Demand | 284 |
| System Infrastructure and Operations | 285 |
| Energy Profiles | 288 |
| Current Infrastructure Related Energy Efficiency Projects | 296 |
| Sources | 297 |
| **Semitropic Water Storage District** | **298** |
| Summary | 298 |
| Background Information | 299 |
| Water Demand | 303 |

| | |
|---|---|
| System Infrastructure and Operations | 303 |
| Energy Profiles | 304 |
| Current Infrastructure Related Energy Efficiency Projects | 312 |
| Sources | 312 |
| **Sonoma County Water Agency (SCWA)** | **314** |
| Summary | 314 |
| Background Information | 315 |
| Water Demand | 318 |
| System Infrastructure and Operations | 318 |
| Energy Profiles | 323 |
| Current Infrastructure Related Energy Efficiency Projects | 331 |
| Sources | 332 |
| **Suburban Water Systems (SWS)** | **333** |
| Summary | 333 |
| Background Information | 334 |
| Water Sources | 335 |
| Water Demand | 338 |
| System Infrastructure and Operations | 339 |
| Energy Profiles | 344 |
| Sources | 352 |
| **Valley Center Municipal Water District** | **353** |
| Summary | 353 |
| Background Information | 354 |
| Water Sources | 355 |
| Water Demand | 356 |
| System Infrastructure and Operations | 357 |
| Energy Profiles | 360 |
| Current Infrastructure Related Energy Efficiency Projects | 368 |
| Sources | 368 |
| **Westlands Water District (WWD)** | **369** |
| Summary | 369 |
| Background Information | 370 |
| Water Sources | 372 |
| Water Demand | 377 |
| System Infrastructure and Operations | 378 |
| Energy Profiles | 380 |
| Current Infrastructure Related Energy Efficiency Projects | 389 |
| Sources | 389 |

# Calexico, City of

## Summary

<table>
<tr><td>Primary functions</td><td colspan="3">Urban Potable Water, Urban Wastewater</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Treatment, Distribution</td></tr>
<tr><td>Hydrologic Region</td><td>Colorado River</td><td>DEER Climate Zone</td><td>15</td></tr>
<tr><td>Quantity of Water and Wastewater (2008)</td><td colspan="3">Water Treated: 5.9 MGD (yearly average)<br>Wastewater Treated: 2.8 MGD (yearly average)</td></tr>
<tr><td>Number of Customers (2005)</td><td>Total: 6,710<br>Residential: 6,184<br>Commercial: 523<br>Industrial: 3</td><td>Service Area Size</td><td>N/A</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">The City of Calexico’s sole supply of water is imported from the Colorado River via the Imperial Irrigation District's (IID) All American Canal. Local surface sources are limited in availability and groundwater is often of poor quality. Treated water is supplied to a relatively flat service area. Wastewater is treated by the city and flows into the New River eventually ending up in the Salton Sea.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3">• Water Treatment – Conventional treatment technologies are employed<br>• Water Distribution – A relatively flat service area requires low distribution energy<br>• Wastewater Treatment – Secondary treatment and UV light treatment are utilized</td></tr>
<tr><td>Water/Wastewater Treatment Technologies</td><td colspan="3">Calexico Water Treatment Plant (Water): Blending, clarifiers, coagulation/flocculation/filtration<br>Calexico Wastewater Treatment Plant (Wastewater): Primary/secondary treatment, anaerobic digesters, aeration lagoons, UV disinfection</td></tr>
<tr><td>Water Resources</td><td colspan="3">The City of Calexico depends solely on the Colorado River for surface water inflows, supplied by the Imperial Irrigation District.</td></tr>
<tr><td>Marginal Water Supplies</td><td colspan="3">Short-term: Colorado River via All American Canal<br>Long-term: Colorado River via All American Canal, Conservation<br>The city’s geographic location and dependence on the All American Canal present limited options for alternative water sources.</td></tr>
<tr><td>Energy Service Provider</td><td colspan="3">IID Energy</td></tr>
<tr><td rowspan="3">Observed Energy Intensities (kWh/MG)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Water Treatment</td><td>1,114</td><td>1,214</td></tr>
<tr><td>Waste Water Treatment</td><td>3,842</td><td>4,472</td></tr>
</table>

## Background Information

The City of Calexico provides potable water to homes and businesses by treating Colorado River water imported by the Imperial Irrigation District (IID). Incorporated in 1908, the City of Calexico has developed from an agricultural border town into a major border crossing and international transportation hub between the United States and Mexico. From the time of its founding; the city has grown to an estimated population of 36,740 in 2005, making it the second largest city in the Imperial Valley. See Table 1 for additional information on the City of Calexico.

Primary sources of information for this section include: the City of Calexico's 2007 Urban Water Management Plan, 2008 water and energy data provided by the city, and personal communication with staff at the city. A detailed list of references is located at the end of this section.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water, Wastewater |
| **Hydrologic Region** | Colorado River |
| **Region Type** | Desert |
| **Energy Service Provider** | IID Energy |
| **DEER Climate Zone** | 15 |
| **Service Area Population (2008)** | 38,733 |
| **Number of Customers in 2005** | 6,710 |
| ***Residential*** | 6,184 |
| ***Commercial*** | 523 |
| ***Industrial*** | 3 |
| **Distribution Topology** | Flat |

### Climate

The Imperial County is considered an arid desert, characterized by hot, dry summers and mild winters. Summer temperatures typically exceed 100 degrees Fahrenheit and the winter low temperatures rarely drop below 32 degrees Fahrenheit. The remainder of the year has a relatively mild climate with temperatures averaging in the mid-70s. The average annual air temperature is 72 degrees Fahrenheit and the average frost-free season is about 300 days per year.

Annual rainfall in the Imperial Valley averages less than three inches, with most rainfall associated with brief but intense storms. The majority of the rainfall occurs November through March. Periodic summer thunderstorms are common in the region.

### Demographics

City of Calexico's population was 36,740 with 7,916 housing units in 2005. Between the years 2000 to 2003 there was little growth; however, during the year 2003 development began to increase in Imperial County. The total county population increased by 3.0 percent from 2004 to 2005. As seen in Table 2, population in the City of Calexico is estimated to grow 53 percent between 2010 and 2030. The population projections stem from incoming development and industry to the City of Calexico.

**Table 2: Current and Projected Population**

| Year | 2003 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| **Population** | 32,396 | 36,485 | 41,653 | 46,153 | 53,874 | 59,658 | 63,628 |
| **Households** | 7,921 | 9,136 | 10,699 | 12,168 | 14,591 | 16,609 | 18,224 |

## Water Sources

The City of Calexico depends solely on imported water from the Colorado River as its supply. Groundwater is present in the area; however, poor quality prevents its use.

### Imported water

Calexico receives water from the Imperial Irrigation District. The water originates from the Colorado River and is transported to Calexico via the All American Canal. Calexico is entitled to receive 35,755 AF/yr of Colorado River water from IID. Calexico is not restricted on the time of year it receives this water.

### Groundwater

Imperial Irrigation District holds legal titles to all its water and water rights in trust for landowners within its service area, which includes the City of Calexico. However, the groundwater in the area is of poor quality and is generally unsuitable for domestic or irrigation use.

## Marginal Water Supply

The city is geographically isolated, has no water system connections to other areas, and has no opportunity for water transfers, wheeling, or other exchanges. Groundwater in the area is brackish and requires treatment before it can be used for either urban or agricultural uses. Thus, Colorado River water via IID is the only water supply for the city in the future. IID has indicated it is confident that urban water users (which comprise less than two percent of its annual water deliveries among all of IID customers) can be assured delivery of their required water supply. Due to water rights and the relatively small water demand of non-agricultural water users, the Imperial Irrigation District would not reduce or cut back urban water deliveries even in years of reduced deliveries. Cuts will be made to agricultural customers instead.

The energy intensity range of the City of Calexico's marginal supply is presented in Table 3; there is no energy intensity associated with the supply. IID transports water in the All American Canal to the City of Calexico. The canal flows from a high to low elevation; requiring no pumping energy. In-conduit hydro electric facilities generate power in the canal. The energy intensity represents the embedded energy for all activities prior to raw water reaching the city.

**Table 3: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Colorado River Water imported via IID | 1,114 – 1,214 kWh/MG* |
| Long-term | Colorado River Water imported via IID | 1,114 – 1,214 kWh/MG* |

*Colorado River imports via IID are gravity-fed. Treatment energy ranges from 1,114 – 1,214 kWh/MG.

## Water Demand

In 2005, Calexico distributed approximately 6,525 AF of water to 6,710 customers. Future projections for number of customers and water demand are presented in Tables 4 and 5. Trends in land use point to an increase in the development of existing urban areas to provide for larger residential capacity and increased population. With an increase in the development of existing urban areas, there will be associated increases in service and infrastructure. The total urban land use in the years 2005 through 2030 will remain small in comparison to agriculture land use within the IID service area.

#### Table 4: Historic and Projected Number of Customers by Type

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| Residential | 5,351 | 6,184 | 6,987 | 7,896 | 8,922 | 10,082 |
| Business | 507 | 523 | 543 | 559 | 576 | 593 |
| Industrial | 2 | 3 | 4 | 5 | 6 | 7 |
| **Total** | **5,860** | **6,710** | **7,534** | **8,460** | **9,504** | **10,682** |

#### Table 5: Historic and Projected Water Demand

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| **Total Demand (AF/yr)** | NA | 6,525 | 9,522 | 10,089 | 10,691 | 11,328 |

## System Infrastructure and Operations

Table 6 summarizes the infrastructure operated by the City of Calexico. The water facilities include infrastructure for treatment, storage, distribution, wastewater collection, and wastewater treatment.

#### Table 6: Infrastructure Summary

| | |
|---|---|
| **Miles of Distribution Piping** | Unknown |
| **Miles of Wastewater Collection Pipes** | 100 |
| **Number of Pump Stations** | 1 |
| **Number of Wastewater Lift Stations** | 15 |
| **Number of Plants** | 2 |
| ***Treatment*** | 1 |
| ***Wastewater*** | 1 |
| **System-wide Storage Capacity** | 33 MG |
| ***Raw Water*** | 25 MG |
| ***Treated Water*** | 8 MG |

### Sub-Regions within Agency

For the purposes of this study, the service area of Calexico will not be divided into sub-regions.

#### *Conveyance*

Water is supplied to the city from the All American Canal. A pump operated by the city is used to draw water from the All American Canal and transport it approximately one mile to a reservoir near the water treatment plant. The reservoir is asphalt lined and can store 25 million gallons. The pump used to transport water to the reservoir is a low lift pump, the area is flat and little energy is used. Calexico water operators were unable to provide energy data on this facility.

### *Water Treatment*

The water treatment plant draws water from the raw water storage reservoir. It consists of two clarifiers, a gravity filtration system, and chlorination system. The plant has three contact clarifiers with different diameters and they are designed to remove solids from any raw water supply with chemical assisted coagulation flocculation sedimentation filtration. The total capacity is 16.0 MG. Presently the maximum daily water demand is approximately 9.0 MGD. Treated water from the plant is pumped into storage tanks co-located with the plant. Water then enters the distribution system.

### *Distribution*

Treated water is released from storage tanks and enters the distribution system. One pumping station co-located with the treatment plant pressurizes the water to 60 psi to enter the distribution system. This pump station consists of four 250 horsepower variable speed pumps each with a capacity of 4,000 gallons per minute (gpm) at 60 psi. Currently, the plant has a pumping capacity of 16,000 gpm with all four pumps operating at full capacity.

### *Wastewater Treatment*

The Water Pollution Control Plant (wastewater) is located on the west of Calexico on the New River. The city maintains 100 miles of sewer lines and 15 lift stations to get wastewater to the plant. The wastewater treatment plant actually consists of two separate plants with a total treatment capacity of 4.2 MGD, currently treating approximately 2.7 MGD. Plant #1, built in 1967, uses an activated sludge treatment with 2.5 MGD capacity with two primary clarifiers, three aerator basins, two digesters, and three final clarifiers. It was last upgraded in 1995. Plant #2, built in 1991, uses aerated lagoons with treatment capacity of 1.8 MG and influent flows through a set of four lagoons; each with a 3 MG volume. An upgrade was completed in 1994. Plant #1 and Plant #2 final effluents are combined and pass through a UV system for disinfection and then discharged into the New River.

## System Storage

The City of Calexico has both raw and treated water storage facilities in case of emergency or planned water supply reduction. Raw water from the All American Canal is stored in an asphalt-lined reservoir offsite from the treatment plant. The reservoir has a storage capacity of 25 million gallons (MG).

After undergoing treatment, the water is stored in three treated water tanks located at the treatment facility. The capacities of the tanks are 4 MG, 3 MG, and 1 MG for a total of 8MG. Two tanks were installed with the original construction of the facility in 1949 and have a capacity of 1 MG and 3 MG. In 1992, the 4 MG tank was added.

Staff indicated the city has about 5 to 6 days of short-term storage including both treated and raw water storage.

## System-wide Operation strategy

Water treatment plant operators operate the system to maintain storage levels in treated water tanks. The water treatment plant operates at higher flow rates a night to fill storage in preparation for the next day's water demand. Production during the day is decreased and water in the tanks is drawn down. If the tanks reach a critical low level, production must be increased.

Operators at the water treatment plant file daily water requests to IID to request water over the next 24 hour period. IID then manually adjusts canal gates to enable proper flow to Calexico; IID monitors the flow to the plant several times daily.

The wastewater treatment plant operates to meet the needs of the influent. Wastewater flows are relatively constant during the day but drop at night. Staff indicated that wastewater flows are also low during cold weather.

### Infrastructure Changes

There were no major infrastructure changes in 2008 that would affect the Study Team's data.

## Energy Profiles

The City of Calexico provided daily energy and daily water flow data to the Study Team. Data was only available on the energy consumption and flow of the water treatment plant and wastewater treatment complex (both plants combined). Data on raw water pumps and wastewater lift stations were not available as water and wastewater operators do not keep records of that data. Energy data was available directly from the plant operators who record daily energy use every day by reading the on-site energy meter. The Study Team obtained sample electricity bills from the City of Calexico for these facilities to verify the operator's records. It was noted that a multiplicative factor appearing on the energy bills was needed to calculate true energy use from the meter readings. The Study Team made these adjustments for the wastewater and UV disinfection system. Verification was not possible with the water treatment plant.

Calexico water systems are powered by IID energy. The cost of energy is not bundled with the cost of water that the city pays. Calexico schedules water demand 24 hours in advance with IID; however, scheduling energy use is not needed.

The energy intensity of each facility type within the City of Calexico is presented in Figure 1.

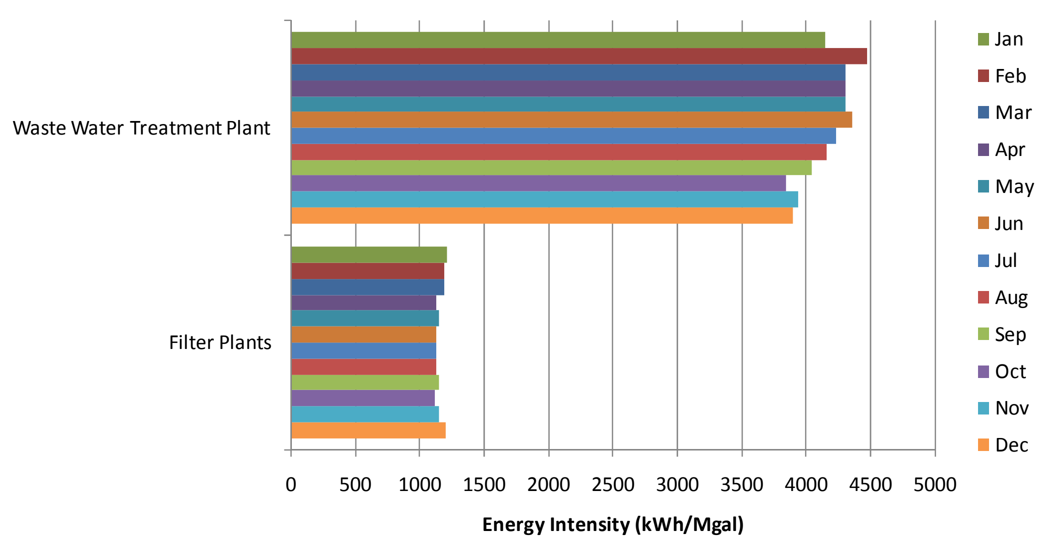
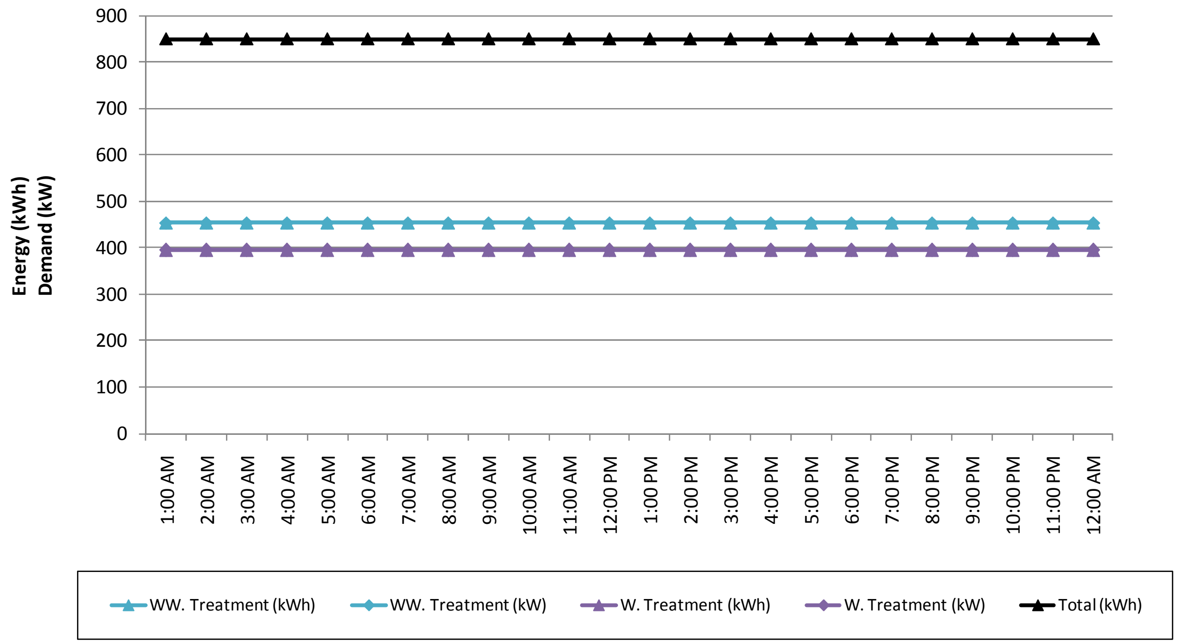


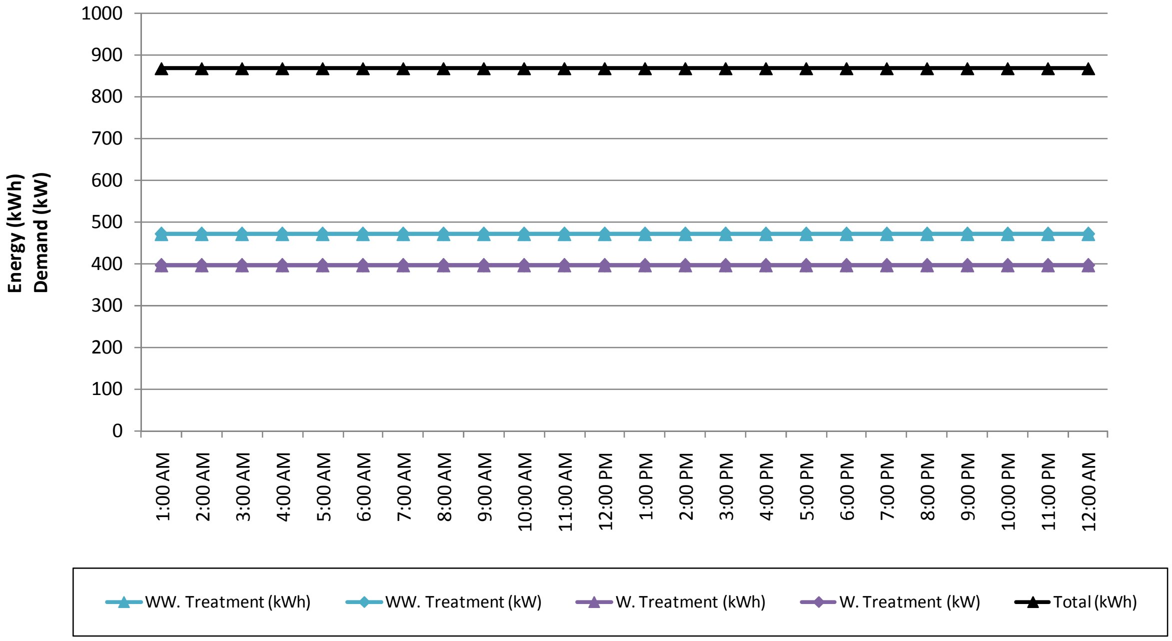

**Figure 1: Calexico Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 2 through 8. The majority of energy used by the City of Calexico's water system is for wastewater treatment.



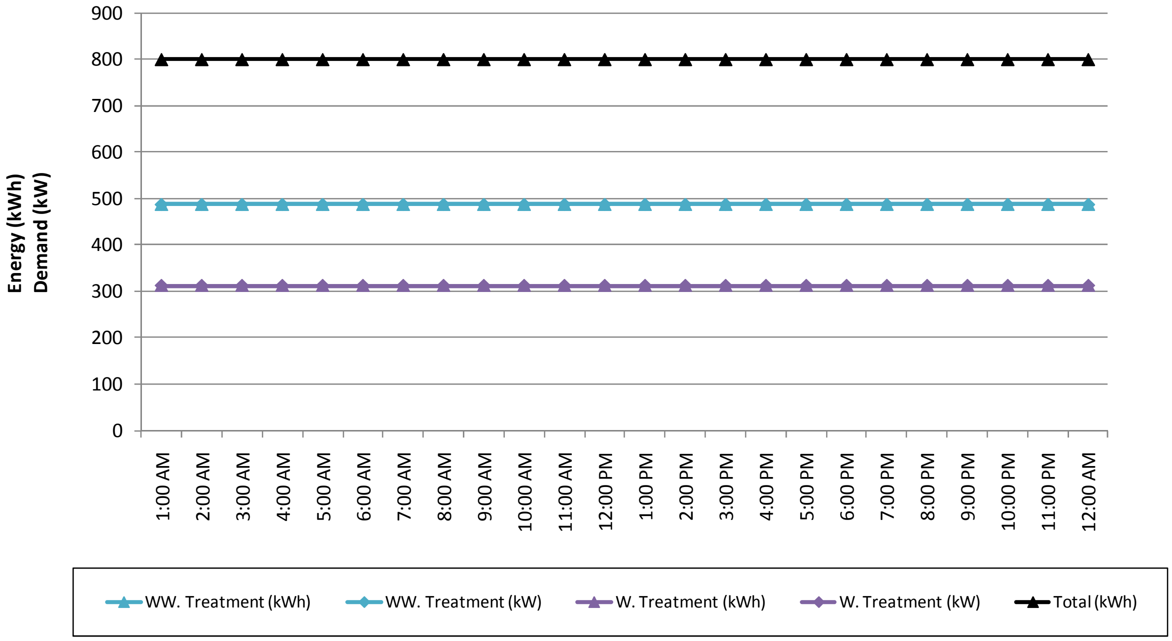

| | |
|---|---|
| **Date** | 6/20/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Water Treatment* | 396 |
| *Wastewater Treatment* | 454 |

**Figure 2: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



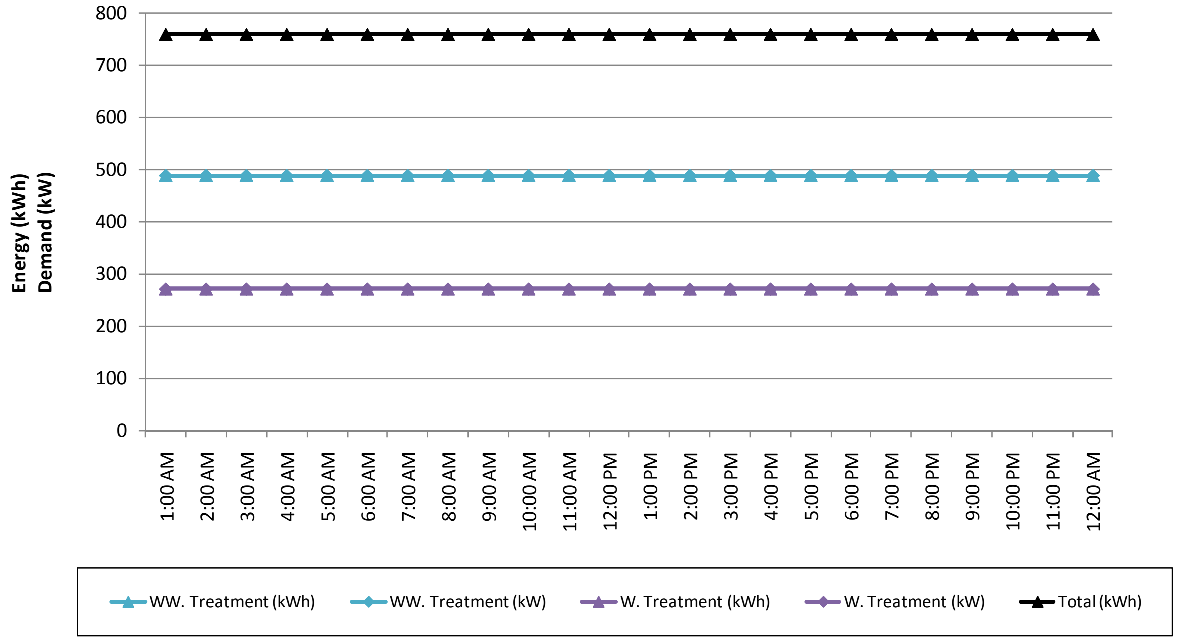

| | |
|---|---|
| **Date** | 7/11/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Water Treatment* | 396 |
| *Wastewater Treatment* | 471 |

**Figure 3: 24-Hour Energy Profile: Summer High Water Demand Day**



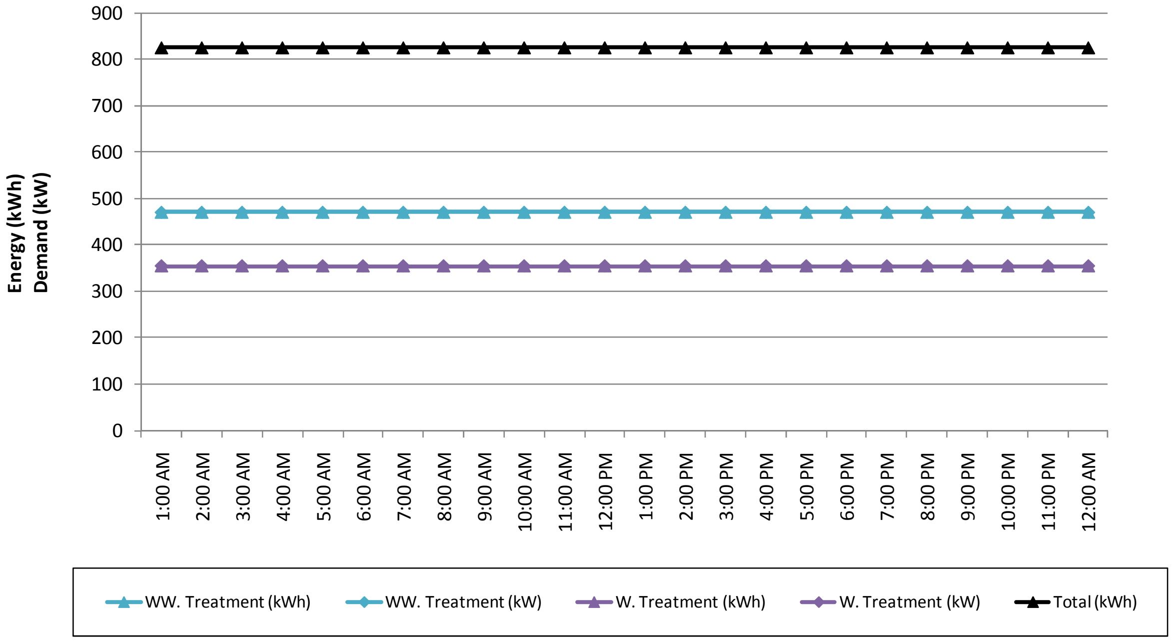

| | |
|---|---|
| **Date** | 7/25/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Water Treatment* | 313 |
| *Wastewater Treatment* | 488 |

**Figure 4: 24-Hour Energy Profile: Summer Average Water Demand Day**



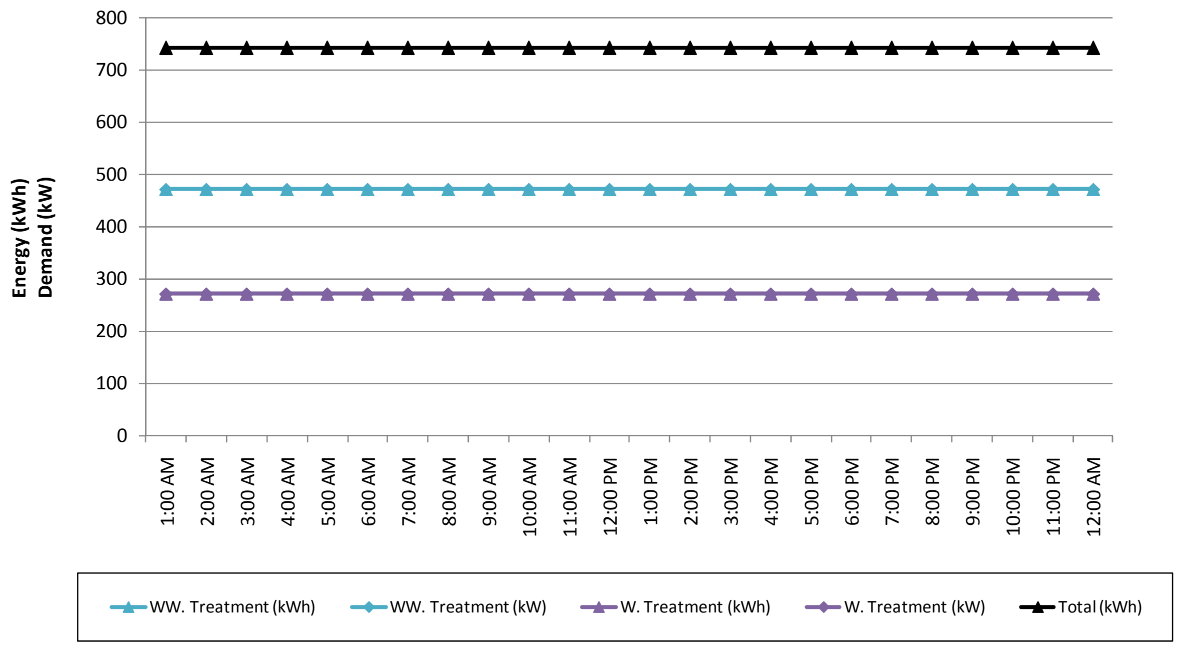

| | |
|---|---|
| **Date** | 9/12/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Water Treatment* | 271 |
| *Wastewater Treatment* | 488 |

**Figure 5: 24-Hour Energy Profile: Summer Low Water Demand Day**



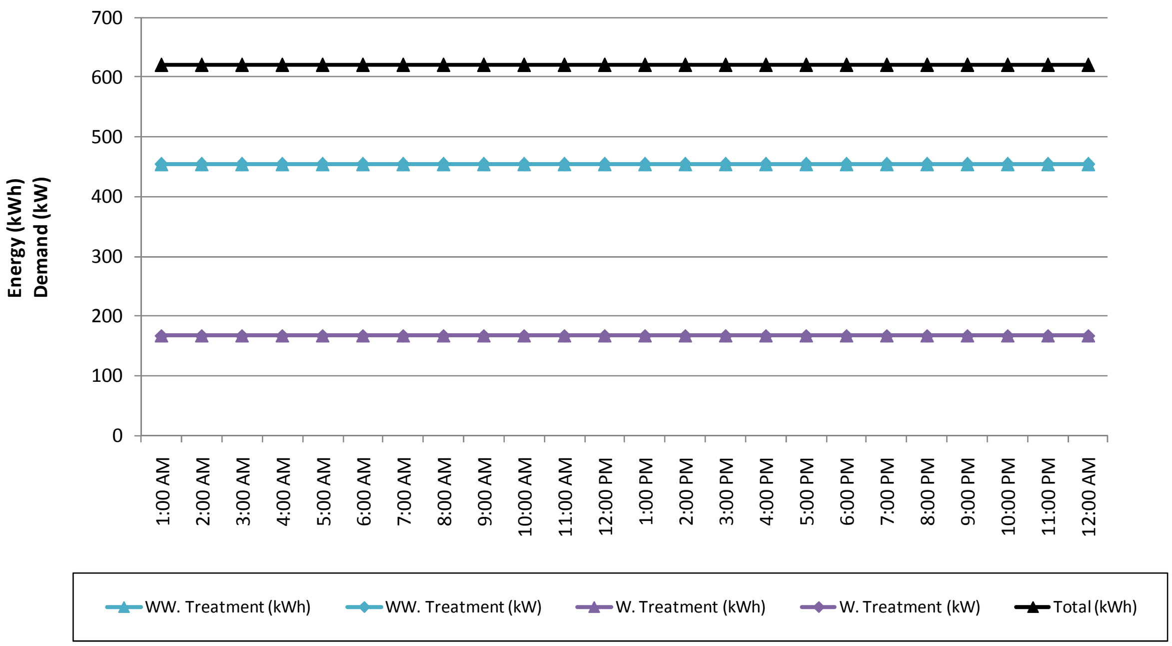

| | |
|---|---|
| **Date** | 5/16/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Water Treatment* | 354 |
| *Wastewater Treatment* | 471 |

**Figure 6: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 3/22/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Water Treatment* | 271 |
| *Wastewater Treatment* | 471 |

**Figure 7: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 12/25/2008 |
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Water Treatment* | 167 |
| *Wastewater Treatment* | 454 |

**Figure 8: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

The city is currently constructing a new 6 MG raw water storage facility. Completion is expected in early 2010.

## Sources

Arturo Estrada, Chief Operator – Calexico Water Pollution Control Plant. Personal Communication. December 9, 2009.

City of Calexico. *2007 Urban Water Management Plan*. February 2007.

Southern California Association of Governments. "Adopted 2008 RTP Growth Forecast, by City." Accessed 11/19/2009.

Victor Rodriguez, Supervisor – Calexico Water Treatment Plant. Personal Communication. December 14, 2009.

## California American Water – Monterey District

### Summary

<table>
<tr><td>Primary function</td><td colspan="3">Urban Water</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Supply, Treatment, Distribution</td></tr>
<tr><td>Hydrologic Region</td><td>Coastal</td><td>DEER Climate Zone</td><td>3</td></tr>
<tr><td>Quantity of water</td><td>Produced: 9.7 MGD<br>Groundwater Produced: 3.3 MGD</td><td colspan="2">Distributed: 13.0 MGD</td></tr>
<tr><td>Number of Customers (2009)</td><td>Total: 125,000 population served</td><td>Service Area Size</td><td>N/A</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">CALAM supplies retail potable water to 19 areas in Monterey, utilizing local rainfall and groundwater for supply. Topography generally moderate to hilly terrain. Existing water supplies consist of local surface water and groundwater which are fully allocated and increases in supply are not expected in the short-term.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3">• Water Supply - significant energy is used for groundwater pumping.<br>• Water Treatment – conventional treatment technologies are used to treat local surface water.</td></tr>
<tr><td>Water/Wastewater Treatment Technology</td><td colspan="3">Carmel Valley Water Treatment Plant: Conventional Treatment</td></tr>
<tr><td>Water Resources</td><td colspan="3">Surface Water: 75%, Groundwater: 22%, Other: 3%</td></tr>
<tr><td>Marginal Water Supplies</td><td colspan="3">Short-term: Local Surface Water<br>Long-term: Recycled water, recovered water, desalinated water</td></tr>
<tr><td>Energy Service Provider</td><td colspan="3">PG&E</td></tr>
<tr><td rowspan="3">Observed Energy Intensities (kWh/MG)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Groundwater</td><td>2,099</td><td>2,514</td></tr>
<tr><td>Water Treatment</td><td>3,546</td><td>6,666</td></tr>
</table>

## Background Information

California-American Water Monterey District (Cal-Am) is a for-profit corporation that provides approximately 95 percent of the potable water supply within the Monterey Peninsula, Carmel Bay, and South Monterey Bay IRWMP Region (Region). Cal-Am operates and maintains most of the water supply infrastructure in the Region, including pumps and pipelines, Los Padres Dam, San Clemente Dam and their associated reservoirs on the main stem of the Carmel River. Table 1 summarizes information about Cal-Am:

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water |
| **Hydrologic Region** | Monterey Peninsula |
| **Region Type** | Coastal |
| **Energy Service Provider** | PG&E |
| **DEER Climate Zone** | 3 |
| **Service Area Population** | 115,000 |
| **Number of Customers in 2006** | 38,480 |
| ***Residential*** | |
| ***Commercial/Industrial*** | |
| ***Agricultural*** | |
| **Distribution Topology** | Moderate |

Primary sources of information on California American Water – Monterey District include: Monterey Peninsula Water Management District's 2007 Integrated Regional Water Management Plan and Cal-Am's 2009 Final Environmental Impact Report for the Coastal Water Project. A detailed list of references is located at the end of this section.

### Climate

Average summer temperatures in Monterey County range from 51 to 68 degrees F. Average winter temperatures range from 44 to 61 degrees F. The warmest months are July through October. Average yearly rainfall totals 18 inches, and falls primarily between November and April. Summer months on the coast can often be foggy due to the chilly and unchanging water temperature of the Pacific Ocean.

### Demographics

Within the Region, the Cal-Am service area includes the cities of Monterey, Carmel-by-the-Sea, Del Rey Oaks, Pacific Grove, Sand City, most of Seaside, and the unincorporated communities of Carmel Valley, Del Monte Forest (Pebble Beach), Carmel Highlands, Robles Del Rio (in Carmel Valley), Rancho Fiesta (in Carmel Valley), Ryan Ranch (Hwy 68 corridor), Bishop Ranch (Hwy 68 corridor), and Hidden Hills/Bay Ridge (Hwy 68 corridor) (see Figure 1).

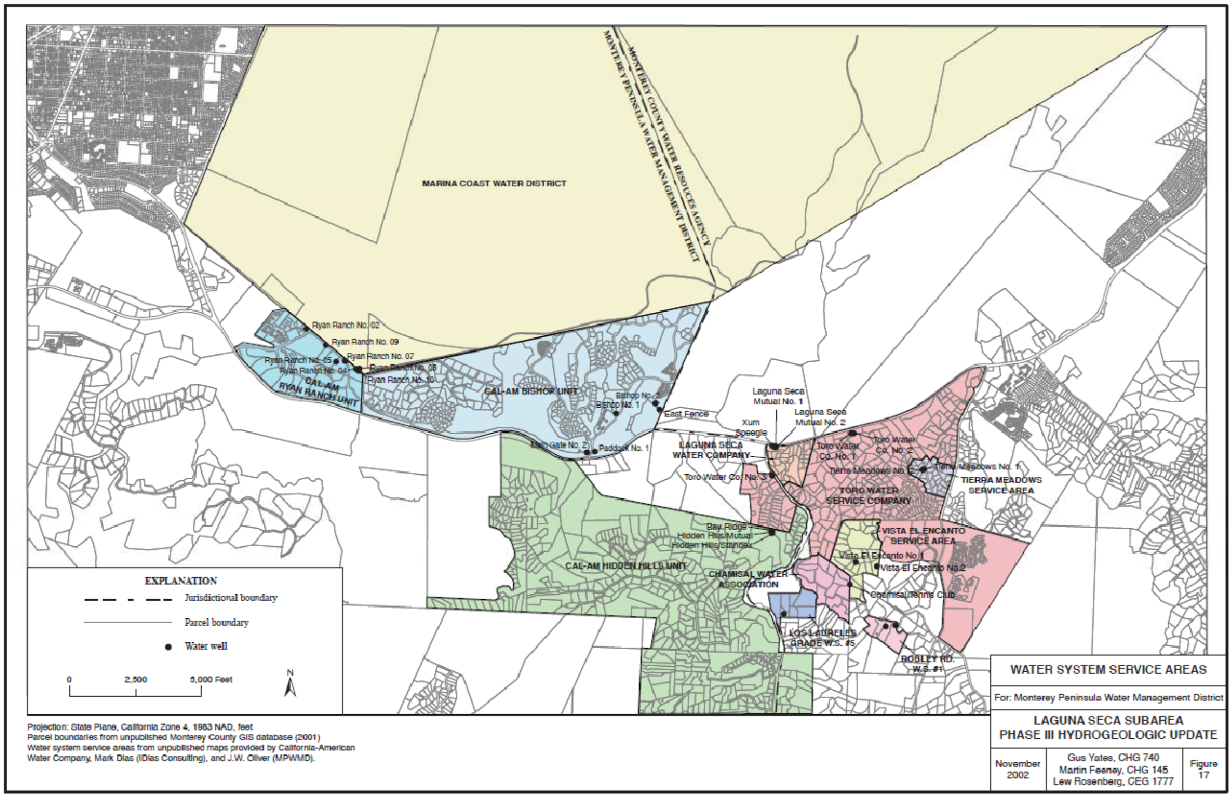



**Figure 1: Monterey Peninsula Water Service Areas**

The population of the Region is estimated to be about 115,000 or about 30 percent of the total population of Monterey County, with most of the population residing in low density housing in the Monterey Peninsula cities. Population growth in the cities is projected to decline slightly in the next 20 years as most areas are built out. Growth in both the unincorporated areas and cities may be constrained by current conditions limiting water supplies and levels of service on local roads in the Region and surrounding area. Total water production from all sources within the Monterey Peninsula Water Management District boundary averaged nearly 20,000 acre-feet annually (AFA) during Water Years 1996 through 2006 (October 1 to September 30).

## Water Sources

In WY2006 Cal-Am produced 14,663 AF within the Region. Cal-Am supplied approximately 75 percent of its demand from surface water from the Carmel Valley, 22 percent from the Seaside Groundwater Basin and 3 percent from other sources (see Figure 2). The estimated total use within the Region (all sources) was a little more than 18,800 AF.

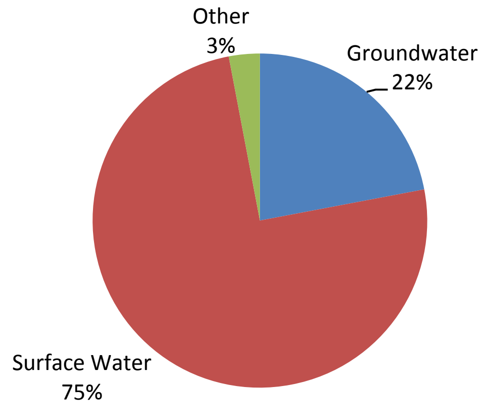



**Figure 1: 2008 Distribution of Sources**

## Groundwater

### *Seaside Groundwater Basin*

The Seaside Groundwater Basin underlies a hilly coastal plain that slopes northward toward the Salinas Valley and westward toward Monterey Bay. The water-bearing aquifers used for potable water supply extend offshore under the Monterey Bay, but the extent of the aquifers under the bay has not been fully explored. Land surface elevations range from sea level at the beach to approximately 900 feet near the eastern boundary of the basin. Recharge to the groundwater system is primarily from infiltration of precipitation, with minor additional amounts contributed by deep percolation of irrigation water, leaky pipes, septic systems, injection wells, and possibly stream flow.

Groundwater extraction near the coast increased markedly beginning in 1995, resulting in declining water levels and depletion of groundwater storage. The main limitation on yield in the SGB is the risk of seawater intrusion, which may reach production wells before the groundwater budget can be brought into balance. Based on detailed analysis of water level trends and groundwater budgets, the estimated sustainable yield of the Seaside Basin under present conditions is 2,880 AFY and the usable groundwater storage capacity at 6,200 AF (Yates, 2005). Although there is significant uncertainty in this value, basin-wide groundwater withdrawals in recent years have been on the order of 5,600 AFY.

In 2006, a Final Decision was rendered that adjudicated the Seaside basin and set a three-year goal aimed at reducing annual extractions to 3,000 AFY, which is termed the "natural safe yield." Satellite systems in the inland subbasins have a production limit of 345 AFY. A Court-appointed Watermaster was established to administer and enforce provisions of a Final Decision that adjudicated Seaside Basin groundwater rights. The Watermaster consists of 13 voting positions held among nine representatives: Cal-Am, Seaside, Sand City, Monterey, Del Rey Oaks, Monterey Peninsula Water Management District (MPWMD) and MCWRA each appoint one representative, and the Landowner Group appoints two representatives.

### *Carmel Valley Aquifer*

The Carmel Valley aquifer, which underlies the alluvial portion of the Carmel River downstream of San Clemente Dam, is about six square-miles and is approximately 16 miles long. It varies in width from 300 to 4,500 feet and in thickness from about fifty feet near Carmel Valley Village to approximately 150 feet near Highway 1. The thickness of the alluvium averages 75 feet and is adequately defined by well logs (U.S.G.S. 1984). In the spring and summer, the alluvial aquifer is drawn down by private pumpers and

Cal-Am, which results in dewatering of the lower six miles of the river for several months in most years and up to nine miles in dry to extremely dry years. Recharge of the aquifer is derived mainly from river infiltration which composes 85 percent of the net recharge. The aquifer is recharged relatively quickly during normal rainfall years.

In 1995, SWRCB issued Order No. WR 95-10 to Cal-Am stating that the company lacked rights to all but 3,376 AFY of water being diverted from the Carmel Valley Aquifer to its customers on the Monterey Peninsula. The order confirmed the nature of these rights and called for an immediate 15 percent reduction in diversions from the Carmel River and underlying aquifer for 1996 and a 20 percent reduction in subsequent years to a maximum diversion amount of 11,285 AFY. The base for these reductions was set at 14,106 acre-feet per year, which was the average of annual diversions between 1979 and 1988. The State opined that Cal-Am should diligently develop and implement a plan for obtaining water consistent with California law and required that any new supplies of water must offset Carmel River pumping on a one-for-one basis. Thus, a new water supply must be found for 10,730 AFY before any additional water is allocated. Subsequent orders have modified the original order and it is in the interest of the Region's stakeholders to work with Cal-Am to ensure these orders are met.

There are two federally-listed endangered species present in the Cal-Am service territory, the California Red Legged From and the Steelhead Trout. The presence of these species in the Carmel Valley Aquifer area has resulted in agreements between Cal-Am, State, and Federal agencies that restrict pumping and withdrawals from the Aquifer and therefore limits available water supplies.

### Local Raw Surface Water

There are two small main stem reservoirs in Carmel Valley, the Los Padres Dam and Reservoir and the San Clemente Dam and Reservoir, which are both owned by Cal-Am. Flows released from Los Padres are used to augment instream flows during the dry season.

Turbidity in the main stem is normally low, except during winter when storm runoff events can elevate turbidity for several days during and after a storm event. Recently, in the reach immediately downstream of the San Clemente Dam, it appears that fine sediment released from the reservoir during drawdown operations has increased turbidity at the Sleepy Hollow weir. This condition is likely to worsen in the near term as the reservoir foreslope, which is comprised of very fine silt particles, fans out and progrades (moves downstream) to the dam spillway.

Water quality in the Carmel River Lagoon typically declines during late summer and fall as freshwater inflows cease and ocean waves start to overtop the sandbar at the mouth of the river. Water temperature often exceeds 70°F, which is above Central Coast Basin Plan guidelines. Dissolved oxygen levels also periodically drop below guidelines (not less than 7.0 mg/L), probably due to a combination of increasing water temperature and decomposition of marine organic material washed into the lagoon by high Ocean waves (MPWMD, 2004).

## Marginal Water Supply

The Study Team identified both short-term and long-term marginal supplies for Cal-Am.  Short-term marginal supply is local surface water; flows released from the Los Padres Dam are used to augment instream flows during the dry season.

The current operating yield in the Seaside Groundwater Basin, the only other water supply source in the Region, is set at 5,600 AFA. Beginning in January 2009, a phased ramp-down in production over a period of 15 years to the natural safe yield of 3,000 AFA is scheduled to begin if an equivalent amount of replenishment water is not found to offset excessive groundwater production. Groundwater produced in excess of targeted levels (without replacement), will result in replenishment assessments imposed on Cal-Am and other producers for exceeding the court-ordered allocations.

Long-term marginal supply includes recycled water, recovered water, and desalinated water (Coastal Water Project). Table 2 shows Cal-Am's current and projected water supplies.

### Table 2: Current and Potential Water Supplies in the Cal-Am Service Area

| Source of Supply | 2007 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| **Carmel River System** | | | | | | |
| Carmel River System – Cal-Am Recognized Water Rights | 3,376 | 3,376 | 3,376 | 3,376 | 3,376 | 3,376 |
| Carmel River System – Interim Limit over Cal-Am Recognized Water Rights Provided in Order WR 95-10 | 7,909 | | | | | |
| **Seaside Basin** | | | | | | |
| Coastal Subarea | 3,504 | 3,087 | a | a | a | a |
| Laguna Seca Subarea | 345 | 246 | a | a | a | a |
| Entire Basin | | | a | a | a | 1,474 |
| **Subtotal Existing Carmel River and Seaside Basin Sources** | **15,134** | **6,709** | **a** | **a** | **a** | **4,850** |
| Aquifer Storage and Recovery Phase 1 | | 920 | 920 | 920 | 920 | 920 |
| **Subtotal Existing Sources** | **15,134** | **7,629** | **a** | **a** | **a** | **7,264** |
| **Other Potential Supply Projects** | | | | | | |
| Expansion of Pebble Beach Recycled Water Project | | | 136 | 136 | 136 | 136 |
| Unaccounted For Water Recovery | 300 | 300 | 300 | 300 | 300 | 300 |
| San City Desalination | | 300 | 300 | 300 | 300 | 300 |
| **Subtotal – Other Potential Supplies** | **300** | **600** | **736** | **736** | **736** | **736** |

a Estimates of Cal-Am's allocation for interim years using the Seaside Basin Watermaster's methodology are not available.

Aquifer Storage and Recovery (ASR) has been shown by MPWMD to be a viable method to store water in the SGB for future use in the Cal-Am system. ASR entails diverting excess winter flows from the Carmel River Basin during high flow periods using existing Cal-Am, wells in the lower stretches of the river. Diverted water is treated to potable drinking water standards and pumped approximately six miles through the Cal-Am distribution system to the hydrologically separate Seaside Basin, where the water is injected into specially-constructed ASR wells for later recovery during dry periods. MPWMD has operated a full-scale ASR test well (Santa Margarita Test Injection Well No. 1) since 2002 and views this technique as one way to improve water management capabilities to the benefit of Carmel River natural resources and Seaside Groundwater Basin long-term reliability.

The energy intensity range of Cal-Am's marginal supply is summarized in Table 3. The energy intensity represents the embedded energy for all activities prior to the water reaching Cal-Am's customers.

### Table 3: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Local Surface Water[a] | 3,546-6,666 kWh/MG |
| Long-term | Recycled Water[b] | 1,422-1,994 kWh/MG |
| | Storage Reservoirs[c] | 31 kWh/MG |
| | Aquifer Storage & Recovery[d] | 2,099-2,514 kWh/MG |
| | Seawater Desalination[e] | 12,276 kWh/MG |

a) EI range from Study 2 results for Cal-Am surface water treatment.
b) Recycled Water EI range from Study 2 results for Monterey Regional Water Pollution Control Agency's recycled water treatment system.
c) Assumed EI from Study 1; may need to add treatment energy.
d) EI range from Study 2 results for Cal-Am groundwater pumping.
e) California Sustainability Alliance, 2008.

## Water Demand

Since 1997, Cal-Am's main system has averaged approximately 10,900 acre-feet of water production per year from its Carmel River sources, which represents about 75 percent of its total annual production. The remaining 25 percent or approximately 3,700 acre-feet per year is produced from Cal-Am's wells in the coastal subareas of the Seaside Groundwater Basin.

### Table 4: Average Annual Unadjusted Demand and Weather-Adjusted Demand for Water Years 1996-2006

| Water Year Type | Average Demand |
|---|---|
| Unadjusted Demand | 14,710 Acre-ft |
| Normal-Year | 15,095 Acre-ft |
| Dry-Year | 15,474 Acre-ft |
| Critically Dry-Year | 15,858 Acre-ft |

CalAm's Monterey District Urban Water Management and Water Shortage Contingency Plan (UWMP) (CalAm, 2006a) includes information on CalAm's near-term demands. According to water production information presented in the UWMP, CalAm's Monterey District produced 15,184 AF in 2005, all of which was from wells. Demand projections included in the UWMP also include an estimate of 15,550 AF for 2005, which assumes that the Stage 1 conservation program implemented by MPWMD in 1999 continues to be in effect. This is slightly higher (358 AF) than MPWMD's average demand unadjusted for weather and somewhat lower (823 AF) than MPWMD's total weather adjusted demand.

A summary of the District's estimate of additional long-term water needs by jurisdiction is shown in Table 5. The table reflects future annual water demands expected to result from buildout of the general plans, and is in addition to existing water demands. Since the different jurisdictions prepare and adopt their general plans at different times, the expected buildout-year represented by these estimates is 2020 to 2025, depending on the planning horizon of each jurisdiction's general plan. The estimate of water needed to meet these future demands is 4,545 AFY.

#### Table 5: 2006 Estimated Additional Water Demand: 20-Year Planning Horizon (AFY)

| | Single-Family Dwellings | Multi-Family Dwellings | 2nd Units | Non-Residential | Residential Remodels | 20% Contigency | Residential Retrofit Credit Repayment | Total Water Needed (AF) |
|---|---|---|---|---|---|---|---|---|
| Airport District | | | | 115 | | 23 | | 138 |
| Carmel | 19 | 56 | 25 | 20 | 120 | 48 | | 288 |
| Del Rey Oaks | 5 | | | 30 | 5 | 8 | | 48 |
| Monterey | 46 | 426 | | 123 | | 109 | 0.526 | 705 |
| Pacific Grove | 73 | 376 | 298 | 260 | 43 | 210 | 3.545 | 1,264 |
| Sand City | 48 | 68 | | 210 | | 60 | | 386 |
| Seaside | 133 | 21 | 44 | 283 | 4 | 97 | 0.023 | 582 |
| Unincorporated | 892 | | | 10 | 37 | 188 | 8.134 | 1,135 |
| **Total** | **1,216** | **947** | **367** | **1,051** | **209** | **743** | **12** | **4,545** |

The Carmel Area Wastewater District (CAWD) treatment plant located at the mouth of Carmel Valley supplied recycled water (approximately 790 AFY) to irrigate turf at several Monterey Peninsula golf courses and at one local school. Use of this reclaimed water has resulted in a one-for-one decrease in Cal-Am system demand.

## System Infrastructure and Operations

Cal-Am collects, stores, and distributes water for 95 percent of the residents and businesses in the Monterey Peninsula. Cal-Am owns and operates a series of production wells along the Carmel River and in the Seaside Groundwater Basin (SGB), and a network of pipelines (including the Cañada Pipeline) extending from the San Clemente Reservoir to the Monterey Peninsula and Seaside communities. Table 6 summarizes the key pieces of the District’s physical infrastructure.

#### Table 6: Infrastructure Summary

| | |
|---|---|
| **Number of Groundwater Wells** | 17 |
| **Number of Reservoirs Operated** | 2 |
| **Miles of Distribution Piping** | |
| **Number of Plants** | |
| ***Treatment*** | 1 |
| **System-wide Storage Capacity** | 37,500 |

### *Conveyance*

Generally water from the main stem of the Carmel River is pumped by Cal-Am to the Monterey Peninsula through a well field in the alluvial aquifer downstream of the San Clemente Dam. Flow releases in the dry season from the Los Padres Reservoir in Carmel Valley are used conjunctively to meet flow requirements in the Carmel River for steelhead and to augment natural flows along the riparian corridor. To reduce impacts to streamside areas from water extraction, flow diversions for municipal supply generally occur at the farthest downstream production wells and progress upstream in response to demand.

Cal-Am owns 12 wells and pumps approximately 70 percent of the water produced in the Seaside Groundwater Basin. Cal-Am also owns and operates the Ryan Ranch, Hidden Hills, and Bishop systems in the Laguna Seca Subarea. Cal-Am acquired these systems in 1990, 1993, and 1997, respectively. The Ryan Ranch and Hidden Hills Units have emergency interconnections with Cal-Am's main system. None of these smaller units are interconnected.

#### *Water Treatment Plants*

Cal-Am Monterey has one surface water treatment plant at Carmel which utilizes standard surface water treatment technology to treat surface water from the Los Padres and San Clemente Reservoirs.

#### *Distribution*

The distribution systems along the Highway 68 corridor are dependent on groundwater extraction. Surface water stored in the Los Padres and San Clemente Reservoirs is treated at the Carmel Valley Treatment Plant and delivered to customers through a gravity distribution system.

### System Storage

The Los Padres Reservoir is operated in conjunction with the San Clemente Reservoir and controls inflow into it. Los Padres, at RM 24 measured from the ocean, is currently estimated to have approximately 1,500 AF of usable storage, which is less than 2 percent of the annual runoff in the watershed. Usable storage at this location is projected to reach zero within 40 to 50 years at historic rates of sedimentation. San Clemente, at RM 18.6, is nearly full of silt and no longer has usable storage. Although there are facilities to divert and treat water at the San Clemente Dam, no diversions have occurred since May 2003 and DSOD has ordered Cal-Am to maintain a minimum pool in the reservoir that is below the spillway level in order to reduce the potential for failure during an earthquake.

Total known usable groundwater storage in the Region, including surface and groundwater, is estimated to be about 37,500 AF. This consists of an estimated maximum of about 6,200 AF in the Seaside Groundwater Basin with the remainder in the Carmel River Basin within the Carmel Valley Aquifer and at Los Padres Reservoir on the main stem of the Carmel River.

## System-wide Operation Strategy

Cal-Am utilizes surface storage reservoirs, the San Clemente and Los Padres Dams, to collect and store rainfall and surface water runoff for distribution. The Carmel River is an additional source of surface supply. Cal-Am must comply with strict production requirements under Order 95-10 under the authority of the Monterey Peninsula Water Management District. Order 95-10 governs Cal-Am's operations strategy, which is continuously monitored.

### Infrastructure Changes

Construction of the first phase of the ASR Project, which will divert up to 2,426 AF annually between December 1 and the following May 31, began in late 2006 with completion of all facilities scheduled for early 2008.

The Sand City desalination facility will provide 300 AFY. Following certification of the EIR for the project, the Sand City desalination facility was approved and is expected to be under construction in 2009.

## Energy Profiles

Cal-Am provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy data provided included: monthly TOU energy data. Daily production flows were provided for the Carmel Valley and Seaside wells in units of thousands of gallons. There was no production at the Ord Grove well for March and April 2008, which is the only facility with a filtration system. The energy intensity for filter plants is zero for March and April. Energy intensity values of groundwater pumping operations for January and December were outliers and were removed from the results table. These outliers resulted do to truncated and incomplete data for the beginning and end of the year.

Energy is provided to Cal-Am by PG&E. PG&E energy is used to supply all facilities in the Cal-Am Monterey District.

The energy intensity of each facility type within California American Water – Monterey District is presented in Figure 3.

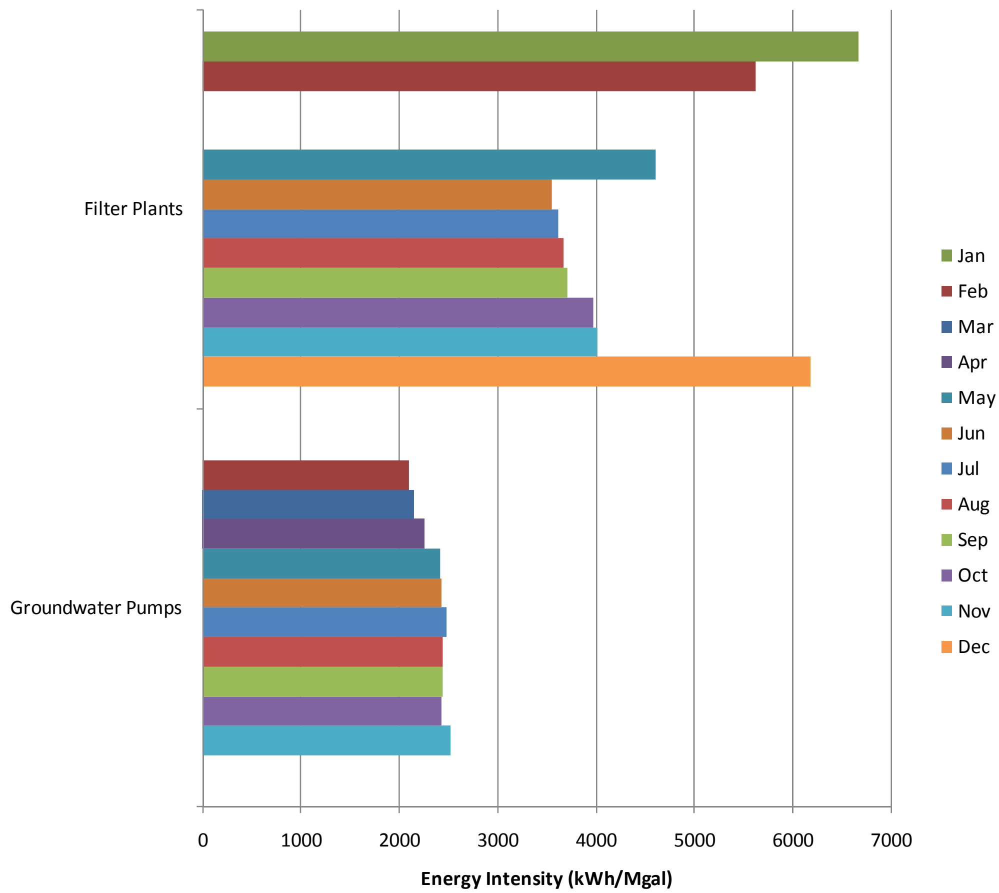
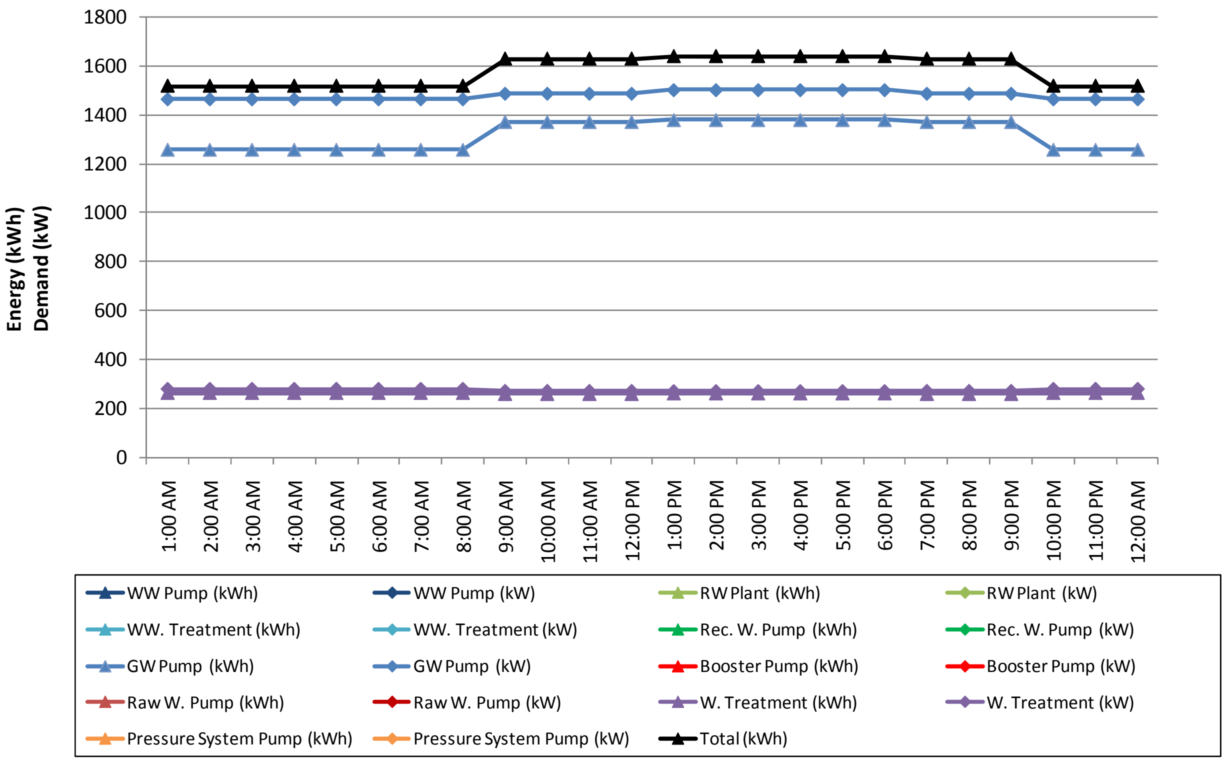


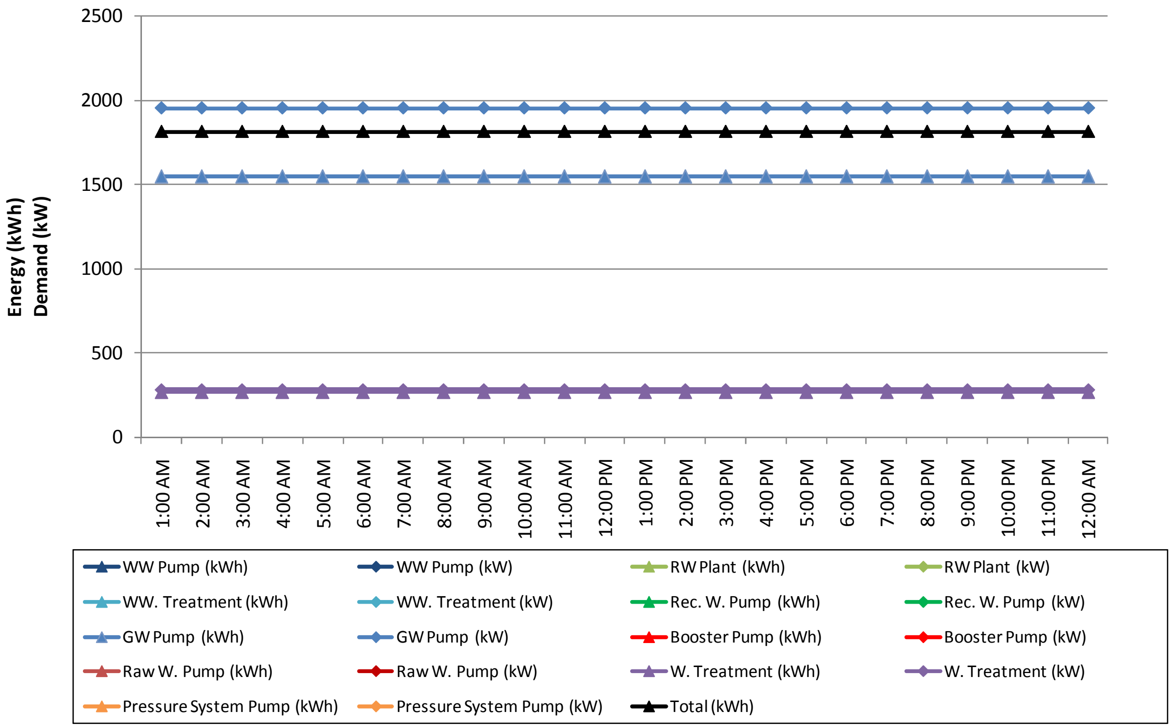

**Figure 3: Cal-Am Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by Cal-Am is for groundwater pumping.



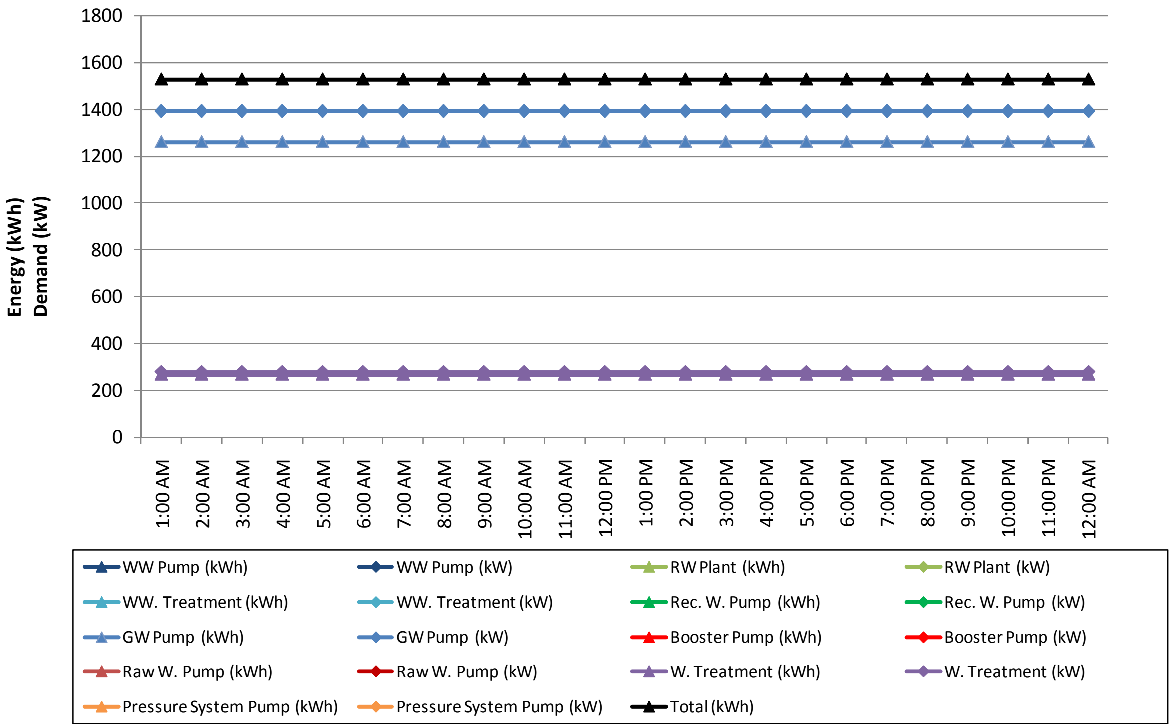

| | |
|---|---|
| **Date** | 7/8/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,380 |
| *Water Treatment* | 260 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



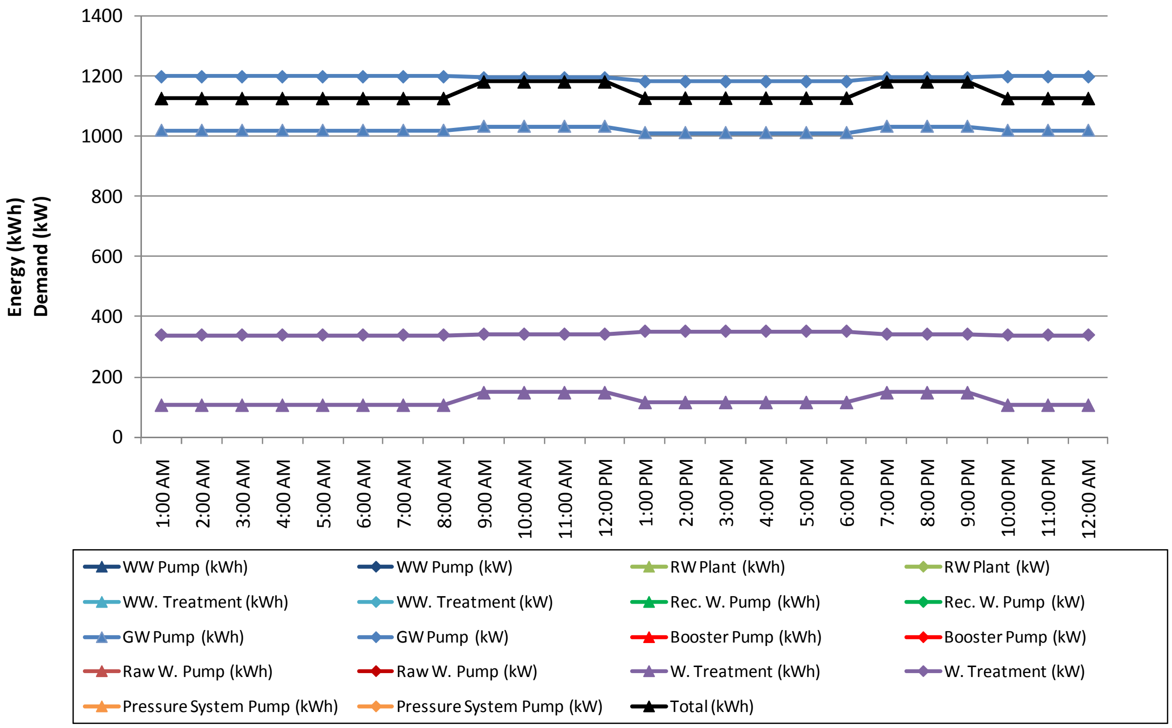

| | |
|---|---|
| **Date** | 9/7/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,548 |
| *Water Treatment* | 266 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



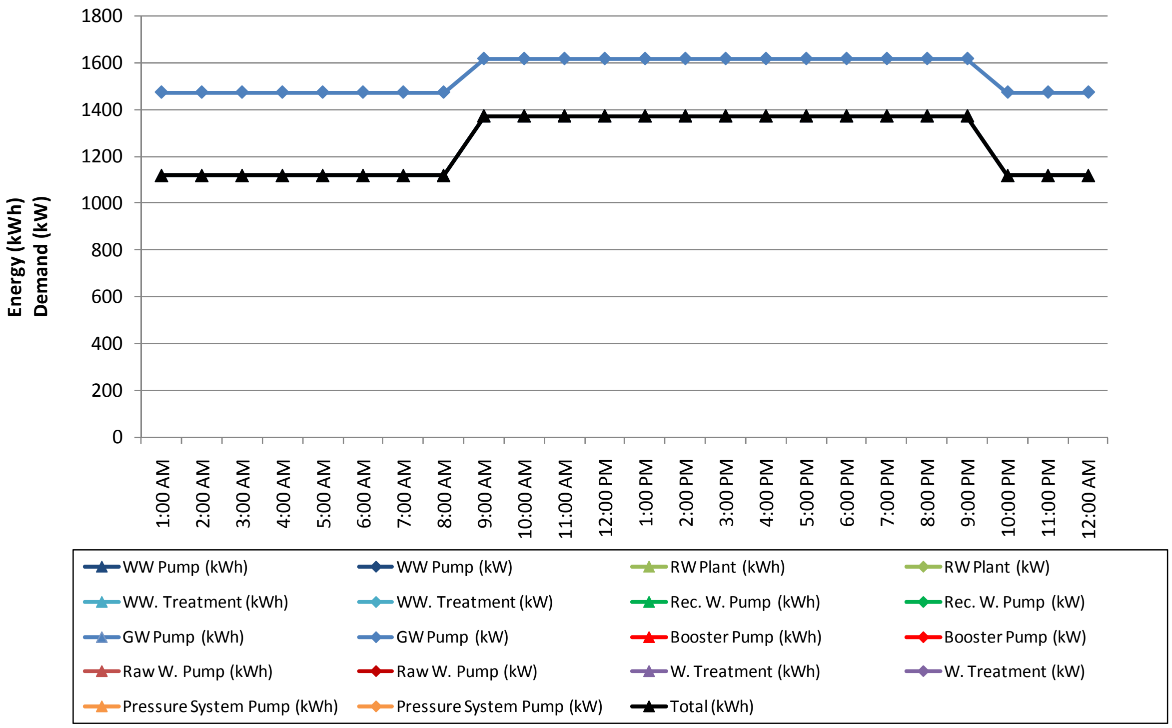

| | |
|---|---|
| **Date** | 9/28/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,261 |
| *Water Treatment* | 268 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



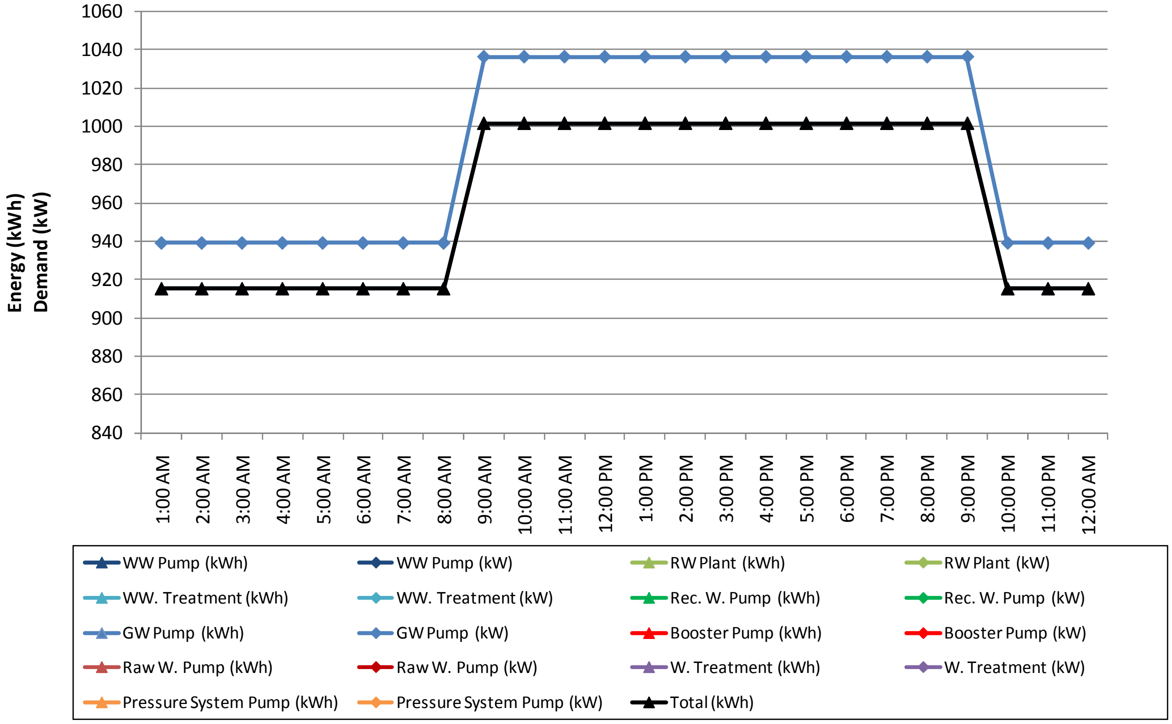

| | |
|---|---|
| **Date** | 10/31/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,011 |
| *Water Treatment* | 116 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



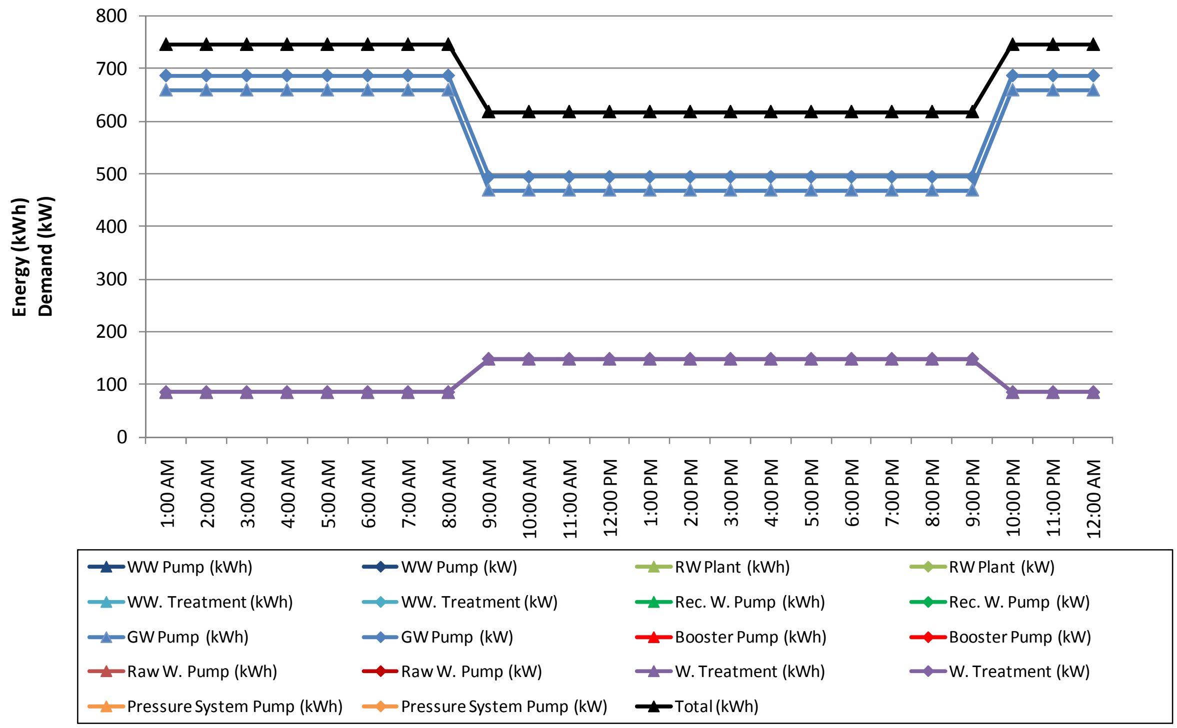

| | |
|---|---|
| **Date** | 4/23/2008 |
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,373 |
| *Water Treatment* | 0 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 1/21/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,002 |
| *Water Treatment* | 0 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 1/4/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 469 |
| *Water Treatment* | 148 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

Cal-Am Monterey continuously strives to meet conservation requirements and in doing so reduces energy consumption.

- Meter testing and calibration: production and customer meters are regularly tested, calibrated, and maintained.
- Leak Detection: Cal-Am Monterey has an official water loss control and leak detection program.
- Water pressure control: Cal-Am Monterey has worked on identifying areas where system pressures exceed 80 psi and plans to lower operating pressures in those areas where feasible.

## Sources

Monterey Peninsula Water Management District. "Monterey Peninsula, Carmel Bay, and South Monterey Bay Integrated Regional Water Management Plan." November 2007.

City of Monterey. http://www.monterey.org/climate.html. Accessed 1/5/2010.

California American Water – Monterey District. "Final Environmental Impact Report". CalAm Coastal Water Project. Published 10/30/2009.

CalAm Coastal Water Project Draft EIR, ESA 205335, January 2009

# Coachella Valley Water District (CVWD)

## Summary

| | | | |
|---|---|---|---|
| **Primary functions** | Urban Water, Agricultural Water, Urban Wastewater | | |
| **Segments of Water Use Cycle** | Supply, Distribution, Treatment | | |
| **Hydrologic Region** | Colorado River | **DEER Climate Zone** | 15 |
| **Quantity of Water and Wastewater (2004)** | Distributed: 110.2 MGD<br>Treated (Wastewater): 18.0 MGD | Recycled: 6.1 MGD | |
| **Number of Customers (2004)** | Total: 90,145<br>Residential: 82,682<br>Commercial: 3,094<br>Public: 207<br>Irrigation: 3,934<br>Temporary Construction: 228 | **Service Area Size** | 1,000 Sq miles |
| **Distinguishing Characteristics** | Coachella Valley Water District (CVWD) was formed in 1918, to protect and conserve local water sources. CVWD delivers irrigation and domestic water and collects and recycles wastewater. The Coachella Valley lies in the northwestern portion the Salton Trough, which extends from the Gulf of California in Mexico northwesterly to the Cabazon area. The Colorado River enters this trough, and its delta has formed a barrier between the Gulf of California and the Coachella Valley. | | |
| **Key Energy Drivers** | • Water Supply: significant energy is used for groundwater pumping<br>• Water Distribution: distribution topology is flat and therefore there is little energy required for distribution.<br>• Wastewater Treatment: significant energy is used for wastewater treatment | | |
| **Wastewater Treatment Technologies** | WRP-1 (Reclamation): Oxidation basin, stabilization basins, evaporation-infiltration basin<br>WRP-2 (Reclamation): Activated sludge, secondary treatment, oxidation treatment<br>WRP-4 (Reclamation): Preliminary treatment, chlorination/dechlorination<br>WRP-7 (Reclamation): Secondary treatment, tertiary treatment<br>WRP-9 (Reclamation): Secondary treatment<br>WRP-10 (Reclamation): Secondary treatment, tertiary treatment | | |
| **Water Resources (2004)** | Groundwater: 28.8%, Imported Water: 74.3%, Recycled: 4.3% | | |
| **Marginal Water Supplies** | Short-term: Groundwater<br>Long-term: Increased groundwater, SWP and CRA, and recycled water supplies, and new supplies from desalinated drain water. | | |
| **Energy Service Provider** | SCE, IID | | |
| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
| | Groundwater | 1,970 | 3,753 |
| | Wastewater Treatment | 923 | 1,437 |

## Background Information

CVWD was formed in 1918, specifically to protect and conserve local water sources. The district since has grown into a multi-faceted agency with more than 525 employees helping the district deliver irrigation and domestic (drinking) water, collect and recycle wastewater, provide regional storm water protection and promote water conservation. Table 1 summarizes information about CVWD.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water, Agricultural Water, Urban Wastewater |
| **Hydrologic Region** | Colorado River |
| **Region Type** | Desert |
| **Energy Service Provider** | IID |
| **DEER Climate Zone** | 15 |
| **Service Area Size** | 1,000 Sq miles |
| **Service Area Population (2005)** | 240,573 |
| **Number of Customers in 2004Error! Bookmark not defined.** | 90,145 |
| ***Residential*** | 82,682 |
| ***Commercial*** | 3,094 |
| ***Agricultural*** | 3,934 |
| ***Public*** | 207 |
| ***Temporary Construction*** | 228 |
| **Distribution Topology** | Flat |

Primary sources of information on Coachella Valley Water District include CVWD's 2005 Urban Water Management Plan and its public website. A detailed list of references is located at the end of this section.

### Climate

Nearly all of the Colorado River Region has a subtropical desert climate with hot summers and mostly mild winters, and the average annual rainfall is quite low. Average annual precipitation ranges from three to six inches, most of which occurs in the winter. Average rainfall is approximately 5.7 inches per year based on data from 1900 to 1995. However, summer storms do occur and can be significant in some years. Winter maximum temperatures are mild, but summer temperatures are very hot, with more than 100 days over 100° F each year in the Imperial Valley. The average 24-hour high temperatures reach over 100° F between July and September.

### Demographics

Population within the CVWD service area has grown steadily over the last 15 years and has increased significantly over the past five years. A booming housing market, supported by readily available and affordable land, low interest rates, and a healthy Southern California economy, has been the main driver in the recent population surge. In recent years, the Coachella Valley has set all-time records for housing starts with more than 8,000 new single family and multi-family housing starts in 2004 alone (WDL, 2004). The active expansion of the Coachella Valley economy and residential sector is likely to continue in future years. By 2030, the population within the greater Coachella Valley is expected to rise to nearly 675,000. This corresponds to a population increase of about 70 percent or 3 percent per year. Housing and employment are expected to following similar trends.

As described in Table 2, the population of the CVWD service area is projected to increase from 265,000 in 2005 to 440,000 by 2030. This population increase will result in a substantial increase in water deliveries. The number of accounts is estimated to increase from about 90,150 in 2004 to about 157,300 in year 2030. In addition to urban water use, CVWD serves approximately 60,000 acres of farmland with irrigation water.

**Table 2: Current and Projected Population and Water Accounts**

| Year | Single Family | Multi-Family | Commercial | Public | Irrigation | Temp. Construction | Total | Population |
|---|---|---|---|---|---|---|---|---|
| 2004 | 79,685 | 2,997 | 3,094 | 207 | 3,934 | 228 | **90,145** | - |
| 2005 | 84,943 | 3,154 | 3,286 | 219 | 4,258 | 228 | **96,087** | 264,869 |
| 2010 | 99,334 | 3,887 | 4,733 | 263 | 6,821 | 228 | **115,266** | 301,988 |
| 2015 | 111,489 | 4,117 | 6,258 | 225 | 7,869 | 228 | **130,186** | 327,701 |
| 2020 | 121,876 | 4,319 | 7,206 | 282 | 8,304 | 228 | **142,215** | 367,852 |
| 2025 | 129,348 | 4,485 | 8,133 | 339 | 8,669 | 228 | **151,203** | 405,125 |
| 2030 | 134,205 | 4,596 | 8,910 | 368 | 9,005 | 228 | **157,313** | 440,112 |

## Water Sources

Domestic water is delivered to more than 102,000 customers. The valley's drinking water comes from a vast underground aquifer. This water is nearly pristine and requires little treatment to meet all the state and federal water quality standards. Figure 1 illustrates the different sources of water used by CVWD.

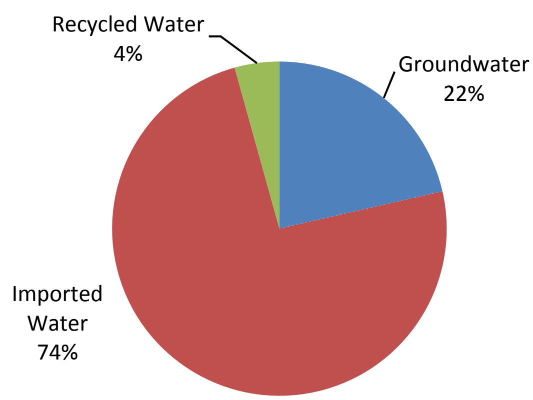



**Figure 1: 2004 Distribution of Sources**

### Groundwater

CVWD obtains water from both the upper and lower Whitewater River subbasins and the Mission Creek subbasin. A common groundwater source, the Whitewater River subbasin, is shared by CVWD, Desert Water Agency (DWA), the cities of Indio and Coachella, and numerous private groundwater producers. The Mission Creek subbasin is a common supply that is utilized by CVWD, Mission Springs Water District and private groundwater producers. Both CVWD and DWA have the legal authority to manage the groundwater basins within their respective service areas. Subject to certain legal requirements, each agency may utilize an assessment on groundwater pumping to finance the acquisition of imported and recycled water supplies and to recharge the groundwater basins.

Groundwater production in the upper Whitewater River subbasin is principally characterized by municipal pumping by DWA and CVWD for domestic water supply and private pumping for golf course and recreational irrigation. CVWD currently accounts for about 45 percent of the pumping from this subbasin. Production in the lower Whitewater River subbasin is characterized by municipal pumping by CVWD, the cities of Indio and Coachella and the Myoma Dunes Mutual Water Company, agricultural pumping for crop irrigation and fish farming, and golf course irrigation. CVWD currently accounts for about 16 percent of the pumping from this subbasin. Production in the Mission Creek sub-basin is characterized by municipal pumping by CVWD and Mission Springs Water District, golf course irrigation and agricultural pumping for fish farming. CVWD currently accounts for about 20 percent of the pumping from this subbasin.

### Local Raw Surface Water

CVWD does not derive any of its direct supply from surface water; however, local runoff from the Whitewater River Canyon is diverted near Windy Point to the Whitewater Spreading Facility for groundwater recharge.

### Recycled Water

CVWD owns and operates a total of six water reclamation plants (WRPs) with a total capacity of 30.63 MGD. WRP-7, WRP-9, and WRP-10, generate reclaimed water for golf courses, large landscape areas and groundwater recharge. The other WRP's include: WRP-1, WRP-2, and WRP-4. Flows from the western part of CVWD are generally directed to WRP-9 and WRP-10. The primary uses of recycled water are for groundwater basin recharge and landscape watering (golf courses and greenbelt areas). Currently, CVWD produces about 6,900 AF/yr of recycled water for irrigation use and approximately 2,000 AF/yr for in-plant water use. In addition to these users, CVWD delivers Coachella Canal water to a number of golf courses in the Lower Valley.

### Imported water

CVWD has access to two sources of imported water – Colorado River water from the Coachella Canal and SWP water that is exchanged with Metropolitan for Colorado River water.  Almost all of the farmland in the area is irrigated with Colorado River water delivered by the Coachella Canal.

#### *The Colorado River and the Coachella Canal*

The Coachella Canal is a branch of the All American Canal that brings Colorado River water into the Imperial and Coachella Valleys. The Quantitative Settlement Agreement (QSA) specifically defined the Colorado River water allocation of CVWD. CVWD's base allocation is 330,000 AF/yr. This allocation will increase to 459,000 AF/yr by 2033 as a result of a 103,000 AF/yr water transfer from IID to CVWD, a 35,000 AF/yr transfer of SWP water from Metropolitan to CVWD, and a 20,000 AF/yr allocation of conserved water from Metropolitan to CVWD. CVWD provides 26,000 AF/yr from lining the Coachella Canal to Metropolitan and 3,000 AF/yr to settle claims of present perfected rights by Colorado River Indian tribes and other uses.

#### *State Water Project (SWP)*

To recharge groundwater supplies, CVWD and DWA obtain imported water supplies from the SWP, which is managed by the DWR. CVWD and DWA do not directly receive SWP water. Instead, their SWP water is delivered to Metropolitan Water District (MWD) pursuant to the Exchange Agreement. MWD, in turn, delivers an equal amount of Colorado River water from the Colorado River Aqueduct to CVWD and DWA at the Whitewater River.

A portion of the water delivered has been banked by Metropolitan for future use under the Advance Delivery agreement. However, until the banked water is needed, CVWD and DWA benefit by higher water levels and lower pumping costs. The recharge program, which has been monitored, modeled, and studied by the U.S. Geological Survey and CVWD, has helped to balance the inflow and outflow of groundwater from the upper Whitewater River subbasin.

In 1996, CVWD and DWA recognized the need for additional imported water in order to eliminate groundwater overdraft. Since then, the two districts have purchased additional Pool A, Pool B, and interruptible water from the SWP resulting in average additional deliveries of 41,200 AF/yr. These additional supplies are not expected to be available in the future and cannot be relied upon to provide a reliable long-term source of water to the Coachella Valley. In 2004, SWP exchange water purchases used for recharge in the Upper Valley totaled 46,215 AF/yr, of which about 18,000 AF/yr was carried over to 2005. Only 191 AF/yr of water was purchased from the SWP Turn-back Pool in 2004.

## Marginal Water Supply

The Study Team indentified both short and long-term marginal supplies for CVWD. Short-term marginal supply consists of groundwater. Because of the significant amount of groundwater in storage, both natural and imported, CVWD does not anticipate any significant short-term, drought or emergency water supply deficiencies. Long-term marginal supply includes water from the Quantification Settlement Agreement, exchanges and transfers, recycled water and desalinated agricultural drainage water.

### *Quantification Settlement Agreement (QSA)*

On October 10, 2003, a landmark agreement was signed between CVWD, IID, San Diego County Water Authority, Metropolitan, the State of California and the U.S. Department of the Interior to quantify water distribution allotments of Colorado River water in California. The agreement further provides additional Colorado River water to CVWD from shares of IID and Metropolitan. The total ultimately available to CVWD would be up to 459, 000 AF/yr during the lifetime of the agreement known as QSA. Under the QSA, CVWD's share of Colorado River water is a reliable supply rather than one that could be at risk.

### *Metropolitan 100,000 AF/yr Water Transfer – 2003 Exchange Agreement*

Under the 2003 Exchange Agreement, CVWD and DWA acquired 100,000 AFY of Metropolitan's State Water Project Table A water as a permanent transfer. The water would be exchanged for Colorado River water and either recharged at the existing Whitewater River Spreading Basins or delivered via the Coachella Canal for irrigation purposes in the Palm Desert-Rancho Mirage area of the Upper Valley. The transferred water may also be subtracted from Metropolitan's Advance Storage account.

Short-term operating criteria are established that cover the years 2005 through 2009. These criteria specify that Metropolitan will deliver no less than 17,000 AF/yr of water if SWP allocations are at least 50 percent of the Table A amounts. If the allocation is less than 50 percent, Metropolitan is required to make up the difference in this five-year period. The parties also agreed to develop long-term operating criteria. The 2003 Exchange Agreement also established the maximum amount of total exchange water delivery at 216,000 AF/yr if Metropolitan does not exercise its call-back option. The maximum exchange delivery is reduced to 165,000 AF/yr if Metropolitan makes a call-back.

### *Berrenda Mesa Water Transfer*

The Berrenda Mesa Water Transfer involves the transfer of 16,000 AF/yr of unused SWP Table A Water from Berrenda Mesa Water District (BMWD) and provisions for a permanent water supply to CVWD and DWA. BMWD is a subagency of Kern County Water Agency (KCWA). KCWA is a SWP contractor that wholesales and distributes water to thirteen local water districts. Upon completion of this transfer, CVWD's SWP Table A amount would be increased from 121,100 to 133,100 AF/yr and DWA's Table A amount from 50,000 to 54,000 AF/yr. The transfer is to be effective beginning in 2010.

## Recycled Water

Water is recycled from the WRP-7, WRP-9 and WRP-10 facilities for non-potable irrigation. WRP-4 effluent is anticipated to be reused beginning in 2010 as recommended in the CVWMP.

Both CVWD and DWA will continue to encourage recycled water use to the maximum extent practical. Municipal recycled water use in the Upper Valley is projected to increase from 8,900 acre-ft in 2004 to 20,000 acre-ft in 2015 and to 22,500 acre-ft by 2030.

CVWD is currently planning a significant expansion of its non-potable water system with the Mid-Valley Pipeline project. This project will deliver a blend of Canal and recycled water from WRP-10 allowing CVWD to meet its goals of reducing pumping by golf courses in the Rancho Mirage-Palm Desert-Indian Wells area. Planning studies have identified 50,200 AF/yr of golf course demand plus a 10 percent allowance for smaller irrigation users. Phase 1 of the project would serve the eight existing golf courses that use recycled water plus three additional nearby courses. This phase could be operational in mid-2008. The second phase would expand the distribution system to serve 12 additional courses by late 2009. Future phases would further extend the system to serve 28 more golf courses. When this project is complete, groundwater overdraft in the Mid-Valley area will be significantly reduced.

### *Desalinated Agricultural Drain Water*

In 2005, CVWD received a state grant to research effective ways to desalinate drainage. In the future the district intends to use up to 11,000 acre-feet of treated drainage for outdoor irrigation annually. The CVWMP envisions that up to 11,000 AF/yr of agricultural drain water will be desalted to a quality equivalent to Canal water and delivered for irrigation use by 2023. Delivery of this water would begin in 2008 at a rate of about 4,000 AF/yr and reaches 11,000 AF/yr in approximately fifteen years.

The energy intensity range of CVWD's marginal supply is summarized in Table 3. The energy intensity represents the embedded energy for all activities prior to the water reaching CVWD's customers.

**Table 3: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Groundwater[a] | 1,970-3,753 kWh/MG |
| Long-term | Groundwater[a] | 1,970-3,753 kWh/MG |
| | CRA Water[b] | ~ 6,064 kWh/MG |
| | MWD Exchange[c] | ~ 7,377 kWh/MG |
| | SWP Water[d] | ~ 9,560 kWh/MG |
| | Desalinated Ag. Water[e] | 3,819-3,945 kWh/MG |
| | Recycled Water[f] | 923-1,437 kWh/MG |

a) EI range from Study 2 results for CVWD.
b) Cumulative EI from Study 1 for CRA water.
c) Cumulative EI from Study 1 for MWD raw water.
d) Cumulative EI from Study 1 for SWP water (east branch).
e) Brackish water desalination EI range from IEUA data from Study 2.
f) EI range from Study 2 results for CVWD wastewater treatment.

## Water Demand

As described in Table 4, the number of CVWD accounts is estimated to increase from about 90,150 in 2004 to about 157,300 in year 2030. This increase will result in a substantial increase in water deliveries. As shown in Table 5, the total water consumption is projected to increase from about 123,500 acre-ft/year in 2004 to 213,400 acre-ft/year in 2030. This equates to a water demand increase of 73 percent.

### Table 4: Historic and Projected Number of Customers by Type

| Customer Type | 2004 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Residential | 82,682 | 88,097 | 103,221 | 115,606 | 126,195 | 133,833 | 138,801 |
| Commercial | 3,094 | 3,286 | 4,733 | 6,258 | 7,206 | 8,133 | 8,910 |
| Public | 207 | 219 | 263 | 225 | 282 | 339 | 368 |
| Irrigation | 3,934 | 4,258 | 6,821 | 7,869 | 8,304 | 8,669 | 9,005 |
| Temporary Construction | 228 | 228 | 228 | 228 | 228 | 228 | 228 |
| **Total** | **90,145** | **96,087** | **115,266** | **130,186** | **142,215** | **151,203** | **157,313** |

### Table 5: Historic and Projected Domestic Water Demand (AF/Yr)

| Customer Type | 2004 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Residential | 77,682 | 81,237 | 97,986 | 112,805 | 125,477 | 134,899 | 141,827 |
| Commercial | 6,821 | 6,036 | 9,121 | 12,456 | 14,620 | 16,746 | 18,381 |
| Public | 1,072 | 1,010 | 1,278 | 1,208 | 1,500 | 1,796 | 1,981 |
| Irrigation | 34,452 | 38,500 | 41,970 | 44,177 | 45,576 | 46,783 | 47,762 |
| Temporary Construction | 3,460 | 3,460 | 3,460 | 3,460 | 3,460 | 3,460 | 3,460 |
| **Total** | **123,487** | **130,243** | **153,814** | **174,106** | **190,633** | **203,685** | **213,410** |

Table 6 presents the total projected water uses for the CVWD service area for the period 2005 through 2030. Passive water conservation is conservation, which is accomplished by customers upgrading their plumbing, water fixtures and water using appliances without incentives from their water provider. Active water conservation is defined as reduction in water used due to a direct incentive program being implemented by CVWD. Net consumption is consumption including savings from passive conservation and active conservation. The subtotal-domestic includes net consumption and water loss. Groundwater recharge is excluded from the total demand because groundwater recharge becomes a portion of the supply used to meet domestic and non-potable demands.

According to Coachella Valley Water District estimates, the number of customers is expected to grow 36.5 percent from 2010 to 2030 increasing water demand by 38.7 percent. The majority of the increase in demand occurs from the Residential sector.

### Table 6: Total Projected Water Demand with Conservation (AF/Yr)

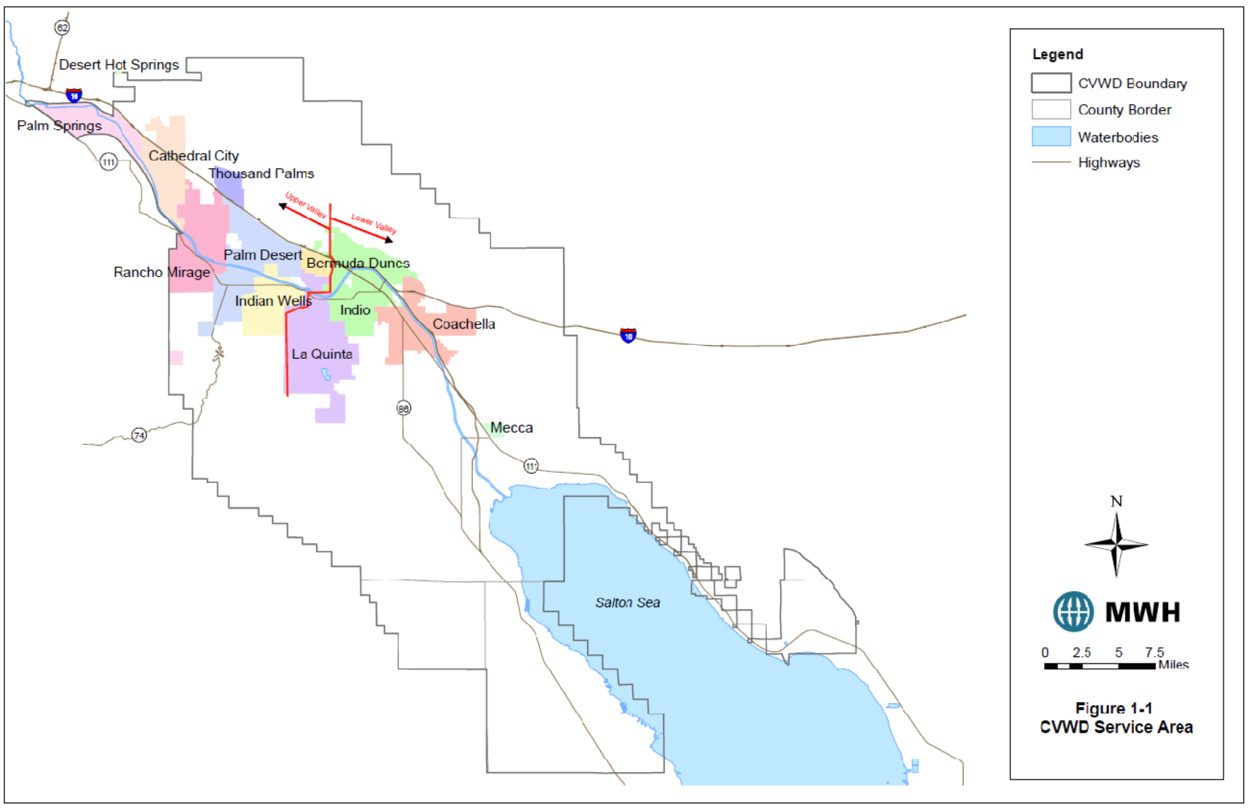
| Usage | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| **Domestic Water Demand** | | | | | | |
| Consumption | 130,243 | 153,814 | 174,106 | 190,633 | 203,685 | 213,410 |
| Additional Passive Conservation | -625 | -734 | -836 | -930 | -1,018 | -1,101 |
| Active Conservation | 0 | -454 | -907 | -1,334 | -1,736 | -2,109 |
| Net Consumption | 129,618 | 152,626 | 172,363 | 188,369 | 200,931 | 210,200 |
| Water Loss | 12,748 | 15,055 | 17,041 | 18,659 | 19,936 | 20,888 |
| *Subtotal - Domestic* | *142,366* | *167,681* | *189,404* | *207,028* | *220,867* | *231,088* |
| **Non-potable Water Demand** | **310,000** | **350,700** | **381,100** | **381,700** | **404,700** | **413,200** |
| **Total Water Demand** | **452,366** | **518,381** | **570,504** | **588,728** | **625,567** | **644,288** |
| **Groundwater Recharge** | **154,300** | **156,800** | **160,400** | **187,100** | **199,500** | **201,400** |

## System Infrastructure and Operations

The water-related services provided by CVWD to most of the Coachella Valley include irrigation water delivery and conservation, domestic water delivery and conservation, wastewater reclamation and recycling, storm water protection, agricultural drainage, water education, and groundwater recharge. Table 7 summarizes the key pieces of the physical infrastructure of the District's system (Figure 2).

### Table 7: Infrastructure Summary

| | |
|---|---|
| **Number of Groundwater Wells** | 144 |
| ***Active*** | 107 |
| ***Inactive*** | 37 |
| **Number of Reservoirs Operated** | 69 |
| **Miles of Distribution Piping** | 1,872 |
| **Number of Plants** | |
| ***Recycled Water*** | 6 |




### Figure 2: CVWD Service Area

## Sub-Regions within Agency

CVWD's infrastructure divided into different sub-regions: Domestic Water System, Non-Potable Water System, Wastewater Reclamation and Recycling System, and Groundwater Recharge.

### Sub-Region 1: Domestic Water System

#### *Supply and Distribution*

Water from the aquifer is nearly pristine, ready to drink "as is," but is subjected to tests to ensure it meets all state and federal drinking water standards. Groundwater is pumped and exported from the Coachella Valley to meet water demands in areas within the CVWD where a supply of potable groundwater is not readily available. CVWD has a number of generators that can be used to operate wells and booster stations in case of power failure.

CVWD provides domestic water for over 240,000 Coachella Valley residents (CVWD, 2005a). The distribution system includes 69 reservoirs, over 1,872 miles of pipelines, and 117 domestic wells.

CVWD's domestic water distribution system is nearly 1,900 miles in length. Replacement of worn or outdated pipes and other facilities is an on-going process.

Most of CVWD's pressure zones are served by steel reservoirs located at higher elevations. Several of the reservoirs are equipped with automatic valves that close during a seismic event, thereby preserving the stored water. Likewise, most of the pressure zones have ties to other zones, which permit CVWD to transfer water to any zone that may suffer deficiencies. CVWD has portable pumps and temporary above ground pipe is available to allow water service to be provided should earthquakes damage portions of the system.

### Sub-Region 2: Non-Potable Water System

#### *Conveyance*

Water delivered to the Coachella Valley is diverted from the Imperial Dam 18 miles upstream from Yuma, Arizona into the All-American Canal. Coachella's supply is then diverted into the 122-mile-long Coachella branch, which extends from near the Mexican border northwestward to Lake Cahuilla near La Quinta. This lake, which is at the terminus of the Coachella Canal, serves as a storage reservoir to regulate irrigation water demands and provides opportunity for recreation. The capacity of the Coachella Canal is approximately 1,500 cfs.

#### *Distribution*

CVWD's Colorado River irrigation distribution includes a pipeline distribution system, a pipeline drainage system, and metered deliveries to every farm. Of the Colorado River water reaching the Coachella Valley, 98.5 percent (or approximately 300,000 AF/yr) is delivered to farmers. Several water conservation and management activities are incorporated into CVWD's irrigation distribution system:

- A network of nearly 500 miles of distribution system consists entirely of buried pipeline to eliminate seepage and evaporation losses.
- CVWD drains are mostly buried, perforated pipelines that require water to penetrate the soil for collection.

### Sub-Region 3: Wastewater Reclamation and Recycling System

#### *Conveyance*

CVWD has typically recovered as much wastewater effluent as possible through the use of percolation basins to return the water to the groundwater basin.

The existing WRPs allow CVWD to provide sanitation service to most of the areas that it serves with domestic water. The remaining areas are on septic systems.

### *Wastewater and Recycled Water Treatment Plants*

CVWD owns and operates a total of six WRP's with a total capacity of 30.63 MGD. WRP-7, WRP-9, and WRP-10, generate reclaimed water for golf courses, large landscape areas and groundwater recharge. The other WRP's include: WRP-1, WRP-2, and WRP-4. Flows from the western part of CVWD are generally directed to WRP-9 and WRP-10. A summary of location and capacity of the treatment plants is listed in Table 8.

**Table 8: CVWD WRP Location and Capacity**

| Plant | Location | Secondary Treatment Capacity (MGD) | Tertiary Treatment Capacity (MGD) |
|---|---|---|---|
| WRP-1 | Bombay Beach | 0.15 | 0.0 |
| WRP-2 | North Shore | 0.033 | 0.0 |
| WRP-4 | Thermal | 7.0 | 0.0 |
| WRP-7 | Indio Hills | 5.0 | 2.5 |
| WRP-9 | Palm Desert Country Club | 0.40 | 0.0 |
| WRP-10 | City of Palm Desert | 18.0 | 15.0 |
| **Total** | | **30.583** | **17.5** |

***WRP-1***

WRP-1 serves the Bombay Beach community near the Salton Sea. WRP-1 has a design capacity of 150,000 gallons per day (gpd) and consists of two mechanically-aerated concrete-lined oxidation basins, two unlined stabilization basins, and six evaporation-infiltration basins. WRP-1 currently receives an average of 40,000 gpd of domestic sewage, and final disposal of treated secondary effluent is by evaporation and/or infiltration.

***WRP-2***

WRP-2 serves the nearby North Shore community housing. WRP-2 has two types of treatment facilities: an activated sludge treatment plant capable of providing secondary treatment to a maximum of 180,000 gpd, and an oxidation treatment basin having a design treatment capacity of 33,000 gpd. The oxidation treatment basin is mechanically aerated and is lined with a single synthetic liner. The activated sludge treatment plant is used only when the maximum daily flow exceeds 33,000 gpd, otherwise the oxidation basin is used for treatment. WRP-2 is currently discharging an average of 18,000 gpd of treated secondary effluent into four evaporation-infiltration basins for final disposal.

***WRP-4***

WRP-4 is a 7.0 MGD treatment facility located in Thermal. WRP-4 provides preliminary treatment at headworks facilities consisting of two pre-aeration ponds, screens, a conveyor, a washer/compactor, a headworks building, and an odor control system. There are 16 aeration lagoons, 8 polishing ponds, and chlorination/dechlorination process units. After treatment, the effluent is chlorinated using chlorine gas and dechlorinated using sulfur dioxide solution prior to discharge to the CVSC via an outfall pipe under a National Pollution Discharge Elimination System (NPDES) permit. Biosolids is transported by truck from the facility for composting and beneficial reuse purposes. The annual average flow to the facility is approximately 4.75 MGD.

***WRP-7***

WRP-7 is located in north Indio on Avenue 38 at Madison Street. The plant is a 5.0 MGD secondary treatment facility with a current tertiary treatment capacity of 2.5 MGD. The tertiary treated wastewater is used for irrigation of greenbelt areas and golf courses in the Sun City area. The current average flow from primary residential sources is 2.11 MGD. The plant consists of two extended aeration basins and two circular clarifiers. Six polishing ponds follow the clarifiers in the treatment process. Biosolids from the belt press and solids removed from the bottoms of the ponds are transported by truck off-site for composting and use as fertilizer. Recycled water that is not used for irrigation is percolated at on-site and off-site ponds. A 5 MGD expansion of the tertiary treatment system is presently under designed. When the expanded tertiary treatment system is constructed, the plant will have a total of 7.5 MGD of tertiary treatment capacity.

***WRP-9***

WRP-9 is located at 77-400 Fred Waring Drive in Palm Desert. This 0.40 MGD secondary treatment facility is planned for decommissioning within the next 3 years. Flows previously treated at this plant will be redirected to WRP-10. WRP-9 treats approximately 0.33 million gallons a day of wastewater from the residential development surrounding the Palm Desert Country Club.

The WRP consists of the following treatment units: A grit chamber, two secondary clarifiers, one chlorine contact chamber, and one aerobic digester, and two infiltration basins. One basin is lined for storage of treated wastewater. Raw wastewater in excess of the design capacity does enter this facility during peak flows. However, this excess influent is pumped WRP-10.

***WRP-10***

WRP-10 is located at 43-000 Cook Street, Palm Desert. WRP-10 consists of an activated sludge treatment plant, a tertiary wastewater treatment plant, a lined holding basin, six storage basins, and 21 infiltration basins.

The combined secondary wastewater treatment design capacity of the WRP is 18 MGD. The secondary treatment plant consists of three mechanical bar screens, one aerated grit chamber, one vortex type grit chamber, 16 aeration basins, and 14 secondary clarifiers. The tertiary filters are rated for 15 <GD. Secondary sludge is pumped to the solids handling facility for thickening and dewatering.

WRP-10 treats an annual average daily flow of 10.8 MGD from the activated sludge plant. Just less than fifty percent of this plant's effluent receives tertiary treatment for reuse and is delivered to customers through an existing recycled water distribution system. The remaining secondary effluent is piped to a holding basin and/or the six storage basins, and then to the 21 infiltration basins for final disposal.

## Sub-Region 4: Groundwater Recharge

### *Conveyance*

With no pipeline in place to deliver SWP water to the Coachella Valley, the two local agencies worked out an agreement with Metropolitan to trade, on an acre-foot-for-acre-foot basis, CVWD's and DWA's SWP water for an equal amount of Metropolitan's Colorado River water. Metropolitan's Colorado River

Aqueduct (CRA) is tapped where it crosses the Whitewater River, and the exchange water is diverted to a series of 19 CVWD ponds, where it percolates to replenish the groundwater basin.

The Colorado River Aqueduct conveys river water from Lake Havasu to Lake Mathews in western Riverside County. Construction of the aqueduct was completed in 1941. The facility consists of 242 miles of canals, pipelines and tunnels along with five pumping stations that lift Colorado River water over 1,600 feet. The aqueduct has a capacity of 1,800 cfs or 1.3 million AF/yr. This aqueduct passes along the easterly side of CVWD and crosses the Whitewater River channel north of Palm Springs. The proximity of the aqueduct to the Coachella Valley made it a logical choice for delivering imported water to the valley.

### System Storage

The Coachella Valley Groundwater Basin has a total storage capacity of 39,200,000 AF.

## System-wide Operation Strategy

CVWD's primary operation strategy is conservation. CVWD has secure rights to all unclaimed Whitewater River water, an important source for aquifer recharge. CVWD also has property in an area west of Palm Springs, Windy Point, for use it's in groundwater replenishment and captures fast-moving floodwaters during storms for groundwater replenishment. Facilities divert storm water, natural runoff from nearby mountains and water released from the Colorado Aqueduct into the riverbed.
The current program has fed 585 billion gallons of water back into the aquifer. In addition to protecting local water from outside threats, CVWD sought to prevent a crisis within. The district used its authority to require artesian-flowing wells be capped to prevent waste. The 122-mile Coachella Canal is the conduit providing imported water to the region.

With a rapid increase in well pumping, CVWD leadership realized groundwater management alone would not be enough to ensure continued, adequate supplies of irrigation water for the region.
The district aggressively lobbied federal officials for inclusion in increased delivery of Colorado River water into California. As a result, in 1919, CVWD's directors approved contracts with Washington, D.C., for importation of Colorado River water into Coachella Valley for farm irrigation.

### Infrastructure Changes

The Dike 4 Groundwater Recharge Facility, which began operation on August 22, 2008, will replenish 40,000 acre-feet annually into the eastern Coachella Valley's aquifer. This amount of water is equal to what is used each year by about 85,000 residents and will alleviate the overdraft of groundwater supplies throughout the eastern valley.

Phase II of the Highway 86 Pipeline project was expected to be completed ahead of schedule in November of 2008. Phase II of the project installs a 30-inch diameter domestic water pipeline serving the Thermal community.

The Mid-Valley Pipeline will deliver water from the Coachella Canal to CVWD's Wastewater Reclamation Plant (WRP) in Palm Desert. There, it will be blended with recycled water and eventually sent to approximately 50 golf courses in Palm Desert, Rancho Mirage and Indian Wells for irrigation. Without this project, the WRP lacks the water supply and infrastructure to expand beyond the existing 12 golf courses. The project started in 2007 and Phase II was scheduled to start in 2009.

## Energy Profiles

CVWD provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy data provided included: monthly energy data from SCE and monthly energy data from IID. Water flow data was provided per well on a monthly basis in units of gallons. Energy data was provided in spreadsheet format and water data was provided as a scanned paper copy of data. SCE provides energy for facilities located in Cathedral City, Palm Springs, and Whitewater. IID provides energy for facilities located in Bard, Bombay Beach, Cactus City, Calipatria, Citrus, Coachella, Indio, Indio Hills, La Quinta, Mecca, Niland, North Shore, Oasis, Riverside County, Salton City, Sun City, Thermal, and Thousand Palms. CVWD facilities located in the cities of Desert Hot Springs, Indian Wells, Palm Desert, and Rancho Mirage receive energy from either IID or SCE. WRPs 1, 2, 4, and 7 receive IID energy and WRPs 9 and 10 receive energy from SCE.

The GW pump stations pressurize the water to the required amount, removing the need for booster pumps.

The energy intensity of each facility type within Coachella Valley Water District is presented in Figure 3.

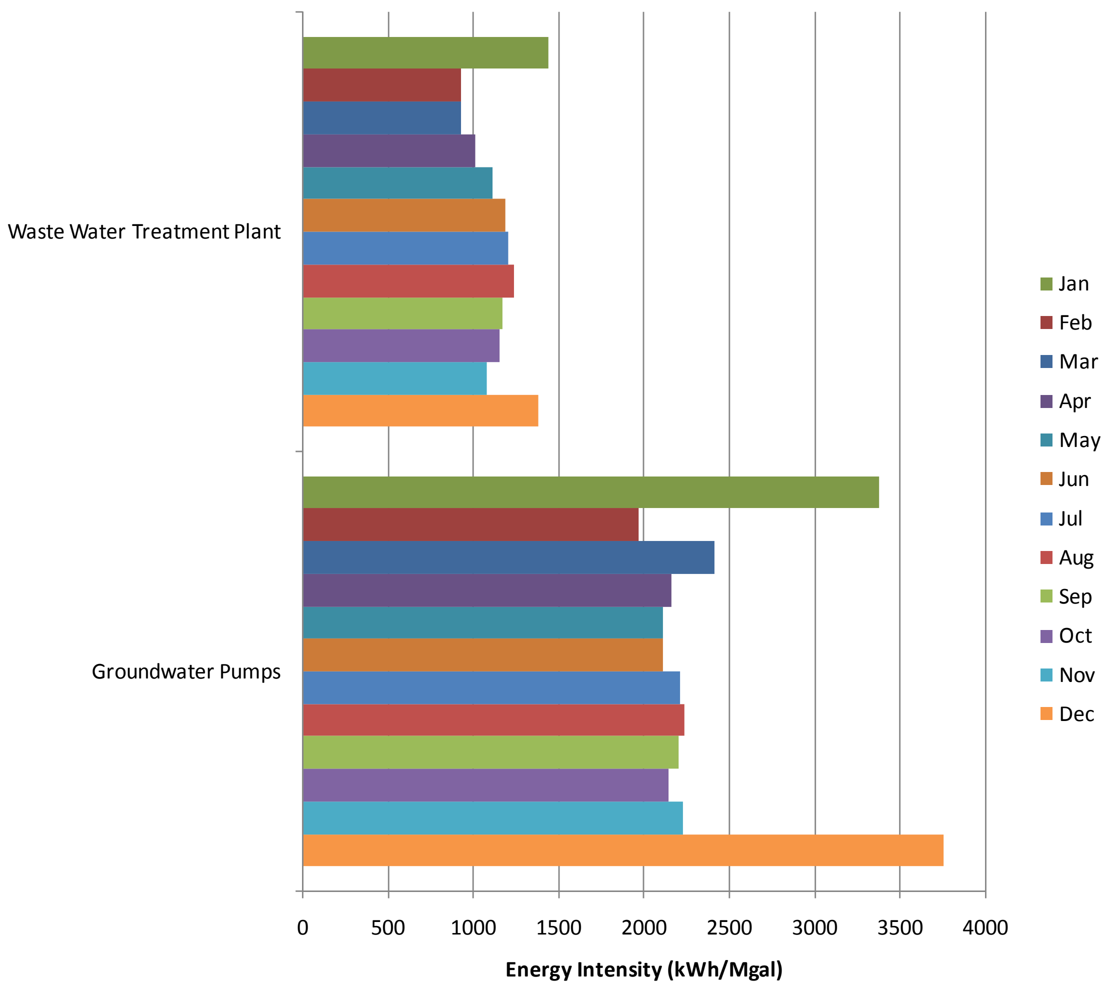
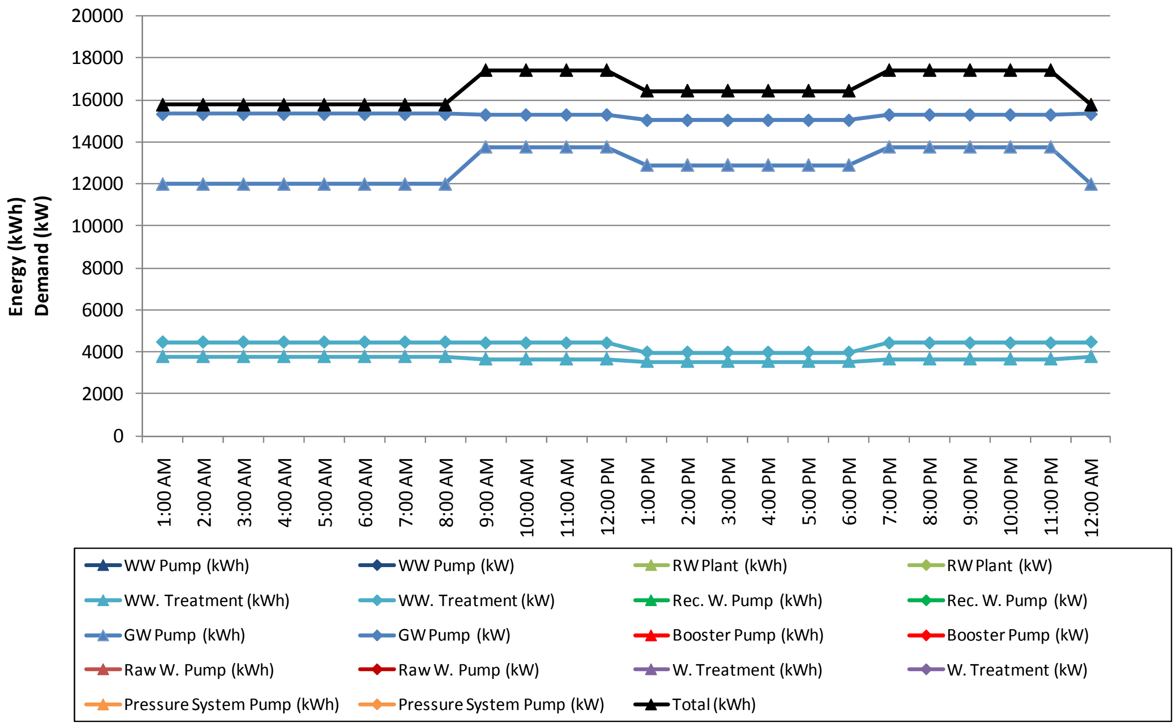


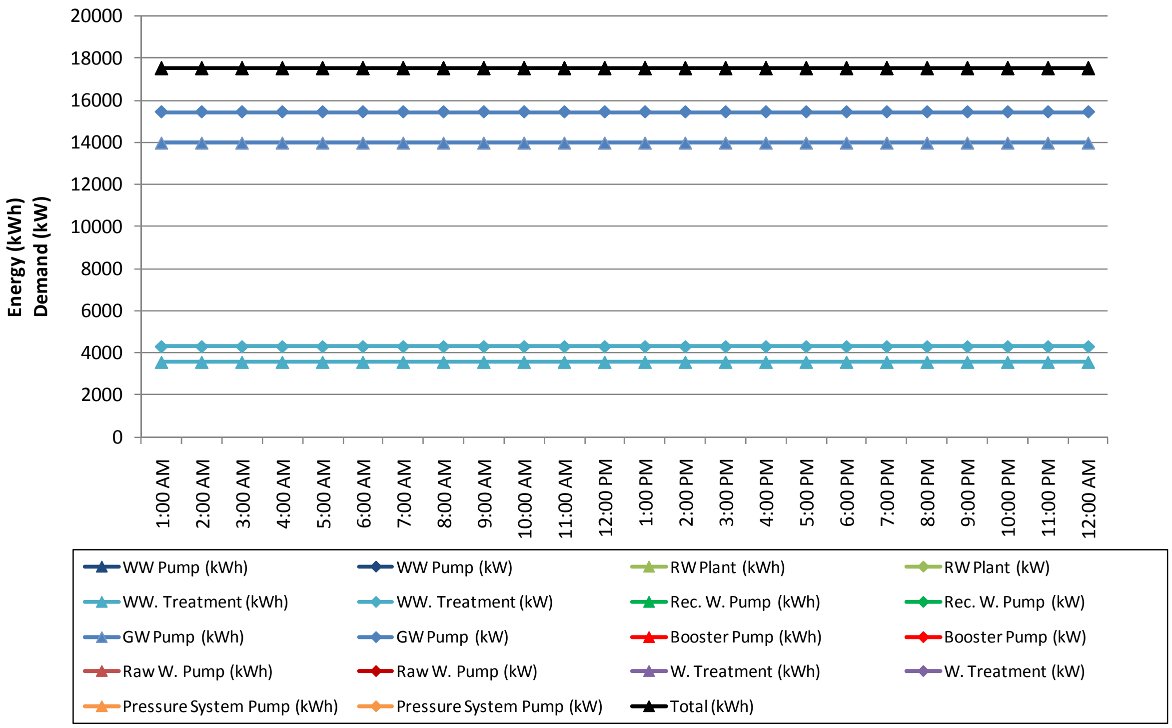

**Figure 3: CVWD Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by Coachella Valley Water District is for groundwater pumping.



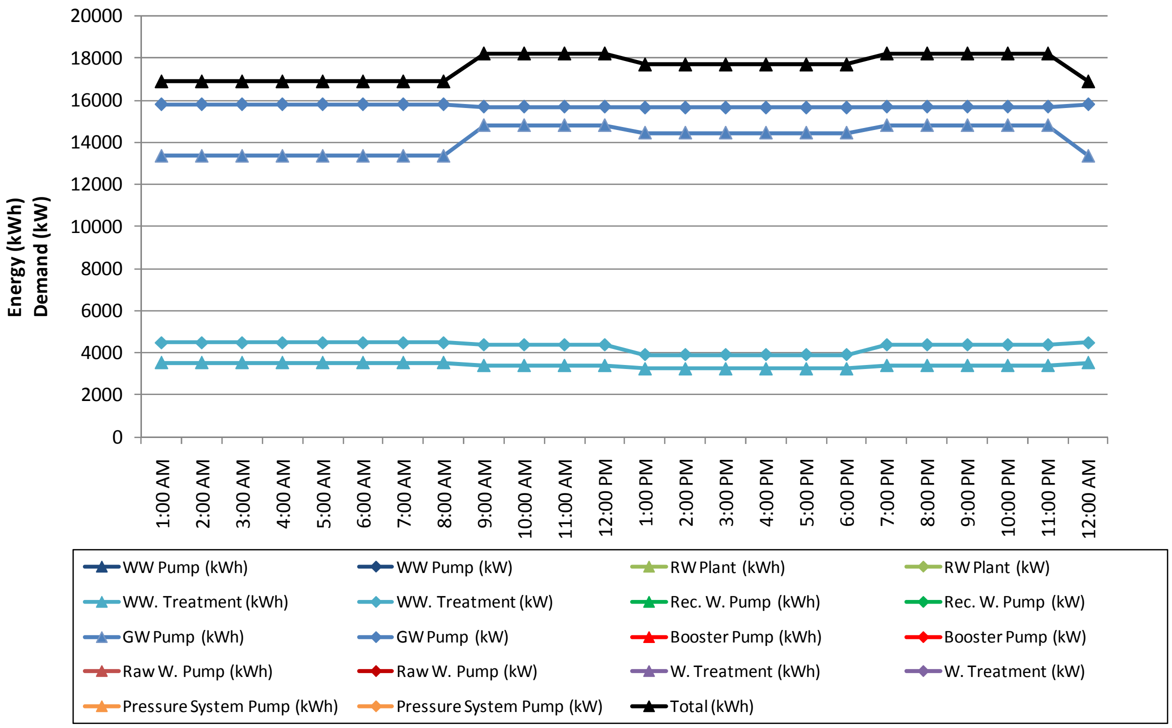

| | |
|---|---|
| **Date** | 6/20/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 12,892 |
| *Wastewater Treatment* | 3,540 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



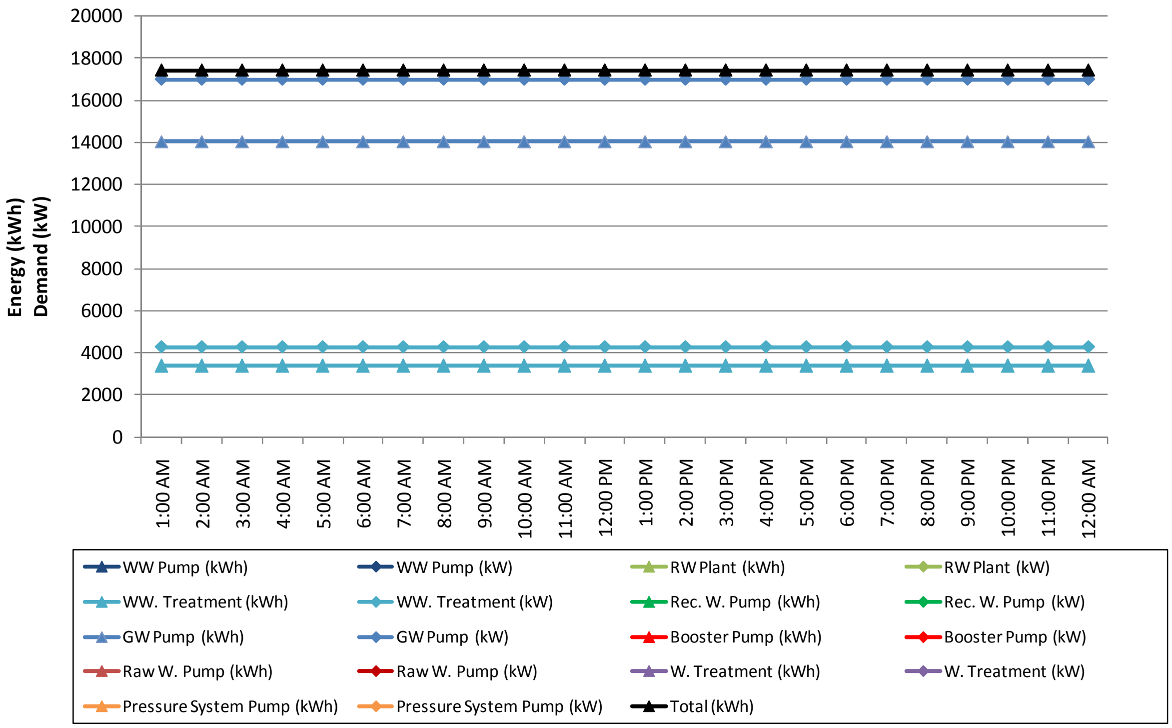

| | |
|---|---|
| **Date** | 6/1/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 13,967 |
| *Wastewater Treatment* | 3,559 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



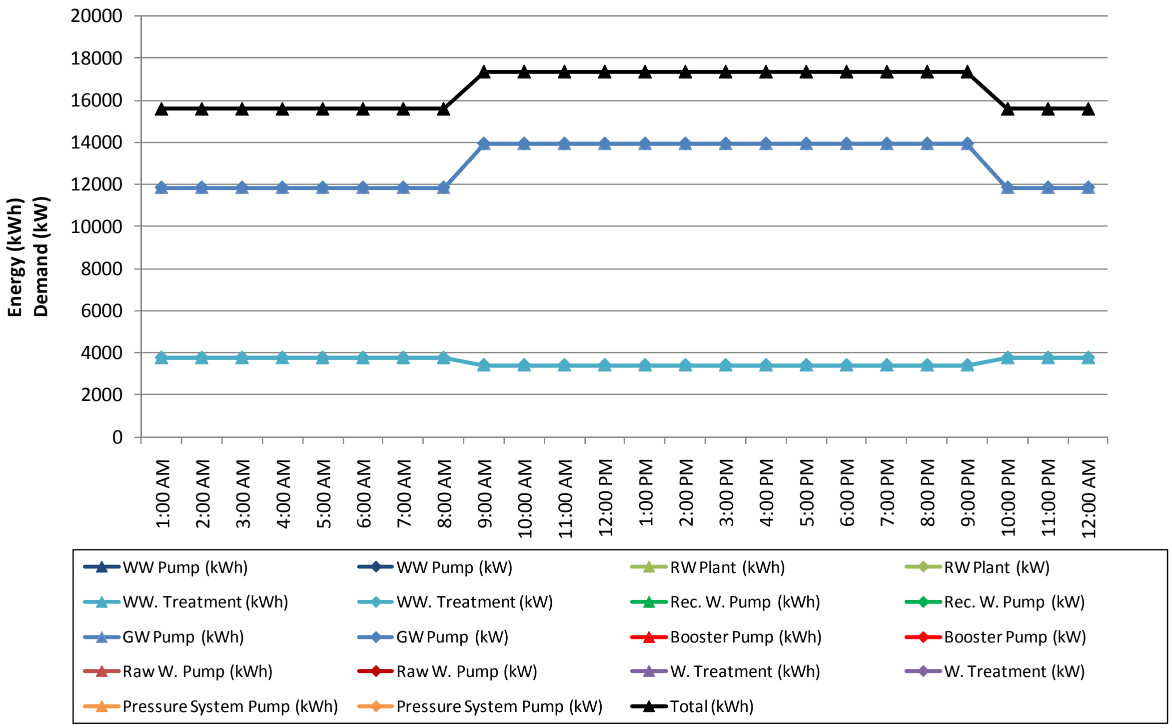

| | |
|---|---|
| **Date** | 8/1/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 14,452 |
| *Wastewater Treatment* | 3,234 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



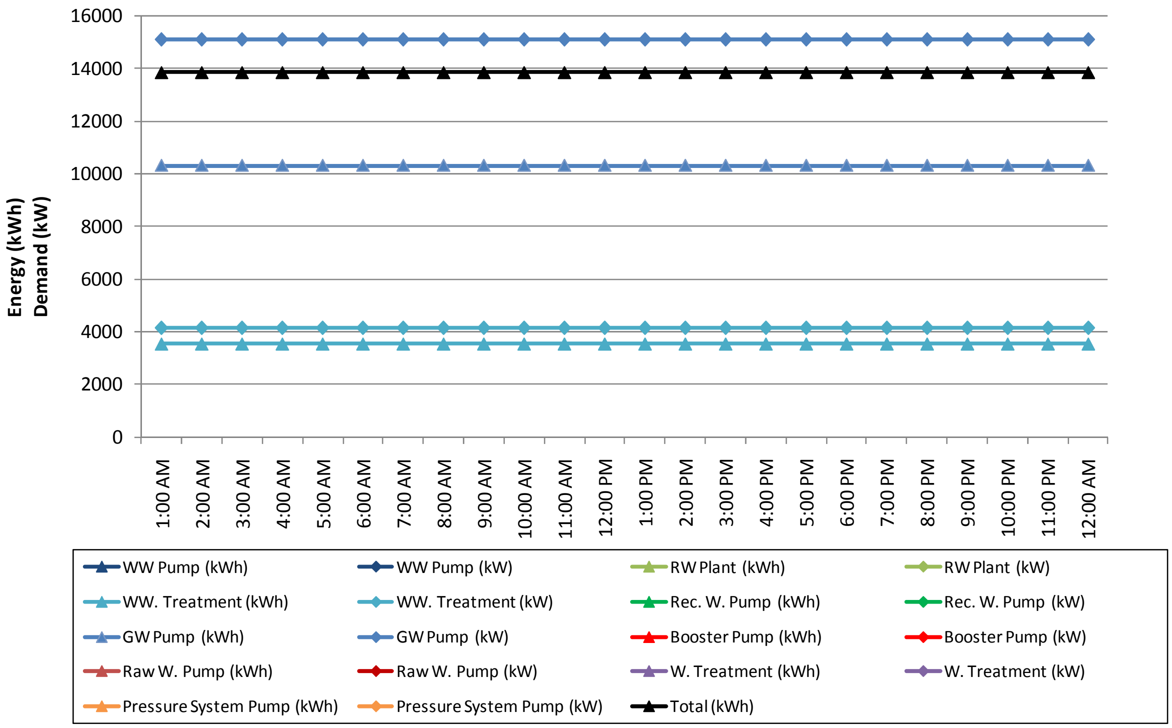

| | |
|---|---|
| **Date** | 9/1/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater* | 14,023 |
| *Wastewater Treatment* | 3,394 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



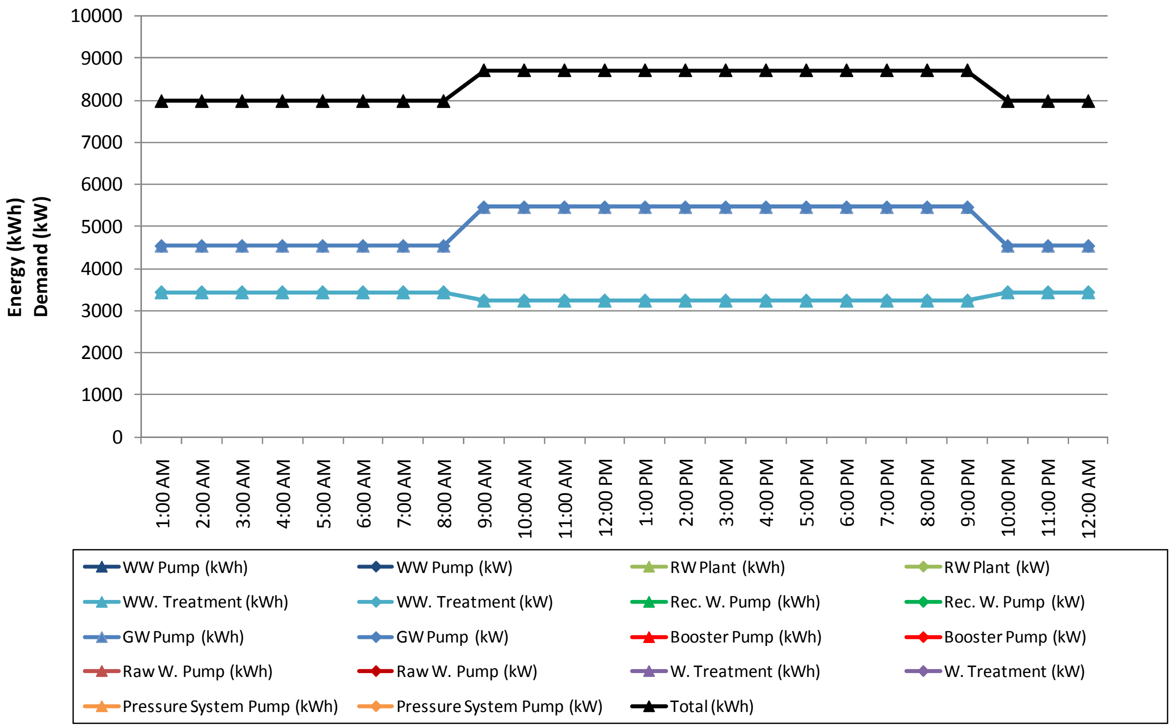

| | |
|---|---|
| **Date** | 5/1/2008 |
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Groundwater* | 13,921 |
| *Wastewater Treatment* | 3,415 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| **Date** | 11/1/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 10,319 |
| *Watewater Treatment* | 3,537 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| **Date** | 12/1/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater* | 5,462 |
| *Wastewater Treatment* | 3,237 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

The Coachella Canal lining project (actually the replacement of close to 36 miles of earthen canal with a new, parallel concrete waterway) conserves enough water to meet the needs of 50,000 households. In the past this water was lost to seepage.

## Sources

Coachella Valley Water District. "2005 Urban Water Management Plan."

Coachella Valley Water District. http://www.cvwd.org/about/about.php. Accessed 12/27/2009.

# Contra Costa Water District (CCWD)

## Summary

<table>
<tr><td>Primary functions</td><td colspan="3">Urban Water, Local wholesale and retail</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Supply, treatment, distribution</td></tr>
<tr><td>Hydrologic Region</td><td>San Francisco and San Joaquin</td><td>DEER Climate Zone</td><td>2</td></tr>
<tr><td>Quantity of Water</td><td colspan="3">Treated by Agency: 32.7 MGD (Ave for 2008)<br>Total Distributed: 105 MGD (Ave for 2008)</td></tr>
<tr><td>Number of Customers (2008)</td><td>Population: 550,000<br>Total Connections: 89,191<br>Residential: 84,229<br>Commercial: 3,145<br>Other: 1,817</td><td>Service Area Size</td><td>137,127 Sq miles</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">Contra Costa Water District's (CCWD) location in the Sacramento-San Joaquin Delta provides access to supplies from the Sacramento and San Joaquin Rivers and their tributaries. The district obtains water primarily from CVP at two locations. Water must be pumped out of the delta to reach customers at higher elevations. CCWD owns and operates Los Vaqueros Reservoir using it to control water quality and for seasonal storage.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3">• Water Conveyance – pumping plants are required to lift water from the Delta up to the Contra Costa Canal and Los Vaqueros Reservoir at a higher elevation<br>• Water Treatment – Two treatment plants using chlorination and ozone to treat water for CCWD customers<br>• Water Distribution – Water is pumped to the eight-pressure zones with an elevation difference of over 450 feet</td></tr>
<tr><td>Water Treatment Technologies</td><td colspan="3">Bollman Water Treatment Plant: coagulation, flocculation, sedimentation, ozone, filtration, and disinfection<br>Randall-Bold Water Treatment Plant: pre-ozone, coagulation, flocculation, sedimentation, filtration, post-ozone, and disinfection</td></tr>
<tr><td>Water Resources (2005)</td><td colspan="3">CVP: 82.9%<br>Surface Water: 12.1%<br>Groundwater: 1.4%<br>Recycled Water: 3.6%</td></tr>
<tr><td>Marginal Water Supplies</td><td colspan="3">Short-term: CVP Water<br>Long-term: Conservation measures, surface water transfers, regional desalination partnership, recycled water</td></tr>
<tr><td>Energy Service Providers</td><td colspan="3">PG&E, CVP, MID</td></tr>
<tr><td rowspan="4">Observed Energy Intensities (kWh/Mgal)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Raw Water Conveyance</td><td>848</td><td>1,704</td></tr>
<tr><td>Water Treatment</td><td>895</td><td>1,210</td></tr>
<tr><td>Water Distribution</td><td>688</td><td>1,524</td></tr>
</table>

## Background Information

The Contra Costa Water District (CCWD) currently serves a population of about 550,000 people in central and east Contra Costa County. About 265,000 people receive treated water directly from CCWD (89,000 connections), and the other 285,000 receive water from five other water agencies that purchase raw water from CCWD. CCWD draws its water from the Sacramento-San Joaquin Delta under a contract with the federal Central Valley Project (CVP). CCWD is the CVP's largest urban contractor. In 1998, CCWD completed construction of the locally-financed $450 million Los Vaqueros Project, including a 100,000 acre-foot reservoir, designed to provide improved water quality and emergency supply reliability for CCWD customers as well as net environmental benefits. See Table 1 for additional information on CCWD.

Primary sources of information for this section include: CCWD 2005 Urban Water Management Plan, water and energy data for 2008 provided by CCWD and PG&E, and interviews with CCWD staff. A detailed list of references is located at the end of this section.

**Table 1: Agency Profile**

| | |
|---|---|
| **Agency Type** | Urban wholesale and retail raw and treated water |
| **Hydrologic Region** | San Francisco and San Joaquin |
| **Region Type** | Coastal |
| **Energy Service Provider** | PG&E, MID, and CVP |
| **DEER Climate Zone** | 2 |
| **Service Area Size** | 137,127 square miles |
| **Service Area Population** | 550,000 |
| **Number of Connections in 2008** | 89,191 |
| ***Residential*** | 84,229 |
| ***Commercial*** | 3,145 |
| ***Industrial*** | 17 |
| ***Public Facilities and Other*** | 1,768 |
| ***Municipal*** | 7 |
| ***Agricultural*** | 25 |
| **Distribution Topology** | Hilly |

## Climate

CCWD's service area generally has hot, dry summers and cool, wet winters. Monthly average temperatures range from 46 degrees in January to 73 degrees in July. Average annual precipitation ranges from 13 inches in Brentwood to 22 inches in Walnut Creek.

## Demographics

Population in the county has grown rapidly due to the availability of land and the trend toward increased suburban growth. There has been ongoing development occurring in the East County area from Pittsburg east to the county line. Population projections based on 2005 projections are provided in Table 2.

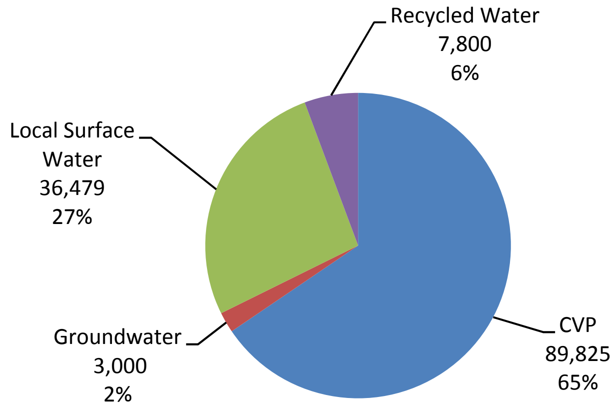
**Table 2: Projected CCWD Service Area Population**

| Year | Population |
|---|---|
| 2005 | 507,823 |
| 2010 | 536,258 |
| 2015 | 564,942 |
| 2020 | 595,126 |
| 2025 | 622,844 |
| 2030 | 649,265 |

The 5,280-acre Concord Naval Weapons Station (CNWS) offers significant development potential if the 2005 military base realignment and closure process, authorized by Congress, makes this site available for civilian use. The CNWS has been identified as an "infill site" and the City of Concord adopted a Reuse Plan for the site in February 2010.

## Water Sources

CCWD gets the majority of its water from the CVP as illustrated in Figure 1.




Notes: Groundwater and recycled water are not delivered by CCWD but are included in demand analysis as they represent water use within CCWD's service area.

**Figure 1: 2008 Distribution of Sources (AF/Yr)**

### Surface Water

CCWD obtains surface water from the Central Valley Project, local water rights, and through transfers from the East Contra Costa Irrigation District. CVP water can be obtained though CCWD's annual allotment and delivered in one of three places.

#### *Central Valley Project Supply*

CCWD's long-term CVP contract was renewed in May 2005 and has a term of 40 years. The contract with the U.S Bureau of Reclamation (USBR) provides for a maximum delivery of 195,000 AF/yr from the CVP, with a reduction in deliveries during water shortages including regulatory restrictions and drought. CCWD can take delivery of this water at Rock Slough and Old River. An additional intake is currently under construction in Victoria Canal and will be operational in July 2010.

### *Mallard Slough Water Rights*

CCWD has additional water rights at Mallard Slough for a maximum diversion of Delta water of up to 26,700 AF/yr. However, diversions from Mallard Slough are unreliable due to frequently poor water quality in the Delta. Water quality conditions have restricted diversions from Mallard Slough to approximately 3,100 acre-feet per year (on average) with none available in dry years. No water was diverted from Mallard Slough in 2008 due to water quality issues.

### *Los Vaqueros Water Rights – Delta Surplus*

CCWD obtained additional water rights for surplus Delta flows as part of the Los Vaqueros Project. Up to 95,980 acre-feet may be diverted for storage in Los Vaqueros between November 1 of each year to June 30 of the succeeding year under Water Rights Permit No. 20749. Combined deliveries of Los Vaqueros Water Rights water and CVP water are limited to 195,000 acre-feet/year. Little or no Los Vaqueros Water Rights water is available for diversion to storage in dry years.

### *Surface Water Transfers*

CCWD entered an agreement with East Contra Costa Irrigation District (ECCID) for water transfers in February 2000. It was the first long-term water transfer for the CCWD. It provides up to 8,200 acre-feet in normal years and includes provisions for an additional 4,000 acre-feet through groundwater exchange when the CVP is in a shortage condition.

## Groundwater

Groundwater resources in the CCWD Service Area do not supply significant amounts of water to meet or augment raw water demands. CCWD does not manage the groundwater, and does not have figures as to how much water is pumped from these wells, but estimates total use within CCWD boundaries of approximately 3,000 AF/yr.

As part of CCWD agreement with ECCID, up to 4,000 AF/yr of groundwater can be obtained via exchanges when the CVP is in a shortage situation. This exchange water can be used anywhere within CCWD's service area.

## Recycled Water

CCWD does not own or operate any recycled water facilities. However, it has entered agreements with other water agencies to provide recycled water to customers within the CCWD service territory.
In 1995, Central Contra Costa Sanitation District (CCCSD) and CCWD reached an agreement allowing CCCSD to purvey recycled water to areas within CCWD's service territory, specifically in Concord and Pleasant Hill. Sixty-one customers were identified with a total potential recycled water demand of approximately 1,600 AF/yr. In 2000, Delta Diablo Sanitation District (DDSD) and CCWD reached an agreement for DDSD to purvey up to 8,600 AF/yr of tertiary treated recycled water to the Delta Energy Center and the Los Medanos Energy Center and 20 acres of parks and landscaped areas for an additional 80 AF/yr. This project is the largest industrial recycled water project in the State of California. In 2004, DDSD and CCWD reached an additional agreement allowing the development of recycled water facilities that will provide up to 1,650 AF/yr to areas in Pittsburg and Antioch.

## Marginal Water Supply

CCWD identified both short- and long-term marginal supply sources. In the short-term, additional demand can be met by water supplied from CCWD's existing Central Valley Project contract. In the long-term, CCWD has identified several options including: conservation, additional surface water transfers, desalination, or recycled water.

CCWD has the right to 195,000 AF of water annually from the CVP; however, actual demand averages about 120,000 AF. Short-term increases in demand could be met by drawing additional water from the CVP up to CCWD's maximum allotment. In addition to CCWD's annual allotment, CCWD is able to draw surplus water for storage in Los Vaqueros Reservoir.

To plan for the long-term, CCWD undertook the Future Water Supply Study and Implementation Plan. Several notable options for meeting future demand include:

- An expanded conservation program to encompass wholesale and retail customers, to achieve a target of at least 5 percent savings by the year 2040
- Additional water transfer agreements including the following possible options: conjunctive use with long-term contract, groundwater banking, lease/purchase water rights, co-investment in agricultural conservation, and fallowing or crop shifting contracts

In addition to these plans, CCWD has been working with three other Bay Area water districts to jointly explore the development of desalination facilities. The studies are exploring a facility that could produce more than 70 million gallons of water a day to benefit more than five million people in the region. Pilot testing was recently completed at CCWD's Mallard Slough Pump Station in Bay Point to evaluate various technologies and identify potential environmental impacts.

The energy intensity range of CCWD's marginal supply is summarized below in Table 3. The energy intensity represents the embedded energy for all activities prior to the water reaching CCWD's distribution system.

**Table 3: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | CVP[a] | 1,743-2,914 kWh/MG |
| Long-term | Surface Water Transfers | 1,743-2,914 kWh/MG |
| | Desalination[b] | 12,276 kWh/MG |
| | Recycled Water[c] | 3,466 kWh/MG |

a) Energy is associated with CCWD raw water pumping and treatment operations. Water is drawn from the San Francisco Bay Delta. CVP and surface water transfers do not use any energy to get water to CCWD's raw water intakes.
b) Estimate obtained from California Sustainability Alliance, 2008.
c) Estimate obtained from Study 1 assuming advanced recycled water treatment technology

## Water Demand

CCWD serves approximately 89,000 connections with a total population of approximately 550,000 customers as summarized in Table 4 below. The corresponding projected water use in each sector is summarized in Table 5. Additional water beyond that which is billed is also consumed; this is known as unaccounted water. Unaccounted water includes authorized unmetered uses including fire fighting, main flushing, and public use. Additional causes of unaccounted water also include inaccurate meter reading, reservoir cleaning, malfunctioning valves, leakage and theft.

### Table 4: Historic and Projected Number of Customers by Type

| Service Area | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Treated Water Service Area (Clayton, Clyde, Concord, Martinez, Pacheco, Pleasant Hill, Port Costa, Walnut Creek, and unincorporated) | 207,313 | 212,958 | 221,102 | 230,146 | 240,429 | 249,525 |
| Raw Water Service Area (Antioch, Bay Point, Brentwood overlap area, Martinez, Oakley, and Pittsburg) | 252,559 | 266,929 | 282,379 | 298,930 | 312,880 | 327,020 |
| Other Unincorporated Areas (Bethal Island, Cypress Corridor, Knightsen, and Veale Tract) | 9,860 | 13,490 | 17,290 | 21,090 | 21,475 | 21,860 |
| Subtotal | 469,732 | 493,377 | 520,771 | 550,166 | 574,784 | 598,405 |
| City of Brentwood (remaining) | 38,091 | 42,881 | 44,171 | 44,960 | 48,060 | 50,860 |
| **Total** | **507,823** | **536,258** | **564,942** | **595,126** | **622,844** | **649,265** |

### Table 5: Historic and Projected Water Demand (AF/Yr)

| Water Use Sectors | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| **Raw Water Service Area** | | | | | | | |
| Municipal[1] | 47,057 | 52,708 | 57,708 | 63,862 | 70,015 | 73,912 | 77,809 |
| Major Industrial/ Irrigation/ Ag. | 34,836 | 53,507 | 72,177 | 72,177 | 72,177 | 72,177 | 72,177 |
| Unincorporated Areas | 233 | 259 | 284 | 305 | 326 | 349 | 371 |
| Subtotal | 82,126 | 106,148 | 130,169 | 136,344 | 142,518 | 146,438 | 150,357 |
| **Treated Water Service Area[2]** | | | | | | | |
| Subtotal | 41,098 | 46,434 | 51,769 | 54,162 | 56,555 | 57,795 | 59,034 |
| **Other Unincorporated Areas** | 213 | 262 | 310 | 354 | 398 | 428 | 457 |
| **Unaccounted for Water** | 10,225 | 12,500 | 12,500 | 12,500 | 12,500 | 12,500 | 12,500 |
| **Total Service Area:** | 133,662 | 165,300 | 194,700 | 203,400 | 212,000 | 217,200 | 222,300 |

1: Water sold to other water agencies
2: Treated water is sold directly to CCWD customers

## System Infrastructure and Operations

Table 6 summarizes the infrastructure operated by CCWD. CCWD operates and maintains a complex system of water transmission, treatment, and storage facilities to supply both treated and untreated (raw) water to its customers.

### Table 6: Infrastructure Summary

| | |
|---|---|
| **Number of Raw Water Reservoirs Operated** | 4 |
| **Raw Water Reservoir Storage** | 110,000 acre-feet |
| **Miles of Distribution Piping** | 862 miles |
| **Pump Stations** | 37 |
| ***Raw Water*** | 9[a] |
| ***Treated Water*** | 28 |
| **Number of Treatment Plants** | 2[b] |
| **Treated Water Storage Tanks** | 41 |
| **Treated Water Storage Capacity** | 72 Mgal |

a) A tenth raw water pump station is currently under construction in Victoria Canal

b) CCWD operates a third treatment plant on behalf of the City of Brentwood

## Sub-Regions within Agency

CCWD can be divided into two sub-regions; Raw Water and Treated Water. The treated water service area is indicated by the light green shaded area in Figure 2. The raw water service area includes that area bound by the green lines. Figure 3 illustrates the main components of the raw water system and the elevation differences between each facility.

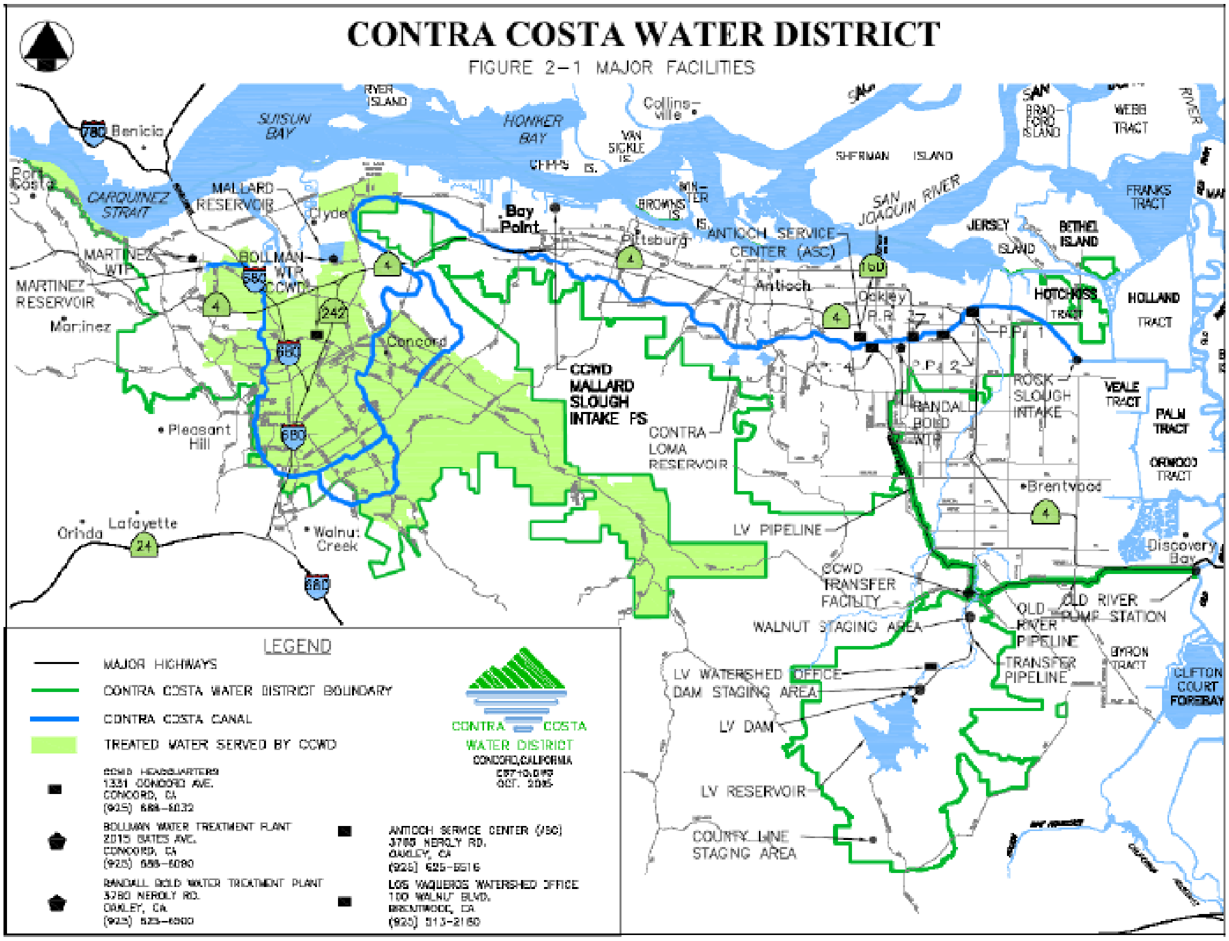



Image Source: CCWD

## Figure 2: CCWD Service Area

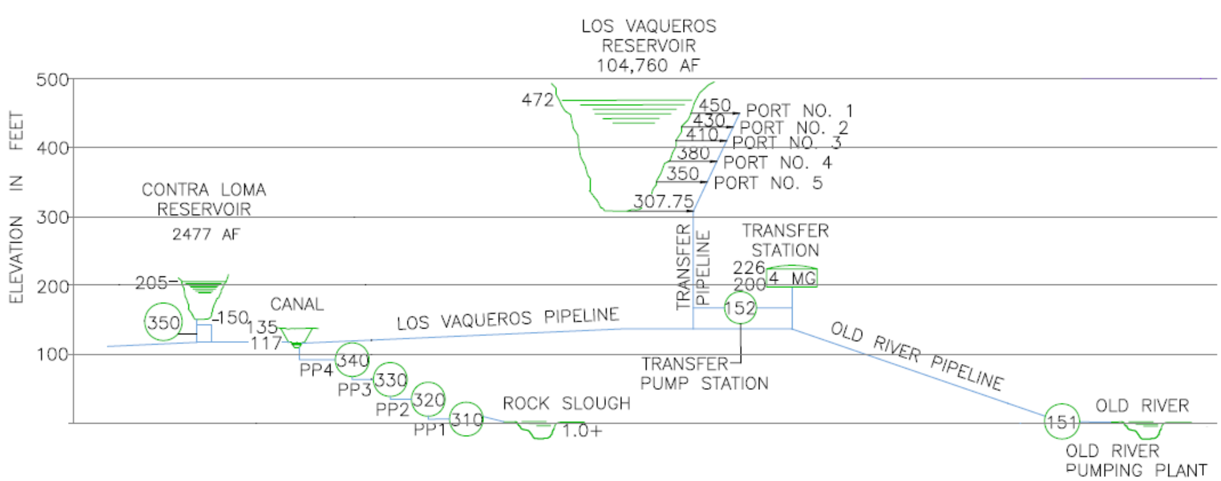



Image Source: CCWD with clarifying edits by the Study Team

## Figure 3: Elevation Map of CCWD Raw Water Pumps

## Sub-Region 1: Raw Water Service Area

Raw water is pumped out of the Delta into the Los Vaqueros for storage or directly into the Contra Costa Canal. The canal flows east to west allowing raw water deliveries to municipal water agencies, CCWD-owned treatment plants, or CCWD raw water customers. Major wholesale municipal customers include the Golden State Water Company (Bay Point), Diablo Water District (Oakley), and the Cities of Antioch, Pittsburg, and Martinez.

### *Conveyance*

The primary conveyance facility for CCWD's raw water supply is the Contra Costa Canal (Canal) depicted in Figure 2. The Canal is approximately 48 miles long, with the major deliveries within the first 19 miles, which run from Rock Slough to the Shortcut Pipeline near the Bollman Water Treatment Plant in Concord. Four pumping plants, within the first 7.1 miles of the canal, lift water approximately 124 feet from Rock Slough (see Figure 3). Water flows the remaining length of the main canal by gravity. The first four miles of the canal are unlined and run from Rock Slough to Pumping Plant 1. The remaining reaches are concrete lined, with capacities ranging from approximately 22 CFS to 350 CFS. The Ygnacio Relift Pump Station diverts water from the main canal into the 5-mile Ygnacio Loop.

When the Los Vaqueros Project was built, it included a new point of diversion (at Old River) that operates in conjunction with the current Rock Slough diversion point. The pumping plant is at the Old River intake and has an installed capacity of 250 CFS. The Old River Pump Station pumps water to an elevation of 200 feet to the 4 million gallon Transfer Reservoir located at the base of Los Vaqueros Reservoir. From the Transfer Reservoir water is either allowed to flow by gravity to the Contra Costa Canal or is pumped up to the Los Vaqueros Reservoir by the Transfer Pump Station. Any water releases from Los Vaqueros Reservoir flows to the Canal by gravity. The Transfer Pumping Plant has an installed capacity of 200 CFS. Diversion from the Old River intake for delivery to CCWD's service area began in the summer of 1997.

In addition to Los Vaqueros, CCWD operates the Contra Loma and Martinez Reservoirs. Contra Loma is a small surface raw water storage facility off the Contra Costa Canal. Water is pumped approximately 95 feet above the canal to the reservoir. This reservoir is mostly for emergency and operational water flow balancing; data on this facility was not available. The Martinez Reservoir serves as the terminus to the Canal.

## Sub-Region 2: Treated Water Service Area

Treated water is distributed to individual customers living in the following communities in the Treated Water Service Area: Clayton, Clyde, Concord, Pacheco, Port Costa, and parts of Martinez, Pleasant Hill, and Walnut Creek. In addition, CCWD treats and delivers water to the City of Brentwood, Golden State Water Company (Bay Point), and the City of Antioch.

### *Treatment Plants*

The region is served by two water treatment plants that draw raw water from the Contra Costa Canal.

The Bollman Water Treatment Plant is CCWD’s primary water treatment facility providing up to 75 MGD of treated water to the CCWD’s treated water service area. The plant's treatment process includes coagulation, flocculation, sedimentation, filtration, ozonation, and disinfection. A high lift booster station is co-located at this plant to pressurize water for the distribution system.

The Randall-Bold Water Treatment Plant (Randall-Bold) is located in the City of Oakley and is jointly owned by Diablo Water District (DWD) and CCWD. The DWD portion of the facility delivers treated water to the City of Oakley while the CCWD portion enters a pipeline to be conveyed to the CCWD treated water service area. The treatment plant's current rated capacity is 40 MGD; CCWD has rights to 25 MGD of production from the plant. The facility treatment processes include a grit basin, influent mixing basin, pre and post ozone contact basin, flocculation, sedimentation, filtration, and disinfection. A high lift booster station is co-located at this plant to pressurize water for DWD's distribution system. Data provided by CCWD on this facility includes the total production of this facility include that dedicated for DWD.

### *Distribution*

Treated water from Randall-Bold is conveyed via the 22-mile Multi-Purpose Pipeline to reach the treated water distribution area. The Multi-Purpose Pipeline follows the Contra Costa Canal downstream from Randall-Bold to the Bollman Water Treatment Plant; it contains one booster pump station. Once the treated water from both plants enters the distribution system, the 26 remaining booster pumps send the water to eight different pressure zones through more than 800 miles of pipeline ranging in diameter from 2 to 66 inches. Most of the treated water demand (approximately 50 percent) occurs in the lowest pressure zone.

## System Storage

CCWD's raw water storage reservoirs are Mallard, Contra Loma, Martinez, and Los Vaqueros.

Mallard Reservoir provides water to Bollman Water Treatment Plant and is used as a storage facility for emergency use, flow regulation, and to provide blending of the different sources of supply during winter months when Mallard Slough water is used. The reservoir has a usable capacity of about 2,100 acre-feet, which is currently equivalent to about two weeks of supply during maximum demand for the Treated Water Service Area (TWSA) customers.

Contra Loma Reservoir is used primarily as a regulating reservoir for peak demands and short-term (1 to 7 days) supplies and for emergency storage for CCWD's customers. The reservoir has an available capacity of about 1,700 acre-feet.

Martinez Reservoir, located in the City of Martinez, is at the terminus of the canal and the Shortcut Pipeline and provides regulating storage to capture flows from canal operations. The Martinez Reservoir has an available capacity of about 230 acre-feet.

The Los Vaqueros Reservoir is located eight miles south of the City of Brentwood and has a capacity of 100,000 AF. The reservoir stores higher quality Delta water for blending with the Delta supply during dry periods when sodium and chloride levels typically increase. The reservoir also stores water for emergency supply (minimum 3-month emergency supply) and for operational flexibility to protect fisheries.

CCWD's has the capacity to store approximately 72 million gallons of treated water within its treated water service area; approximately a three-day supply of water. On a daily basis only 25 percent of the treated water storage amount is used for operational needs, the rest is dedicated to fire flow and emergency needs.

### System-wide Operation Strategy

CCWD purchases water from the CVP at a rate of $35/AF and takes delivery primarily at three locations in the Delta. CCWD schedules deliveries starting in March going until February the next year.

Water mainly enters Rock Slough and Old River; Mallard Slough is further down the Delta and recently (including 2008) the water quality was too poor to draw water from this location. Most water (approximately 80 percent of CCWD's needs) is pumped from the Old River intake. This intake is favored for two reasons, the water quality is better than the other two intakes (being further "up" the delta) and the pump uses a screened intake. The intake at Rock Slough is not screened and a biological opinion from U.S. Fish and Game requires CCWD to maximize use at Old River from January to August. An added benefit to doing the majority of pumping at Old River is that all that water has the potential to be pumped into the Los Vaqueros Reservoir, thus CCWD is more flexible in the amount and timing of storage.

Los Vaqueros Reservoir is strictly operated for water quality purposes. During dry times the water quality of the Delta is poor as it contains a high level of sediment and salinity; up to 250 ppm of chloride while CCWD's target is 65 ppm. To combat this, higher quality water from the reservoir is released and blended with water from the Delta to increase its quality. During wet times when the Delta water quality is good blending is not needed and Los Vaqueros is filled to save high quality water for later. Reservoir use varies year by year. During a wet year, there are limited releases as the water quality in the Delta is good and no blending is needed; the reservoir will be filled up if needed. During dry years the reservoir can be significantly drawn down to ensure water quality.

CCWD operates distribution pumps to minimize on-peak energy consumption. Pumps are operated to fill local storage during off-peak times and remain off as long as possible during peak summer hours. If tanks draw down to critical levels, however, the pumps must turn back on to fill them.

### Infrastructure Changes

CCWD shut down the Rock Slough pumping plants on October 20, 2008 in order to begin the first phase of a project to line the first four miles of the canal that are currently unlined. Water demand needs during this period were met by the Old River Pump Station and Los Vaqueros Reservoir. This change is reflected in the data received by the Study Team.

Construction started in the spring of 2008 on the Alternative Intake Project, which consists of a new intake in Victoria Canal and an extension of the pipeline system that delivers water to the Los Vaqueros Reservoir and the Contra Costa Canal. This project will not affect the data received by the Study Team.

A 40 kW solar system was installed on the Ygnacio Pump Station mid-2008. It has the potential to provide up to 30 percent of the energy required for the pump station. Any solar energy generated is not reflected in the Study Team's data as energy meter data does not reflect on-site generation. Data on solar generation was unavailable from CCWD. The Study Team believes the absence of this data will not cause a significant impact on the overall data as there are 26 other booster pump stations with significant energy use that would still dominate the energy use profile for booster pumps.

## Energy Profiles

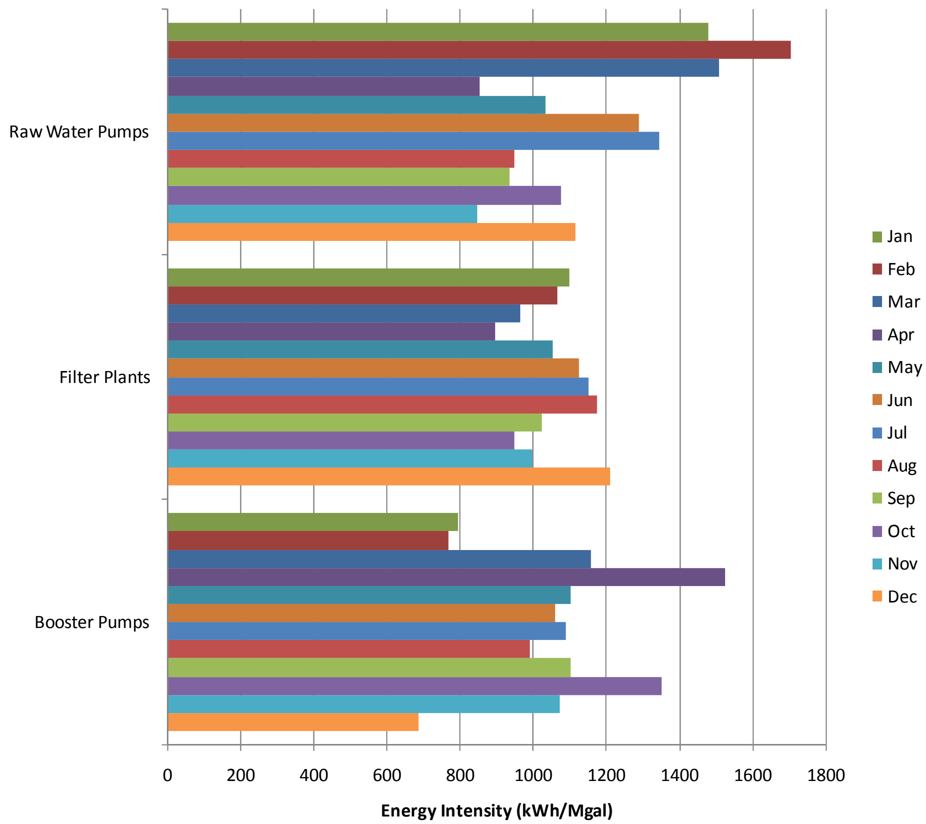
CCWD provided energy and water flow data to the Study Team for its calculations of energy profiles; additional data was provided by PG&E. Energy data provided included: hourly energy data for raw water pumps, monthly energy bills for booster pumps and water treatment plants, and interval data (15-minute time increment) for select large facilities. Energy use of the shared Randall-Bold Water

Treatment Plant includes the total energy used by the facility. Water flow data was provided on a daily basis for all raw water pumps and both treatment plants. Water flow rates through individual booster pumps were not available. Thus the Study Team applied the total treated water delivery flow pattern to each booster pump station for energy profile calculation purposes. Water outflow from the shared Randall-Bold Water Treatment Plant includes the total water treated by the facility.

Energy is provided to CCWD from three energy service providers: PG&E, CVP, and MID. PG&E energy is used to power 26 distribution pumps and the two water treatment plants owned by CCWD. CVP and MID energy are both used to power raw water pumps and MID power is used for the Multi-Purpose Pipeline pump; a treated water pump. CVP power is allocated to CCWD in proportion to the water that is purchased from CVP, its cost is bundled in the cost of water. Of the approximately $35/AF CCWD pays for CVP water; about $4/AF accounts for the cost of energy.

Under the initial agreements with CVP, CVP provides enough power for CCWD to lift water from the Delta up to the elevation of the Contra Costa Canal (approximately 124 feet). When the Los Vaqueros Project and the Old River Pump Station was built, this same agreement held. However the Old River Pump Station pumps to the Transfer Pump Station at a higher elevation (200 feet) compared to the Contra Costa Canal (124 feet), see Figure 3 for details. The incremental energy required by the Old River Pump Station to pump water above 124 feet is purchased from Modesto Irrigation District as additional power. It is not available from CVP under the current agreement unless a Biological Opinion requires CCWD to use Old River in lieu of Rock Slough. CCWD is treated as a retail customer of MID's yet pays approximately wholesale price for the energy received.

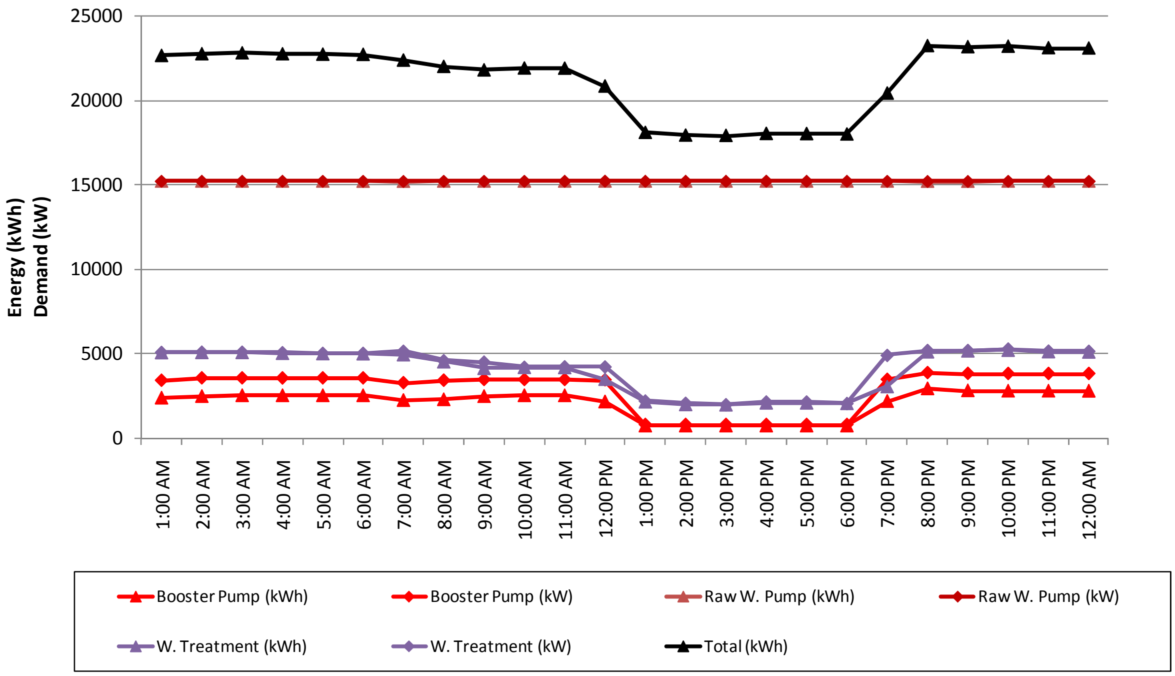
The energy intensity of each facility type within CCWD is presented in Figure 4**Figure**. Energy intensity for raw water pumping varies significantly between the summer and winter seasons. This is because during the late winter when water supply is abundant but demand is low, raw water is pumped into Los Vaqueros Reservoir by the Transfer Pump Station (a raw water pump). The Transfer pump station has a high energy intensity because of the elevation difference it must overcome (Figure 3) thus increasing the total energy intensity for raw water operations. During the summer when water is released from the reservoir and the Transfer Pump Station is not used, energy intensity is lower as it only represents the energy needs of Old River and Rock Slough. The months of May and September – December represent raw water pumping directly into the Contra Costa Canal with no diversions to Los Vaqueros. The months of January – March and June – July represent operations that including pump water into Los Vaqueros. Raw water energy intensity data for April and November were removed as outliers indicated by CCWD staff.




Note: Raw water Energy Intensities vary due to seasonal pumping into Los Vaqueros Reservoir. See text above graph for more details.

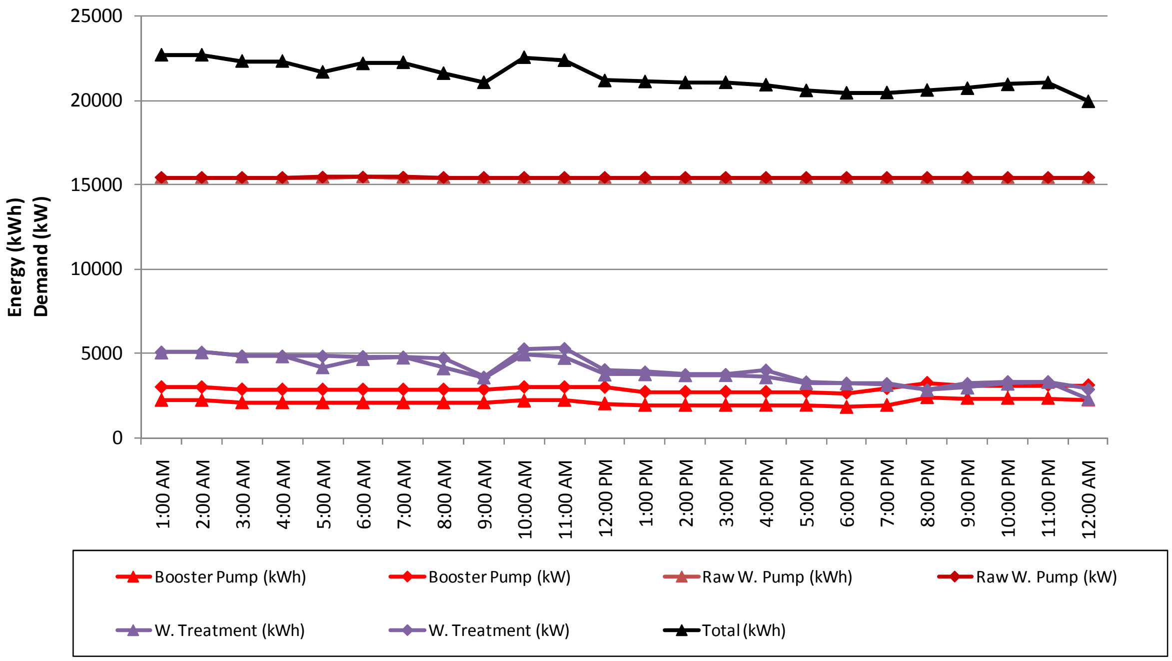
### Figure 4: Monthly Energy Intensity by Facility Type

Hourly energy profiles and peak energy demand is documented in Figures 5 through 11. The majority of energy used by CCWD is for raw water pumping as its major supply is water from the CVP that must be pumped to higher elevations to enter the system. However, the winter average water demand illustrates a day in which minimal raw water pumping was performed; the majority of energy use on this day was for treatment and distribution.



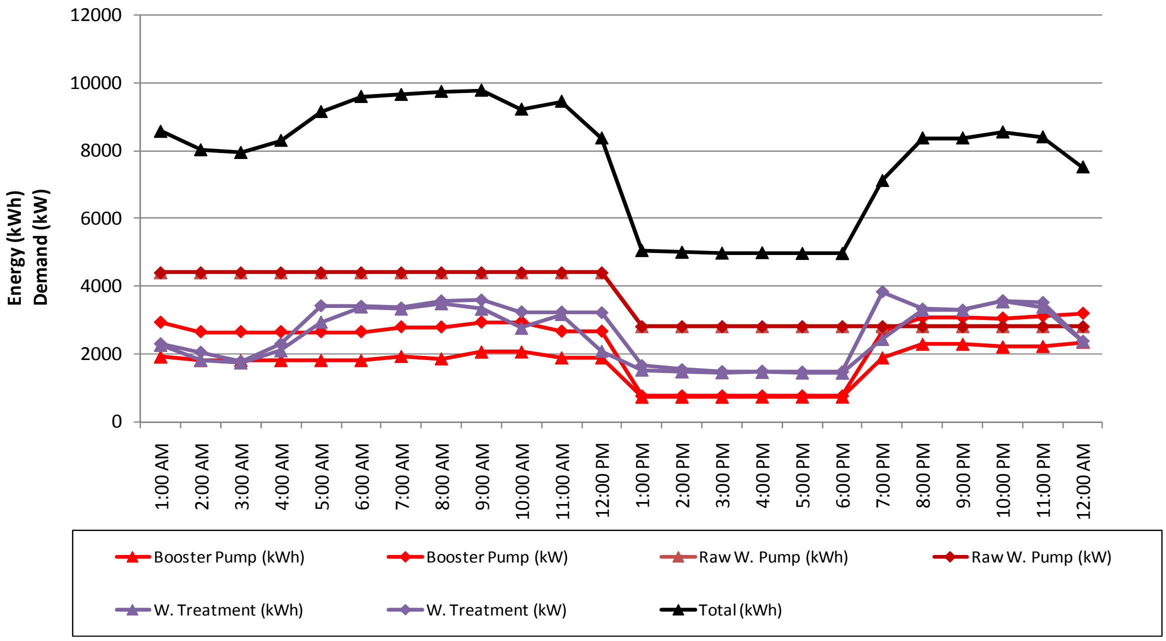

| | |
|---|---|
| **Date** | 7/8/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 754 |
| *Raw Water Pump* | 15,207 |
| *Water Treatment* | 2,025 |

**Figure 5: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



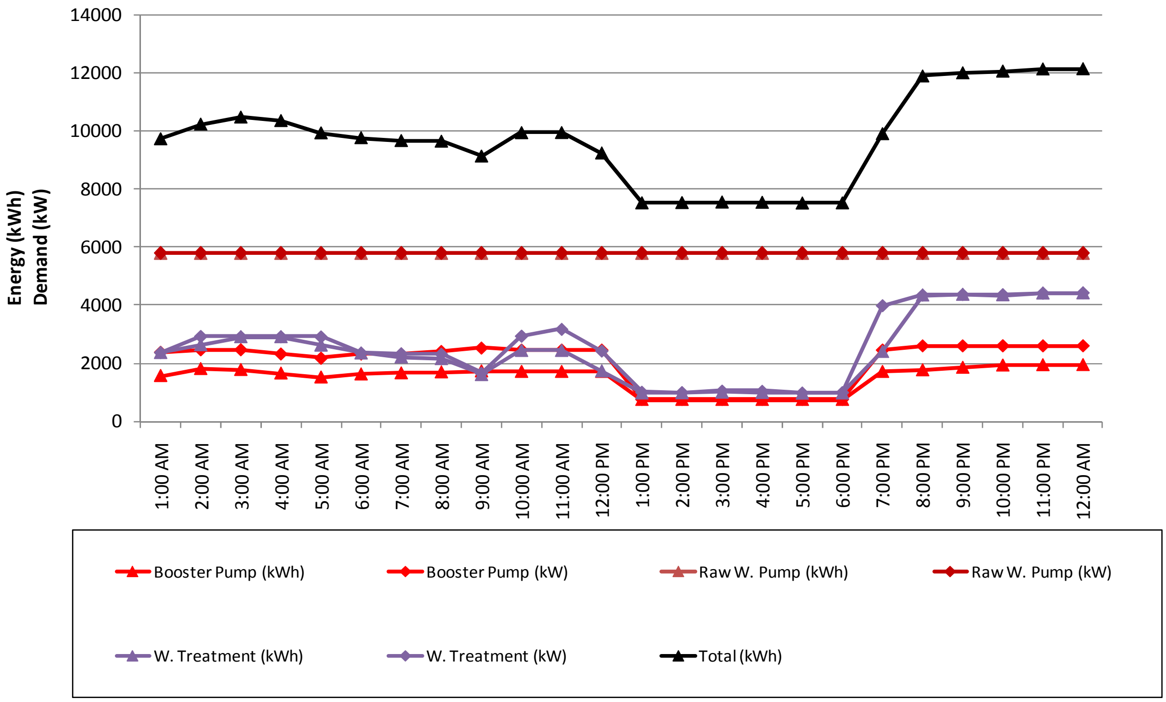

| | |
|---|---|
| **Date** | 7/4/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,933 |
| *Raw Water Pump* | 15,414 |
| *Water Treatment* | 3,515 |

**Figure 6: 24-Hour Energy Profile: Summer High Water Demand Day**



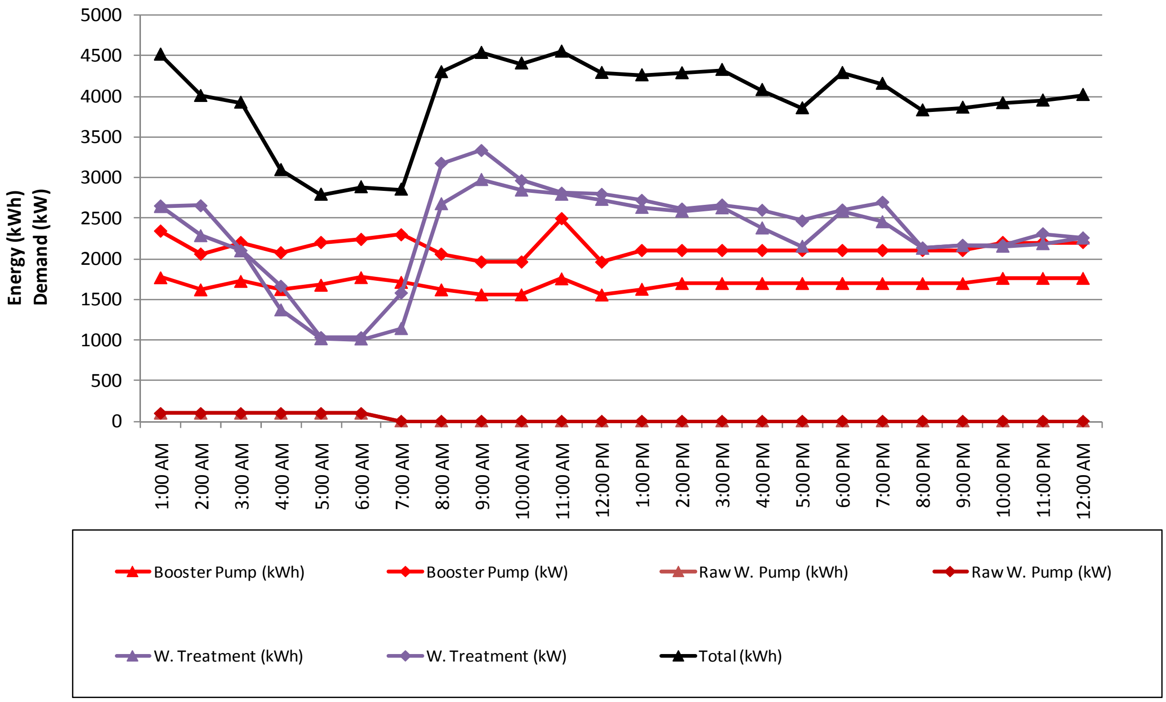

| **Date** | 9/12/2008 |
|---|---|
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 728 |
| *Raw Water Pump* | 2,800 |
| *Water Treatment* | 1,449 |

**Figure 7: 24-Hour Energy Profile: Summer Average Water Demand Day**



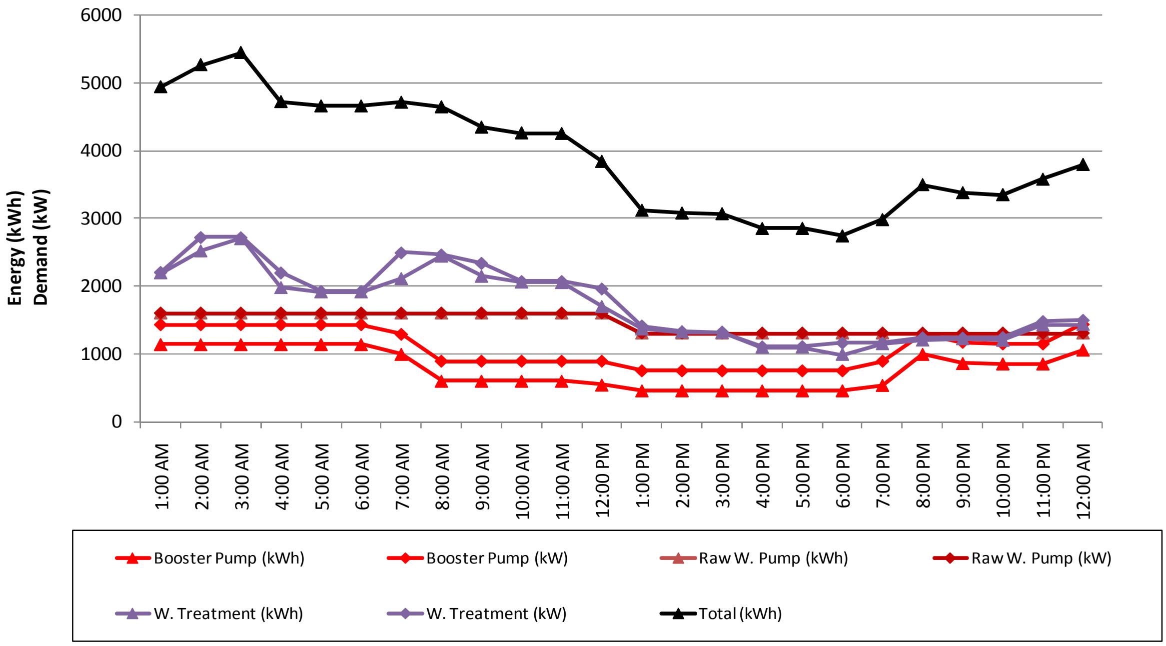

| | |
|---|---|
| **Date** | 5/12/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 740 |
| *Raw Water Pump* | 5,800 |
| *Water Treatment* | 997 |

**Figure 8: 24-Hour Energy Profile: Summer Low Water Demand Day**



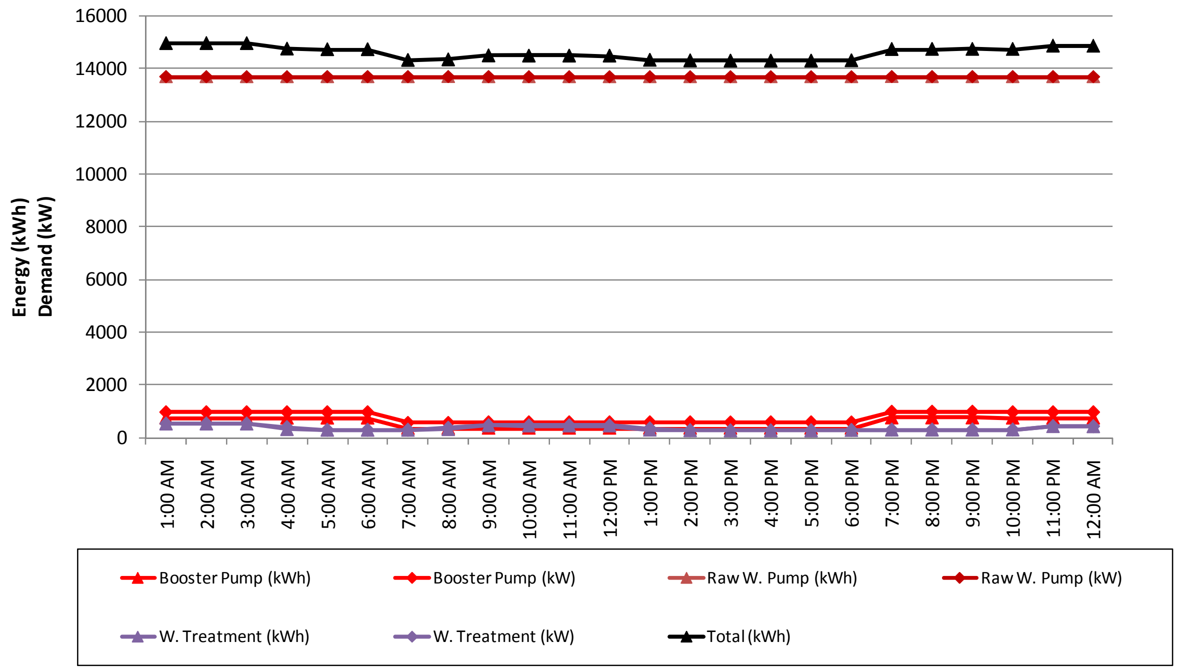

| **Date** | 4/28/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,699 |
| *Raw Water Pump* | 0 |
| *Water Treatment* | 2,385 |

**Figure 9: 24-Hour Energy Profile: Winter High Water Demand Day**




| **Date** | 1/19/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 455 |
| *Raw Water Pump* | 1,300 |
| *Water Treatment* | 1,168 |

**Figure 10: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 2/5/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 352 |
| *Raw Water Pump* | 13,684 |
| *Water Treatment* | 268 |

**Figure 11: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

CCWD regularly maintains and upgrades pump stations with energy efficient retrofits. Some examples include:

- Retrofitting old low lift pump stations at the Bollman Water Treatment Plant to use variable speed drive motors
- Retrofitting the Lime Ridge Pump Station with premium efficiency motors

CCWD installed 40 kW of solar panels at the Ygnacio Pump Station. It generates enough energy to offset 30 percent of the electricity used annually by the pump station. The facility was completed in summer 2008 and is now in use.

A small hydroelectric generation facility (approximately 1 MW) is being designed to capture the energy in the water flowing downhill from the transfer facility at the foot of Los Vaqueros Reservoir to the Contra Costa Canal. This is an elevation difference of approximately 75 feet. The facility would help offset the energy that CCWD must purchase from MID to pump water from Old River. The majority of raw water pumped by CCWD follows this route. Operation is projected to begin in 2011.

## Sources


Contra Costa Water District. *Treated Water Sales*. 2008.

Contra Costa Water District. *Year 2008 Untreated Water Consumption*. 2008.

Contra Costa Water District. CCWD public website: http://www.ccwater.com/welcome/profile.asp. Accessed December 17, 2009.

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Jeff Quimby, Principal Engineer – CCWD. Interviewed October 23, 2009 by Laurie Park, and Amul Sathe

Joe Piro, Senior Engineer O&M Department – CCWD. Interviewed October 23, 2009 by Laurie Park, and Amul Sathe.

California Sustainability Alliance. *The Role of Recycled Water in Energy Efficiency and Greenhouse Gas Reduction*. 2009.

# East Bay Municipal Utility District – Water (EBMUD)

## Summary

| | | | |
|---|---|---|---|
| **Primary functions** | Urban Water, Wastewater | | |
| **Segments of Water Use Cycle** | Supply, Treatment, Distribution, Recycled Water Production | | |
| **Hydrologic Region** | Coastal | **DEER Climate Zone** | 3 and 12 |
| **Quantity of Water** | Treated and Distributed: 200 MGD (average for 2008) | | |
| **Number of Customers (2005)** | Total: 391,216<br>Residential: 363,980<br>Commercial: 17,231<br>Industrial: 2,578<br>Institutional: 3,892<br>Irrigation: 3,535 | **Service Area Size** | 325 Sq miles |
| **Distinguishing Characteristics** | EBMUD supplies water and provides wastewater treatment for parts of Alameda and Contra Costa counties. Water is conveyed via gravity from the Mokelumne River (Pardee Dam) via gravity fed pipelines to EBMUD's service territory. Water is treated at one of 5 water treatment plants before being distributed. Geographically, the western portion of the service area is characterized by a plain that extends from Richmond to Hayward and from the shore of the Bay inland up into the Oakland/Berkeley Hills that rise to about 1,900 feet above sea level. | | |
| **Key Energy Drivers** | • Water Conveyance – Most water flow by gravity to EBMUD with some use of pumps to supplement flows, energy use depends on reservoir levels , water demands, rainfall and operations<br>• Water Treatment- Two water treatment plants use conventional technologies and utilize ozone disinfection. Three treatment plants use inline direct filtration.<br>• Water Distribution – Booster pumps are needed to distribute water to customer at elevations above about 250 feet | | |
| **Water Treatment Technologies** | Upper San Leandro and Sobrante (Water): Aeration, Coagulation, Flocculation, Sedimentation, Filtration, Disinfection, Ozonation, Flouridation, Corrosion Control<br>Orinda, Laffayette, and Walnut Creek (Water): Coagulation, Filtration, Disinfection, Flouridation, Corrosion Control | | |
| **Water Resources** | Imported Surface Water: 90%, Local Runoff: 10% | | |
| **Marginal Water Supplies** | Short Term – Surface Water<br>Long Term – Groundwater storage, Desalination | | |
| **Energy Service Provider** | PG&E | | |
| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
| | Raw Water Conveyance | 10 | 597 |
| | Water Treatment | 135 | 310 |
| | Water Distribution | 319 | 699 |

## Background Information

The East Bay Municipal Utility District (EBMUD) supplies water and provides wastewater treatment for parts of Alameda and Contra Costa counties on the eastern side of San Francisco Bay in northern California. EBMUD serves approximately 1.3 million people in a 325-square-mile area including Oakland, Berkeley, and Alameda. EBMUD is a publicly owned utility formed under the Municipal Utility District Act passed by the California Legislature in 1921. Table 1 summarizes information about the agency.

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water, Agricultural Water |
| **Hydrologic Region** | SF Bay Area |
| **Region Type** | Coastal |
| **Energy Service Provider** | PG&E |
| **DEER Climate Zone** | 3 (67%) and 12 (33%) |
| **Service Area Size (if available)** | 325 Sq miles |
| **Service Area Population (if available)** | 1,300,000 |
| **Number of Customers in 2005** | 391,216 |
| ***Residential*** | 363,980 |
| ***Commercial*** | 17,231 |
| ***Industrial*** | 2,578 |
| ***Institutional*** | 3,892 |
| ***Irrigation*** | 3,535 |
| **Distribution Topology** | Flat to Hilly |

Primary sources of information on East Bay Municipal Utility District – Water include: EBMUD's 2005 Urban Water Management Plan, EBMUD's 2008 Annual Report, water and energy data for 2008 provided by EBMUD and PG&E, and EBMUD's public website. A detailed list of references is located at the end of this section.

## Climate

Most precipitation normally falls between November and May and very little falls between late spring and late fall. EBMUD's service area receives precipitation in the form of rain while EBMUD's water source, the Mokelumne Basin, receives snow during the winter months. Table 2 summarizes climate data for both the service area and the basin.

### Table 2: EBMUD Climate Data

| | EBMUD Service Area | | Mokelumne Basin | | |
|---|---|---|---|---|---|
| Month | Average Rainfall (Inches) | Average Temperature (°F) | Average Precipitation (Inches) | Average Snow Depth (Inches) | Average Temperature (°F) |
| JAN | 5.53 | 49.9 | 8.93 | 58 | 27.5 |
| FEB | 4.73 | 53.7 | 7.92 | 76 | 27.7 |
| MAR | 3.78 | 55.3 | 7.08 | 73 | 28.8 |
| APR | 1.92 | 57.9 | 4.10 | 51 | 33.6 |
| MAY | 0.71 | 60.2 | 2.16 | 11 | 41.2 |
| JUN | 0.16 | 62.8 | 0.80 | 0 | 49.7 |
| JUL | 0.04 | 63.2 | 0.25 | 0 | 56.5 |
| AUG | 0.08 | 64.0 | 0.29 | 0 | 56.5 |
| SEP | 0.31 | 65.5 | 0.82 | 0 | 50.7 |
| OCT | 1.40 | 62.8 | 2.50 | 1 | 43.0 |
| NOV | 3.44 | 56.2 | 5.61 | 22 | 33.0 |
| DEC | 4.73 | 50.2 | 7.87 | 44 | 28.2 |
| **Totals** | **26.83** | **-** | **48.33** | **-** | **-** |

## Demographics
EBMUD serves a large urban area east of the San Francisco Bay including parts of Alameda County and Contra Costa County; including downtown Oakland. Significant growth is expected in the area over the next several decades. Table 3 shows population projections for the Bay Area and the EBMUD service area over the next twenty-five years.

### Table 3: Population Estimates and Projections

| | Number of People | | | | | |
|---|---|---|---|---|---|---|
| **Region** | **2005** | **2010** | **2015** | **2020** | **2025** | **2030** |
| EBMUD Service Area | 1,338,000 | 1,380,000 | 1,427,000 | 1,475,000 | 1,536,000 | 1,598,000 |
| Service Area Within Alameda County – Total | 489,000 | 503,000 | 523,000 | 543,000 | 564,000 | 581,000 |
| Service Area Within Alameda County – Unincorporated Areas | 38,000 | 38,000 | 39,000 | 40,000 | 40,000 | 41,000 |
| Service Area Within Contra Costa County – Total | 849,000 | 877,000 | 904,000 | 932,000 | 972,000 | 1,017,000 |
| Service Area Within Contra Costa County – Unincorporated | 132,000 | 136,000 | 138,000 | 140,000 | 143,000 | 146,000 |

Source: EBMUD 2005 UWMP

## Water Sources
EBMUD gets the majority of its water from the Mokelumne River, a surface water source fed by snowmelt, as illustrated in Figure 1. Additional water is obtained from local runoff in the EBMUD service area.

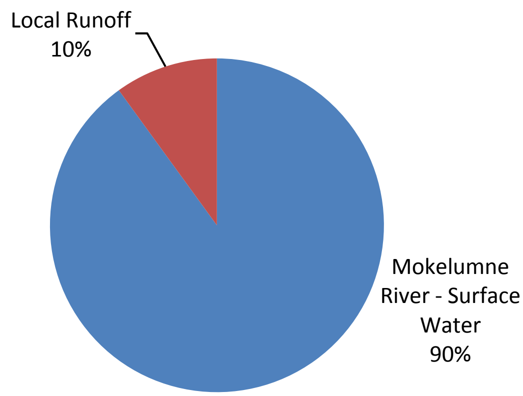



**Figure 1: Typical Distribution of Sources**

### Surface Water

In a typical year, 90 percent of EBMUD's water comes from the Mokelumne River. The river is fed by melting snow that accumulates in the Sierra Nevada Mountains during the winter months. Downstream, water is stored in two reservoirs, Pardee and Camanche, owned and operated by EBMUD.

The river's waters are shared with multiple water agencies. EBMUD has water rights that allows for a maximum delivery of 325 MGD from the river, subject to the availability of river runoff and senior water rights of other users. EBMUD's position in the hierarchy of Mokelumne water users is determined by a variety of agreements between Mokelumne water rights holders. Conditions that restrict EBMUD's ability to use its full entitlement include:

- Upstream water use by prior right holders.
- Downstream water use by riparian and senior appropriators and other downstream obligations, including protection of public trust resources.
- Variability in rainfall and runoff.

EBMUD diverts water from Pardee Dam and Reservoir located near Valley Springs in the Sierra foothills. Water diverted from Pardee Dam enters the Mokelumne Aqueducts; a 91-mile pipeline owned and operated by EBMUD to transport water from the reservoir to EBMUD's service area. Once in the service area, the aqueduct supplies the three inline treatment plants and three terminal reservoirs. Two of the terminal reservoirs supply the two conventional treatment plants while the third terminal reservoir (Briones) is able to supply water to the three inline treatment plants.

### Local Runoff

Local surface water feeds EBMUD's terminal reservoirs within its service territory. The availability of water from local runoff is dependent on hydrologic conditions in the local watershed and the amount of storage available for capturing local runoff. Because the East Bay reservoirs provide emergency standby storage and have limited runoff limited space is available to develop a reliable supply from local runoff. Average local supply is 15-25 MGD during normal hydrologic years and is much less during drought conditions.

### Marginal Water Supply

The Study Team had identified both short and long term marginal supplies for EBMUD. The short term marginal supply is surface water supplied from the Mokelumne River. Several long term marginal supply options have been identified by EBMUD.

EBMUD's short term supply is surface water received from the Mokelumne River. This source is the largest supply and EBMUD's only controlled supply. Should demand decrease or increase, its supply can be adjusted accordingly (within capacity and entitlement limitations). The energy intensity of marginal supply is summarized in Table, energy intensity includes the energy required for all facilities prior to water entering EBMUD's distribution system.

EBMUD has investigated several long term marginal supply options. Different supplies serve different purposes, these include: 1) increase base supply, 2) insure against shortages of current supply during dry years, 3) develop emergency interties in preparation for natural disasters. The Study Team considers actions to increase base supply as true "marginal supply." However, for purposes of completeness, the Study Team does describe the two other supply type options.

Options for marginal supply are listed below:

- EBMUD is investigating long-range options for combined use of groundwater and surface water sources beyond the EBMUD service area. Proposed groundwater storage would involve injecting surface water into a groundwater basin for subsequent recovery in drier years to supplement depleted surface water supplies. One option focuses on the East Contra Costa-Bixler Exploration to develop potential groundwater storage in partnership with local interests in the Bixler area and with San Joaquin County interests. The second option is continuing work on the San Joaquin Conjunctive Use Alternative in partnership with San Joaquin County water interests toward the development of a groundwater recharge/extraction project.
- EBMUD, SFPUC, Contra Costa Water District, and Santa Clara Valley Water District are jointly exploring the development of regional desalination facilities. Bay Area Regional Desalination would consist of one or more treatment plants to remove salt from seawater or other brackish water sources with a likely capacity of 20-80 MGD of potable water.
- The energy intensity range of EBMUD marginal supply is summarized below in Table 4. The energy intensity represents the embedded energy for all activities prior to the water entering EBMUD's distribution system.

### Table 4: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short Term | Mokelumne River[a] | 145 - 906 kWh/MG |
| Long Term | Groundwater[b] | 1,051 kWh/MG |
| | Desalination[c] | 12,276 kWh/MG |

a) Includes raw water pumping and treatment energy use
b) Study 1: Estimate for the San Francisco Region
c) Estimate obtained from California Sustainability Alliance, 2008.

EBMUD's actions to ensure water supply reliability in dry years include:

- The Freeport Regional Water Project (FRWP) – EBMUD is partnering with Sacramento County Water Agency (SCWA) and with the City of Sacramento. The project enables delivery of up to 100 MGD of water diverted from the Sacramento River near the town of Freeport to EBMUD customers during dry years and provides needed water for the Sacramento region as well.
- The Bayside Groundwater Project - Treated water from EBMUD's distribution system would be injected through the single well into the South East Bay Plain Basin (SEBPB) in wet years for later recovery through extraction and use during a drought. This provides for an annual 1 MGD

injection into an existing well with the potential future expansion of with up to four additional wells and up to 10 MGD.

In preparation for natural disasters, EBMUD recently completed an intertie with the San Francisco Public Utilities Commission (SFPUC). The intertie connects EBMUD with SFPUC and allows the agencies to provide the each other with mutual aid. If the EBMUD system were to experience an emergency, up to 30 MGD from the SFPUC through the City of Hayward could be provided to EBMUD. The Intertie provides an alternative water source during a natural disaster or a planned outage of critical facilities in either system on a short-term basis.

## Water Demand

EBMUD serves more than 390,000 customers, mostly residential, see Table 5. The number of customers is expected to grow significantly over the next few decades. Alameda and Contra Costa counties are projected to be among the top three counties in the area for growth in number of households through 2030. Additionally, downtown Oakland continues its revitalization and growth. Almost 45,000 households are projected to be added to Oakland between 2000 and 2030.

Single-family residential customer category is the largest water user in EBMUD by multi-family dwelling units, commercial, industrial, institutional and irrigation users; see Table 6. Approximately 63 percent of total water consumption, based on historical average, is delivered to EBMUD's residential customers.

According to East Bay Municipal Utility District estimates, the number of customers is expected to grow 12.6 percent from 2010 to 2030 increasing water demand by 3.6 percent. The majority of the increase in demand occurs from the Residential sector.

**Table 5: Historic and Projected Number of Customers by Type**

| Customer Type | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Residential | 363,980 | 372,938 | 395,908 | 418,878 | 420,278 | 421,679 |
| Commercial | 17,231 | 17,804 | 18,146 | 18,487 | 18,767 | 19,047 |
| Industrial | 2,578 | 2,606 | 2,641 | 2,676 | 2,713 | 2,749 |
| Institutional | 3,892 | 4,055 | 4,139 | 4,224 | 4,286 | 4,348 |
| Irrigation | 3,535 | 3,580 | 3,687 | 3,794 | 3,830 | 3,866 |
| **Total** | **391,216** | **400,983** | **424,521** | **448,059** | **449,874** | **451,689** |

**Table 6: Historic and Projected Water Demand (AF/Yr)**

| Customer Type | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Residential | 254 | 150 | 162 | 164 | 164 | 165 |
| Commercial | 19 | 16 | 17 | 17 | 17 | 17 |
| Industrial | 26 | 25 | 26 | 26 | 26 | 27 |
| Institutional | 10 | 11 | 11 | 11 | 12 | 12 |
| Irrigation | 12 | 11 | 11 | 10 | 10 | 11 |
| **Total** | **222** | **224** | **226** | **228** | **230** | **232** |

## System Infrastructure and Operations

EBMUD's water supply system consists of a network of reservoirs, aqueducts, water treatment plants, pumping plants, and distribution facilities. Raw water from Pardee Reservoir is transported approximately 91 miles through the Mokelumne Aqueducts to the terminal reservoirs and inline treatment plants. Water from the terminal reservoirs can be treated at one or more of the five water treatment plants and enters the distribution system. Table 7 is a summary of EBMUD's water supply infrastructure. Figure 2 and Figure 3 illustrate EBMUD infrastructure connections.

**Table 7: Infrastructure Summary**

| | |
|---|---|
| **Number of Reservoirs Operated** | 7 |
| **Miles of Distribution Piping** | 4,100 |
| **Number of Plants** | |
| ***Treatment*** | 5* |
| **Treated Water Tanks** | 170 |
| **System Wide Storage Capacity (Treated Water)** | 830 MG |
| **Number of Pump Stations** | |
| ***Raw Water*** | 5 |
| ***Treated Water*** | 140 |

* A 6th treatment plant (San Pablo WTP) exists though is a stand by plant that requires between 1-2 years lead time to be operational

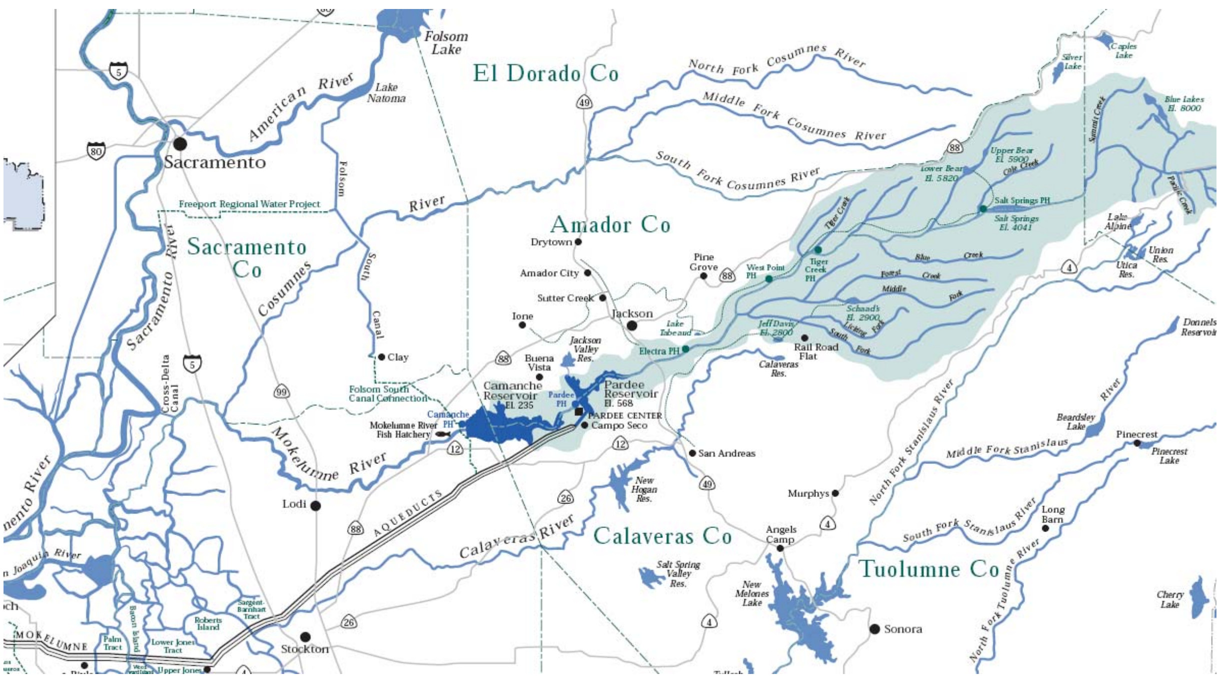



**Figure 2: Mokelumne River Watershed and Aqueduct**

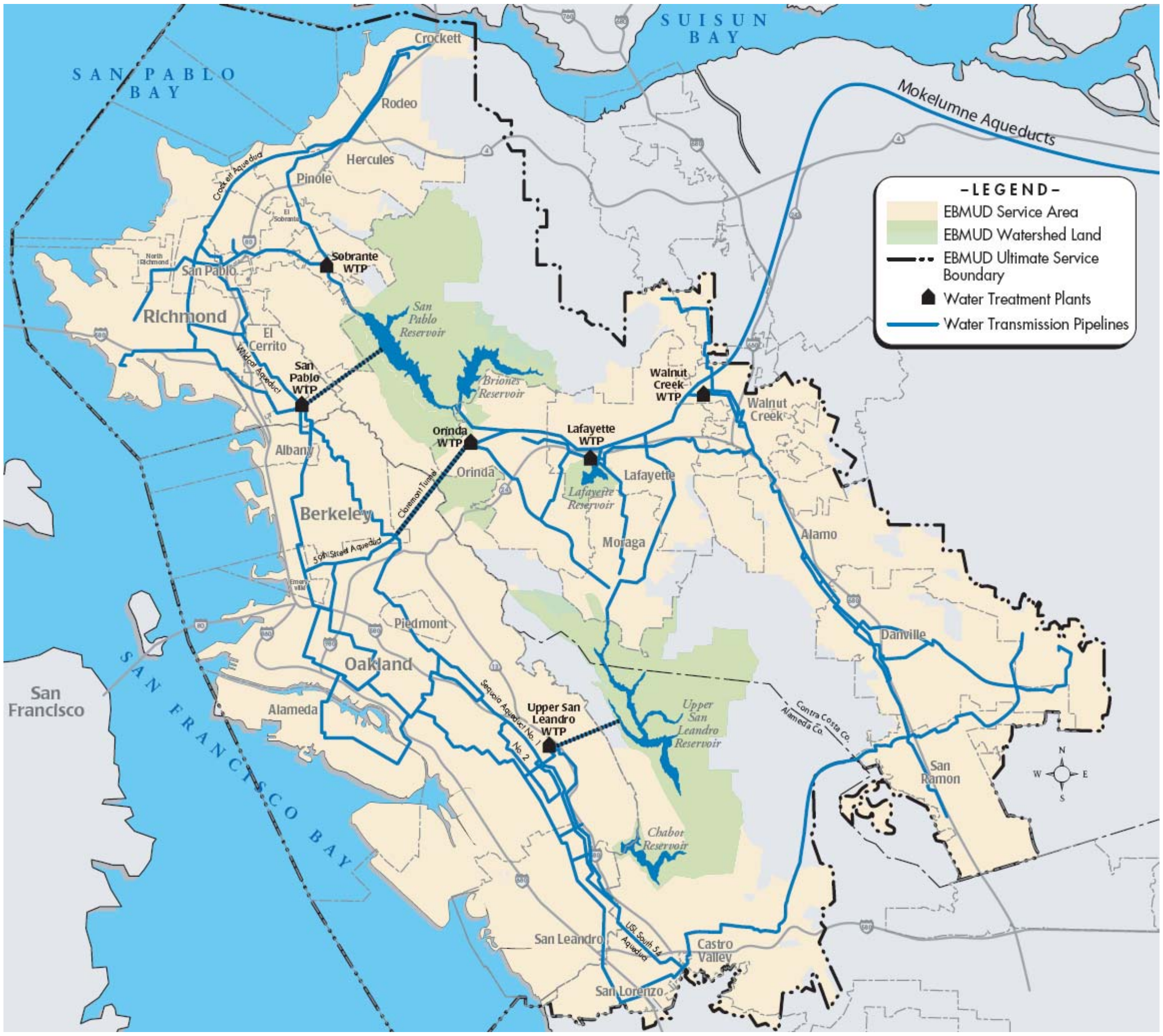



**Figure 3: EBMUD Water Treatment and Distribution Infrastructure**

### *Conveyance*

EBMUD operates Pardee Dam and Reservoir and Camanche Dam and Reservoir located on the Mokelumne River. In addition to storing water, the reservoirs are used for power generation. Pardee Dam's generators have a capacity of 23.6 MW and generate 140 GWH during an average year. Camanche Dam generators have a capacity of 10.8 MW and generate 40 GHH during an average year.

Raw water for EBMUD service area use is first diverted from Pardee Reservoir. It is transported through Pardee Tunnel, a 2.2-mile 8-foot-high structure, to the Mokelumne Aqueduct System near Valley Springs in Calaveras County. The Mokelumne Aqueducts are comprised of three steel pipelines and transport water about 81 miles from Pardee Tunnel to Walnut Creek at the east end of two Lafayette Aqueducts, which continue further about 7 miles to Orinda. Within the Mokelumne Aqueduct the three pipelines are 5 feet 5 inches, 5 feet 7 inches, and 7 feet 3 inches in diameter. Mokelumne Aqueduct No. 1, No. 2, and No. 3 were completed in 1929, 1949, and 1963, respectively. These steel pipelines have a capacity to carry a total of 200 MGD by gravity flow and up to 325 MGD with pumping at the Walnut Creek pumping plants.

Five raw water pump stations are used for conveyance. Three of these pumps are on the Moklumne aqueduct in Walnut Creek and can be used increase flows above 200 MGD, the limit for gravity flow. These pumps transport water to the EBMUD service territory. The other two pumps are used to pump raw water to two of the terminal reservoirs (Briones and USL Reservoir)

The San Pablo Reservoir helps regulate flows in the Mokelumne Aqueduct as diversions from Pardee Resevoir on a day-to-day basis may not match treated water demand. Table 8 summarizes the storage capacity and water sources for each terminal reservoir.

**Table 8: Terminal Reservoir Capacity and Water Sources**

| Reservoir | Capacity (TAF) | Water Sources |
|---|---|---|
| Briones | 60.5 | Mokelumne Aqueducts via the Briones PP, Bear Creek |
| Chabot | 10.4 | San Leandro Creek, Upper San Leandro Reservoir, Miller Creek |
| Lafayette | 4.3 | Lafayette Creek[a] |
| San Pablo | 38.6[b] | Mokelumne Aqueducts San Pablo Creek, Bear Creek, Briones Reservoir |
| Upper San Leandro | 38.0 | Mokelumne Aqueducts via the Moraga PP, San Leandro Creek and tributaries |

a) The raw water line for the Mokelumne Aqeducts was disconnected from the reservoir in 1971.

### *Treatment Plants*

EBMUD's five operating water treatment plants can filter and process more than 375 MGD. The water treatment plants are Upper San Leandro in Oakland, Sobrante in El Sobrante, and plants located in and named for Orinda, Lafayette and Walnut Creek. Each water treatment plant uses chlorination, fluoridation, and lime or sodium hydroxide. In addition, ozone is used for disinfection at Sobrante and Upper San Leandro. The capacities of the water treatment plants are shown in Table 9.

**Table 9: EBMUD Water Treatment Plant Capacity**

| Treatment Plant | Capacity (MGD) |
|---|---|
| Lafayette WTP | 25 |
| Orinda WTP | 190 |
| San Pablo WTP* | 30 |
| Sobrante WTP | 50 |
| Upper San Leandro WTP | 45 |
| Walnut Creek WTP | 90 |

* Stand by plant that requires between 1-2 years lead time to be operational

### *Distribution*

EBMUD distribution system serves a range of terrain from flat to hilly. The western portion of the service area is characterized by a plain that extends from Richmond to Hayward and from the shore of the Bay inland up the Oakland/Berkeley Hills. The Oakland Berkeley hills rise to about 1,900 feet. East, the terrain is characterized by rolling hills as the land descends to about 100 feet above sea level near Walnut Creek. Although much of the central area is hilly, it is undeveloped and comprises of the watershed lands of EBMUD's local reservoirs; the distribution system does not deliver significant amounts of water there.

Approximately 50 percent of treated water is distributed to customers by gravity. For those customers at higher elevations a system of distribution pumps is used to deliver water. In total, the distribution network includes 4,100 miles of pipe, 140 pumping plants, and 170 treated water storage tanks.

### System Storage

EBMUD has the capacity to store both raw and treated water. Raw water is stored along the Mokelumne River in Pardee (197,950 AF). Additionally, raw water is stored within EBMUD's service territory in three surface water reservoirs with a combined capacity of 151,000 AF (Chabot and Lafayette Reservoirs are not part of the raw water system). Treated water can be stored in tanks in the distribution system with a total capacity of 830 million gallons. The Study Team estimates treated water storage capacity can provide up to 4 days of average supply to EBMUD customers. The system is designed to supply up to 1.5 times the maximum daily demand.

### System-wide Operation Strategy

EBMUD supply is subject to precipitation in the Sierra Nevada Mountains. This requires unique operations compared to other retail water agencies. EBMUD determines its water supply availability in April the rest of the water year after final snow measurements are made in the Sierra Nevada's. Additional supply assessments are made as necessary during dry year periods. Using the April measurements, EBMUD forecasts the amount of remaining storage on September 30$^{th}$ (the end of the water year). If the forecast reveals there will be less than 500,000 AF of storage in September, water rationing/reduction goals are set to conserve supply. EBMUD operates with these guidelines to minimize the severity of rationing in subsequent years while meeting obligations for fishery flow releases and downstream agencies.

EBMUD's water treatment plants are sized to account for seasonal changes in water demand. Different water treatment plants operate for varying period of the year; two plants serve as "main" produces while the others supplement demand need in the summer when demands are greater. In 2008 Orinda WTP, EBMUD's largest facility was operated between 100 MGD to160 MGD. Walnut Creek WTP, the next largest facility, supplemented Orinda with low production in the winter time increasing production levels in the summer when demand increased. Lafayette, Sobrante, and Upper San Leandro WTP only produced water from March through November when high demand in the summer required additional supply.

The joint operation of treatment and raw water conveyance are done so such that terminal reservoirs maintain a 180-day supply of standby storage under normal conditions.

### Infrastructure Changes

No infrastructure changes were made aware to the Study Team that could affect 2008 water and energy data for EBMUD

## Energy Profiles

EBMUD provided energy and water flow data to the Study Team for its calculations of energy profiles; additional energy data was provided by PG&E. Energy data provided included monthly energy bills all facilities and interval data (15-minute time increment) for select large facilities. Water flow data was provided on a daily basis for all raw water pumps and all treatment plants. Water flows rates through individual booster pumps were not available. Thus the study team applied the total treated water delivery flow pattern to each booster pump station for energy profile calculation purposes.

The energy intensity of each facility type within East Bay Municipal Utility District - Water is presented in Figure 4. Intermittent raw water pumping operations subject to operation needs cause the large variance in energy intensity of raw water pumps. The majority of water is gravity fed from the Mokelumne River to EBMUD's service area; however additional flow is added by raw water pumps at times of need. Energy Intensity values for raw water pumping operations in June and July were removed as outliers. Discussion with EBMUD staff indicated raw water pumping tests were conducted during this time that caused the system to operate outside its normal range increasing energy use considerably.

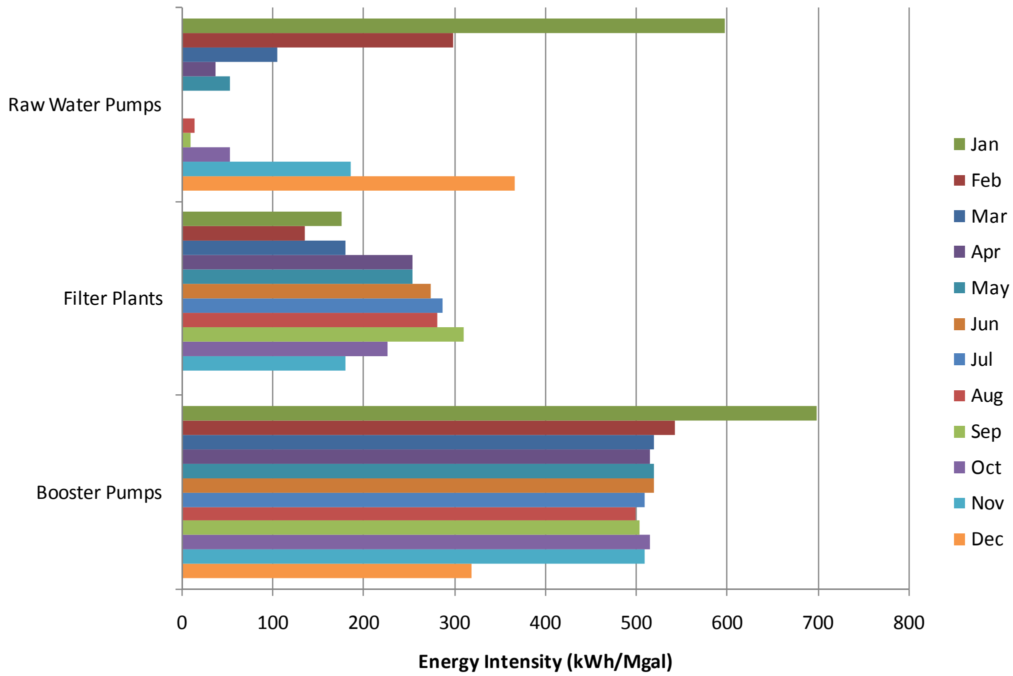
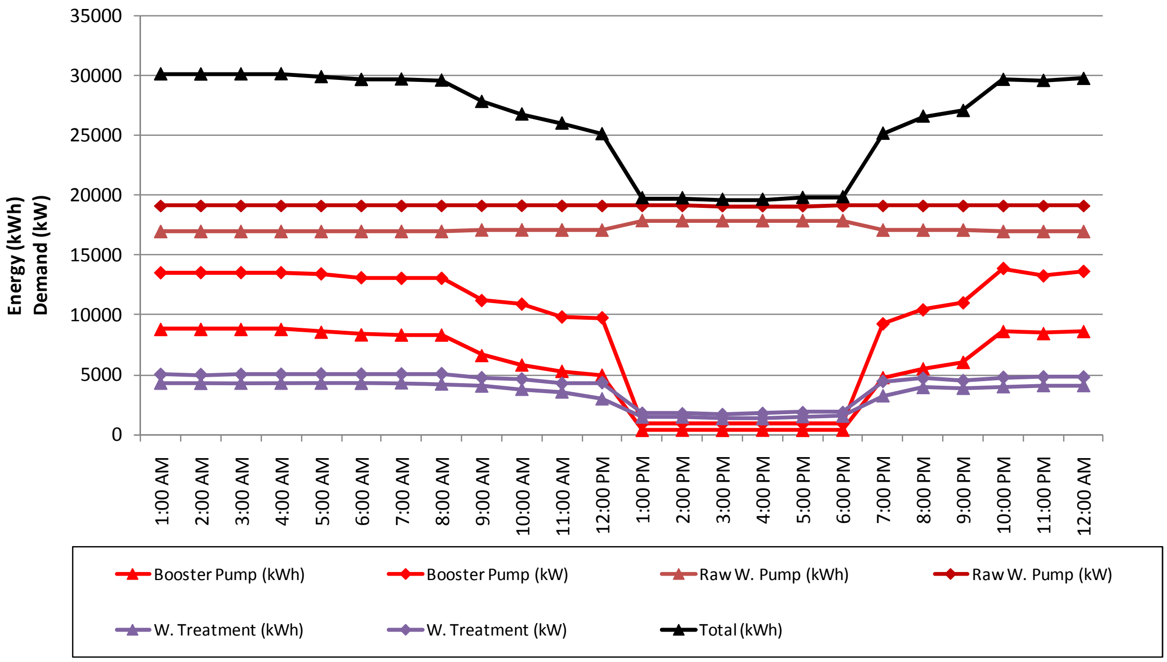



**Figure 4: EBMUD –Water Monthly Energy Intensity by Facility Type**

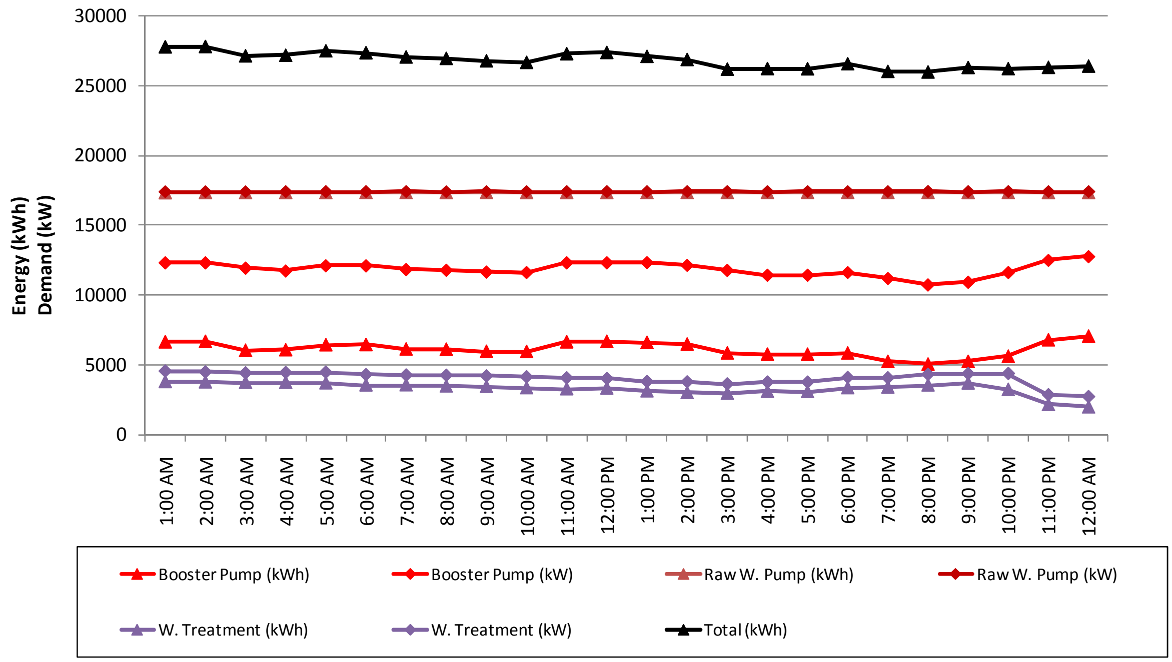
Hourly Energy profiles and peak energy demand is documented in Figures 5 through 11. The majority of energy used by EBMUD is for raw water pumps and booster pumps. Staff indicated that operations on two of the days that are graphed in these figures (7/8/08 and 6/21/08) do not necessarily reflect typical raw water pump operation. Raw water pumping energy was significantly higher than normal on these days because Walnut Creek pumps # 1, 2 & 3 were in operation simultaneous for a water rights pump test. Most of the time none of the Walnut Creek PP are in service, when the plant is operating only one or two units are in operation drawing between 3700 kW to 5200 kW.




| **Date** | 7/8/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 387 |
| *Raw Water Pump* | 17,899 |
| *Water Treatment* | 1,415 |

Note: EBMUD Staff indicated this day is not typical of a summer peak energy demand day. Raw water pumping energy was significantly higher than normal on this day because Walnut Creek pumps # 1, 2 & 3 were in operation simultaneous for a water rights pump test. Most of the time none of the Walnut Creek PP are in service, when the plant is operating only one or two units are in operation drawing between 3700 kW to 5200 kW, not 17,000+ KW as indicated in the graph.

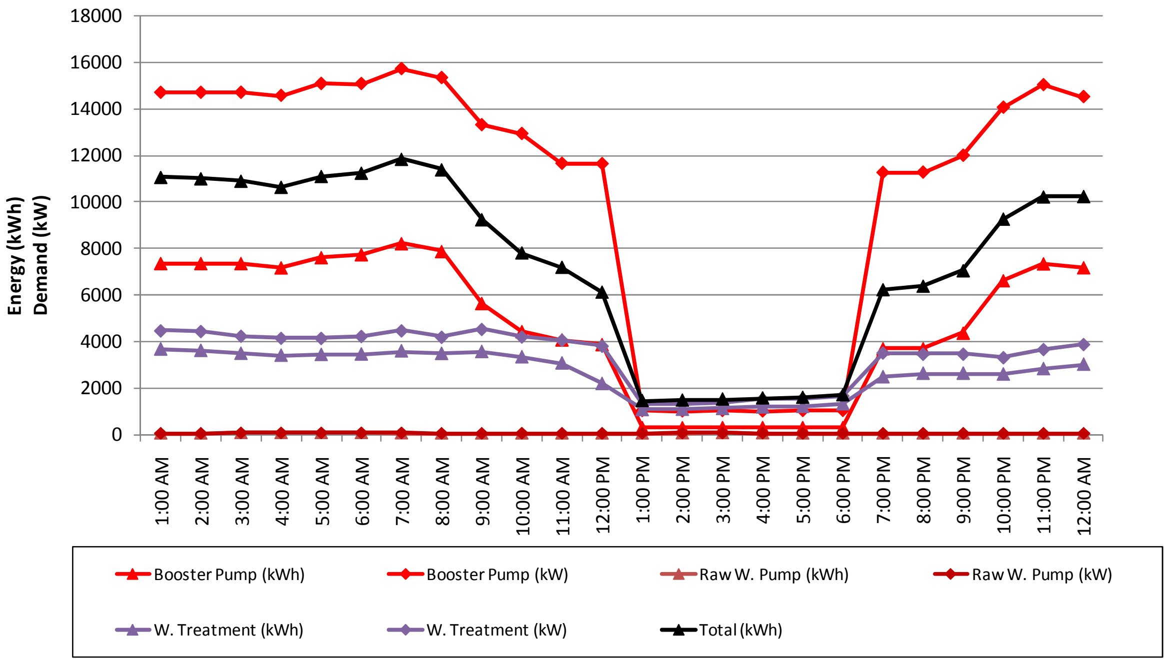
**Figure 5: 24-Hour Energy Profile: Summer Peak Energy Demand Day**




| | |
|---|---|
| **Date** | 6/21/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 7,590 |
| *Raw Water Pump* | 17,374 |
| *Water Treatment* | 3,038 |

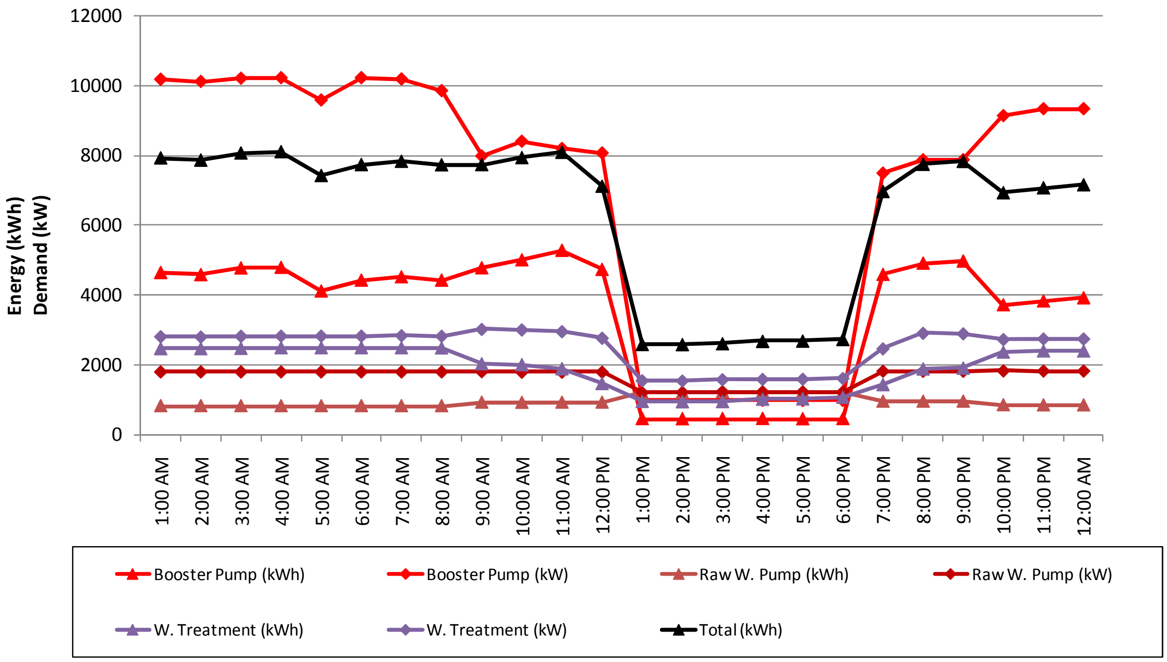
Note: EBMUD Staff indicated this day is not typical of a summer peak energy demand day. Raw water pumping energy was significantly higher than normal on this day because Walnut Creek pumps # 1, 2 & 3 were in operation simultaneous for a water rights pump test. Most of the time none of the Walnut Creek PP are in service, when the plant is operating only one or two units are in operation drawing between 3700 kW to 5200 kW, not 17,000+ KW as indicated in the graph.

**Figure 6: 24-Hour Energy Profile: Summer High Water Demand Day**



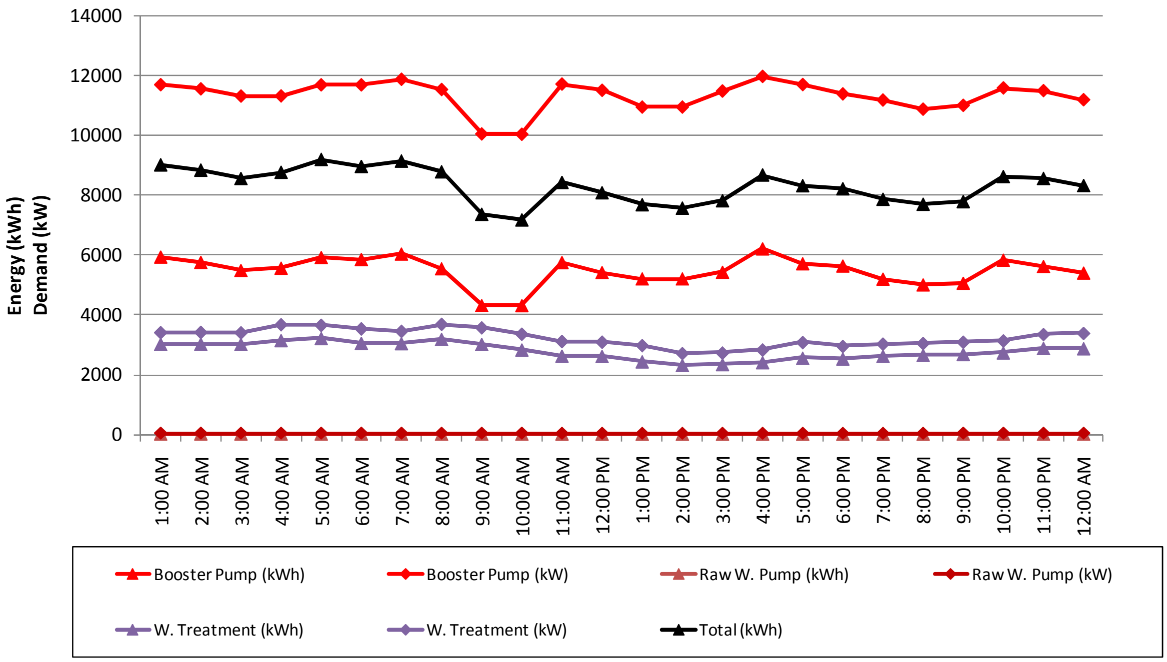

| **Date** | 8/4/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 332 |
| *Raw Water Pump* | 56 |
| *Water Treatment* | 1,184 |

**Figure 7: 24-Hour Energy Profile: Summer Average Water Demand Day**



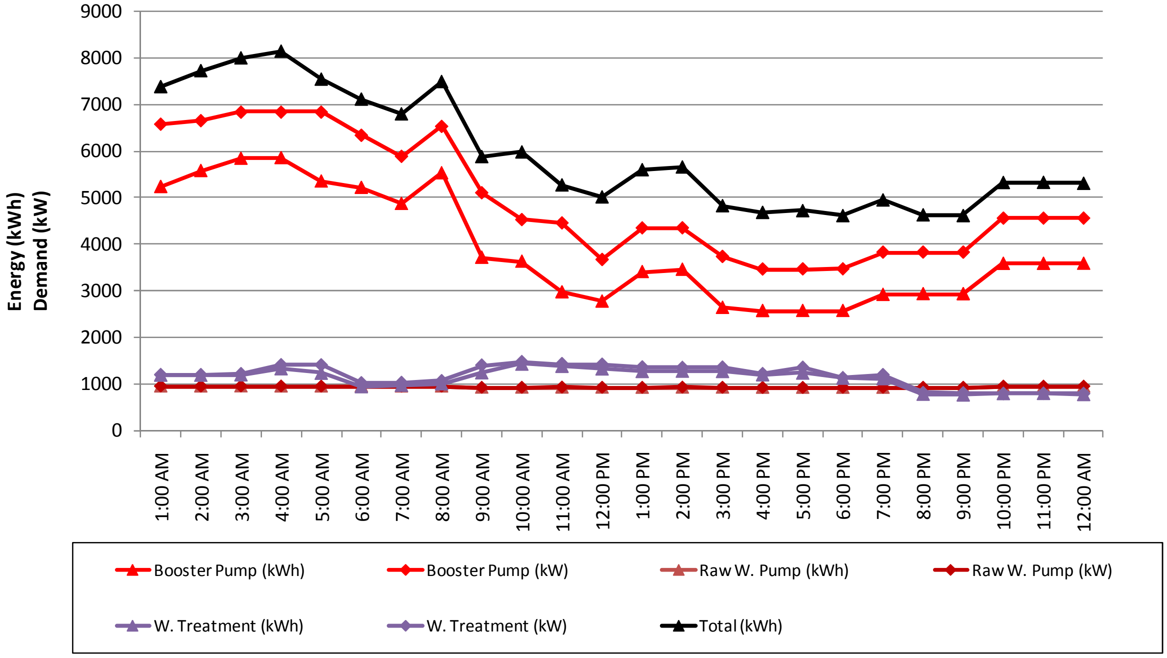

| | |
|---|---|
| **Date** | 10/31/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 478 |
| *Raw Water Pump* | 1,223 |
| *Water Treatment* | 994 |

**Figure 8: 24-Hour Energy Profile: Summer Low Water Demand Day**



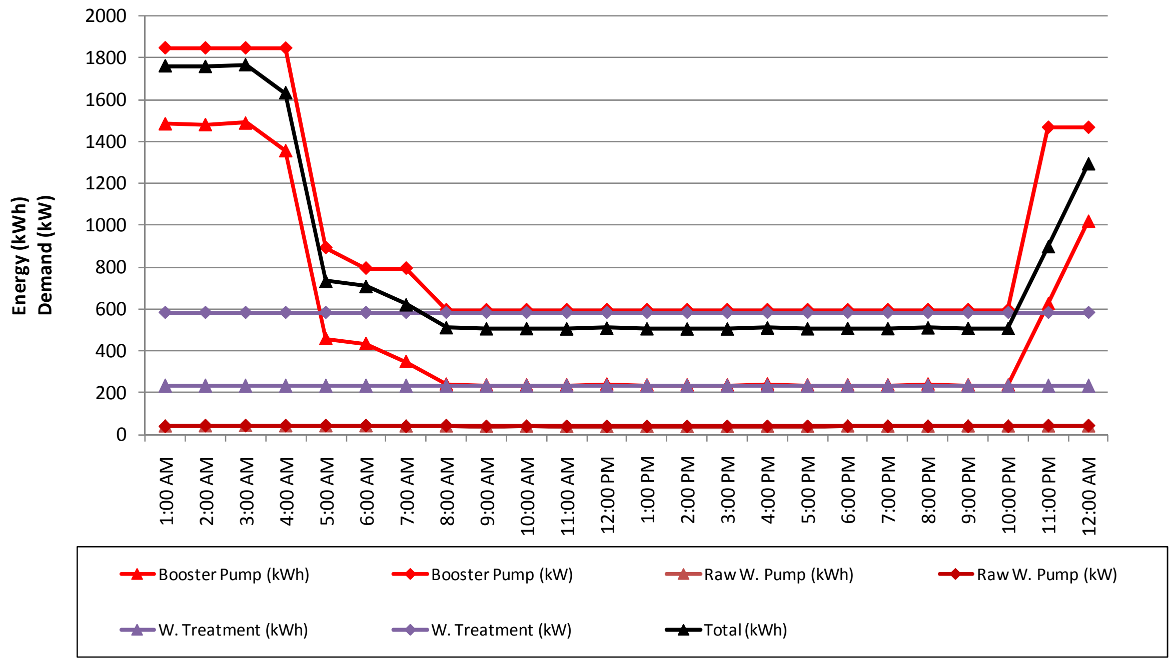

| | |
|---|---|
| **Date** | 4/27/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 7,262 |
| *Raw Water Pump* | 35 |
| *Water Treatment* | 2,446 |

**Figure 9: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 3/7/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 2,586 |
| *Raw Water Pump* | 920 |
| *Water Treatment* | 1,237 |

**Figure 10: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 12/27/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 236 |
| *Raw Water Pump* | 38 |
| *Water Treatment* | 234 |

**Figure 11: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

EBMUD operates an Energy Management System (EMS) for a portion of its distribution pumping system. The EMS operates in a section of the distribution system that covers approximately 20 percent of EBMUD's service territory and contains approximately 20 pumping plants. The system acts to optimize the coordinated operation of pumping and storage facilities to reduce on-peak energy use.

EBMUD generates power from solar panels at two of its facilities. These produce 640 MWh of energy annually to offset facility electricity. Additional solar installations and other sites are planned in the future.

## Sources

EBMUD. *All About EBMUD*. 2007

EBMUD. *Annual Report 2008*. 2008

EBMUD. EBMUD public website: http://ebmud.com/about_ebmud/. Accessed 12/22/2009.

EBMUD. *Urban Water Management Plan*. 2005

## Glenn-Colusa Irrigation District (GCID)

### Summary

| | | | |
|---|---|---|---|
| **Primary functions** | Agricultural Water | | |
| **Segments of Water Use Cycle** | Supply, Distribution | | |
| **Hydrologic Regions** | Sacramento River | **DEER Climate Zone** | 11 |
| **Quantity of water** | Maximum Contracted: 736.5 MGD<br>Non-Contract Water Right: 163.1 MGD | Recaptured: 0.138 MGD | |
| **Number of Customers** | Land Owners: 1,076<br>Tenant Water Users: 300 | **Service Area Size** | 273.4 Square miles |
| **Distinguishing Characteristics** | GCID is located in the central portion of the Sacramento Valley on the west side of the Sacramento River and is the largest irrigation district in the Sacramento Valley, encompassing approximately 273.4 square miles (175,000 acres), with rice as the predominant crop. The service area extends from northeastern Glenn County near Hamilton City to south of Williams in Colusa County. District boundaries also encompass the communities of Willows and Maxwell. GCID operates an aggressive recapture program that includes groundwater seepage and tailwater runoff from cultivated fields. | | |
| **Key Energy Drivers** | • Water Supply – Energy is used to pump water into GCID's main canal. Groundwater pumping account for a small portion of energy use.<br>• Recaptured Water Deliveries – Energy is used by pump systems that recapture water. | | |
| **Water/Wastewater Treatment Technology** | N/A – no treatment is needed as all deliveries are raw water | | |
| **Water Resources** | At maximum supply: 100% Local Surface Water | | |
| **Marginal Water Supplies** | Short Term: Current local surface water, groundwater<br>Long Term: Increasing drain water reuse, conjunctive use programs | | |
| **Energy Service Provider** | PG&E, PWRPA | | |

| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
|---|---|---|---|
| | Booster Pumps (Main Pump) | 39 | 116 |
| | Raw Water Conveyance (Relift) | 27 | 39 |

## Background Information

Glenn-Colusa Irrigation District (GCID) has been diverting Sacramento River water since 1883 and was one of the first large-scale water users within the Sacramento Valley. Table 1 summarizes background information about the GCID. GCID conveys Sacramento River water to 141,000 acres of valuable, productive agricultural land. In addition, GCID delivers water to 20,000 acres of critical wildlife habitat comprising the Sacramento, Delevan, and Colusa National Wildlife Refuges. GCID does not currently supply M&I water to any regions that overlie its service area. Rice is the predominant crop, accounting for approximately 85 percent of the District's irrigated acreage. Other important crops include tomatoes, orchards, vineseeds, cotton, alfalfa, and irrigated pasture. A district map for GCID is shown in Figure 1.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Agricultural Water |
| **Hydrologic Region** | Sacramento Valley |
| **Region Type** | Central Valley |
| **Energy Service Provider** | PG&E, PWRPA |
| **DEER Climate Zone** | 11 |
| **Service Area Size** | 273.4 square miles |
| **Service Area Population** | Not available |
| **Number of Customers in 2008** | 1,076 landowners; 300 tenant water users |
| **Distribution Topology** | Flat |

Primary sources of information on Glenn-Colusa Irrigation District include 2007 Sacramento Valley Regional Water Management Plan and GCID's public website. A detailed list of references is located at the end of this section.

### Climate

The Sacramento Valley is characterized by hot, dry summers and cool, wet winters. The average high and low temperatures in the summer are 95.4°F and 61.1°F, respectively and the average high and low temperatures in the winter are 54.3°F and 37.0°F, respectively. The total annual precipitation in the headwaters area of the Sacramento River averages between 60 and 70 inches per year. Most of the precipitation in the valley occurs during November through April.

### Demographics

GCID diverts water primarily for irrigation and environmental uses Table 2 (Irrigated Acreage) shows the 1995 normalized estimates of irrigated acreage for the primary crops grown within GCID's service area. The variation around these estimates (+/- percentage figures) was provided by GCID to account for typical variations in particular crop acreage (primarily due to year type), as well as anticipated future variation.

## Table 2: Irrigated Acreage

| Crop | 1995 |
|---|---|
| Rice | 99,300 (± 10%) |
| Grain | 5,500 (± 10%) |
| Alfalfa | 4,300 (± 10%) |
| Pasture | 4,100 (± 10%) |
| Tomatoes | 3,800 (± 10%) |
| Other | 13,200 (± 10%) |
| **Total Irrigated Acreage:** | **130,200 (± 10%)** |

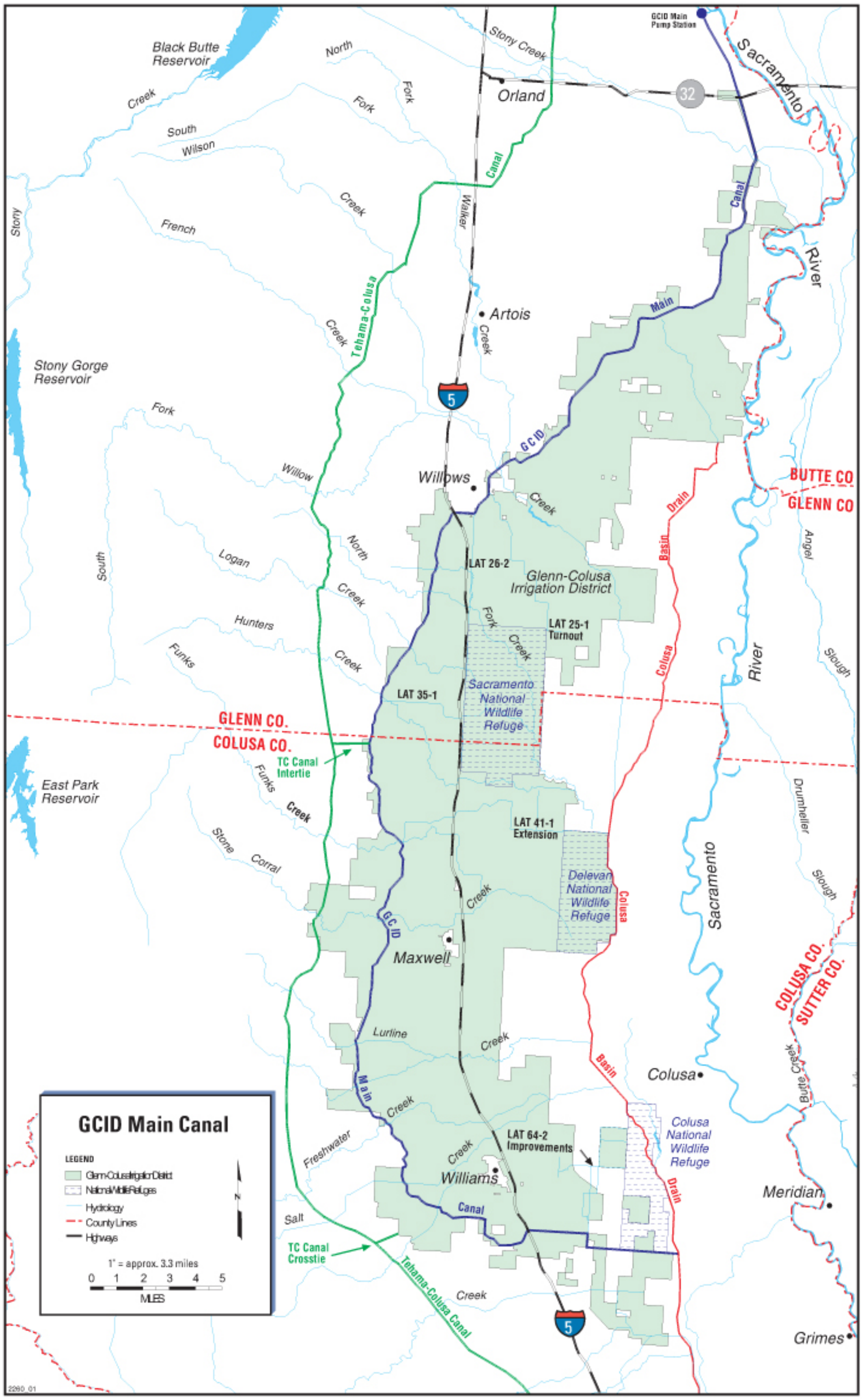



Figure 1: Glenn-Colusa Irrigation District Map

## Water Sources

GCID obtains its water primarily from the Sacramento River. GCID's recaptured water accounts for about 8 percent of its total supply. GCID has the ability to tap groundwater resources in dry water years, but this is an atypical supply source. Figure 2 below shows the approximate breakdown of supply sources. Their distributions can vary slightly year to year given availability of each source and demand.

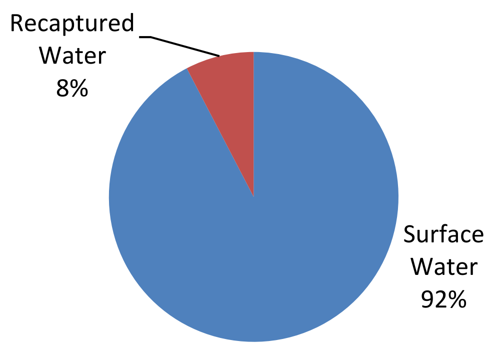



**Figure 2: Typical Distribution of Sources**

### Local Raw Surface Water

GCID holds rights to divert water from the natural flow of the Sacramento River; water rights specifications are shown in Table 2. Supplies from the Sacramento River run through a 65-mile long irrigation canal into a complex system of over 900 miles of laterals that drain to GCID's customers. GCID diverts a maximum of 3,000 cubic feet per second (cfs) from the river, with the peak demand occurring in spring.

**Table 2: GCID Water Rights**

| Source | Priority Date Application | Date (Permit) | Date (License) | Diversion Season | Maximum Quantity |
|---|---|---|---|---|---|
| **Sacramento River** | 3/3/15 | 10/20/15 | 5/14/47 | Mar 1 - Nov 1 | 110 cfs |
| **Sacramento River** | 12/3/19 | 12/14/20 | 3/20/65 | Apr 15 – Oct 1 | 83.27 cfs |
| **Sacramento River** | 1/14/20 | 12/14/20 | 3/30/65 | Apr 15- Nov 1 | 32.0 cfs |
| **Hunters Creek** | 5/28/36 | 8/17/36 | 1/14/59 | Apr 15- Oct 1 | 2 cfs |
| **Stone Corral Creek** | 10/8/47 | 12/20/50 | 4/24/56 | Apr 20- Sep 30 | 11 cfs |
| **Unnamed Stream Tributary to Funks Creek** | 3/12/68 | 9/10/68 | 4/23/76 | Primary: Apr 1- Jun 30 Secondary: Sep 1 to Dec 31 | 2 cfs 415 AF/yr |
| **Sacramento River** | 2/19/1999 | 5/16/2001 | Pending | Nov1-Mar 31 | 1,200 cfs 182,900 AF/yr |
| **Sacramento River** | NA | NA | NA | Apr 1- Oct 31 | 2,700 cfs |
| **Colusa Basin Drain** | NA | NA | NA | Apr 1- Aug 31 | 134 cfs |

The GCID surface water supply entitlement is currently addressed in a contract entered into with the Bureau of Reclamation in 1964, Contract No. 14-06-200-0855A (Contract No. 0855A). This contract provides for an agreement between GCID and the United States on the diversion of water from both the Sacramento River and Stoney Creek from April 1 through October 31 of each year. The contract remained in effect until March 31, 2006.

The contract specifies the total quantity of water that may be diverted each month during the period April through October each year. The monthly distribution of the Base and Project Supply is shown in Table 3. The contract identifies July and August as the critical months.

**Table3: GDIC Settlement Contract Supply**

| | Base Supply (ac-ft) | Project Supply (ac-ft) |
|---|---|---|
| Critical Months | 220,000 | 105,000 |
| Non-critical Months | 500,000 | 0 |
| **Total Annual** | **720,000** | **105,000** |

## Water Reuse

As a part of their overall management program, GCID operates an aggressive recapture program, which captures both subsurface flows (from system leakage and deep percolation recovered by open surface drains) and tailwater runoff from cultivated fields from within their service area. GCID recaptures this water with both gravity and pump systems. The captured water is delivered to either laterals or the main canal for reuse. Currently, GCID recycles approximately 180,000 acre-ft annually. Relatively small quantities of tailwater are available to GCID from areas outside of the District's boundaries.

## Groundwater

Groundwater is not included in GCID's current water supply. The GCID boundary lies within the Sacramento Groundwater Basin where the groundwater quality is generally good and sufficient for agricultural, domestic, and M&I uses. The total depth of freshwater aquifer in the GCID area is estimated at 900 to 1,500 feet below ground surface (bgs). The freshwater is underlain by saline water found in old marine units.

GCID groundwater use is generally limited because surface water supplies are often sufficient to meet demand. Groundwater use is primarily driven by climatic conditions. Historical trends show that groundwater levels in the GCID area are generally stable over the long term, although short-term fluctuations in groundwater levels are observed that can be correlated with precipitation trends. GCID manages and operates a voluntary groundwater conjunctive water management program to increase capacity when water supply does not meet demand.

## Marginal Water Supply

The Study Team identified both short-term and long-term marginal supplies for GCID. Short-term marginal supply includes local surface supply water. Long-term marginal supply is planned construction of a regulating reservoir, additional use of surface water, and a voluntary groundwater conjunctive use program that includes about 100 landowners and provides a combined capacity of approximately 500 cfs.

GCID is seeking funding to implement a conjunctive water use management program. The conjunctive water management program will provide GCID the flexibility to use groundwater resources (potentially up to 30,000 ac-ft) in lieu of surface water supplies when increased in-stream flows are required to meet water quality standards in the Sacramento Delta. GCID anticipates that construction of ten new, high-production groundwater wells may be required in the long term to meet their proposed contribution.

GCID is investigating the feasibility of constructing a 30,000 to 40,000 acre-foot regulating reservoir on the Colusa Basin Drain and is seeking funding to identify a footprint, establish general operational parameters, and evaluate environmental challenges for this proposed project. The reservoir would allow for the improved management of up to 50,000 acre-ft of water upon completion.

The energy intensity range of GCID's marginal supply is summarized in Table 4. The energy intensity represents the embedded energy for all activities prior to the water reaching customers.

### Table 4: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short Term | Local Surface Water[a] | 65-155 kWh/MG |
| Long Term | Groundwater[b] | 176-188 kWh/MG |
| | Increase Water Reuse & Conjunctive use programs[c] | 27-39 kWh/MG |
| | Increased Local Storage[d] | ~31 Kwh/MG |

a) Total EI for raw water pumping and distribution of local surface water from Study 2 results.
b) EI range estimated from Study 1 Groundwater analysis for the Sacramento River hydrologic region.
c) EI range for booster pumps (conveyance) from Study 2 results.
d) Proposed regulating reservoir on Colusa Basin Drain; EI estimated from Study 1.

## Water Demand

Agricultural

Land use within GCID's service area is primarily rice, due to the presence of fine-textured and poorly drained soils within the majority of GCID. Other key crops include alfalfa, tomatoes, and cotton. Water requirements are typically highest during the summer months (July and August) due to the requirements of rice and the area's hot, dry climate. Water needs are greatest early in the growing season for the flooding of rice fields. Although surface water is the primary source of irrigation water, groundwater is used in drought years on an individual grower basis, as well as per agreements with GCID.

Annual cropping patterns have remained fairly constant over the last few decades, other than in response to farm programs in the early 1980s. Associated water requirement needs and associated diversions have therefore been more a function of water-year type and climate than changes in cropping.

Table 5 shows 1995 normalized estimates of irrigated acreage estimates for the primary crops grown within GCID's service area, as well as projections for 2020.

**Table 5: GCID Irrigated Acreage- 1995 and 2020 Estimates**

| Crop | 1995 | 2020 |
|---|---|---|
| Rice | 99,300 (± 10%) | 99,100 (± 10%) |
| Grain | 5,500 (± 10%) | 5,000 (± 10%) |
| Alfalfa | 4,300 (± 50%) | 4,500 (± 50%) |
| Pasture | 4,100 (± 20%) | 3,300 (± 20%) |
| Tomatoes | 3,800 (± 40%) | 6,400 (± 40%) |
| Other Crops | 13,200 (± 10%) | 18,500 (± 10%) |
| **Total Irrigated Acreage** | **130,200 (± 10%)** | **136,800 (± 10%)** |

In response to increasingly stringent limitations on burning, many of GCID's landowners flood a portion of their fields to clear their land of leftover rice straw. GCID estimates that approximately 54,000 acres were flooded in 2004, a trend that is expected to continue or increase, assuming other options (including the sale of stubble for ethanol production) are not determined to be more economically feasible.

Urban

M&I water demand within the vicinity of GCID's service area is anticipated to increase only slightly, with additional annual water requirements in the year 2020 expected to increase by less than 10,000 acre-ft. This water is assumed to be groundwater.

Environmental

GCID conveys water to three National Wildlife Refuges (Sacramento, Delevan, and Colusa), encompassing approximately 22,500 acres. Water requirements for these three refuges total 105,000 acre-ft. GCID has recently upgraded its water system to better supply the refuges and provide year-round service. Additionally, GCID serves approximately 700 acres of privately owned duck clubs. Approximately 8,350 acres of riparian vegetation are estimated to be incidentally supplied by irrigation, including vegetation directly adjacent to delivery laterals or influenced by leakage from the delivery system.

## System Infrastructure and Operations

Tables 6 through 8 summarize the infrastructure operated by GCID. GCID's main facilities within its service area include a 3,000-cfs pumping plant and fish screen structure, a 65-mile main canal, and approximately 900 miles of lateral canals and drains that serve its approximately 175,000-acre service area. The pump station is situated on an oxbow off the main stem of the Sacramento River. Water flow passes through a 1,100-ft fish screen structure where a portion of it is pumped into GCID's main irrigation canal. The remaining flow in the oxbow passes by the screens and then back into the main stem of the Sacramento River. A large siphon was constructed on Stony Creek in 1998 among other siphons and cross-drainage structures in 1999 and 2000. GCID's water recapture system consists of 19 drain recapture pump stations and 18 gravity surface diversions that recapture about 180,000 acre-ft/year on average.

### Table 6: District Facilities

| Facilities | Capacity/ Size | Location |
|---|---|---|
| Pumping Plant | 3,000 cfs | Hamilton City Pump Station (Mile 1.4) Sacramento River |
| Fish Screen Structure | 1,200 ft. | Pumped into GCID's main irrigation canal |
| Main Canal | 3,000 cfs/65 miles | Hamilton City Pump Station |
| Lateral Canals | 900 miles | Laterals off of the Main Canal |

### Table 7: Diversion Facilities

| Facility | Water Source | Pump/ Gravity | Capacity (cfs) | Average Historical Diversion |
|---|---|---|---|---|
| Hamilton City Pump (mile 1.4) | Sacramento River | Pump | 3,000 | 659,900 |
| Tehama-Colusa Canal Intertie (miles 37.2) | Tehama-Colusa Canal | Gravity | 1,000 | 25,400 |
| Tehama-Colusa Canal Crosstie | Tehama-Colusa Canal | Gravity | 130 | 23,400 |

### Table 8: Conveyance System

| Facility | Source Facility | Capacity (cfs) | Lined | End Spill Location | % Leakage Loss Estimate |
|---|---|---|---|---|---|
| GCID Main Canal | Hilton City Pump Station | 3,000 | No | NA | 13 |
| River Branch Canal (Lateral 12-4) | GCID Main Canal at MCM 12.8/ 12.9 | 75 | No | Lower part of PCGID | 15 |
| Bondurant Slough (Drain A) | GCID Main Canal (48-inch Sluice Gate) | 200 | No | Colusa Basin Drain | 12 |
| Quint Canal (Lateral 21-2) | GCID Main Canal | 130 | No | Colusa Basin Drain (20-47 Drain) | 12 |
| Willow Creek | GCID Main Canal | 100 | No | Quint Canal | 12 |
| Lateral 25-1 | GCID Main Canal | 150 | No | Western Canal | 12 |
| Lateral 26-2 | GCID Main Canal | 130 | No | Sacramento National Wildlife Refuge | 10 |
| Lateral 35-1 | GCID Main Canal | 75 | No | Sacramento National Wildlife Refuge | 10 |
| Hunter Creek | GCID Main Canal | 75 | No | Logan Creek and Colusa Basin Drain | 10 (clay) |
| Lateral 41-1 | GCID Main Canal | 140 | NO | Delevan National Wildlife Refuge, | 10 (clay) |
| Stone Corral Creek | GCID Main Canal | 50 | No | Delevan, Maxwell, and Colusa Basin Drain | <10 |
| Lateral 45-1 | GCID Main Canal | 43 | No | Kulh Weir-MID | 11 |
| Lateral 48-1 (Lurline Creek System) | GCID Main Canal | 100 | No | CDMWC and MID | 12 |
| Lateral 49-2 | GCID Main Canal | 100 | No | CDMWC and MID | 12 |
| Lateral 51-1 | GCID Main Canal | 100 | No | CDMWC Colusa Drain | 12 |
| Salt Creek System | GCID Main Canal | 50 | No | Joins Freshwater Creek and goes into Colusa Drain | 10 (can gain water) |
| Lateral 64-1 | GCID Main Canal | 80 | No | Colusa National Wildlife Refuge | 10 |
| Lateral 56-1 | Tehama-Colusa Canal Crosstie | 130 | No | Spring Creek/ Salt Creek System | 10 |

## System Storage

GCID currently has no significant storage facilities.

## System-wide Operation Strategy

GCID diverts water from the Sacramento River at its Main Pump Station into the Main Canal for agricultural and wildlife refuge deliveries. GCID diverts contracted water from April through October for agricultural irrigation and delivers water to wildlife refuge land year round from the Main Canal. GCID has a water right permit to divert 182,900 acre-ft during the non-contract period of November through March. GCID's overall operations strategy is to first meet demand with local surface water diversions, and to supplement demand with groundwater through conjunctive-use programs during dry water years.

### Infrastructure Changes

No known major changes to infrastructure during the study period of calendar year 2008.

## Energy Profiles

GCID provided the Study Team with permission to use energy and water flow data collected for a previous study conducted by GEI/NCI in 2008 (PWRPA Load Forecasting) for its calculations of energy intensity and load profiles. Energy data included interval data (15-minute time increment) for their main pump station and relift facilities. Water flow data was provided on a monthly basis as a total for the main pump station and all relift pumps. Water flow rates through individual booster pumps were not available. The Study Team applied the total treated water delivery flow pattern to each booster pump station for energy profile calculation purposes.

Energy is provided to GCID through the Power and Water Resource Pooling Authority (PWRPA), a publically owned utility (POU). PWRPA is a joint powers authority comprised of nine irrigation districts to manage individual power assets and loads.

The energy intensity of each facility type within Glenn-Colusa Irrigation District is presented in Figure 3.

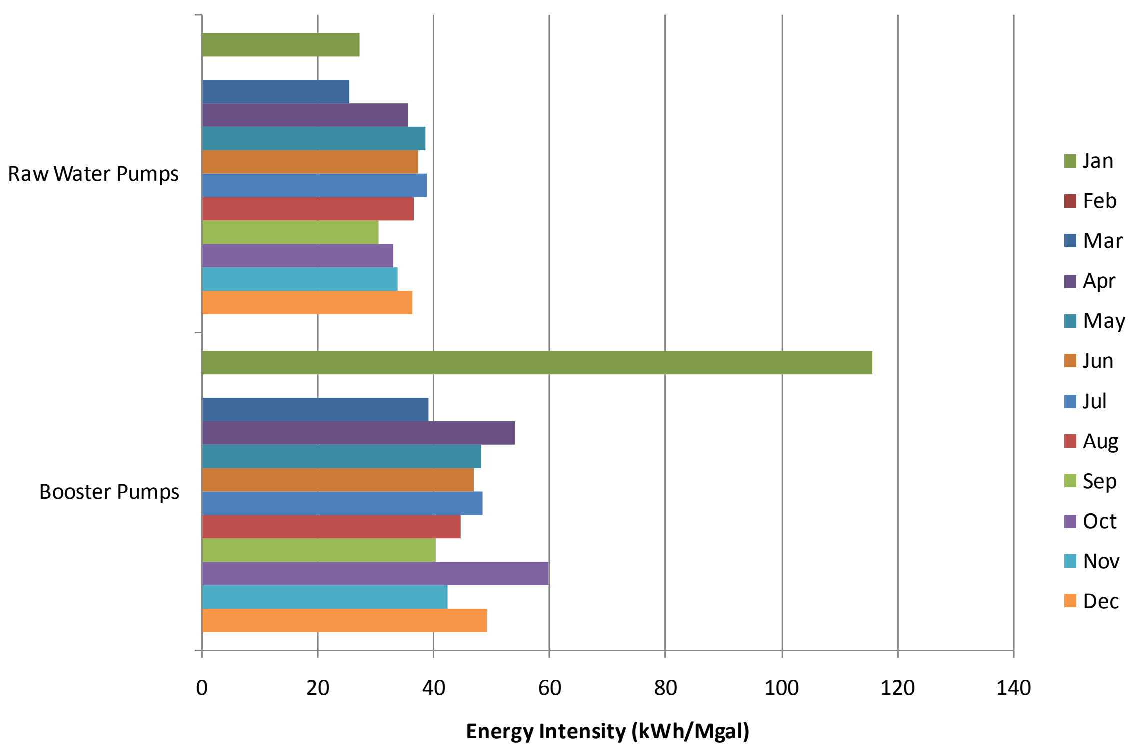
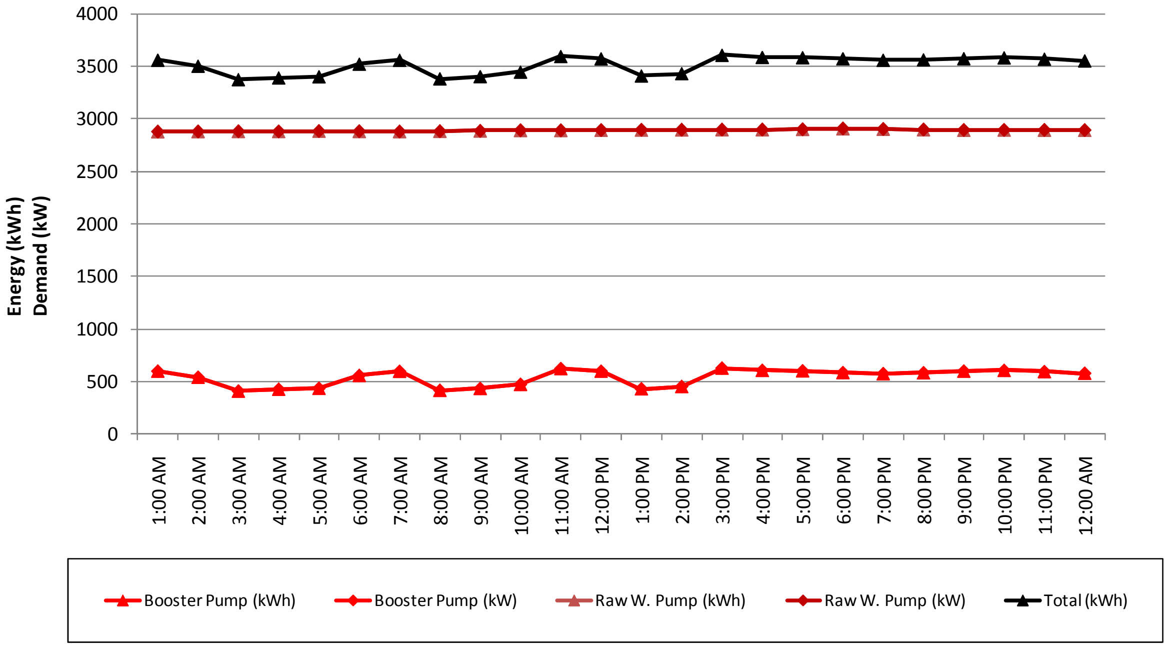


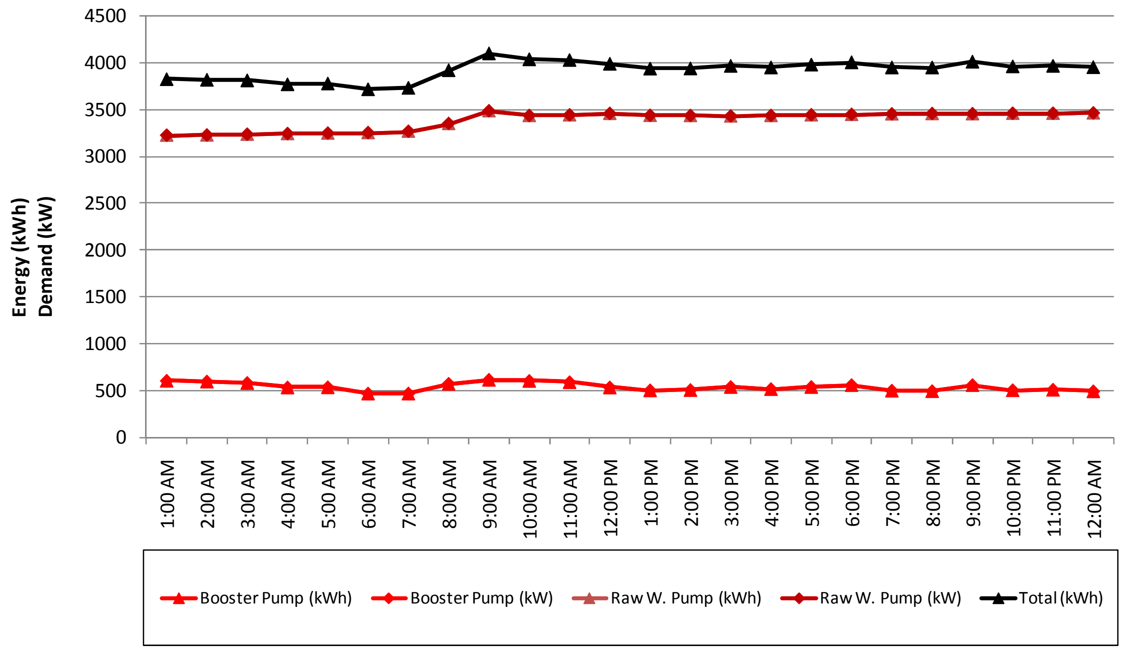

**Figure 3: GCID Monthly Energy Intensity by Facility Type**

Hourly energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by Glenn-Colusa Irrigation District is for the Main Pump (Hamilton City Pump) which draws raw water from the Sacramento River into the main canal.



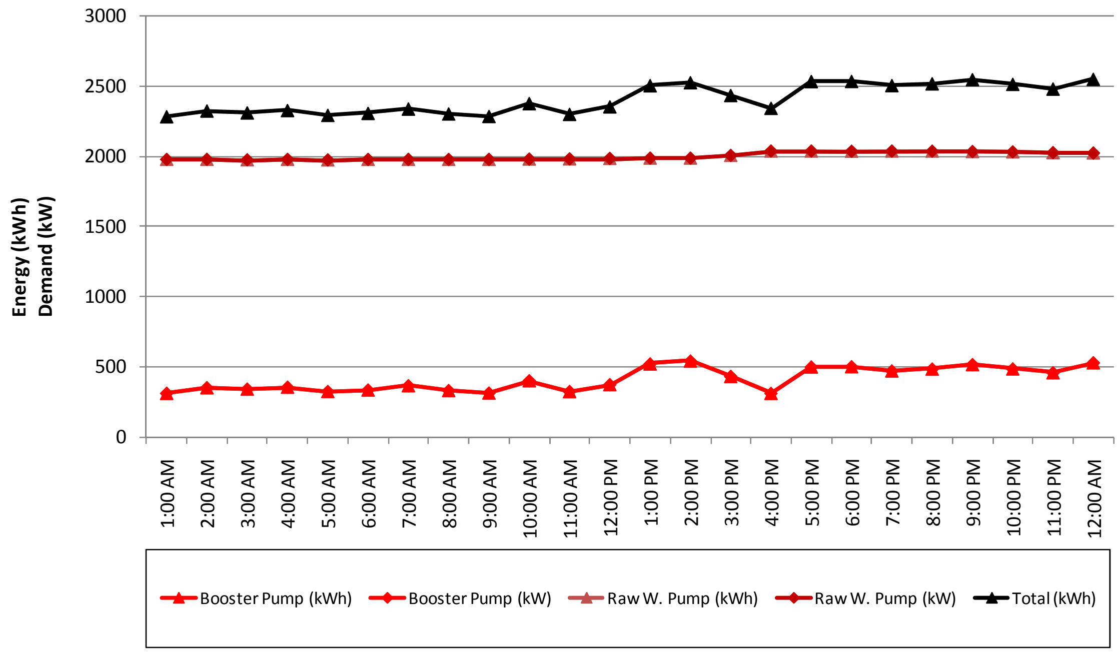

| | |
|---|---|
| ***Date*** | 7/8/2008 |
| ***Day*** | Tuesday |
| ***Peak Demand (kW)*** | |
| *Booster Pumps* | 612 |
| *Raw Water Pump* | 2,899 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



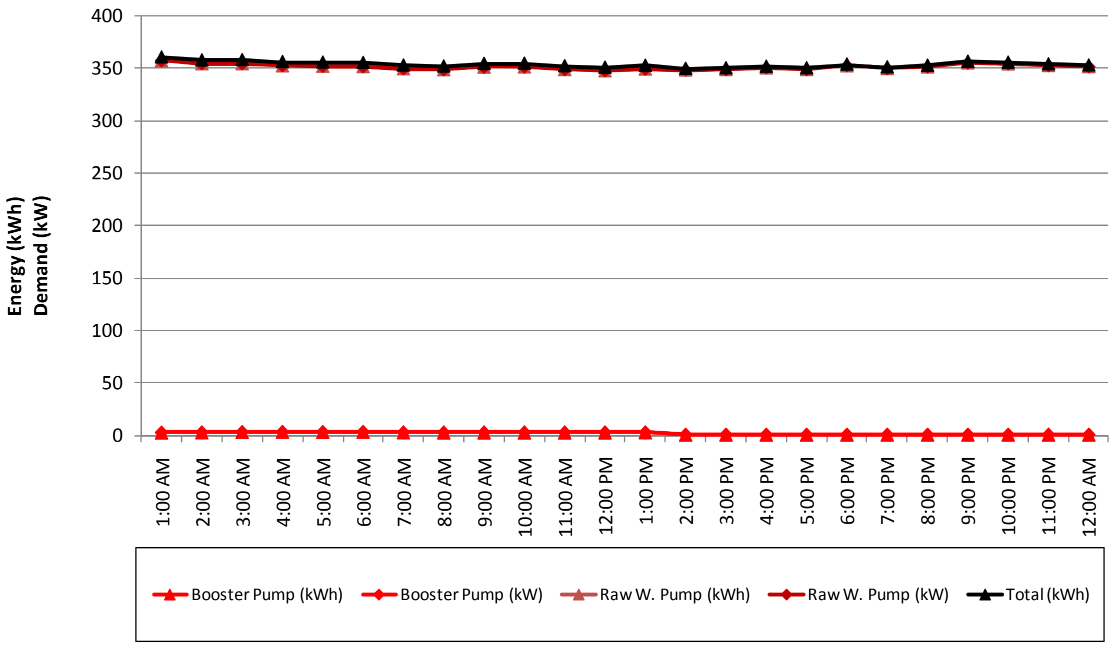

| | |
|---|---|
| **Date** | 5/1/2008 |
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 531 |
| *Raw Water Pump* | 3,435 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



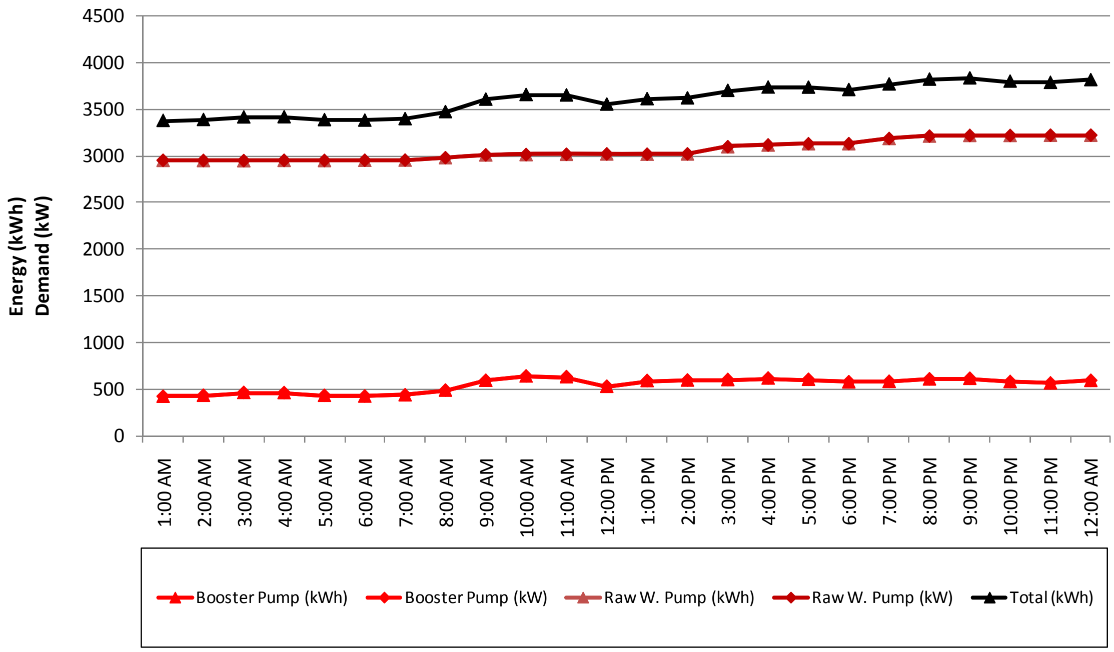

| | |
|---|---|
| **Date** | 6/6/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 414 |
| *Raw Water Pump* | 2,025 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



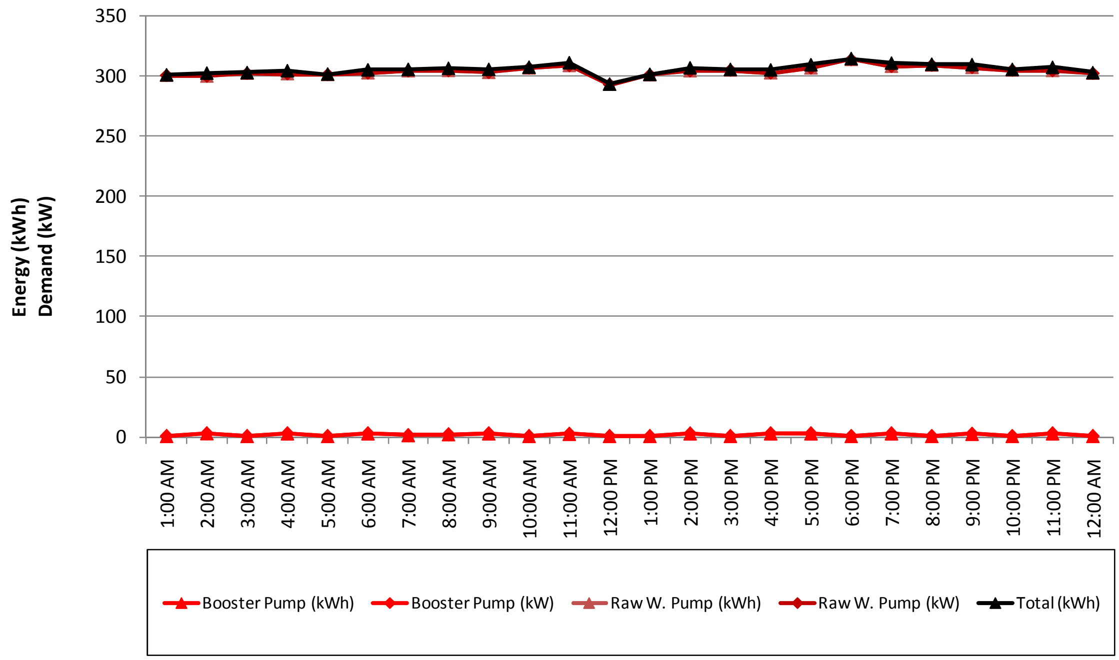

| | |
|---|---|
| **Date** | 9/21/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1 |
| *Raw Water Pump* | 350 |

Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day



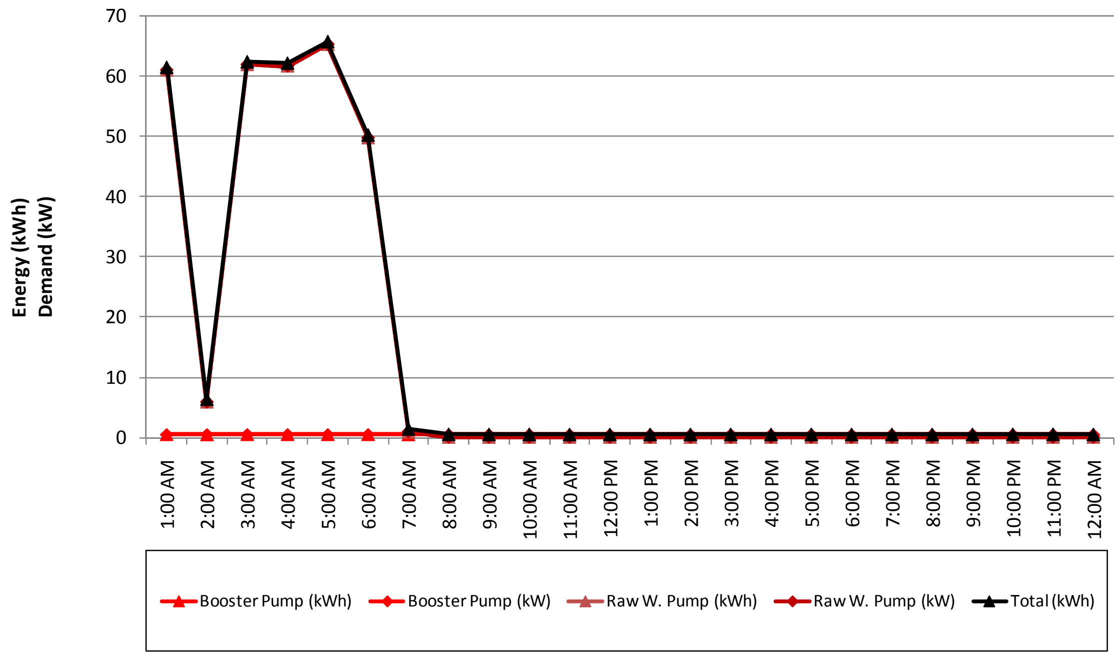

| | |
|---|---|
| **Date** | 4/30/2008 |
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 604 |
| *Raw Water Pump* | 3,116 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| **Date** | 1/24/2008 |
|---|---|
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 2 |
| *Raw Water Pump* | 305 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 3/10/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 0 |
| *Raw Water Pump* | 0 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

GCID's recapture program is to collect groundwater seepage and tailwater runoff from cultivated fields and recirculate it back into the system for reuse. The recapture infrastructure includes 19 drain recapture pump stations that recapture an average of 76,000 acre-ft per season and 18 gravity surface diversions that recapture an average of 180,000 acre-ft per season.

GCID has been modernizing its facilities to create a canal system with automated control and monitoring, including motor-operated radial and slide gates, water-level and flow measurement at key points in the system, and integrated SCADA to match supplies and demands throughout the system. GCID also has an ongoing program to increase coverage of the SCADA system and to automate remaining major flow control structures. Five major control structures on the main canal require replacement and modernization.

## Sources


Sacramento Regional Water Management Plan, January 2007

Glenn-Colusa Irrigation District Website, Background Section (http://www.gcid.net/WhoWeAre.html)

## Inland Empire Utilities Agency (IEUA)

### Summary

| | |
|---|---|
| **Primary functions** | Wholesale, Wastewater, Recycled Water, Urban Potable Water |
| **Segments of Water Use Cycle** | Supply, Water Treatment, Wastewater Treatment, Recycled Water Production |
| **Hydrologic Region** | South Coast; **DEER Climate Zone**: 10 |
| **Quantity of Water and Wastewater (2005)** | Total Water Supplied: 64.4 MGD<br>Recycled Water Supplied: 7.2 MGD[a]<br>Wastewater Treated: 60 MGD |
| **Number of Customers (2005)** | Retail Water Agencies: 8<br>Wastewater Contracts: 7<br>**Service Area Size**: 242 Sq miles |
| **Distinguishing Characteristics** | Inland Empire Utilities Agency (IEUA) is a municipal water District that delivers supplementary, imported, and recycled water within its service area as well as provides regional wastewater treatment services with domestic and industrial disposal systems and energy/production and composting facilities. IEUA is a member agency of MWD and imports water for distribution to its customers. Water supply is supplemented by recycled water and brackish water desalination. |
| **Key Energy Drivers** | • Wastewater Treatment- Water is treated to tertiary standards<br>• Recycled Water Deliveries – recycled water distribution pumps are required to deliver water to customers.<br>• Water Treatment – brackish water desalination using reverse osmosis consumes significant energy |
| **Water/Wastewater Treatment Technologies** | Carbon Canyon, Regional Plant (RP) #1, #4, #5 (Recycled Water): Preliminary, primary, secondary, tertiary (see "System Infrastructure and Operations" section for more details<br>Regional Solids Plant #2 (biosolids handling) and RP #1: Thickening; dewatering; anaerobic digestion; biosolids conditioning.<br>Chino Desalter (owned by Chino Desalting Authority) - Reverse Osmosis |
| **Water Resources** | MWD Imports: 25%, IEUA<br>Recycled Water: 3%<br>Brackish Desalination: 2%<br>Groundwater (Non-IEUA): 63%<br>Local Surface Water (Non-IEUA): 7% |
| **Marginal Water Supply** | Short-term: Recycled Water<br>Long-term: Recycled Water, Brackish Water Desalination |
| **Energy Service Provider** | SCE, SCG |

| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Value** | **Upper Value** |
|---|---|---|---|
| | Wastewater Collection | 44 | 44 |
| | Recycled Water Production Total | 2,103 | 2,122 |
| | *Primary Treatment* | 454 | 462 |
| | *Secondary Treatment* | 1,207 | 1,220 |
| | *Tertiary Treatment* | 125 | 126 |
| | Recycled Water Distribution | 752 | 914 |
| | Brackish Water Desalination | 3,819 | 3,945 |

a) Rapid growth in recycled water use has occurred since 2005. Production in 2009 ranges from 21-45 MGD.

## Background Information

Inland Empire Utilities Agency (IEUA) was formed in 1950 to supply supplemental water to the region via imports from MWD. IEUA is a member agency of MWD. Since its formation, IEUA has expanded to become a recycled water purveyor, biosolids/fertilizer treatment provider, and a leader in water supply salt management, for the purpose of protecting the region's vital groundwater supplies. IEUA's 242 square mile service area is located in the southwest corner of San Bernardino County, approximately 35 miles east of Los Angeles. It serves a mostly flat valley that slopes from north to south at a one- to two-percent grade. Valley elevation ranges from about 2,000 feet in the foothills below the San Gabriel Mountains to about 500 feet near Prado Dam. IEUA provides regional wastewater service and imported water deliveries to eight contracting agencies. Additional information on IEUA is available in Table 1.

Primary sources of information on IEUA include: IEUA's 2005 Urban Water Management Plan, IEUA's public website, 2008 water and energy data provided by IEUA, and interviews with IEUA staff. A detailed list of references is located at the end of this section.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Wastewater, Recycled Water, Wholesale |
| **Hydrologic Region** | South Coast |
| **Region Type** | Desert |
| **Energy Service Provider** | SCE |
| **DEER Climate Zone** | 10 |
| **Service Area Size** | 242 Sq miles |
| **Service Area Population (2005)** | 814,000 |
| **Number of Contractors in 2005** | |
| ***Water*** | 8 |
| ***Wastewater*** | 7 |
| **Distribution Topology** | Flat to Moderate |

### Climate

IEUA's service area is located within the desert climate zone of southern California. The region receives an average annual rainfall of about 15 inches. Monthly average temperatures range from a low of 67 degrees in January to a high of 95 degrees in July. Daily records show summer temperatures have been as high as 114 degrees.

### Demographics

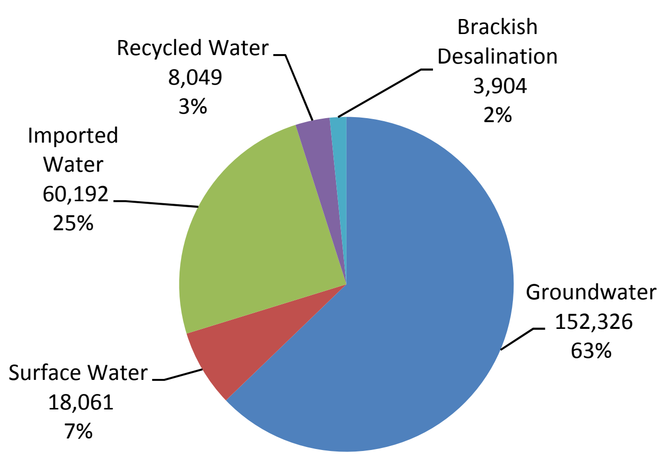
The population within IEUA's service area is expected to continue to grow over the next twenty years, but at a lower average annual rate of increase than experienced in the last fifteen years. Table 2 indicates the service area population is expected to increase 24 percent from 2010 to 2025 to approximately 1,108,349 people; an annual growth rate of 1.6 percent. The largest growth in population is expected in the City of Ontario.

**Table 2: Historic and Projected Population within IEUA's Service Area**

| Community | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| Chino | 71,668 | 78,715 | 91,090 | 114,978 | 124,476 | 126,646 |
| Chino hills | 66,787 | 77,819 | 80,126 | 81,916 | 83,636 | 85,284 |
| Fontana | 148,928 | 174,968 | 179,426 | 195,373 | 211,105 | 226,186 |
| Montclair | 46,049 | 54,930 | 59,600 | 66,750 | 71,250 | 76,000 |
| Ontario | 158,394 | 172,408 | 203,811 | 225,385 | 248,424 | 273,047 |
| Rancho Cucamonga | 142,743 | 178,855 | 203,870 | 220,180 | 233,400 | 242,700 |
| Upland | 70,393 | 73,235 | 73,600 | 73,700 | 73,800 | 73,900 |
| San Antonio (unincorporated) | 3,238 | 3,238 | 3,281 | 4,290 | 4,413 | 4,586 |
| **Total** | **708,200** | **814,168** | **894,804** | **982,572** | **1,050,504** | **1,108,349** |

## Water Sources

IEUA contractors obtain their water from multiple sources; IEUA only provides a portion of this water. IEUA provides imported water, recycled water, and desalinated brackish water. Customers obtain the rest of their supply from groundwater (the majority of their supply) and local surface water.




Notes:
1. IEUA only provides imported water, recycled water and desalinated brackish water to its customers.
2. Rapid growth in recycled water use has occurred since 2005, exact data was not available. Production in 2009 ranges from 21-45 MGD.

**Figure 1: IEUA Contractor 2005 Distribution of Supply (AF)**

### Imported Water

Imported water from northern California, delivered through the State Water Project (SWP), is purchased by IEUA from MWD for wholesale distribution to the retail agencies within IEUA's service area. While MWD distributes water from both the State Water Project and from the Colorado River to its member agencies, IEUA uses only State Water Project water due to salinity concerns within the Chino Basin. SWP water destined for IEUA arrives via the SWP East Branch. MWD takes delivery of water from SWP after Devil Canyon Power Plant.

### Recycled Water

IEUA operates four regional recycled water plants that produce disinfected and filtered tertiary treated recycled water in compliance with California's Title 22 regulations. In aggregate, these facilities currently produce over 70,000 acre-feet of recycled water. IEUA wholesales disinfected tertiary recycled water to eight contracting agencies as well as multiple customers in its northern service area.

Recycled water is put to various uses including irrigation of golf courses and parks, supply for the Prado Regional Park Lake, recharge the Chino Basin aquifer, releases to the Santa Ana River, cooling water for Reliant's Etiwanda power generating station, and distribution to the City of Chino and the City of Chino Hills industries and business. Distribution of recycled water is high in the summer and low in the winter.

### Brackish Groundwater Desalination

The Chino I Desalter was constructed in 2000 through a Joint Participation Agreement among five agencies: the Santa Ana Watershed Project Authority, Western Municipal Water District, Orange County Water District, Metropolitan Water District of Southern California, and IEUA. The facility was built in part to remove salt and nitrates as well as prevent poor quality water from the Chino groundwater basin from moving down the watershed into Orange County groundwater basins. The facility currently produces 10,000 acre-feet per year of which approximately 9,000 acre-feet is used for potable purposes, serving an estimated 20,000 families within the cities of Chino and Chino Hills.

In 2002, the Chino Basin Desalter Authority, a Joint Powers Authority comprised of the cities of Chino, Chino Hills, Ontario, and Norco, the Jurupa Community Services District, and the Santa Ana River Water Company, was formed to manage the operation of this facility.

### Groundwater

While IEUA does not directly or solely manage the Chino Groundwater basin, it is the largest supply for IEUA contractors. IEUA's service area includes much of the Chino Groundwater Basin. Water rights within the Chino Basin were adjudicated in 1978. Management of the Chino Groundwater Basin is guided by the 2000 "Peace Agreement" of the Chino Basin Optimum Basin Management Program. The Chino Basin Watermaster has held oversight responsibilities for the groundwater basin since its formation in 1978 with the adjudication of water rights.

Historically, Chino Basin Watermaster has purchased imported water from MWD (through IEUA) to provide replenishment water when pumping exceeds the safe yield of the basin. New sources of replenishment water now include local storm water and recycled water developed through the Chino Basin Groundwater Recharge Program. In addition, groundwater is re-allocated for urban use when it is not pumped by the agricultural users. Over time, as agricultural production declines within the IEUA service area, the reallocation of groundwater is expected to increase.

Groundwater quality in the lower Chino Basin is poor, as nitrates and Total Dissolved Solids (TDS) exceed drinking water standards. Other water quality concerns include the presence of perchlorate, volatile organic chemicals and other contaminants in the Chino groundwater. Some of the contaminants are from natural sources (such as arsenic). Other contaminants were introduced by human activities, including weapons testing, the use and inappropriate disposal of solvents, and the application of fertilizer products. The Chino Basin Watermaster is working in partnership with the cities, retail agencies, private groundwater pumpers, IEUA, and Santa Ana Regional Water Quality Control Board (SARWQCB) to address these water quality problems and increase the water supplies available from the groundwater basin. This partially promoted the construction and operation of the Chino Desalter operated by IEUA. Local groundwater supplies from basins other than the Chino Groundwater Basin represent a significant supplemental source of water for the retail water agencies within IEUA's service area.

IEUA's retail agencies that use groundwater from all or some of these basins include the City of Upland, Cucamonga Valley Water District, Fontana Water Company, and the San Antonio Water Company. Water from these basins also yield supplies for the City of Pomona, Southern California Water Company, West End Consolidated Water Company, Jurupa Community Services District, Western Municipal Water District, and West San Bernardino County Water District.

### Marginal Water Supply

The Study Team indentified both short-term and long-term marginal supplies for IEUA. Short-term marginal supply includes recycled water while long-term marginal supply includes both recycled water, brackish water desalination, and capture and storage of storm water. IEUA is making a significant investment in order to reduce dependence on imported water. These include capital expenditures of about $200 million dollars for recycled water projects over the next 10 years, $50 million dollars for construction of recharge basins, $190 million for brackish water desalination (to be spent by the Chino Desalting Authority), and $ 27.5 million for the storage of imported water for extraction in dry years.

As demand for water increases in the short-term, IEUA expands its recycled water distribution system. IEUA's four wastewater treatment plants produce tertiary treated water that could be used for recycled water purposes. Aggressive growth in recent years has connected many more customers; increasing use of recycled water from approximately 7,000 AF in 2005 to 27,000 AF in mid-2009 an finally to 50,000 by 2011.

In the long-term, IEUA's plans for brackish water desalination and recycled water will help meet regional goals of reduced dependence on imported water. IEUA identified the increased use of groundwater pumping from the Chino Groundwater Basin as a critical element of water management strategies for meeting future water needs within its service area. The water extracted in excess of the annual safe yield, will be replenished from a mix of storm water, recycled water, and imported water during wet year periods. IEUA's part in this effort is to develop additional desalting capacity and recycled water capacity to aid in recharge operations.

Additional desalting capacity will be developed in the southern portion of the Chino Groundwater Basin. These facilities will provide hydraulic control in the Chino Basin, ensuring that poor quality groundwater from this area does not migrate out of the Chino Basin and contaminate groundwater basins in Orange County. In addition, they will produce new reliable water supplies to meet demand within IEUA's service area. A facility with a treatment capacity of 40,000 AF is being discussed as a potential alternative supply in ten to fifteen years.

Recycled water supplies are currently expanding and IEUA plans to continue expanding through 2025. Water supplied through IEUA's Regional Recycled Water Program will serve the area's needs for irrigation and industrial process water as well as provide replenishment water for the Chino Groundwater Basin in conjunction with local storm water and imported deliveries. IEUA planned capacity expansion of recycled water is summarized in Table 3.

**Table 3: Historic and Projected Recycled Water Supply (AF)**

| | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| Recycled Water Production (AF/yr) | 4,700 | 8,400 | 61,000 | 74,000 | 86,000 | 104,000 |

The energy intensity range of IEUA's marginal supply is summarized in Table 4. The energy intensity represents the embedded energy for all activities prior to the water reaching IEUA's customers.

**Table 4: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Recycled Water[a] | 0 kWh/MG |
| Long-term | Recycled Water[a] | 0 kWh/MG |
| | Brackish Desalination | 3,819-3,945 kWh/MG |

a) IEUA's treatment standards require tertiary treatment of wastewater regardless of whether is it used for recycled water purposes or released as effluent. Consequently, the incremental energy needed to produce recycled water is nil.

## Water Demand

The overall trend in the area's water demand in the past ten years has been one of growth, reflecting the increase in population and resulting urban uses. However, in 2005, the trend towards increasing water usage was reversed despite significant growth in population over the five year period, see Table 5. Two reasons can be attributed to this decrease: 1) fiscal year 2005 was the second wettest year on record in the region (within the last hundred years) and 2) regional conservation programs were significantly expanded during the five-year period. All of the water used for urban purposes is distributed through the eight retail water agencies that serve the population within the area. Water used for agricultural purposes is pumped directly from private wells.

**Table 5: 1995-2005 Water Demand Use within IEUA's Service Area (AF/yr)**

| Year | Urban Use | Agricultural Use | Total |
|---|---|---|---|
| 1995 | 171,869 | 35,966 | 207,835 |
| 1996 | 193,553 | 32,941 | 226,494 |
| 1997 | 197,219 | 31,814 | 229,033 |
| 1998 | 172,412 | 30,775 | 203,187 |
| 1999 | 191,577 | 32,336 | 223,913 |
| 2000 | 220,884 | 30,993 | 251,877 |
| 2001 | 203,026 | 27,397 | 230,423 |
| 2002 | 210,150 | 27,878 | 238,028 |
| 2003 | 216,745 | 28,429 | 245,174 |
| 2004 | 229,461 | 31,790 | 261,251 |
| 2005 | 214,189 | 30,000 | 244,189 |

Within the urban sector, more than half (57 percent) of the water used within IEUA's service area in 2005 was for single family homes. The remaining demand is divided among non-residential (commercial/industrial) uses (20 percent), multifamily (11 percent), and unmetered uses and system losses (12 percent).

According to IEUA estimates, water demand is expected to grow 20 percent from 2010 to 2025 (Table 6) while population grows 24 percent during the same time (Table 2). The largest increase in demand occurs in the City of Ontario and Cucamonga Valley Water District. Demand for agricultural uses is expected to fall.

### Table 6: Historic and Future Projected Water Demand (AF)

| Contractor/Customer | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| City of Chino | 15,764 | 18,400 | 21,900 | 26,200 | 29,900 | 30,100 |
| City of Chino Hills | 17,333 | 16,726 | 22,700 | 24,700 | 25,400 | 26,400 |
| City of Ontario | 46,420 | 43,000 | 61,300 | 66,600 | 76,600 | 84,300 |
| City of Upland | 23,038 | 22,000 | 22,500 | 22,500 | 22,600 | 22,600 |
| Cucamonga Valley Water District | 51,831 | 51,500 | 65,400 | 72,500 | 79,500 | 86,000 |
| Fontana Water Company | 44,317 | 46,600 | 52,000 | 57,000 | 62,700 | 66,000 |
| Monte Vista Water District | 11,924 | 12,463 | 13,200 | 14,100 | 14,800 | 15,500 |
| San Antonio Water Company | 10,257 | 3,500 | 3,600 | 3,400 | 3,400 | 3,500 |
| **Subtotal** | 220,884 | 214,189 | 262,600 | 287,000 | 314,900 | 334,400 |
| **Agricultural Demand** | 30,993 | 30,000 | 22,000 | 15,000 | 7,000 | 7,000 |
| **Total Demand** | 251,877 | 244,189 | 284,600 | 302,000 | 321,900 | 341,400 |

## System Infrastructure and Operations

IEUA operates and maintains a complex system of treatment plants and distribution pipelines. IEUA's system includes four wastewater/recycled water treatment plants (water reclamation facilities), a biosolids handling facility, a brackish water desalination facility, and a system of recycled water distribution pumps. The four reclamation facilities are designed to reclaim wastewater received from the eight member agencies and have a total combined design treatment capacity of 84 MGD. Each facility includes the necessary treatment technology to produce recycled water that can be beneficially used pursuant to the State of California, Title 22 regulations. Table 7 summarizes IEUA infrastructure.

### Table 7: Infrastructure Summary

| | |
|---|---|
| **Number of Wastewater Collection Pumps** | 2 |
| **Number of Plants** | |
| ***Brackish Desalting*** | 1 |
| ***Wastewater*** | 4 |
| ***Solids Handling*** | 1 |
| **Total Wastewater Treatment Capacity** | 84 MGD |

### *Brackish Water Treatment Plants*

The Chino I Desalter was constructed in 2000 through a Joint Participation Agreement among five agencies: the Santa Ana Watershed Project Authority, Western Municipal Water District, Orange County Water District, Metropolitan Water District of Southern California and IEUA. The desalter is located in Chino. It was originally built to produce 10,000 AF/yr, but has been expanded to produce 15,900 AF/yr.

Groundwater is pumped from 14 wells throughout the Chino Basin area to the desalter where it is treated using reverse osmosis. This water is then pumped into the municipal water supply systems for the cities of Chino, Chino Hills, and Norco, and into the Jurupa Community Services District water system. The Chino Desalter Plant produces 14 MGD of treated water and 2 MGD of concentrated brine. The brine is transported by a regional brine pipeline where it is subsequently treated and discharged to the Pacific Ocean.

In recent years the Chino II Desalter became operational, increasing total desalination capacity to 24,600 AF/yr. Limited information was available to the Study Team on this facility.

### *Wastewater Collection Pumps*

IEUA's service area is generally flat sloping downhill north to south at a one to two percent grade; thus, the majority of the wastewater collection system is gravity fed. Two lift stations are employed in the wastewater collection system, one of these is used to move wastewater between Carbon Canyon Wastewater Reclamation Facility and Regional Plant No. 1 to manage flows and respond to changes in recycled water demand. Another lift station is used to divert water from RP-1 to RP-4. A pump station is also used to transport non-reclaimable water to the Los Angeles County Sanitation District for further treatment.

### *Wastewater/Recycled Water Treatment Plants*

Regional Water Reclamation Plant No. 1 (RP-1) is located in the City of Ontario. This facility was originally commissioned in 1948 and has undergone several expansions to increase the design wastewater treatment capacity to the current 44 MGD and biosolids treatment capacity equivalent to a wastewater flow rate of 60 MGD. This facility serves the Cities of Ontario, Rancho Cucamonga, Upland, Montclair, Fontana, and an unincorporated area of San Bernardino County. RP-1 employs the following treatment technologies; preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, tertiary treatment and biosolids handling. RP-1 uses digestion to generate biogas and power onsite electric generation; the electricity is used to power the plant. These processes are illustrated in Figure 2. Additionally, RP-1 has an array of solar panels to partially meet energy demand by the plant.

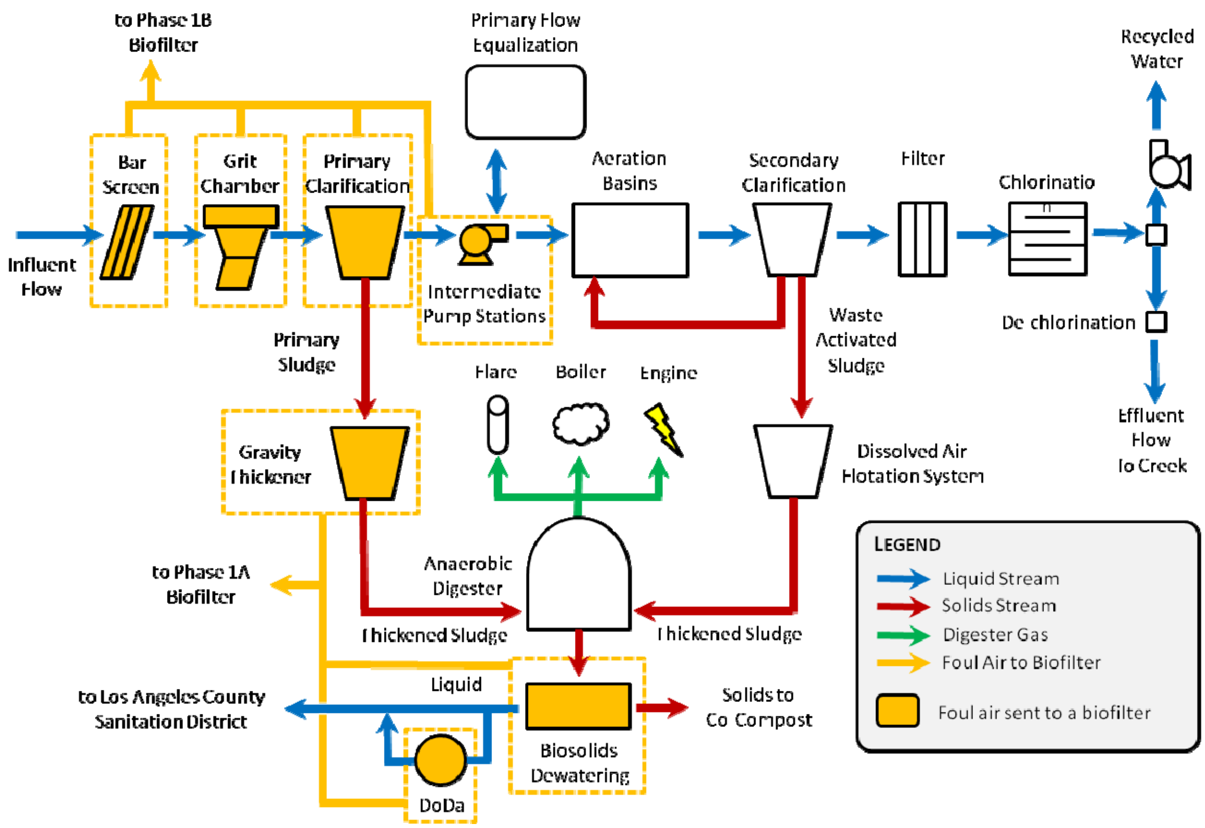



**Figure 2: RP-1 Process Flow Diagram**

Regional Water Reclamation Plant No. 4 (RP-4) Located in the City of Rancho Cucamonga. It has been in operation and producing recycled water since 1997. RP-4 treats an average flow of 11 MGD and is operated in conjunction with RP-1 to provide recycled water to users. The RP-4 facility was recently expanded to increase capacity from 7 MGD to 14 MGD. RP-4 employs the following treatment technologies: raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment. These processes are illustrated in Figure 3.

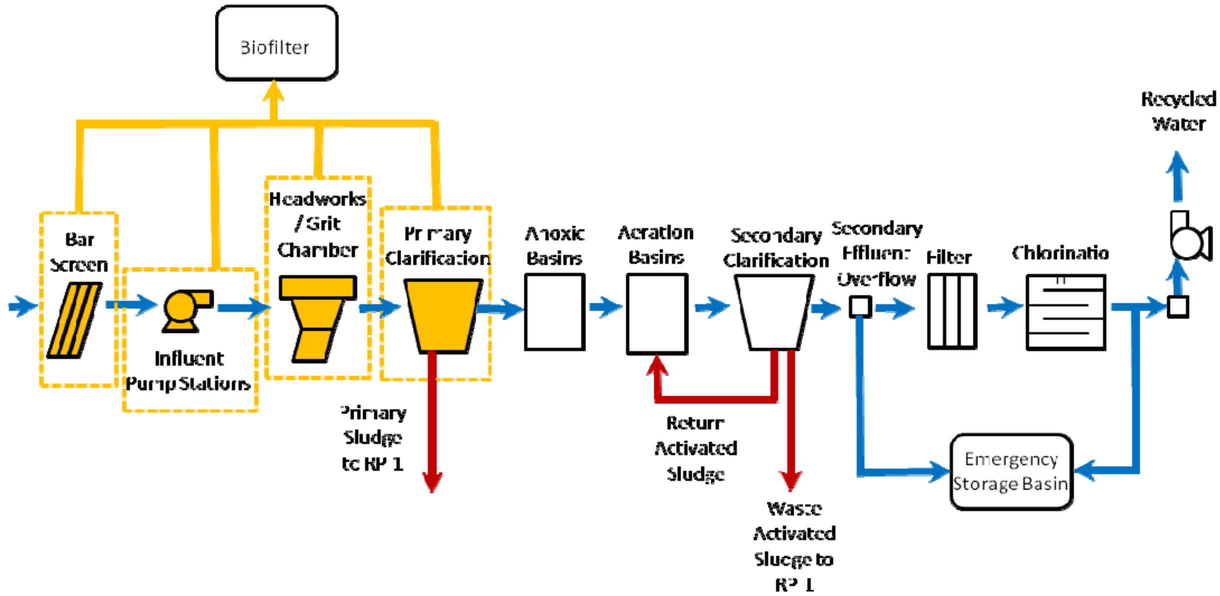



**Figure 3: RP-4 Process Flow Diagram**

Regional Water Reclamation Plant No. 5 (RP-5) is located in the City of Chino. It was originally commissioned in 2000 and is designed to treat a daily average flow of 16.3 MGD. This facility serves the Cities of Chino Hills, Chino and Ontario. RP-5 employs the following treatment technologies: raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment. These processes are illustrated in Figure 4. Additionally, RP-5 has an array of solar panels to partially meet energy demand by the plant.

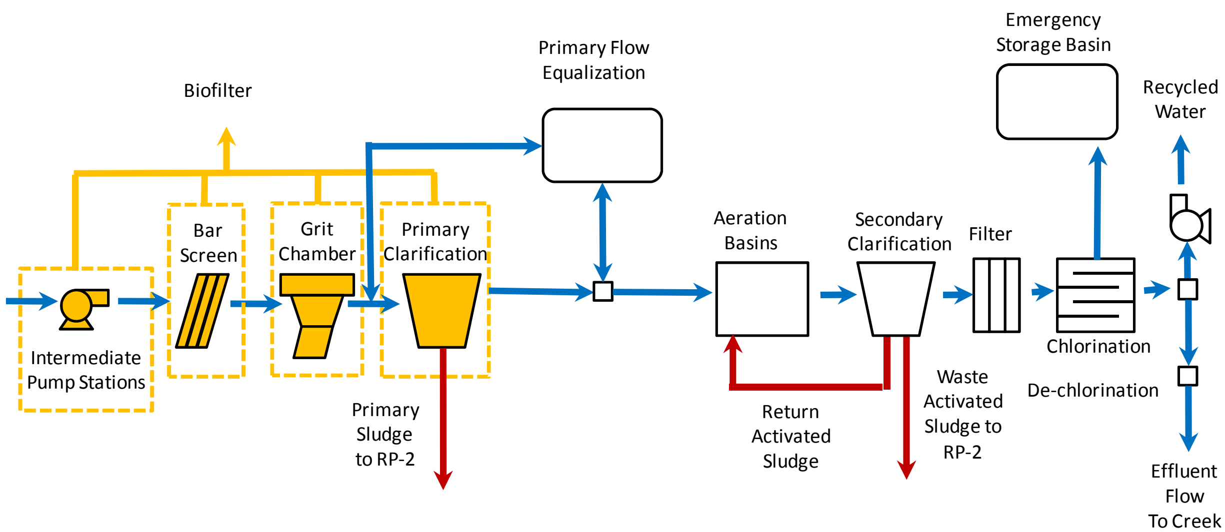



**Figure 4: RP-5 Process Flow Diagram**

Carbon Canyon Wastewater Reclamation Facility (CCWRF) is located in the City of Chino and has been in operation since May 1992. The facility works in tandem with Regional Plant No. 2 (RP-2) and serves the areas of Chino, Chino Hills, Montclair, and Upland. Liquids are treated at CCWRF, while the solids removed from the waste flow are treated at RP-2. CCWRF treats an annual average flow of 9.5 MGD. CCWRF employs the following treatment technologies: preliminary and primary treatment, secondary treatment, and tertiary treatment.  These processes are illustrated in Figure 5. Additionally, CCWRF has an array of solar panels to partially meet energy demand by the plant.

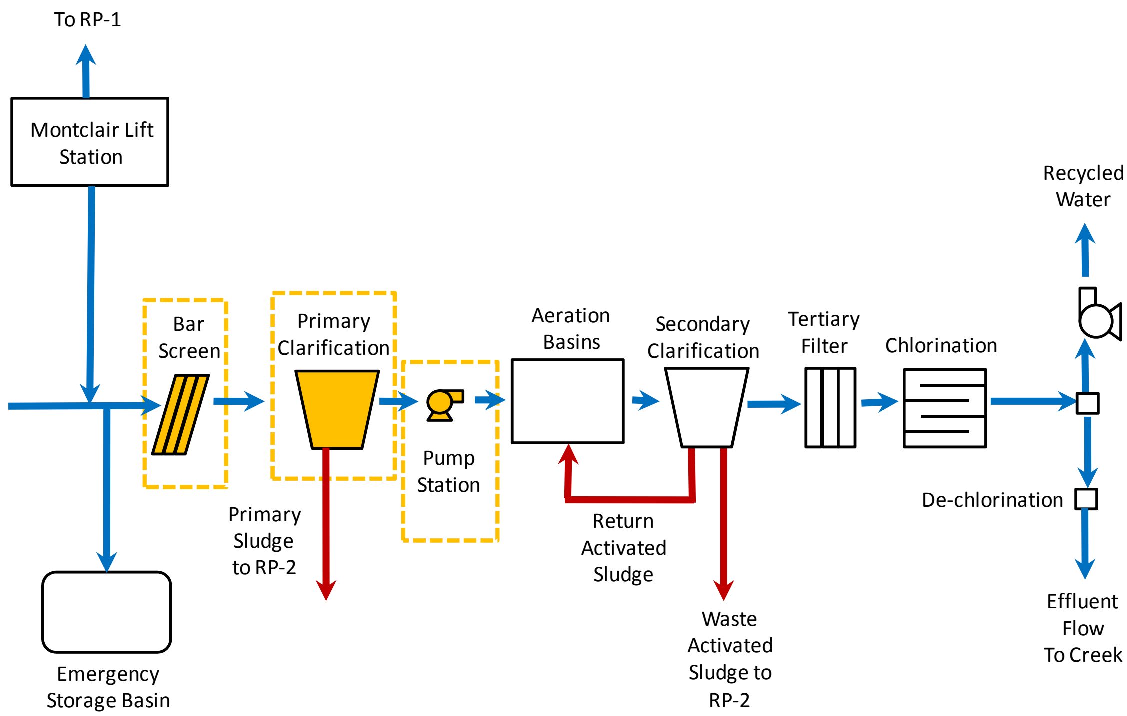



**Figure 5: CCWRF Process Flow Diagram**

RP-2, located in the City of Chino, has been in operation since 1960 and treats the biosolids flow streams from the CCWRF and RP-5 facilities. As a result of treating these biosolids, biogas is produced and utilized as a fuel source to operate engine generators that produce electricity. This electricity is used to partially power RP-2.  RP-2 includes treatment processes that concentrate (or thicken), stabilize, and dewater the biosolids from RP-5 and the Carbon Canyon Water Reclamation Facility (CCWRF). The major treatment process used to thicken the primary solids are Gravity Thickener (GT) Units and for secondary solids, Dissolved Air Flotation Thickener (DAFT) Units. After these solids are thickened they are transferred to Anaerobic Digester Units for stabilization.  The solids are dewatered and transferred to the Inland Empire Regional Composting Facility (IERCF) where they are further treated.  Water produced from processes is sent to RP-5 for treatment. These processes are illustrated in Figure 6.

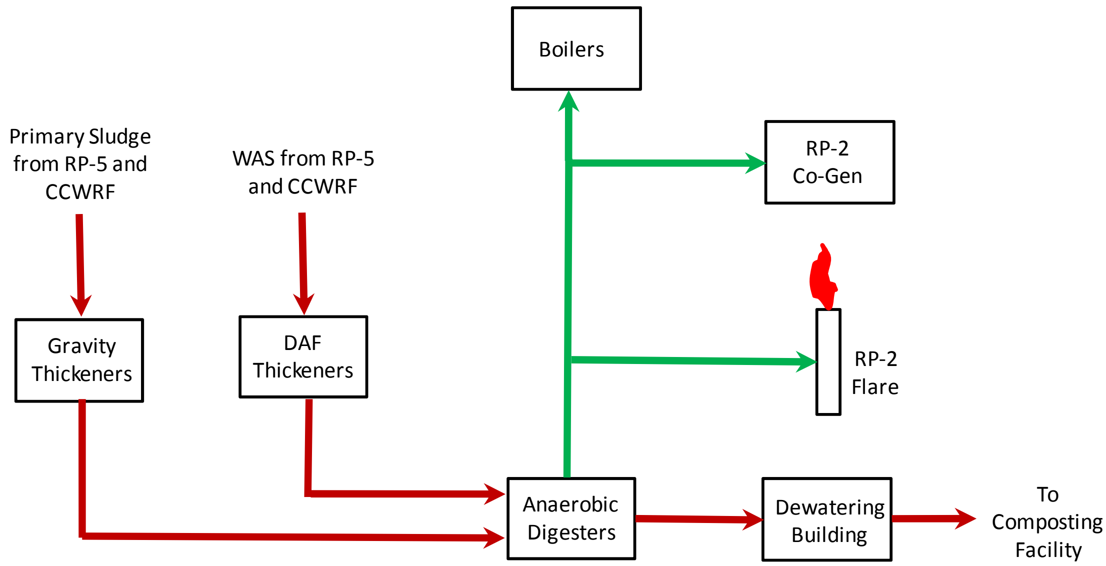



**Figure 6: RP-2 Process Flow Diagram**

### *Recycled Water Distribution*

Pump stations are required to transport recycled water to IEUA's customers. IEUA's service area is generally flat sloping downhill in the south where wastewater plants are located. Recycled water demand; however, is uphill from the plants requiring pumping. Recycled water can be supplied by all four plants and distributed to five pressure zones.

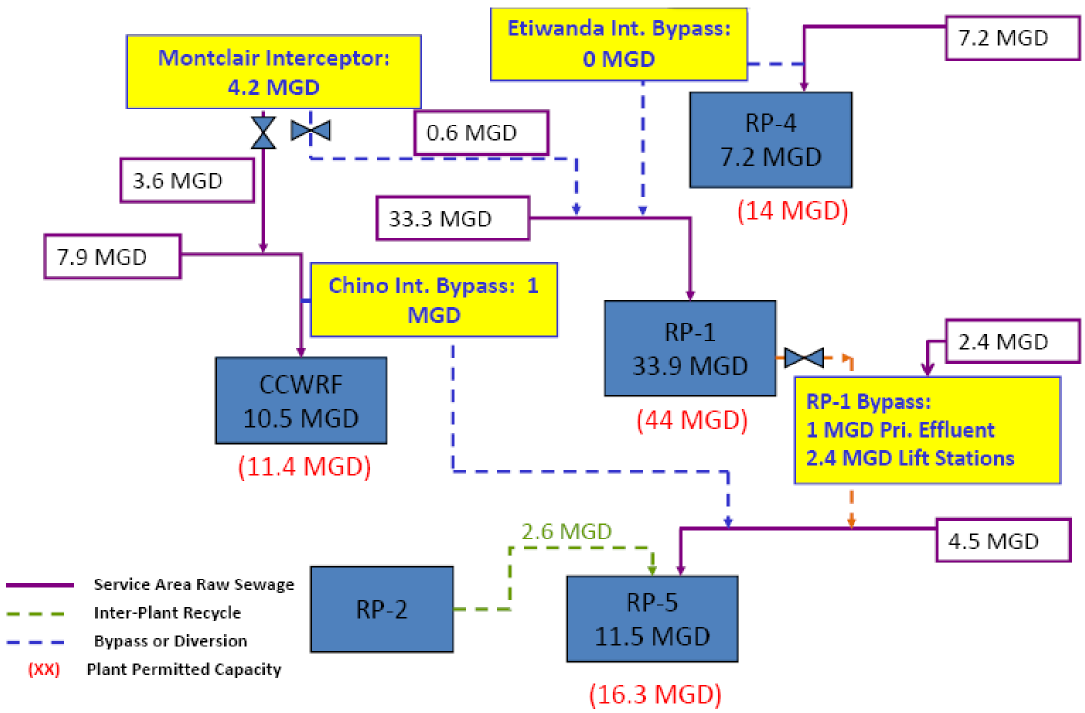
## System Storage

IEUA had limited storage capacity for recycled water; however, it is generally not needed. Water can be injected into the Chino Groundwater Basin or sent to contractors who can store water in their facilities.

## System-wide Operation Strategy

IEUA operates its water reclamation facilities to meet the total needs of the incoming effluent and the regional demand for recycled water. All four reclamation facilities are uniquely interconnected through various diversion points within the eight member agency wastewater collection systems. This allows influent flows between the facilities to be shifted to meet recycled water demands within the IEUA service area. The interconnections between facilities are illustrated in Figure 7.

Each plant's treatment processes are integrated with instrumentation and control systems for controlling and monitoring various aspects of their operations. Currently, all four reclamation facilities treat a total combine average daily flow of about 60 MGD. The Chino Desalter typically operates at full capacity at all hours of the day.




Note: Average daily water volumes (MGD) for FY 2008/09 are shown.

**Figure 7: IEUA System Connections**

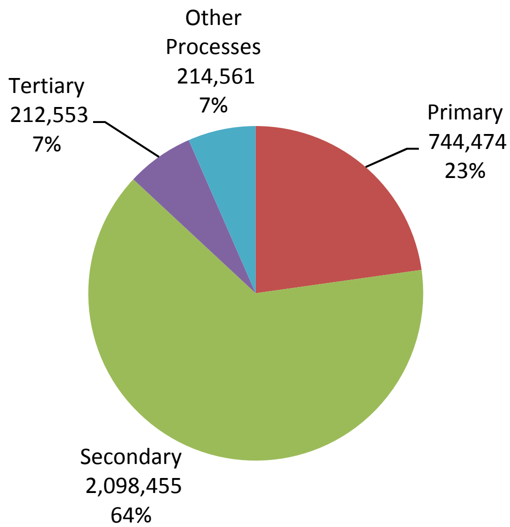
### Infrastructure Changes

The Study Team was not able to collect full information on infrastructure changes during 2008. However, due to the nature of the energy and water data received, this is not necessary. IEUA staff provided results of a calibrated simulation of the IEUA water treatment system under typical conditions. See the Energy Profiles section for more details. In recent years the Chino II Desalter became operational increasing total desalination capacity. No information on the energy consumption or water production at this facility was provided to the Study Team.

## Energy Profiles

IEUA staff provided energy consumption and water flow values for typical operations during the summer and winter. The data were the results of a calibrated simulation of the IEUA water treatment system under typical conditions. Energy information included typical monthly total energy consumption by each plant, each process within each plant, and collection and distribution systems. Water flow information included typical daily influent to each plant and though each distribution and collection system. Since monthly energy consumption and daily flow data was provided, the Study Team could not develop energy profiles with an hourly time step. The energy and flow data was processed by the Study Team to determine the energy intensity of each facility type and the hourly energy profiles presented in this section. Energy intensity and energy profiles include total energy required for plants and processes regardless of the source of energy.

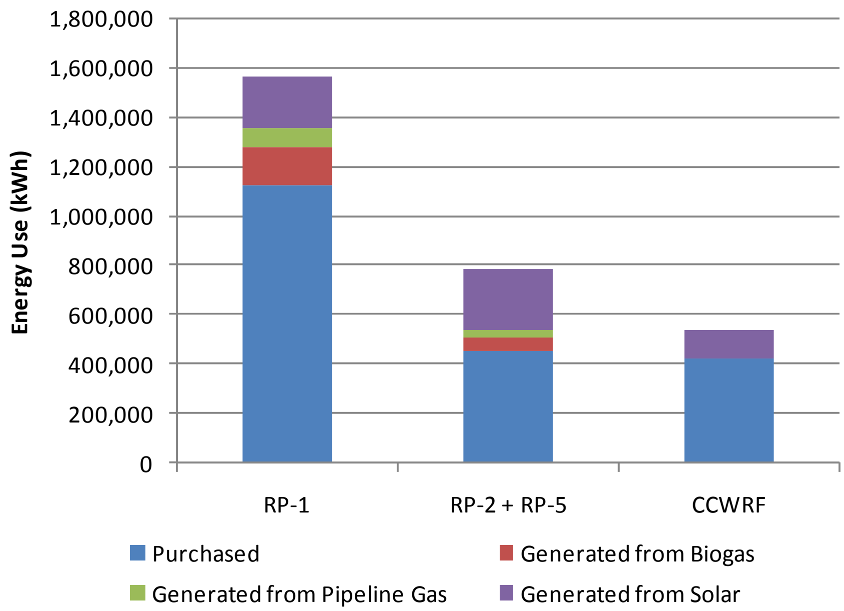
The majority of energy used by IEUA is for wastewater treatment plants. Within wastewater treatment plants the majority of energy is the Secondary Treatment Process, which include Aeration Blowers for the Activated Sludge Process. Figure 8 illustrates the distribution of energy use by facility type in a typical summer month.




Note: Represents total treatment energy for RP-1, RP-4, and CCWRF

**Figure 8: Wastewater Treatment Energy Use by Process (kWh) – Typical Summer Month**

IEUA generates energy at wastewater treatment plants using biogas digesters and solar arrays. Only a portion of the energy consumption at each plant is met by these self-generating activities. Additional electricity is purchased from SCE. Gas is also purchased from SCG and fed to IEUA's electric generators; however, current air quality regulations limit the amount of pipeline natural gas that can be feed to the generators. Figure 9 displays the distribution of energy sources for each plant in a typical summer month.




### Figure 9: Treatment Energy Use by Source – Typical Summer Month

Imported water from MWD has significant energy intensity associated with it. The water originates in northern California; the State Water Project must convey this water to southern California through a series of pump stations, canals, and pipelines. The energy intensity of imported water via the SWP is listed in Table 8 along with other IEUA supplies. The energy intensity represents the embedded energy for all activities prior to the water reaching IEUA's customers.

### Table 8: Energy Intensity of Current Supplies and Imports

| Supply | Energy Intensity Range |
|---|---|
| Recycled Water[a] | 752-914 kWh/MG |
| Brackish Desalination | 3,819-3,945 kWh/MG |
| SWP Imported Water[b] | 9,560 kWh/MG |

a) Only includes energy associated with recycled water deliveries, IEUA's treatment standards require tertiary treatment of wastewater regardless of whether is it used for recycled water purposes or released as effluent.

b) Source: Study 1. Represents energy intensity of SWP operations to deliver water to Devil Canyon Power Plant. Does not include power generation by MWD.

The energy intensity of each facility type and selected processes within IEUA is presented in Figure 10. The total energy intensity for wastewater treatment plants includes energy used by primary, secondary, and tertiary treatment as well as influent pumping and other chemical addition processes. Of these, only primary, secondary, and tertiary treatments are itemized separately in Figure 10 as they are of particular interest. Energy intensity values include all energy use regardless of the source of energy.

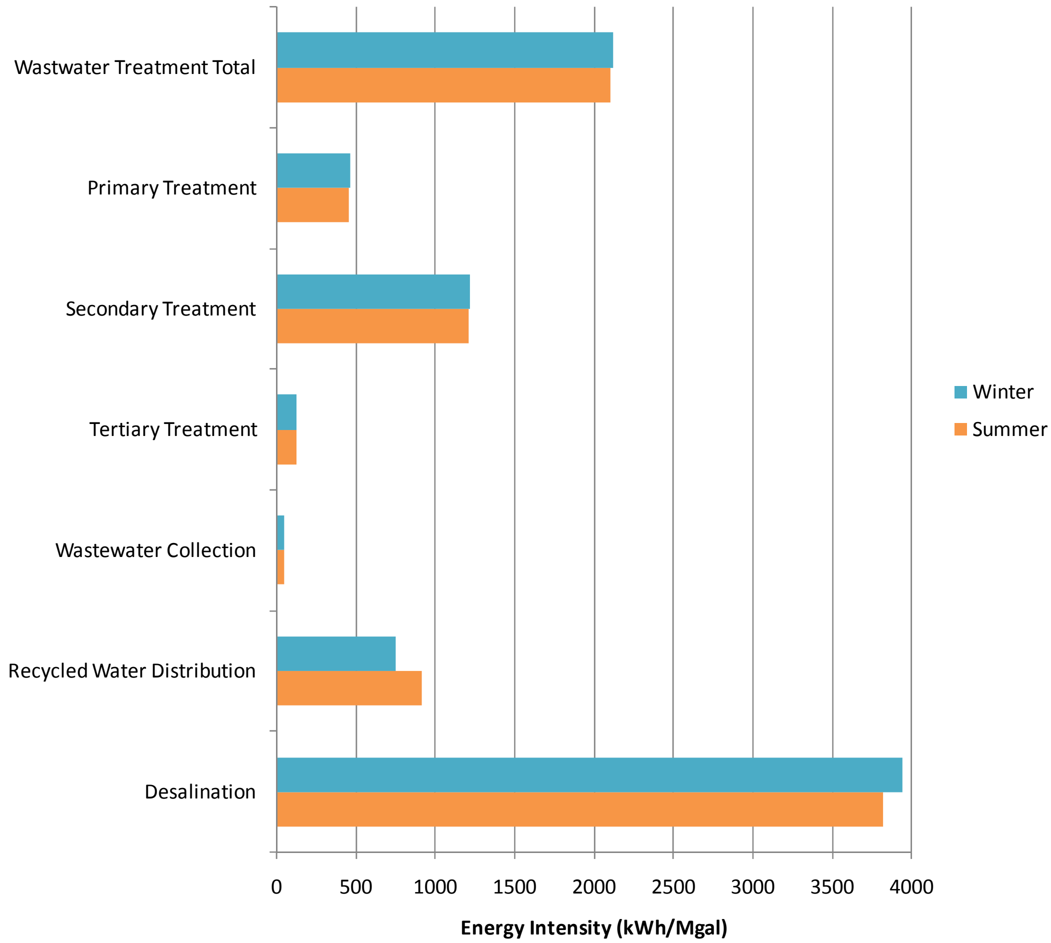



**Figure 10: IEUA Monthly Energy Intensity by Facility Type**

Hourly energy profiles were not generated at the request of IEUA staff as detailed data was not provided to the Study Team. Instead the Study Team reports typical daily energy use as well as estimated peak demand for a Summer Average and Winter Average day. These results are documented in Table 9. Values include all energy use regardless of the source of energy.

**Table 9: Typical Energy Use by Facility Type**

| | Summer | | Winter | |
|---|---|---|---|---|
| | Average Daily Energy Use (kWh) | Peak Demand (kW) | Average Daily Energy Use (kWh) | Peak Demand (kW) |
| ***Water Treatment*** | 49,656 | 2,069 | 48,120 | 2,005 |
| ***Wastewater Treatment*** | 130,680 | 5,445 | 132,024 | 5,501 |
| ***Wastewater Pumps*** | 2,712 | 113 | 2,688 | 112 |
| ***Recycled Water Pumps*** | 44,448 | 1,852 | 16,488 | 687 |

## Current Infrastructure Related Energy Efficiency Projects

IEUA has several recent and planned energy-related capital projects. In April of 2009, IEUA dedicated its solar-power system that has been operating since December 2008. The system provides 10 percent of the total electrical power needed for IEUA's facilities. IEUA has ongoing plans to upgrade and modernize existing facilities to enhance efficiency. It plans to continue to expand recycled water distribution systems in its service area and promote usage of recycled water.

## Sources


IEUA. *2005 Regional Urban Water Management Plan*. November 2005, Volume II.

IEUA. *Comprehensive Annual Financial Report*. June 30, 2008.

IEUA. IEUA Public Website: http://www.ieua.org/facilities/facilities.html. Accessed 11/24/2009.

Joel Ignacio, Senior Associate Engineer – IEUA. Personal Communication – provided data on IEUA's typical flow and energy use for each facility and each segment of each facility during a typical summer and winter month. July 2009 – November 2009.

## Los Angeles County Sanitation Districts (LACSD)

### Summary

| | | | |
|---|---|---|---|
| Primary functions | Urban Wastewater, Recycled Water | | |
| Segment of Water Use Cycle | Wastewater Treatment | | |
| Hydrologic Region | Southland | DEER Climate Zone | 9 |
| Quantity of wastewater | Treated: 480 MGD | Recycled: 170 MGD | |
| Number of Customers | 24 Independent Special Districts | Service Area Size | 820 Sq miles |
| Distinguishing Characteristics | The Sanitation Districts convey and treat approximately 480 MGD, 170 MGD of which are available for reuse. Three active sanitary landfills handle approximately 18,000 tons per day (tpd), of which 15,000 tpd are disposed (approximately forty percent of the County-wide disposal capacity) and 3,000 tpd are recycled. The agency also operates four landfill energy recovery facilities; two recycle centers, and three transfer/materials recovery facilities, and participates in the operation of two refuse-to-energy facilities. | | |
| Key Energy Drivers | • Wastewater Collection – Lift stations are required for wastewater collection<br>• Wastewater Treatment – Considerable energy is used by the treatment plants<br>• Recycled Water Deliveries – Energy is used to recharge groundwater or to deliver water for a variety of applications | | |
| Wastewater Treatment Technologies | Long Beach WRP, Los Coyotes WRP, San Jose Creek WRP, Whittier Narrows WRP, and Saugus WRP (Wastewater): Primary, secondary, tertiary, reclamation<br>Pomona WRP (Recycled Water): Primary, secondary, tertiary, reclamation<br>Joint Water Pollution Control Plant (Wastewater): Primary, secondary, solids processing<br>La Cañada WRP (Wastewater): Extended aeration secondary, reclamation<br>Valencia WRP (Wastewater): Primary, secondary, tertiary, reclamation, solids processing<br>Lancaster WRP (Wastewater): Primary and secondary treatment (aerated oxidation ponds), solids processing, membrane bioreactors, UV disinfection, reclamation<br>Palmdale WRP (Wastewater): Primary and secondary treatment (aerated oxidation ponds), solids processing, reclamation | | |
| Marginal Water Supply | N/A | | |
| Energy Service Providers | SCE, SCG | | |
| Observed Energy Intensities (kWh/MG) | Segment | Lower Range | Upper Range |
| | Wastewater Treatment | 1104 | 1446 |
| | Wastewater Pumps | 205 | 400 |

## Background Information

The Sanitation Districts are a partnership of 24 independent special districts serving about 5.3 million people in Los Angeles County. The Sanitation Districts' service area covers approximately 800 square miles and encompasses 78 cities and unincorporated territory within the County. Table 1 summarizes key information about the Districts.

The Sanitation Districts construct, operate, and maintain facilities to collect, treat, recycle, and dispose of wastewater and industrial wastes. Individual districts operate and maintain their own portions of the collection system. Local jurisdictions are responsible for the collection of wastewater through local sewers and the collection of solid waste. The Sanitation Districts also provide for the management of solid wastes including disposal, transfer operations, materials recovery, and energy recovery.

**Table 1: Agency Profile**

| | |
|---|---|
| Agency Type | Urban Wastewater, Recycled Water |
| Hydrologic Region | Los Angeles Basin |
| Region Type | Southland |
| Energy Service Provider | SCE, SCG |
| DEER Climate Zone | 9 |
| Service Area Size | 800 Sq miles |
| Service Area Population | 5.3 million |
| Number of Member Agencies | 24 |
| Distribution Topology | Flat |

Primary sources of information on the Los Angeles County Sanitation District include: LACSD's public website, the 2006 Greater Los Angeles County Integrated Regional Water Management Plan, and population projections of the Southern California Association of Governments. A detailed list of references is located at the end of this section.

### Climate

Los Angeles enjoys plenty of sunshine throughout the year, with an average of 263 sunshine days and only 35 days with measurable precipitation annually. Los Angeles receives about 15 inches of precipitation annually.

### Demographics

Social trends in the Greater Los Angeles County Region (Region) may be summarized on the basis of certain demographic trends. The Public Policy of California (PPIC) (PPIC, 2002) describes trends for portions of California, including Los Angeles, Ventura, and Orange Counties, and is representative of the Region. Population growth in the Region is slowing (a 10 percent increase from 1990-2000, down from a 20 percent increase from 1980-1990). In the last decade, births represented the largest portion of population increase in the Region, followed by international migration. Domestic migration was a net loss to the Region's population during that period. Population growth outpaced job growth (by more than 2:1) and growth in residential units, increasing the number of persons per household. Ethnic diversity continues to increase, as the percentage of Caucasian residents declines (from 58.0 percent in 1980, 47.0 percent in 1990, and 38.8 percent in 2000). An estimated population in the region is provided in Table 2 and projected population for the Los Angeles County is provided in Table 3.

#### Table 2: 2006 Estimated Greater Los Angeles County Region Population

| Subregion | Population |
|---|---|
| Lower San Gabriel and Los Angeles Rivers | 3,219,316 |
| North Santa Monica Bay | 106,480 |
| South Bay | 2,903,382 |
| Upper Los Angeles | 2,338,290 |
| Upper San Gabriel River and Rio Hondo | 1,640,528 |
| Region Totals | 10,207,996 |

#### Table 3: Historic and Projected Population for Los Angeles County

| Year | Population |
|---|---|
| 2005 | 10,206,002 |
| 2010 | 10,615,700 |
| 2015 | 10,971,589 |
| 2020 | 11,329,802 |
| 2025 | 11,678,528 |
| 2030 | 12,015,892 |
| 2035 | 12,338,623 |

## Wastewater Sources

The water recycling of LACSD facilities serve approximately five million people in 78 cities and unincorporated county areas within Los Angeles County. Effluent quality from the WRPs ranges from undisinfected secondary to coagulated, filtered, disinfected tertiary. During FY 2006-07, Districts' facilities produced an average of 486.43 MGD, or 545,067 AFY of effluent, which is a decrease of 3.2 percent from the preceding fiscal year, and a 9.3 percent decrease from the previous historic peak of FY 89-90. As a result of widespread water conservation that began in January 1991 in response to the drought-induced, statewide water crisis, as well as an economic recession, total average effluent flow had decreased by 11 percent to 477.36 MGD in FY 91-92 from the historic peak of FY 89-90.

The overall increase in effluent flows is due in part to population growth, a healthier economy, and the easing of conservation measures in response to the improved statewide water supply situation following the heavy rains of the winters of 1993, 1995 and 1997, and the extremely heavy, El Niño generated rainfall of 1998. Since 1999, total flow production has resumed decreasing despite population increases in the Districts' service area. This most recent decrease in effluent production is a result of ongoing water conservation efforts (low flow toilets, water efficient washing machines, etc.), combined with record low rainfall (which reduces inflow into the collection system) in the 2006-07 storm season. Table 4 lists the number of sites in each category of use, along with the total acreage and average daily usage.

### Table 4: Categories of Recycled Water Usage Fiscal Year 2004-2005

| Reuse Application | No. of Sites | Area Applied (acres) | Usage (MGD) |
|---|---|---|---|
| Parks | 96 | 2,942.8 | 4.380 |
| Gold Courses | 20 | 2,263.8 | 4.604 |
| Schools | 95 | 1,107.8 | 2.012 |
| Roadway Greenbelts | 87 | 602.3 | 1.095 |
| Public Facilities | 24 | 492.7 | 1.255 |
| Commercial Buildings | 119 | 382.9 | 1.027 |
| Nurseries | 18 | 134.8 | 0.277 |
| Cemeteries | 6 | 1,284.4 | 1.604 |
| Residential | 16 | 114.2 | 0.326 |
| Churches | 8 | 9.5 | 0.034 |
| Industrial | 18 | 158.7 | 4.973 |
| Agriculture | 9 | 4,179 | 12.597 |
| Environmental | 1 | 400 | 8.294 |
| Groundwater Recharge | 3 | 646 | 42.152 |
| Total | 520 | 14,718.9 | 84.630 |

## Wastewater Treatment

The San Jose Creek WRP provides primary, secondary and tertiary treatment for 100 million gallons of wastewater per day. The Whittier Narrows WRP provides primary, secondary and tertiary treatment for 15 million gallons of wastewater per day and serves a population of approximately 150,000 people.

## Recycled Water Production

The Sanitation Districts are pioneers in using reclaimed water beneficially and remain strong proponents of expanding reuse. Upstream WRPs provide a high quality source of reclaimed water that essentially meets drinking water standards and is reused at more than 520 sites throughout the county. Flows received at the JWPCP higher in salts making it less practical to reclaim and reuse. Uses of recycled water include industrial, commercial, and recreational applications; groundwater recharge; agriculture; and landscape, park, and golf course irrigation.

The La Cañada WRP provides extended aeration secondary treatment for 200,000 gallons of wastewater per day (see flow diagram below). The plant serves the Country Club and 425 surrounding homes. All of the disinfected, secondary effluent is put into the four lakes on the 105 acre Country Club golf course.

The Long Beach WRP provides primary, secondary and tertiary treatment for 25 million gallons of wastewater per day. The plant serves a population of approximately 250,000 people. Almost 5 million gallons per day of the purified water is reused at over 40 reuse sites.

The Los Coyotes WRP provides primary, secondary and tertiary treatment for 37 million gallons of wastewater per day. The plant serves a population of approximately 370,000 people. Over 5 million gallons per day of the purified water is reused at over 200 reuse sites.

The Pomona WRP provides primary, secondary and tertiary treatment for 13 million gallons of wastewater per day. The plant serves a population of approximately 130,000 people. Approximately 8 million gallons per day of the purified water is reused at over 90 different reuse sites.

## System Infrastructure and Operations

The Sanitation Districts construct, operate, and maintain facilities to collect, treat, recycle, and dispose of wastewater and industrial wastes. Individual districts operate and maintain their own portions of the collection system. Local jurisdictions are responsible for the collection of wastewater through local sewers and the collection of solid waste. The Sanitation Districts also provide for the management of solid wastes including disposal, transfer operations, materials recovery, and energy recovery. Table 5 summarizes the key pieces of the physical infrastructure of the District's system.

#### Table 5: Infrastructure Summary

| | |
|---|---|
| Number of Landfills | |
| *Sanitary* | 3 |
| *Energy Recovery* | 4 |
| Recycle Center | 2 |
| Transfer/Materials Recovery Facilities | 3 |
| Refuse-To-Energy Facilities | 2 |
| Miles of Sewer Piping | 1,400 |
| Number of Plants | |
| *Wastewater/Recycled Water* | 11 |
| *Pumping* | 52 |

The 24 districts work cooperatively under a Joint Administration Agreement with one administrative staff headquartered near the City of Whittier. Each Sanitation District has a separate Board of Directors consisting of the mayor of each city within that District and the Chair of the Board of Supervisors for county unincorporated territory. Each Sanitation District pays its proportionate share of joint administrative costs.

The Sanitation Districts' 1,400 miles of main trunk sewers and 11 wastewater treatment plants convey and treat approximately 500 million gallons per day (mgd), 200 mgd of which are available for reuse in the dry Southern California climate. Three active sanitary landfills handle approximately 19,500 tons per day (tpd), of which 16,000 tpd are disposed (approximately forty percent of the County-wide disposal capacity) and 3,500 tpd are recycled. The agency also operates four landfill energy recovery facilities; two recycle centers, and three transfer/materials recovery facilities, and participates in the operation of two refuse-to-energy facilities.

### Sub-Regions within Agency

Figure 1 below shows the Sanitation Districts and its treatment plants, as well as the trunk sewers that convey the systems waste. From the map, the Sanitation Districts can be divided into two regions, the Joint Outfall System and the Santa Clarita and Antelope Valleys.


Figure 1: Map of the Los Angeles County Sanitation Districts

## Sub-Region 1: Joint Outfall System

Seventeen of the Sanitation Districts that provide sewerage services in the metropolitan Los Angeles area are also signatory to a Joint Outfall Agreement that provides for operation and maintenance of a regional, interconnected system of facilities known as the Joint Outfall System (JOS). The service area of the JOS encompasses 73 cities and unincorporated territory, and includes some areas within the City of Los Angeles and Orange and San Bernardino Counties.

This system provides wastewater collection, treatment, reuse, and disposal for residential, commercial, and industrial users and includes the following treatment plants:

- The Joint Water Pollution Control Plant located in the City of Carson
- The La Canada WRP in the City of La Canada Flintridge
- The Long Beach WRP in the City of Long Beach
- The Los Coyotes WRP in the City of Cerritos
- The Pomona WRP in the City of Pomona
- The San Jose Creek WRP adjacent to the City of Industry
- The Whittier Narrows Water Reclamation Plant (WRP) near the City of South El Monte

Sanitation District No. 2 acts as the agent for the other signatory Sanitation Districts in administering the Joint Outfall Agreement.

The JOS is a unique system that provides regional wastewater treatment for Los Angeles County, covering an extensive area that includes 73 cities and unincorporated County territory. The six water reclamation plants in the JOS provide a high level of treatment producing reclaimed water that is recycled at hundreds of sites throughout the County.

### *Wastewater and Recycled Water Treatment Plants*

The JWPCP is one of the largest wastewater treatment plants in the world and is the largest of the Districts' wastewater treatment plants. The facility provides both primary and secondary treatment for approximately 300 million gallons of wastewater per day.

The La Cañada WRP provides extended aeration secondary treatment for 200,000 gallons of wastewater per day (see flow diagram below). The plant serves the Country Club and 425 surrounding homes.

The Long Beach WRP provides primary, secondary and tertiary treatment for 25 million gallons of wastewater per day. The plant serves a population of approximately 250,000 people. Almost 5 million gallons per day of the purified water is reused at over 40 reuse sites.

The Los Coyotes WRP provides primary, secondary and tertiary treatment for 37 million gallons of wastewater per day. The plant uses $O_2$ aeration. The plant serves a population of approximately 370,000 people. Over 5 million gallons per day of the purified water is reused at over 200 reuse sites.

The Pomona WRP provides primary, secondary and tertiary treatment for 13 million gallons of wastewater per day. The plant serves a population of approximately 130,000 people. Approximately 8 million gallons per day of the purified water is reused at over 90 different reuse sites.

The San Jose Creek WRP provides primary, secondary and tertiary treatment for 100 million gallons of wastewater per day. It provides primary, secondary and tertiary treatment for 15 million gallons of wastewater per day. The plant serves a population of approximately 150,000 people.

### *Effluent Conveyance*

Effluent from the reclamation plants gravity feeds through trunk sewers to the JWPCP. The treated water from the JWPCP is sent to the Pacific Ocean through a network of tunnels and outfall pipes that eventually extends one and a half miles off the Palos Verdes Peninsula to a depth of 200 feet.

All of the disinfected, secondary effluent from the La Cañada WRP is put into the four lakes on the 105 acre Country Club golf course.

## Sub-Region 2: Santa Clarita and Antelope Valleys

### *Wastewater and Recycled Water Treatment Plants*

The Santa Clarita Valley Sanitation District operates the Saugus and Valencia WRPs. Sanitation Districts Nos. 14 and 20 serve the Antelope Valley. Sanitation District No. 14 operates the Lancaster WRP, and Sanitation District No. 20 operates the Palmdale WRP. The Antelope Valley Field Office supports operations at the Lancaster and Palmdale WRPs and assists the community with issues related to wastewater treatment.

The Saugus WRP provides primary, secondary and tertiary treatment for 7 million gallons of wastewater per day. The Saugus WRP operates with the Valencia WRP as part of the Santa Clarita Valley Sanitation District. No facilities for solids processing are located at the Saugus WRP. The Valencia WRP is a tertiary treatment plant with solids processing facilities. The plant provides primary, secondary, and tertiary treatment for 21.6 million gallons of wastewater per day. The Valencia WRP processes all wastewater solids generated in the Santa Clarita Valley Sanitation District (i.e. from the Saugus and Valencia WRPs). The wastewater solids are anaerobically digested, stored, and then dewatered using plate and frame filter presses. Methane gas is produced during the digestion process and is utilized by a co-generation process that heats water and produces electricity.

The Lancaster WRP provides primary and secondary treatment (aerated oxidation ponds) for 16 million gallons of wastewater per day. The plant serves a population of approximately 160,000 people. The Lancaster WRP processes all wastewater solids generated at the plant. The wastewater solids are anaerobically digested, stored, and then dewatered by spreading them onto concrete drying beds. The dewatered cake, or biosolids, is hauled away for composting. Methane gas is produced during the digestion process and is utilized by a co-generation process that heats water and produces electricity.

### *Effluent Conveyance*

All wastewater solids from the Saugus WRP effluent are conveyed by trunk sewers to the Valencia WRP for treatment.

The dewatered cake, or biosolids, generated in the Valencia WRP is hauled away for agricultural land application.

Over 3 million gallons per day of the chlorinated effluent from the Lancaster WRP is reused at a local farm for irrigation of alfalfa. Nearly 3 million gallons per day are sent to Piute Ponds to maintain 200 acres of wetlands as a wildlife refuge. Over 0.5 million gallons per day receive advanced treatment consisting of chemical coagulation to reduce phosphate and dual-media filtration and are sent to Apollo Lakes Regional Park.

## Other Water-Energy Related Infrastructure

### *Energy Recovery Facilities*

The Sanitation Districts were among the first to utilize landfill gas as a natural resource to produce renewable energy. The Sanitation Districts operate landfill energy recovery facilities at the Puente Hills, Spadra, Calabasas, and Palos Verdes landfills that provide reliable and economic electrical power and help to serve to California's increasing energy needs.

The Sanitation Districts' use of waste (refuse) as a fuel to produce power reduces our reliance on fossil fuels while helping to prolong the remaining landfill capacity in the region. The Commerce Refuse-to-Energy Facility is the first of its kind in Southern California and is owned by a separate authority created by a joint powers agreement between the Sanitation Districts and the City of Commerce and is operated by the Sanitation Districts. Similarly, the Southeast Resource Recovery Facility (SERRF) in Long Beach is owned by a separate authority created by a joint powers agreement between the Sanitation Districts and the City of Long Beach, but is operated by a private company under contract.

### *Tracking the Future with Waste-By-Rail*

The Sanitation Districts take the lead role in implementing the Waste-by-Rail System, the transport of waste to distant disposal facilities by train. The system will provide long-term disposal capacity to replace local landfills as they reach capacity and close. The Puente Hills MRF will form the initial infrastructure for the Waste-by-Rail System. To further develop the system, the Districts have purchased and are completing the development of the Mesquite Regional Landfill in Imperial County (see map, bottom right), which is permitted to handle up to 20,000 tons per day for approximately 100 years. The landfill will be operational by 2009.

### System-wide Operation Strategy

LACSD is operated to maximize energy recovery and system efficiency using state of the art technology and energy conscientious planning.

LACSD participates in Demand Response Programs offered by SCE to reduce energy usage during peak times which lowers energy usage and costs.

The JWPCP is one of the largest wastewater treatment plants in the world and is the largest of the Districts' wastewater treatment plants. The facility provides both primary and secondary treatment for approximately 300 million gallons of wastewater per day.

Solids collected in primary and secondary treatment are processed in anaerobic digestion tanks where bacteria break down organic material and produce methane gas. After digestion, the solids are dewatered at solids processing and hauled off-site for use in composting and land application, or combined with municipal solid waste for co-disposal. Methane gas generated in the anaerobic digestion process is used to produce power and digester heating steam in a total energy facility that utilizes gas turbines and waste-heat recovery steam generators. The on-site generation of electricity permits the JWPCP to produce most of its electricity.

- The JWPCP serves a population of approximately 3.5 million people throughout Los Angeles County. Prior to discharge, the treated wastewater is disinfected with hypochlorite and sent to the Pacific Ocean through a network of outfalls. These outfalls extend two miles off the Palos Verdes Peninsula to a depth of 200 feet. During the dry season, San Jose has the ability to bypass about 20 MG to the JWPCP.

### Infrastructure Changes

In April of 2008, the fourth stream turbine in the Districts' power generation broke down and remained offline for the rest of the year.

## Energy Profiles

LACSD provided energy data to the Study Team in a several formats. Data for the main treatment plant meters and some of the larger system pumps were provided as hourly energy and demand. Energy produces by the JWPCP gas generation facilities was provided on a monthly basis and was included in the wastewater treatment data set. All other energy data were provided as monthly bills.

Water data was received from LACSD as daily influent and effluent flows for the seven of the District's 11 treatment plants. All flow data pertained to the Joint Outfall System. Individual flow data were not provided for the system pumps that move water to the treatment plants. In order to assign flows to the system pumps, a system schematic was provided that portrayed which pumps the plants fed water to and the average pumping rate in gallons per minute for each pump. To distribute the influent flow for each treatment plant to the system pumps that service them, the average daily flow of each plant was determined. The pump average flow was adjusted based on the difference between the average influent flow and the actual influent flow for each day that was converted to millions of gallons. It was assumed that all pumps were operations the entire year.

The energy intensity of each facility type within the Los Angeles County Sanitation District is presented in Figure 2.

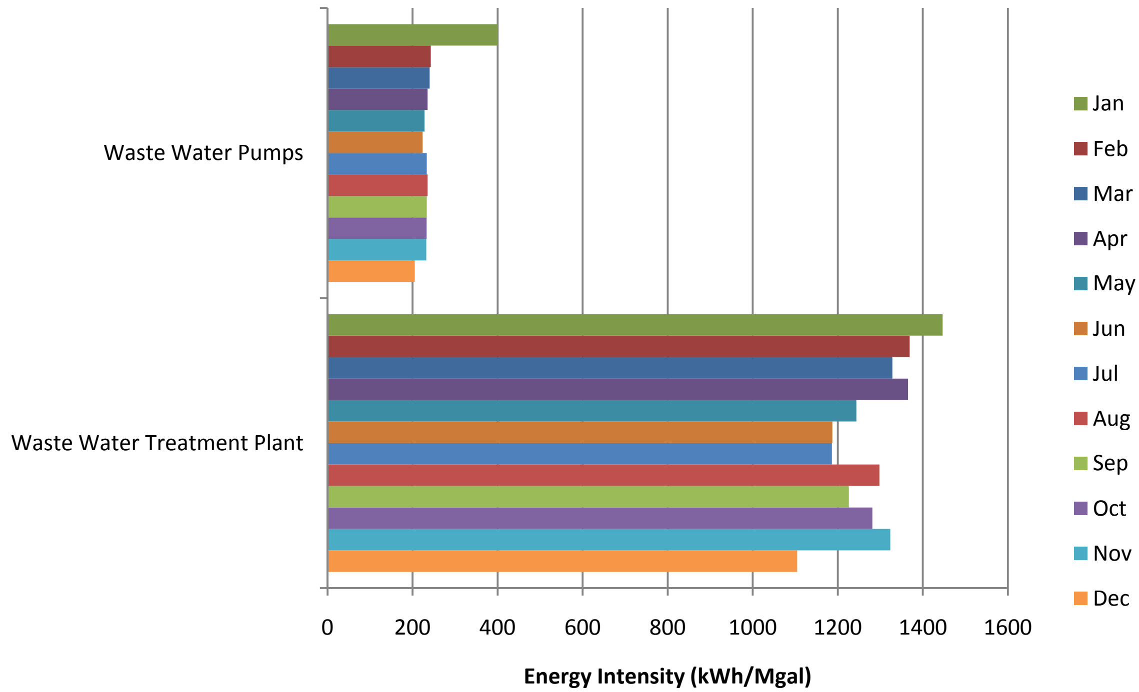



**Figure 2: LACSD Monthly Energy Intensity by Facility Type**

The JWPCP obtains the majority of its energy from its on-site biodigester, as illustrated in Figure 2. However, the three other wastewater treatment facilities operated by LACSD only get a small portion of their energy from biogas generation, see Figure 4.

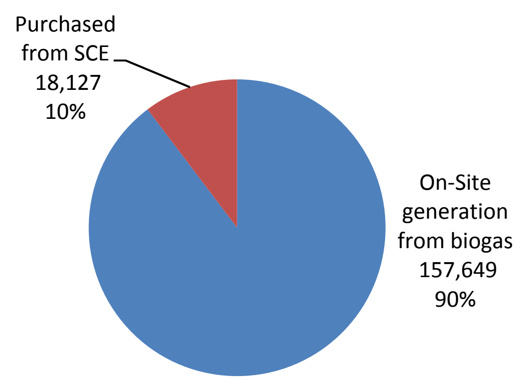



**Figure 3: JWPCP 2008 Energy Use (MWh)**

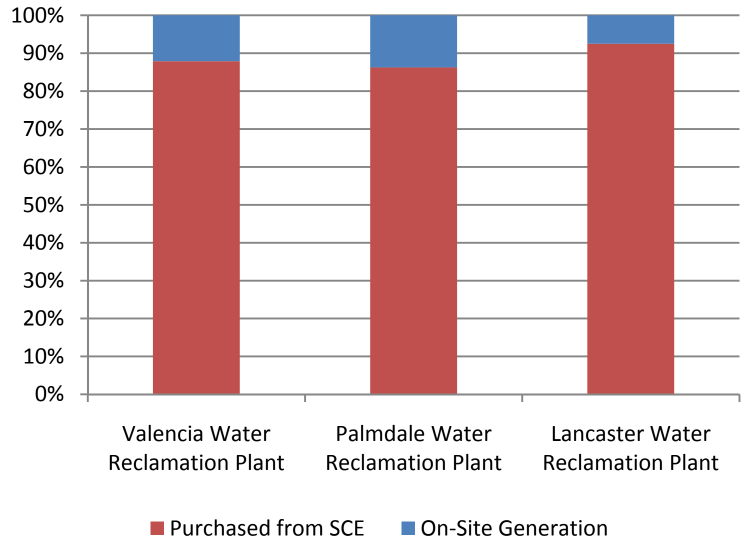
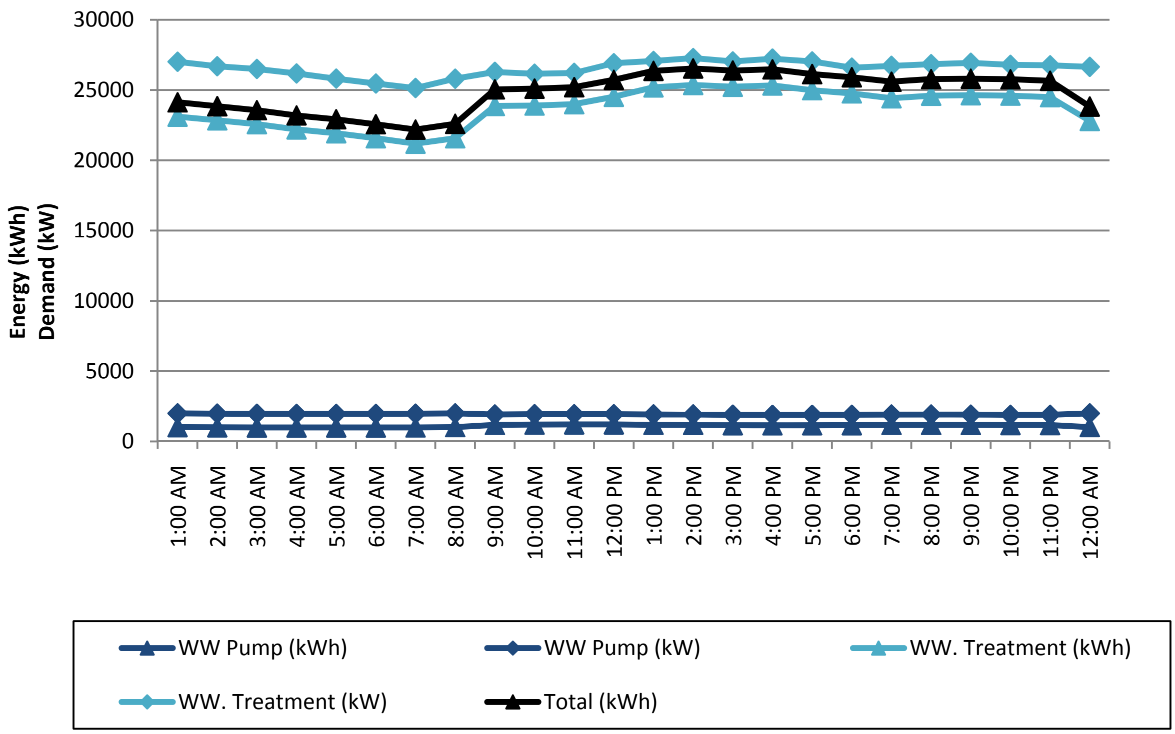


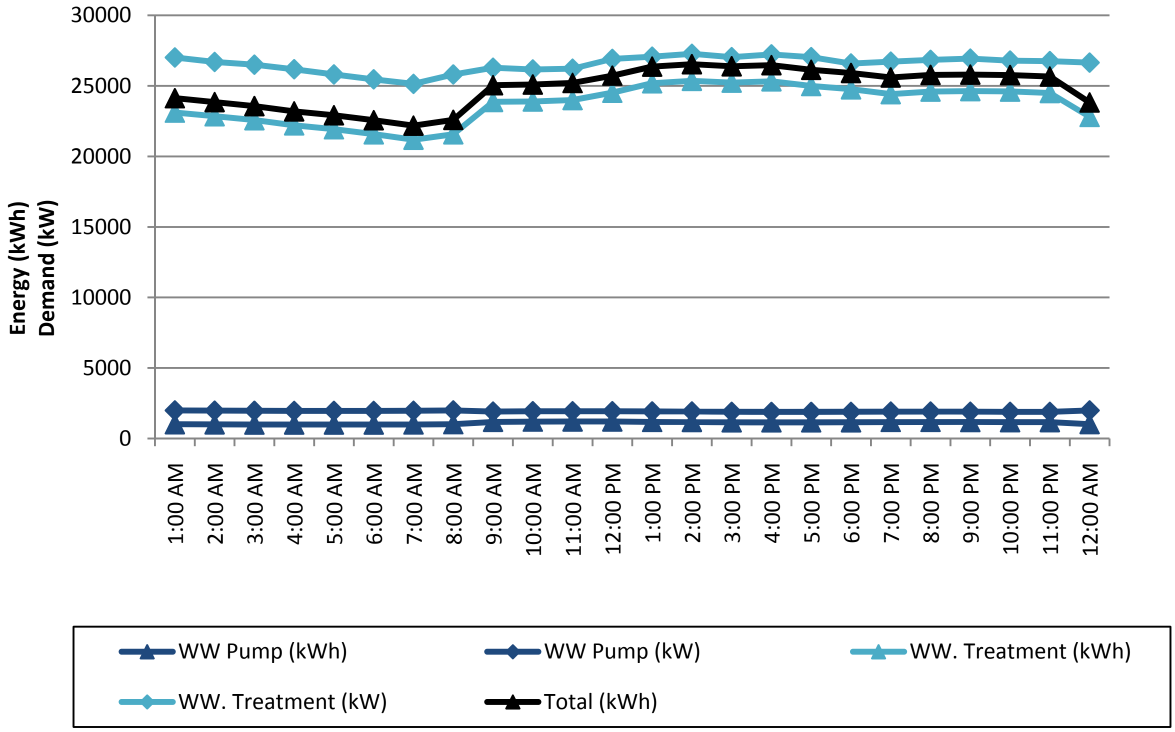

**Figure 4: Typical Distribution of Energy Sources for Three LACSD Wastewater Treatment Plants**

Hourly Energy profiles and peak energy demand is documented in Figures 5 through 11. The majority of energy used by Los Angeles County Sanitation District is for wastewater treatment.



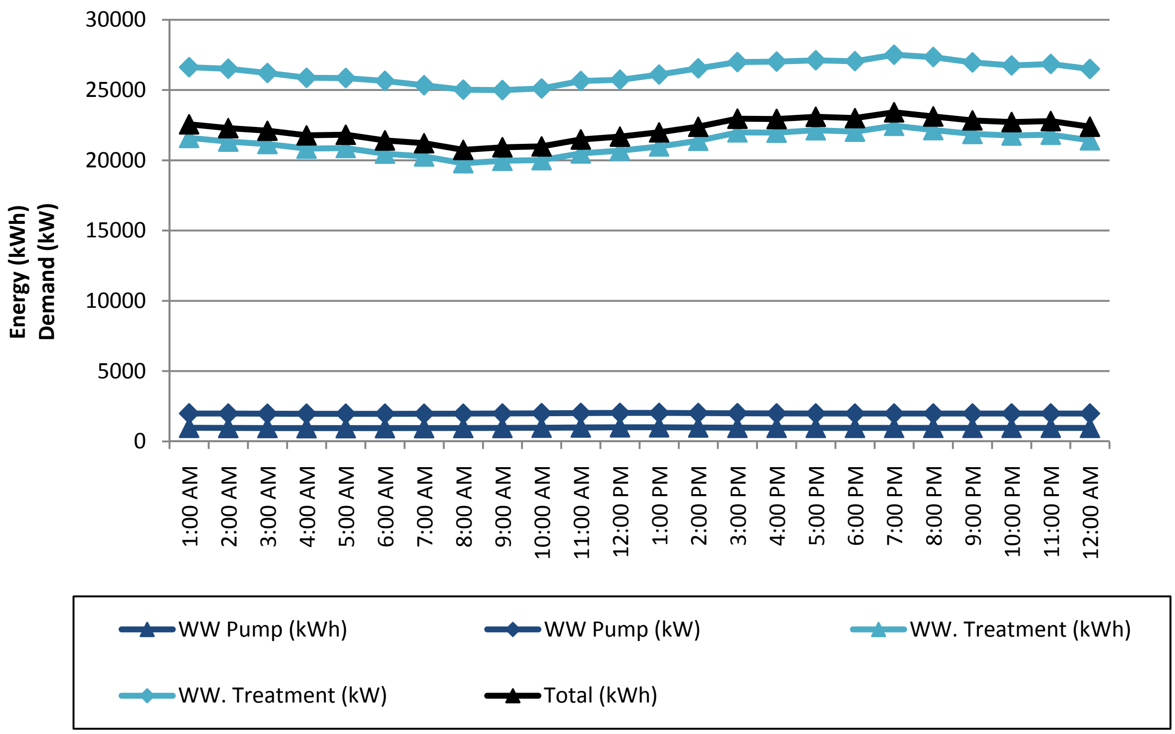

| | |
|---|---|
| Date | 6/20/2008 |
| Day | Friday |
| Peak Demand (kW) | |
| *Wastewater Treatment Plants* | 25,184 |
| *Waste Water Pumps* | 1,147 |

**Figure 5: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



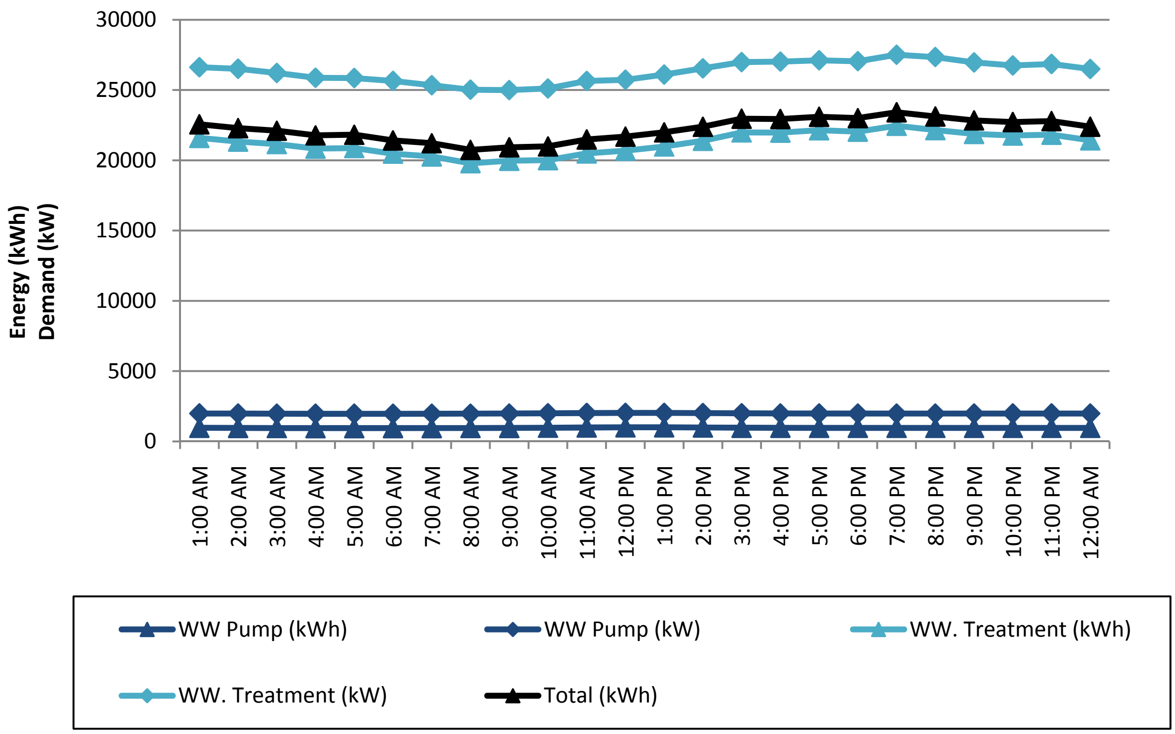

| | |
|---|---|
| Date | 6/20/2008 |
| Day | Friday |
| Peak Demand (kW) | |
| *Wastewater Treatment Plants* | 25,184 |
| *Waste Water Pumps* | 1,147 |

**Figure 6: 24-Hour Energy Profile: Summer High Water Demand Day**



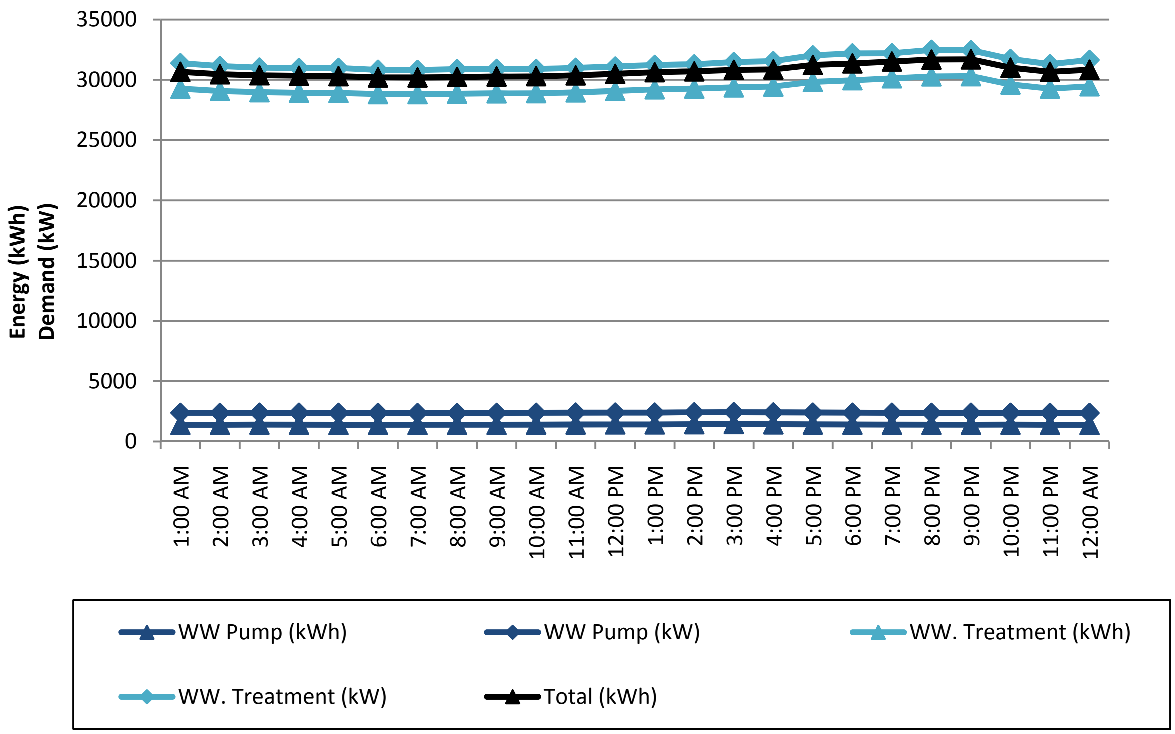

| | |
|---|---|
| Date | 9/15/2008 |
| Day | Monday |
| Peak Demand (kW) | |
| *Wastewater Treatment Plants* | 24,574 |
| *Waste Water Pumps* | 1,091 |

**Figure 7: 24-Hour Energy Profile: Summer Average Water Demand Day**



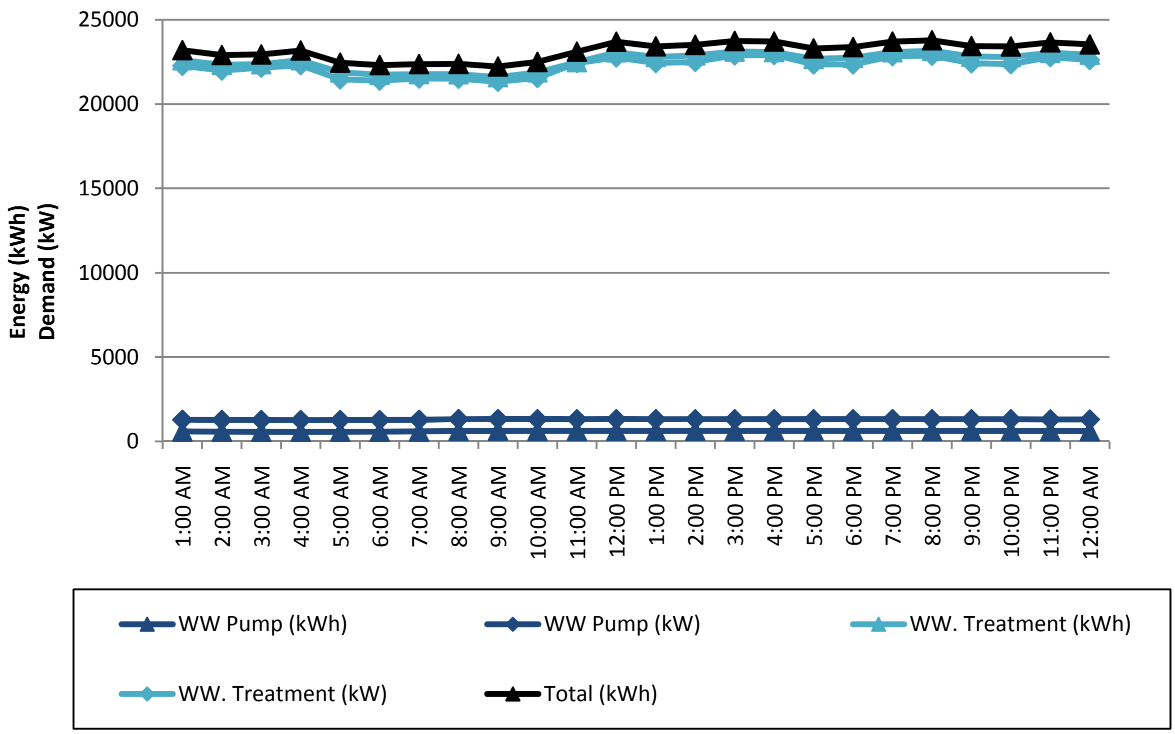

| | |
|---|---|
| Date | 7/5/2008 |
| Day | Saturday |
| Peak Demand (kW) | |
| *Wastewater Treatment Plants* | 22,031 |
| *Waste Water Pumps* | 968 |

**Figure 8: 24-Hour Energy Profile: Summer Low Water Demand Day**



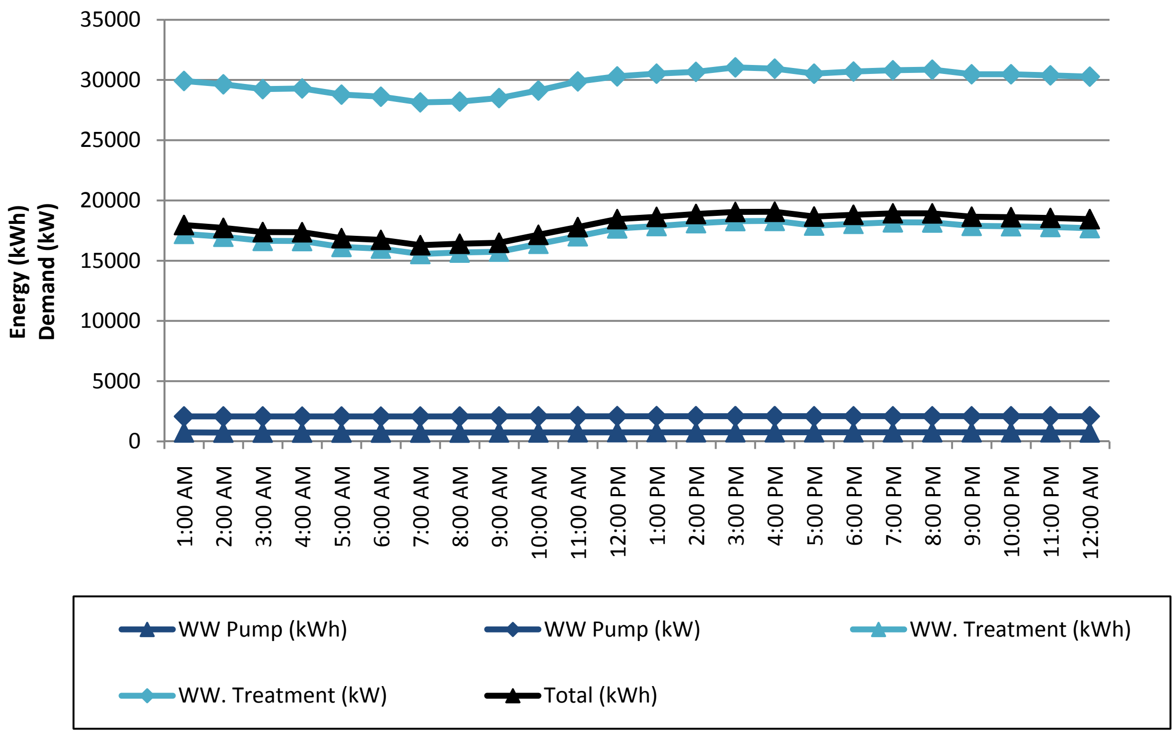

| | |
|---|---|
| Date | 1/27/2008 |
| Day | Sunday |
| Peak Demand (kW) | |
| *Wastewater Treatment Plants* | 29,545 |
| *Waste Water Pumps* | 1,425 |

**Figure 9: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| Date | 12/4/2008 |
| Day | Thursday |
| Peak Demand (kW) | |
| *Wastewater Treatment Plants* | 22,960 |
| *Waste Water Pumps* | 623 |

**Figure 10: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| Date | 11/2/2008 |
| Day | Sunday |
| Peak Demand (kW) | |
| *Wastewater Treatment Plants* | 18,166 |
| *Waste Water Pumps* | 756 |

**Figure 11: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

A total of 127 megawatts (MW) of electricity is generated in Sanitation Districts' wastewater and solid waste operations. Plans are underway to increase generation to 139 MW in 2009. About 40MW is used in powering Districts' operations; the rest is used to reduce the amount of power produced by utilities, thereby reducing greenhouse gas emissions.

The JWPCP uses biogas to generate 22 MW of electricity. This facility treats 320 million gallons per day, is energy self-sufficient, saving approximately $15 million per year, and sells excess electricity to the local power grid.

The Antelope Valley Green Energy Program uses biogas in a 250 kilowatt (KW) fuel cell at the Palmdale WRP and a 230 KW microturbine at the Lancaster WRP. Each of these projects was the first of its type to use biogas from a treatment plant and includes innovative systems to clean trace materials from the biogas to produce zero to ultra-low air emissions.

Future projects include:

- Whittier Narrows WRP – installing UV disinfection (current)
- Santa Clarita (Valencia-Saugus) – chloride issues, water softeners, removing salts: UV disinfection
- Consider flow equalization at some reclamation facilities to increase efficiency by flatting the diurnal curve of influent

According to the EPA, the Sanitation Districts are among the top twenty largest green energy users in the nation and are the only organization on the list that also produces all of the green power it uses.

## Sources


Andre Schmidt, Energy Recovery Section - Los Angeles County Sanitation District. Interviewed by: Lacy Cannon and Bill Bennett, 9/9/2009

*The Greater Los Angeles County – Integrated Regional Water Management Plan*. Adopted December 2006.

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# Marin Municipal Water District (MMWD)

## Summary

| | | | |
|---|---|---|---|
| **Primary functions** | Urban Water, Recycled Water | | |
| **Segments of Water Use Cycle** | Supply, Treatment, Distribution, Recycled Water Production | | |
| **Hydrologic Regions** | San Francisco | **DEER Climate Zones** | 3 and 12 |
| **Quantity of Water** | Treated: 29 MGD (average)<br>Distributed: 34.1 MGD (average) | Recycled: 0.91 MGD<br>(during summer months only, no production in winter) | |
| **Number of Customers (2005)** | Total: 64,588<br>Residential: 59,422<br>Other: 5,166 | **Service Area Size** | 147 Sq miles |
| **Distinguishing Characteristics** | The Marin Municipal Water District (MMWD) in the eastern corridor of Marin County covers approximately 147 square miles and serves a population of approximately 190,000. MMWD manages several local reservoirs for its supply in addition to imports from Sonoma County Water Agency. MMWD serves an area with hilly terrain; about 90% of the water must be pumped at least once before it reaches customers. | | |
| **Key Energy Drivers** | • Water Supply – Many reservoirs are at high elevations, though varying operations cause a large range in energy use<br>• Treatment – Treatment is required at two treatment plants for all local surface water<br>• Water Distribution – Significant energy is used to pump water through the hilly terrain | | |
| **Water and Wastewater Treatment Technologys** | Bon Tempe and San Geronimo Treatment Plants (Water): coagulation, sedimentation, filtration, and chloramines<br>Ignacio Treatment Facility (Water): quality monitoring, chemical addition<br>Recycled Water Facility: filtration, tertiary treatment | | |
| **2008 Water Resources** | 73% Local Surface Water, 25% Imported, 2% Recycled | | |
| **Marginal Water Supply** | Short-term: Local Surface Supply<br>Long-term: Recycled Water, Additional Russian River Supply, Desalination | | |
| **Energy Service Provider** | PG&E | | |
| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
| | Raw Water Pumps | 9 | 480 |
| | Water Treatment | 105 | 322 |
| | Water Distribution | 352 | 633 |
| | Recycled Water Treatment | 984 | 1,262 |
| | Recycled Water Distribution | 969 | 1,304 |

## Background Information

The Marin Municipal Water District (MMWD) serves the populous eastern corridor of Marin County from the Golden Gate Bridge northward up to, but not including, Novato, is bounded by the San Francisco Bay on the east, and stretches through the San Geronimo Valley in the west. MMWD covers approximately 147 square miles and serves approximately 61,000 customers (a population of approximately 190,000). More information is available in Table 1.

Primary sources of information for this section include: MMWD's 2005 Urban Water Management Plan, 2008 water and energy data provided by MMWD and PG&E, and personal communication with MMWD staff. A detailed list of references is located at the end of this section.

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water, Recycled Water |
| **Hydrologic Region** | San Francisco |
| **Region Type** | Coastal |
| **Energy Service Provider** | PG&E |
| **DEER Climate Zone** | 3 (67%) and 12 (33%) |
| **Service Area Size** | 147 Sq miles |
| **Service Area Population** | 190,000 |
| **Number of Customers in 2008** | 59,694 |
| ***Residential*** | 55,525 |
| ***Other*** | 4,292 |
| **Distribution Topology** | Hilly |

### Climate

MMWD has a Mediterranean coastal climate. Summers are mild and dry, and winters are cool and wet; with an annual average of 30 inches of precipitation in the service area and over 50 inches of rainfall on the Mt. Tamalpais watershed. The region is subject to wide variations in annual precipitation and contains a multitude of microclimates. Summer fog helps reduce summer irrigation requirements.

### Demographics

MMWD serves a largely urban area. Population within MMWD's service area is expected to increase 8.6 percent in the next 20 years as seen in Table 2.

### Table 2: Projected MMWD Service Area Population

| Year | Population |
|---|---|
| 2010 | 195,362 |
| 2015 | 202,155 |
| 2020 | 205,763 |
| 2025 | 208,971 |
| 2030 | 212,256 |

## Water Sources

MMWD obtains it water from local rainfall collected in reservoirs, imported water, and recycled water. Until 1976, all of MMWD's water supply was obtained solely from rainfall collected from a watershed of approximately 28 square miles of MMWD-owned lands, and 36 square miles not owned by MMWD. Today, 73 percent of MMWD's water comes from this rainfall collected in seven reservoirs in Marin County. The majority of the remaining water supply comes from the Russian River in Sonoma County under a contract with the Sonoma County Water Agency.  A small amount comes from MMWD's recycled water plant.

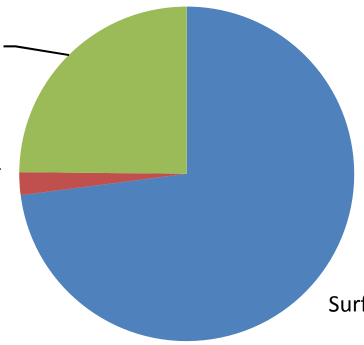



**Figure 1: 2008 Distribution of Sources (AF/Yr)**

### Local Raw Surface Water

MMWD collects local rainfall in seven reservoirs owned by MMWD. Five reservoirs are on the Mt. Tamalpais Watershed: Phoenix, Lagunitas, Bon Tempe, Alpine, and Kent. The other two, Nicasio and Soulajule, are in the hills of West Marin. As part of routine operation, reservoir water is seasonally aerated to maintain a proper oxygen balance. The capacities of these reservoirs are listed in Table 3.

**Table 3: MMWD Owned Surface Water Reservoirs**

| Reservoir | Storage Capacity (AF) |
|---|---|
| Lagunitas | 350 |
| Phoenix | 411 |
| Alpine | 8,891 |
| Bon Tempe | 4,017 |
| Kent | 32,895 |
| Nicasio | 22,430 |
| Soulajule | 10,572 |

### Imported Water

MMWD receives imported water through a contract with Sonoma County Water Agency (SCWA) for water from the Russian River.  Through the agreement, MMWD can take deliveries of up to 14,300 acre-feet per year from the SCWA.  In winter, the maximum delivery rate is 23 MGD and in summer total deliveries are limited to 12.8 MGD.  The contract continues through June 2034. Imports are subject to available pipeline capacity.  Currently, imports to MMWD flows through the SCWA pipelines to Petaluma.  From Petaluma, the water flows southward in the North Marin Water District's aqueduct eight miles to the northern end of the MMWD service area to facilities in Novato. As water use increases and other deliveries are required through the same conduit, the pipeline's capacity may cause limitations in the future.

### Recycled Water

Since the early 1980s, MMWD has been producing recycled water for non-agricultural uses. MMWD's plant draws on the effluent of the Las Gallinas Valley Sanitary District that has been treated to secondary standards. MMWD further treats the water to tertiary standards and distributes it to more than 250 customers in northern San Rafael. Recycled water is used for landscape irrigation, toilet flushing, car washes, HVAC cooling towers, commercial laundries, and other non-drinking purposes.

Within the MMWD service area there are 13 wastewater agencies. Of these seven are collection agencies, six having treatment facilities, and three utilize recycled water for landscape and irrigation purposes. The majority of wastewater in MMWD's service territory is treated to a secondary treatment level and released into the San Francisco Bay.

### Marginal Water Supply

The Study Team identifies the short- and long-term marginal supplies for MMWD. In the short-term, local surface supply is MMWD's marginal supply. MMWD's marginal supply in the long-term is available from additional Russian River supply, recycled water, and desalination.

In the short-term, MMWD estimates operational improvements can be made to augment water supplies by 1,000 acre-feet. This would require reconfiguration of a water intake pump at Alpine Lake to allow MMWD to tap currently inaccessible water, the construction of an additional untreated water pipeline and inlet structure at Kent Lake, and the installation of a larger pump station in Corte Madera to optimize the distribution of water.

MMWD's long-term marginal supply options are listed below.

### Recycled Water

MMWD's existing recycled water plant is limited by a lack of customers along the plant's distribution system. MMWD has identified a promising potential new customer; the Peacock Gap Golf Course in San Rafael. Existing distribution would need to be expanded to reach this customer to supply 300 acre-feet per year. Other customers could be added along the new distribution pipeline route.

### Imported Water – SCWA

Currently, MMWD receives only a portion of water it is contracted to receive from the Russian River due to capacity limitations in the delivery system, owned and operated by SCWA and the North Marin Water District. MMWD identified two phases expanding supply in the future; one is the construction of a new pipeline in Novato to allow MMWD to receive 2,300 acre-feet more water per year from the Russian River, and the other is for SCWA to make improvements to its infrastructure to increase water delivery capacity by 1,000 acre-feet per year for Marin.

#### *Desalination*

MMWD has been investigating desalination as a potential water source for Marin since 1990. In 2005, a temporary pilot desalination plant was built. Since then, two options were evaluated. The first was a permanent 5-million-gallon-per day (MGD) desalination plant (producing 3,300 acre-feet/year) located about one mile north of the Richmond-San Rafael Bridge on MMWD-owned property in San Rafael. The second option was a smaller, permanent 1-MGD desalination plant (producing 1,000 acre-feet/year) built to exclusively provide water for the San Quentin Prison. In August 2009, the MMWD Board of Directors voted to keep desalination as one of Marin's potential future water supply sources by approving a 5-million-gallon-per-day (MGD) desalination facility, expandable to 15 MGD.

The energy intensity range of MMWD's marginal supply is summarized in Table 4. The energy intensity represents the embedded energy for all activities up until the point where water is ready to enter the distribution system.

**Table 4: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Local Surface Water[a] | 114 - 802 kWh/MG |
| Long-term | Recycled Water[a] | 984 – 1,262 kWh/MG |
| | Imports from SCWA[b] | 1,728 – 1,975 kWh/MG |
| | Seawater Desalination[c] | 12,276 kWh/MG |

a) Calculated using data from MMWD

b) Calculated using SCWA data, total energy intensity to supply and distribute water from SCWA, see SCWA section of this report for details

c) Estimate obtained from California Sustainability Alliance, 2008.

## Water Demand

MMWD serves over 64,000 customers, mostly residential, as summarized in Table 5. The corresponding projected water use in each sector is summarized in Table 6.In response to increasingly stringent limitations on burning, many of GCID's landowners flood a portion of their fields to clear their land of leftover rice straw. GCID estimates that approximately 54,000 acres were flooded in 2004, a trend that is expected to continue or increase, assuming other options (including the sale of stubble for ethanol production) are not determined to be more economically feasible.

<u>Urban</u>

M&I water demand within the vicinity of GCID's service area is anticipated to increase only slightly, with additional annual water requirements in the year 2020 expected to increase by less than 10,000 acre-ft. This water is assumed to be groundwater.

<u>Environmental</u>

GCID conveys water to three National Wildlife Refuges (Sacramento, Delevan, and Colusa), encompassing approximately 22,500 acres. Water requirements for these three refuges total 105,000 acre-ft. GCID has recently upgraded its water system to better supply the refuges and provide year-round service. Additionally, GCID serves approximately 700 acres of privately owned duck clubs. Approximately 8,350 acres of riparian vegetation are estimated to be incidentally supplied by irrigation, including vegetation directly adjacent to delivery laterals or influenced by leakage from the delivery system. According to MMWD's estimates, the number of customers is expected to grow 6.5 percent between 2010 to 2025 increasing water demand by 3 percent. The majority of the increase in demand occurs from the residential sector. During this same time period population in MMWD's service area is expected to grow 7 percent (Table 2).

**Table 5: Historic and Projected Number of Customers by Type**

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| Residential | 55,945 | 59,422 | 64,373 | 66,553 | 67,743 | 68,537 |
| Business | 3,327 | 3,534 | 3,828 | 3,958 | 4,028 | 4,097 |
| Institutional/Gov | 287 | 305 | 330 | 342 | 348 | 372 |
| Landscape | 1,250 | 1,327 | 1,437 | 1,486 | 1,512 | 1,490 |
| **Total** | **60,809** | **64,588** | **69,968** | **72,339** | **73,631** | **74,496** |

**Table 6: Historic and Projected Water Demand (AF/Yr)**

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| Residential | 19,984 | 19,758 | 19,824 | 20,227 | 20,315 | 20,343 |
| Business | 3,449 | 3,414 | 3,426 | 3,495 | 3,511 | 3,515 |
| Institutional/Gov | 2,198 | 2,211 | 2,218 | 2,263 | 2,273 | 2,276 |
| Landscape | 2,613 | 2,602 | 2,612 | 2,665 | 2,676 | 2,681 |
| Other | 205 | 315 | 340 | 350 | 355 | 360 |
| Unaccounted | 2,605 | 3,400 | 3,680 | 3,800 | 3,870 | 3,925 |
| **Total** | **31,054** | **31,700** | **32,100** | **32,800** | **33,000** | **33,100** |

## System Infrastructure and Operations

MMWD operates a complex system of reservoirs, treatment plants, storage tanks, and pumps to deliver water to its customers. Table 7 summarizes the infrastructure operated by MMWD.

**Table 7: Infrastructure Summary**

| | |
|---|---|
| **Number of Reservoirs Operated** | 7 |
| **Miles of Distribution Piping** | 941 |
| **Number of Pump Stations** | 95 |
| **Number of Plants** | 3 |
| ***Treatment*** | 3 |
| **Number of Storage Tanks** | 139 |
| **System-wide Storage Capacity** | |
| ***Raw Water Reservoirs*** | 29,927 Mgal |
| ***Treated Water Tanks*** | 83 Mgal |

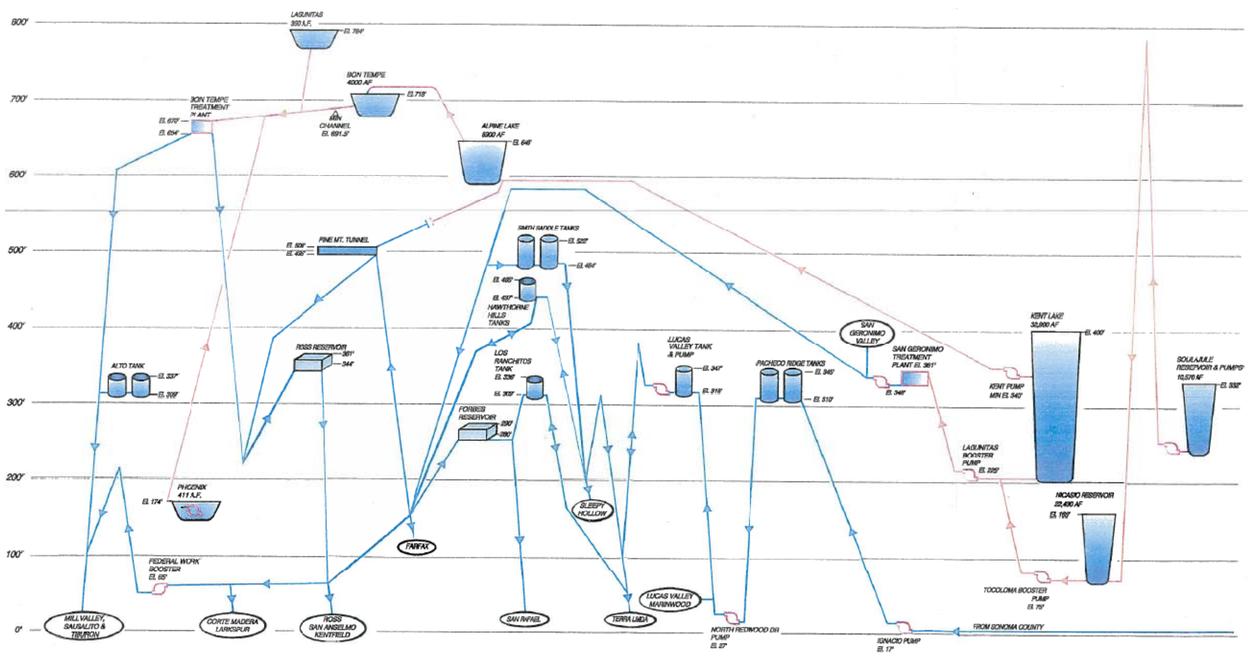
### Sub-Regions within Agency

For the purposes of this study, the service area of MMWD will not be divided into sub-regions.

#### *Conveyance*

Raw water in MMWD's seven reservoirs must be conveyed to one of MMWD's two water treatment plants. A system of raw water pumps are used to transfer water between reservoirs and convey it to the plants. Figure 2 illustrates the connections between each reservoir and water treatment plant. Significant energy is required by these pumps to convey water due to the hilly terrain. For example, although Soulajule Reservoir and Kent Lake are at similar elevations, water must be pumped 400 feet above the reservoirs to transfer water between the two.

Of the 95 pumps owned and operated by MMWD, only a select few are used for raw water conveyance. Within the data provided by MMWD, the Study Team identified eight raw water pumps.




Source: MMWD

**Figure 2: MMWD Infrastructure and Elevation Map**

### *Treatment Plants*

Raw surface water is treated at one of two water treatment plants in MMWD; a third plant monitors imports from SCWA.

The Bon Tempe Treatment Plant on Mt. Tam and the San Geronimo Treatment Plant in Woodacre treat water from MMWD's reservoirs. The plants use conventional treatment techniques: coagulation, sedimentation, filtration, and chloramine treatment. Chemicals are added for control corrosion; fluoride is added as well. The combined maximum daily treatment plant capacity is 59 million gallons per day.

The water imported from SCWA originates from the Russian River. Russian River water is drawn from the ground beneath the river bed and is naturally filtered in the process. This water enters the MMWD system at the Ignacio Treatment Facility, where water quality is monitored continually. Additional treatment is performed to bring it to MMWD's required purity. This includes chemical addition such as chlorine, fluorine, and pH adjustments.

### *Distribution*

After water is treated it can be pumped directly to customers or stored in tanks until needed. Because of Marin's hilly terrain, about 90 percent of the water must be pumped at least once before it reaches customers. Some water must travel through six different pump stations. The majority of the 95 pump stations owned and operated by MMWD are used to distribute treated water to customers.

Figure 2 illustrates the connections between each water treatment plant and major townships within MMWD's service area. The distribution system is highly interconnected, allowing water from any of MMWD's sources to reach almost any customer. The hilly terrain requires the distribution system to traverse a service area with a maximum elevation difference of more than 500 feet.

### *Recycled Water*

In 1989, the MMWD's recycled water plant was upgraded to its current capacity of 2 MGD. The plant uses tertiary treatment to further treat secondary effluent water from Las Gallinas Valley Sanitary District. Recycled water produced is store in five tanks with a total capacity of 1.7 million gallons (Mgal). Recycled water is distributed using four pump stations through 25 miles of pipeline to 323 service connections.

Recycled water is mostly produced during the summer and fall months. In 2008, production spanned April through November with an average production rate of 0.91 MGD.

## System Storage

MMWD operates 139 storage tanks within its distribution system with a total capacity of 83 Mgal of treated water. Additionally, 25,927 Mgal of raw water can be stored in MMWD's surface reservoirs. According to the Study Team's estimates, treated water storage capacity could provide approximately 2.5 days worth of supply.

## System-wide Operation Strategy

Information on the operations strategies of MMWD was not available from staff.

## Infrastructure Changes

Information on major infrastructure changes in MMWD during 2008 was not available from staff.

# Energy Profiles

MMWD provided the Study Team with energy data from PG&E and measured water flow data. Energy data came in the form of monthly energy bills for all facilities. Each pump station had a single energy meter regardless of the number of pumps located at that site. Flow data came in the form of total daily water flow data although it was limited. Flow data was only provided at each of the three treatment facilities and the recycled water plant. Water flow rates through individual booster pumps were not available. Thus the Study Team applied the total treated water delivery flow pattern to each booster pump station for energy profile calculation purposes. The energy and flow data was processed by the Study Team to determine the energy intensity of each facility type and the hourly energy profiles presented in this section.

The energy intensity of each facility type within MMWD is presented in Figure 3. Energy intensity is not reported for recycled water production and distribution during the winter months as recycled water is not produced during this time. Energy intensity of water treatment plants and water distribution pumps in January and December were removed from consideration as water flows were low and energy data was incomplete.

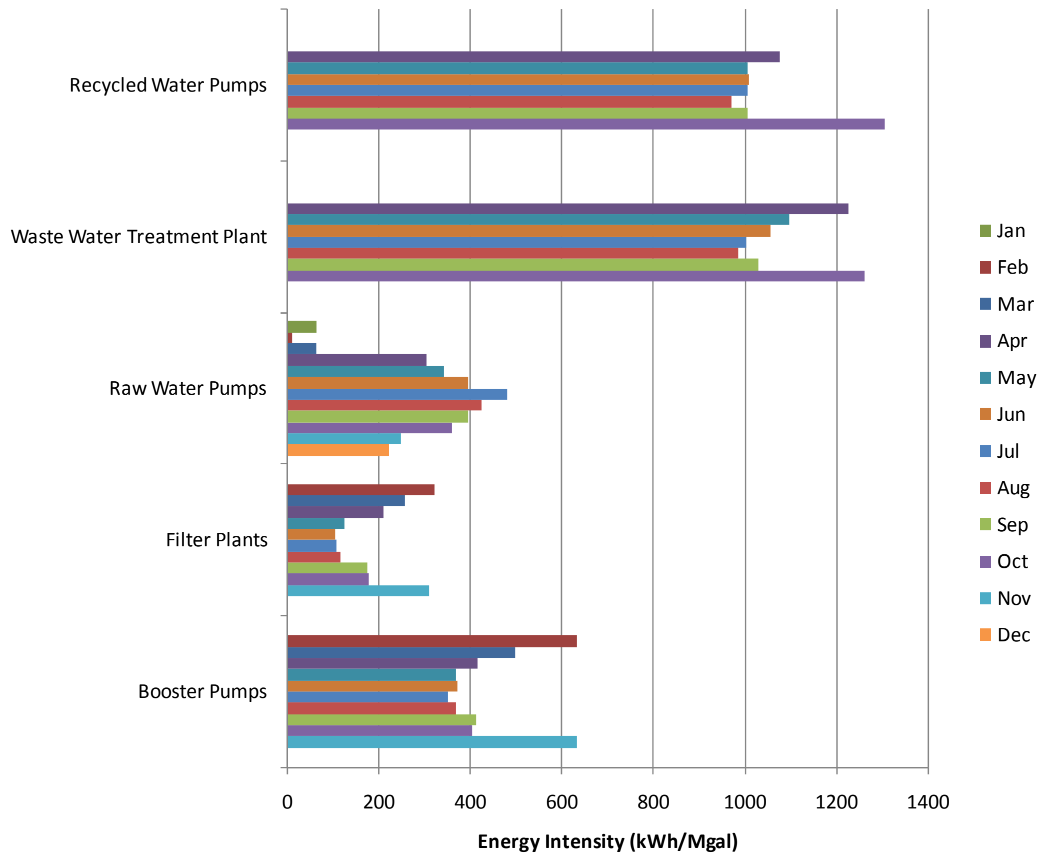
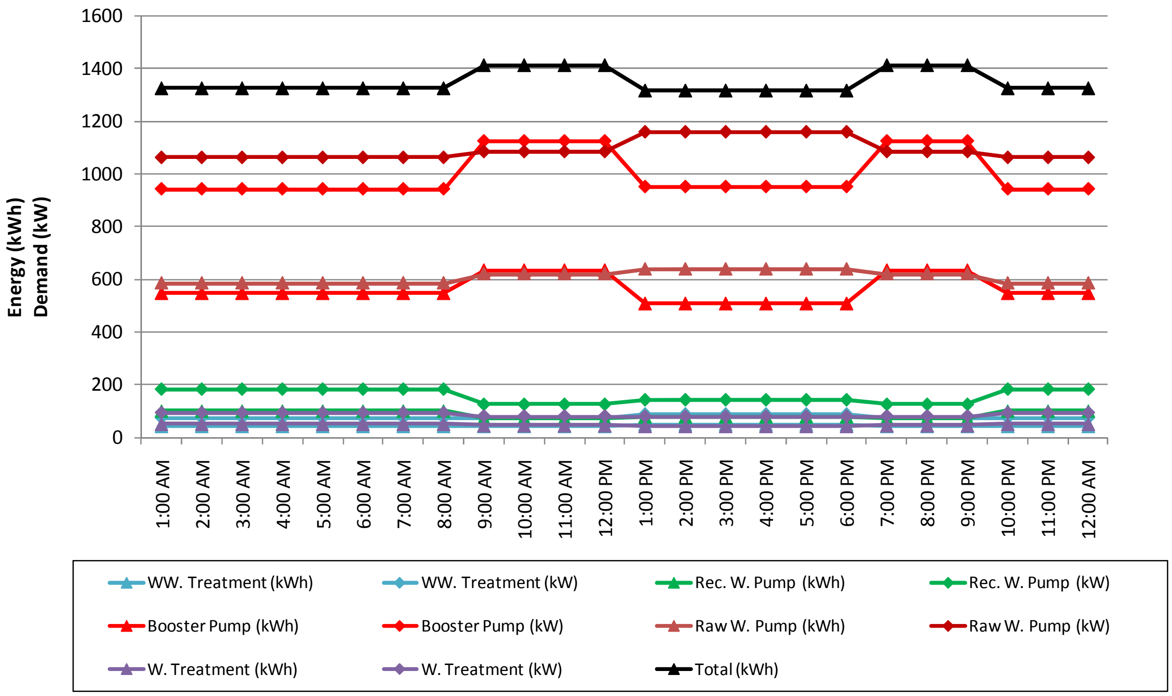


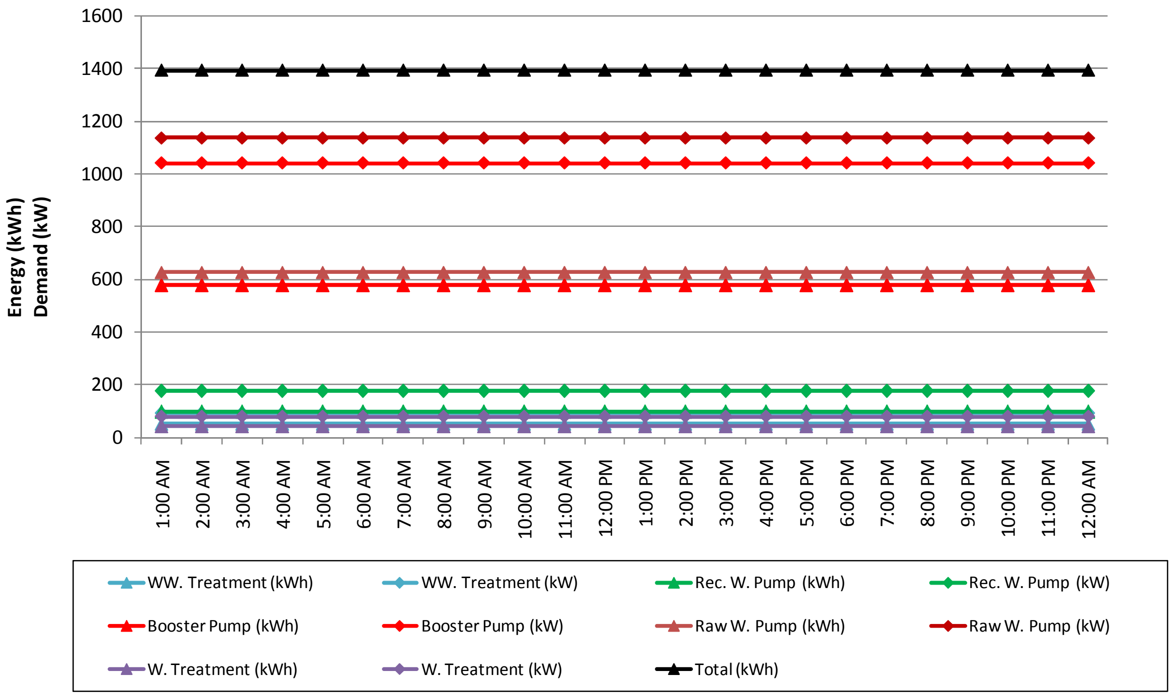

**Figure 3: MMWD Monthly Energy Intensity by Facility Type**

Hourly energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by MMWD is for raw and treated water pumping due to MMWD's hilly terrain.



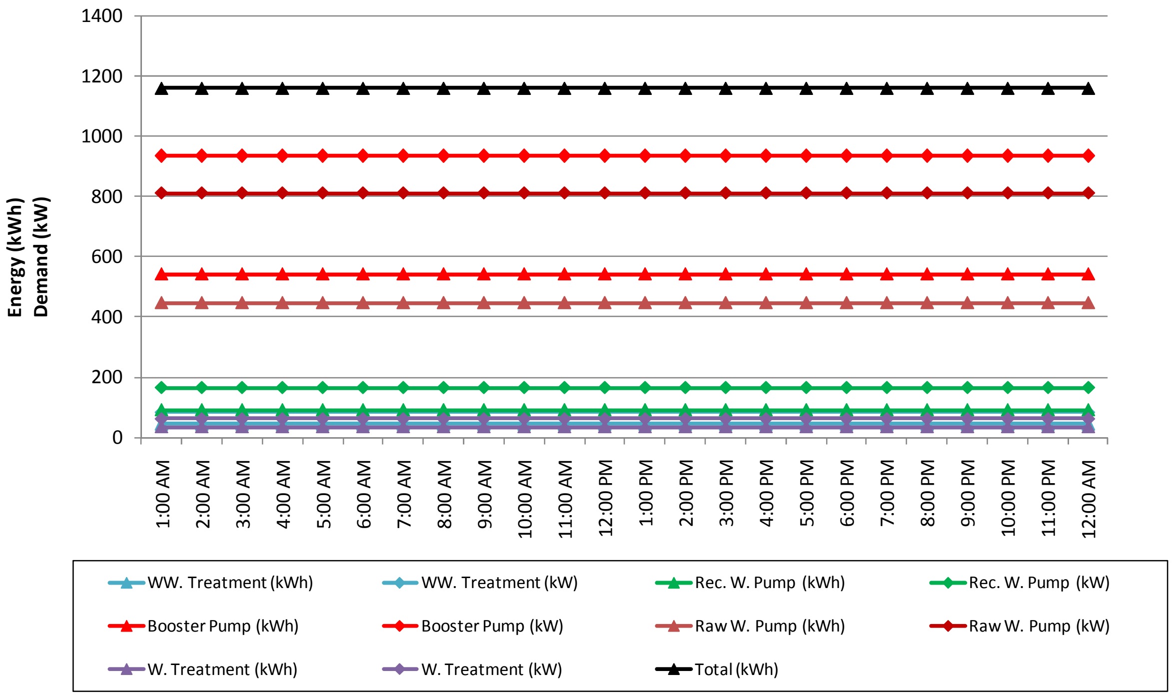

| | |
|---|---|
| **Date** | 7/8/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 949 |
| *Raw Water Pump* | 1,827 |
| *Recycled Water Pumps* | 78 |
| *Water Treatment* | 1,360 |
| *Recycled Water Production* | 48 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



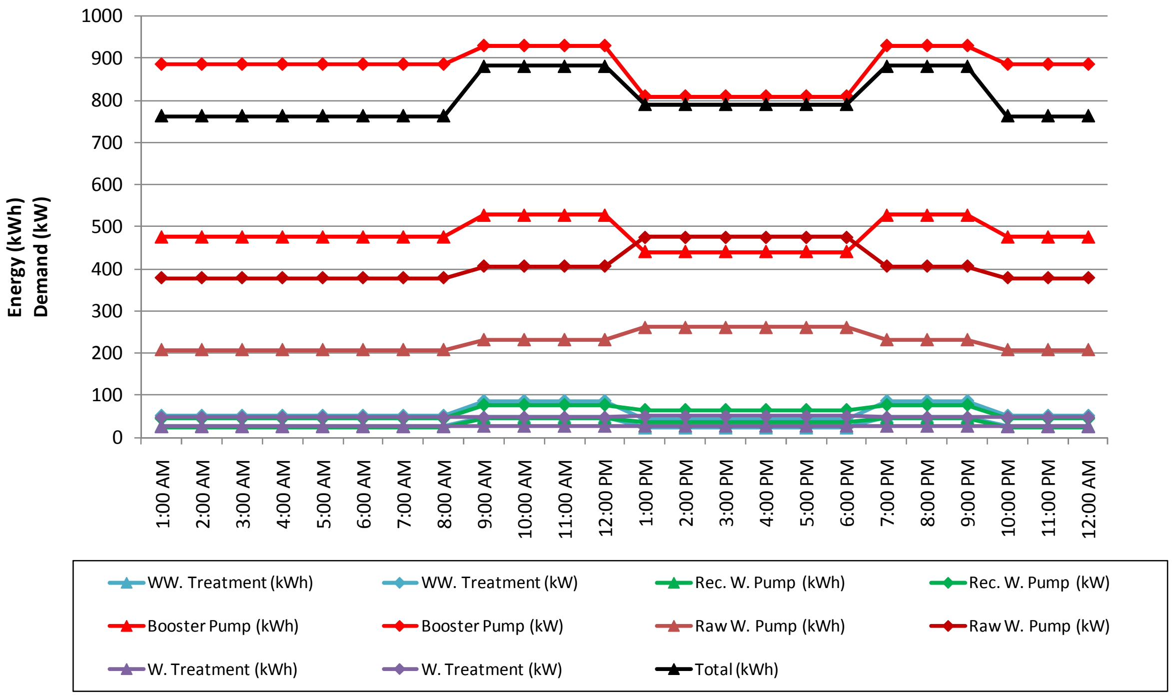

| | |
|---|---|
| **Date** | 6/21/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,077 |
| *Raw Water Pump* | 1,820 |
| *Recycled Water Pumps* | 97 |
| *Water Treatment* | 1,471 |
| *Recycled Water Production* | 50 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



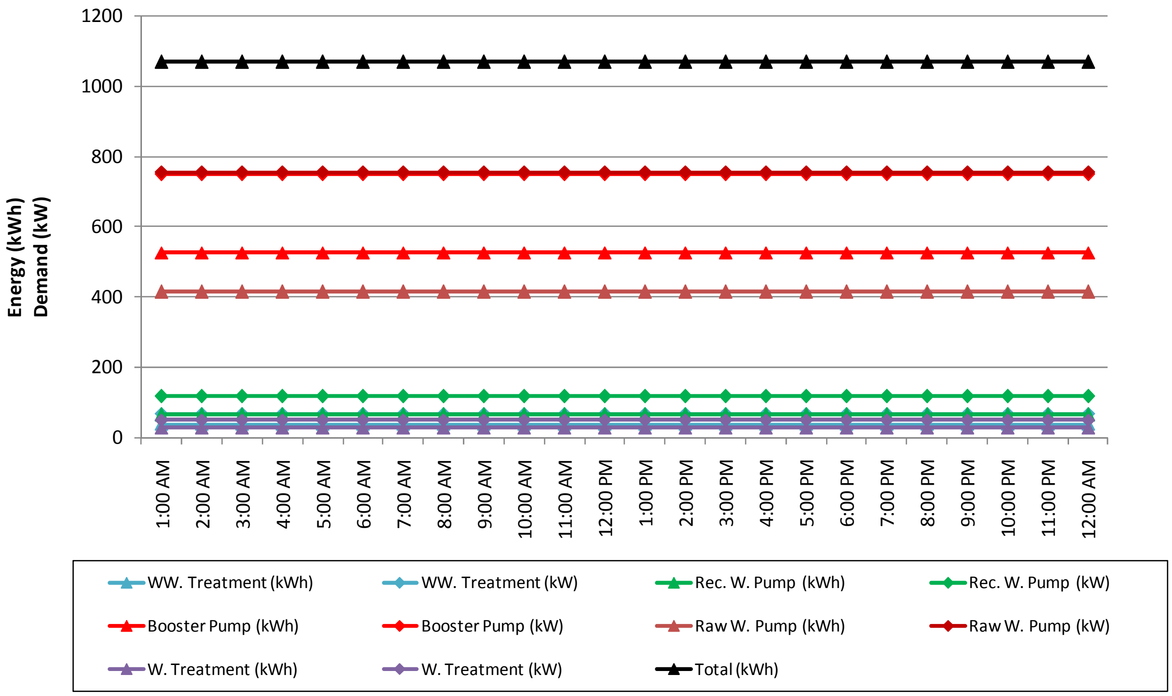

| | |
|---|---|
| **Date** | 9/6/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,005 |
| *Raw Water Pump* | 1,382 |
| *Recycled Water Pumps* | 91 |
| *Water Treatment* | 1,250 |
| *Recycled Water Production* | 46 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



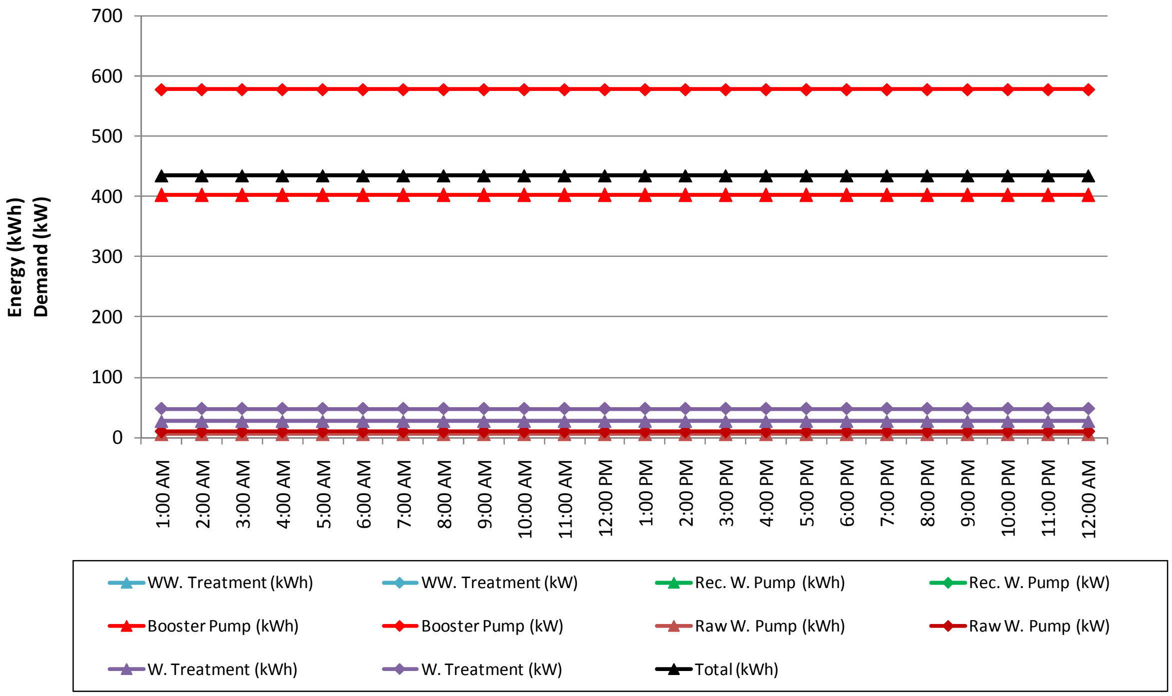

| **Date** | 10/31/2008 |
|---|---|
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 861 |
| *Booster Pumps* | 271 |
| *Raw Water Pump* | 36 |
| *Water Treatment* | 707 |
| *Pressure System Pumps* | 24 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



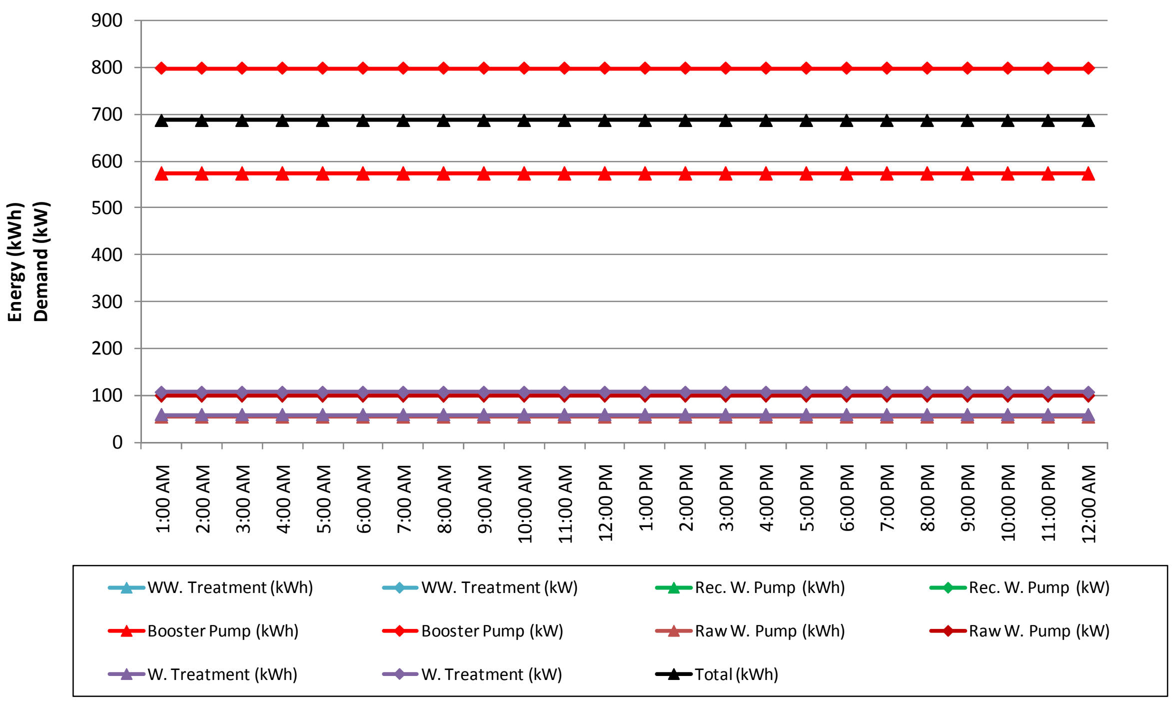

| | |
|---|---|
| **Date** | 4/26/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,106 |
| *Raw Water Pump* | 430 |
| *Recycled Water Pumps* | 65 |
| *Water Treatment* | 1,417 |
| *Recycled Water Production* | 37 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| **Date** | 3/8/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 813 |
| *Raw Water Pump* | 20 |
| *Recycled Water Pumps* | 0 |
| *Water Treatment* | 613 |
| *Recycled Water Production* | 0 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| **Date** | 12/28/2008 |
|---|---|
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,250 |
| *Booster Pumps* | 63 |
| *Raw Water Pump* | 0 |
| *Water Treatment* | 318 |
| *Pressure System Pumps* | 0 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

The Study Team did not locate any information on the current energy efficiency project. Information on this subject was not available from MMWD staff.

## Sources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MMWD. *2005 Urban Water Management Plan.* 2005

California Sustainability Alliance. *The Role of Recycled Water in Energy Efficiency and Greenhouse Gas Reduction*. 2009.

Dana Roxon, Principal Engineer – MMWD. Personal communication. June 2009 – November 2009.

# Monterey Regional Water Pollution Control Agency (MRWPCA)

## Summary

<table>
<tr><td>Primary functions</td><td colspan="3">Urban Wastewater, Recycled Water Production, Agricultural Supply</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Wastewater Treatment, Recycled Water Production, Recycle Water Distribution,</td></tr>
<tr><td>Hydrologic Region</td><td>Coastal</td><td>DEER Climate Zone</td><td>3</td></tr>
<tr><td>Quantity of wastewater</td><td>21 MGD Average Flow Secondarily Treated</td><td colspan="2">Recycled: 29.6 MGD Permitted Capacity</td></tr>
<tr><td>Number of Customers</td><td>Total Population: Approximately 266,000</td><td>Service Area Size</td><td>Not Available</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">Monterey Regional Water Pollution Control Agency (MRWPCA) member communities include Pacific Grove, Monterey, Del Rey Oaks, Seaside, Sand City, Fort Ord, Marina, Castroville, Moss Landing, Boronda, Salinas and some unincorporated areas in northern Monterey County. Wastewater is treated at one regional plant that provides some recycled water while discharging the rest into the ocean. The recycling operations provide irrigation water to 12,000 acres of food-chain crop farmland near Castroville.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3"><ul><li>Wastewater Treatment – treatment to secondary levels and discharges 2 miles into Monterey Bay (by permit).</li><li>Recycled Water Distribution – multiple pump stations move water through 45 miles of distribution piping to reach recycled water customers</li></ul></td></tr>
<tr><td>Wastewater Treatment Technology</td><td colspan="3">Regional Wastewater Treatment Plant (Wastewater):<br>Primary Treatment, Secondary treatment, Tertiary treatment and chlorination</td></tr>
<tr><td>Water Resources</td><td colspan="3">N/A - wastewater only</td></tr>
<tr><td>Marginal Water Supply</td><td colspan="3">N/A - wastewater only</td></tr>
<tr><td>Energy Service Provider</td><td colspan="3">PG&E</td></tr>
<tr><td rowspan="3">Observed Energy Intensities (kWh/MG)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Wastewater Treatment</td><td>1,422</td><td>1,994</td></tr>
<tr><td>Wastewater Pumps</td><td>243</td><td>333</td></tr>
</table>

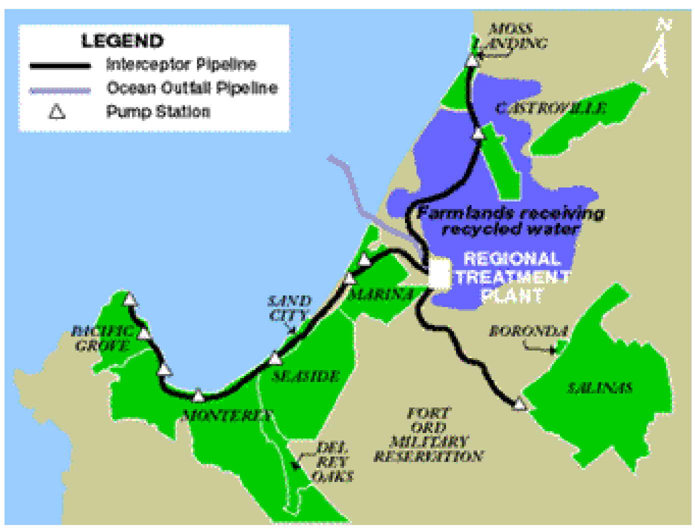
## Background Information

Table 1 summarizes information about MRWPCA. MRWPCA operates the Regional Wastewater Treatment Plant (RTP) located two miles north of Marina and the Salinas Valley Reclamation Plant (SVRP). MRWPCA also maintains 25 pump stations in their service area. The secondary treated effluent from the RTP may either be sent to the SVRP for tertiary treatment or it may be released to an outfall pipe that discharges 2 miles into Monterey Bay.

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Wastewater Treatment, Tertiary Treated Recycled Water Production, Agricultural Irrigation Water Supply |
| **Hydrologic Region** | Central Coast |
| **Region Type** | Coastal |
| **Energy Service Provider** | PG&E |
| **DEER Climate Zone** | 3 |
| **Service Area Population 2008** | Approximately 263,000 |
| **Number of Customers in 2008** | Approximately 80,000 |
| **Distribution Topology** | Moderate |

MRWPCA member communities include Pacific Grove, Monterey, Del Rey Oaks, Seaside, Sand City, Fort Ord, Marina, Castroville, Moss Landing, Boronda, Salinas and some unincorporated areas in northern Monterey County(see Figure 1).




### Figure 1: MRWPCA Service Area Map

Primary sources of information on the Monterey Regional WPCA include: MRWPCA's public website, the Monterey Peninsula Water Management District's Integrated Regional Water Management Plan, projections from the Association of Monterey Bay Area Governments, and Monterey County's Urban Water Management Plan. A detailed list of references is located at the end of this section.

## Climate

Average summer temperatures in Monterey County range from 51 to 68 degrees F. Average winter temperatures range from 44 to 61 degrees F. The warmest months are July through October. Average yearly rainfall totals 18 inches, and falls primarily between November and April. Summer months on the coast can often be foggy due to the chilly and unchanging water temperature of the Pacific Ocean.

## Demographics

The Region contains areas along the coast in the Carmel Highlands, Pebble Beach, Pacific Grove, Monterey and further inland in Carmel Valley and Hidden Hills. The economic base in the Region is made up of tourism, government, education, and the military. A limited water supply has constrained growth in the construction industry. However, according to "Tools for Assessing Jobs-Housing Balance and Commute Patterns in the Monterey Bay Region, Final Report," May 9, 2001, prepared by the Association of Monterey Bay Area Governments (AMBAG), over the next 20 years, population and housing in Monterey County is expected to increase by more than 30 percent (see Table 2). Monterey County is expected to see a slightly higher percentage increase in population and housing than in jobs.

**Table 2: Historic and Projected Population in MRWPCA Service Area**

| | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|---|
| Boronda | 727 | 740 | 753 | 766 | 791 | 804 | 817 |
| Castroville | 6,649 | 6,574 | 6,498 | 6,423 | 6,270 | 6,193 | 6,117 |
| Del Rey Oaks | 1,754 | 1,956 | 2,159 | 2,362 | 2,766 | 2,969 | 3,171 |
| Marina | 20,879 | 22,602 | 24,323 | 26,044 | 29,493 | 31,211 | 32,931 |
| Monterey | 29,229 | 29,399 | 29,563 | 29,746 | 30,078 | 30,240 | 30,404 |
| Moss Landing | 333 | 368 | 401 | 434 | 502 | 525 | 568 |
| Pacific Grove | 15,449 | 15,394 | 15,333 | 15,275 | 15,159 | 15,101 | 15,036 |
| Salinas | 142,109 | 142,717 | 143,325 | 143,970 | 145,156 | 145,757 | 146,357 |
| Sand City | 419 | 574 | 728 | 882 | 1190 | 1345 | 1498 |
| Seaside | 33,471 | 33,765 | 34,055 | 34,353 | 34,934 | 35,223 | 35,511 |
| Unincorporated County | 8,341 | 9,896 | 11,447 | 13,000 | 16,108 | 17,656 | 19,208 |
| **Total** | **261,110** | **265,751** | **270,366** | **275,052** | **284,276** | **288,878** | **293,478** |
| **Total Monterey County** | **442,632** | **445,309** | **466,606** | **483,733** | **499,341** | **515,549** | **530,362** |

## Recycled Water

MRWPCA operates the SVRP at the RTP and manages the reclaimed flow distribution system under contract from the Monterey County Water Resources Agency. The treatment and distribution of recycled water is paid for by Salinas Valley agricultural growers and property owners. The recycling operations provide irrigation water to 12,000 acres of food-chain crop farmland near Castroville.

Methane gas, a byproduct of the treatment process, was initially burned off as waste at the RTP. In 1992, the gas was successfully utilized as a fuel source for large, engine-driven generators to create electricity.

Today, most of the electricity required to run the treatment plant is produced from a blend of methane and natural gas. Almost 9.5 million kilowatt hours of electricity are produced per year, enough to power 9,900 average homes for a month.

Wastewater is treated to secondary treatment standards at the RTP facilities and water that has not been designated for tertiary treatment and recycling is discharged via an ocean outfall. Water designated for tertiary treatment is conveyed to the adjacent SVRP which produces enough reclaimed water to irrigate 12,000 acres of farmland annually.  The SVRP has a plant design capacity of 29.6 MGD. The recycled water is delivered to farmland in the greater Castroville area through the Castroville Seawater Intrusion Project (CSIP) distribution system, reducing demands on Salinas Valley groundwater and retarding seawater intrusion in that area.

## System Infrastructure and Operations

MRWPCA operates the 29.6 MGD wastewater treatment plant and water recycling facility, located two miles north of Marina. It also maintains 28 pump stations, 35 pressure-vacuum stations and approximately 32 miles of pipeline that transport wastewater to the treatment plant. (Member Entity sewer systems are maintained independently by each entity.) Table 3summarizes the key pieces of the physical infrastructure of MRWPCA's system.

**Table 3: Infrastructure Summary**

| | |
|---|---|
| **Number of Supplemental Wells within the CSIP System** | 22 |
| **Wastewater Treatment and Recycling Permitted and Design Capacity** | 29.6 MGD |
| **Miles of Distribution Piping** | 45 |
| **Pump Stations *Wastewater, MRWPCA Owned*** | 10 |
| **Number of Treatment Plants** | |
| ***Wastewater*** | 1 |
| ***Recycling*** | 1 |

The Monterey County Water Recycling Projects (MCWRP) is comprised of two components – the treatment component and the distribution component. The treatment component is the Salinas Valley Reclamation Project (SVRP), and the distribution component is the Castroville Seawater Intrusion Project (CSIP). The MCWRP was completed and placed into service in 1997.

### *Wastewater Collection*

Marina Coast Water District (MCWD) collects wastewater in its two wastewater collection systems serving the City of Marina and the Ord Community. Wastewater is conveyed to an interceptor operated by the Monterey Regional Water Pollution Control Agency (MRWPCA). The wastewater is then conveyed to the MRWPCA regional treatment plant (RTP) northeast of Marina, see Figure 1.

### *Wastewater and Recycled Water Treatment Plants*

In 1992, MRWPCA and the Monterey County Water Resources Agency formed a partnership to build two projects: a water recycling facility at the Regional Treatment Plant (SVRP); and a distribution system (CSIP), including 45 miles of pipeline and 22 supplemental wells. Its objective was to prevent the advance of seawater intrusion by supplying irrigation water to nearly 12,000 acres of farmland in the northern Salinas Valley. This would significantly reduce the draw of water from the underground aquifers. The $75 million projects were completed in 1997 after three years of construction.

The recycled water facility is capable of producing an average of 29.6 million gallons of recycled water per day. This is the equivalent of one foot of water over 91 acres of land.

Wastewater entering the RTP from homes and businesses passes through primary, secondary and tertiary treatments that clarify and extract sediment. Primary treatment consists of sedimentation and clarification while secondary treatment including trickling filters, solids contact, secondary sedimentation, waste solids thickening, anaerobic digestion, digester gas collection and disposal, and sludge dewatering. Tertiary treatment is performed at the water recycling facility where undergoes coagulation and flocculation, filtration, and chlorination.

During the tertiary filtration process, treated water filters through a 6-foot bed of coal, sand and gravel in which minute particles are trapped. This is the same as the filtering process performed for drinking water. The disinfection process destroys bacteria and germs by maintaining a specific chlorine level in the water for two hours. The final product is clear, odorless and safe to use for food-chain crop irrigation. Technicians perform frequent water quality tests and monitor the system to ensure that safety standards are being maintained.

### *Recycled Water Distribution and Discharge*

This Regional Treatment Plant has excess treatment capacity, but MRWPCA cannot store and pipe all of the effluent flow, which results in discharges to the Monterey Bay.

After treatment, the recycled water is held temporarily in an 80-acre/foot storage pond before it is distributed to farmland via an underground pipeline system. During the rainy season, when the growers don't need the treated water, it is safely discharged two miles into the Monterey Bay.

The distribution system includes 45 miles of pipeline and 22 supplemental wells, capable of supplying up to 29.6 MGD. Recycled water consumption occurs in the Salinas River Basin (immediately north of the planning Region described in this document) and retards seawater intrusion into the aquifers near the coast.

After treatment, the recycled water is used to irrigate edible food crops in the northern Salinas Valley. Reducing the need to pump water from wells is part of a regional effort to slow seawater entering the underground aquifers.

## System-wide Operation Strategy

During the summertime, the Salinas Valley Reclamation Plant (SVRP) produces tertiary treated water from the effluent of the Regional Wastewater Treatment Plant. This recycled water meets all State and Federal standards for irrigating golf courses, parks, schools, and agricultural crops, including non-processed food crops which may be eaten raw. Currently, only agricultural applications are in place, as a conveyance and distribution system for urban uses does not exist. Demand for recycled water is lower in the wintertime and excess water is discharged into the ocean.

## Infrastructure Changes

There were no infrastructure changes in 2008 that affect the Study Team's data. However, several infrastructure changes are currently planned or are ongoing.

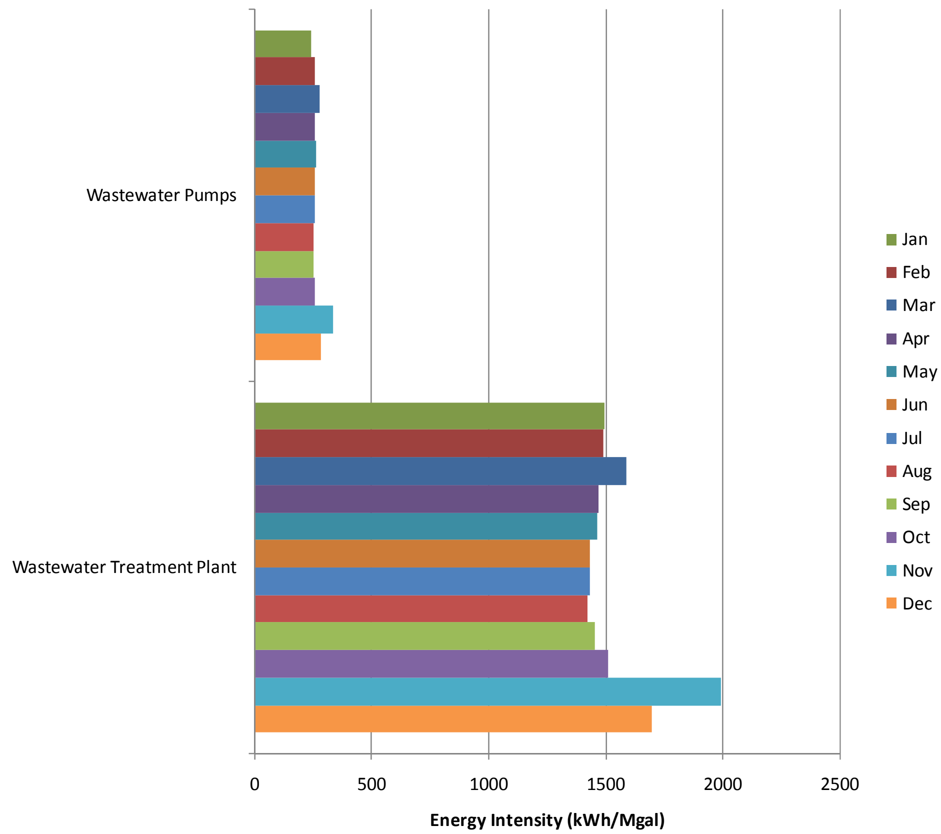
The Regional Urban Recycled Water Project (RURWP) will provide irrigation water to numerous golf courses, parks, and landscaped areas in the Marina, Fort Ord, Seaside, Del Rey Oaks, and Monterey areas. The proposed project would be constructed in two Phases, with Phase I delivering approximately 1,700 acre-ft/year of recycled tertiary-treated water, and Phase II delivering a combined total of approximately 3,100 acre-ft/year The RURWP facilities will include a pipeline distribution system, pump stations, and storage tanks and reservoirs.

The proposed Seaside Basin Groundwater Replenishment Project (GRP) involves the purification and conveyance of recycled water from MRWPCA's facilities for recharge of the Seaside groundwater basin. The Seaside Basin Groundwater Replenishment Project would work in parallel with the aquifer storage and recovery (ASR) project being pursued by the MPWMD on this same basin. The Seaside basin is a major element of the water supply for the Monterey Peninsula cities. This project, along with the ASR project, would augment that water supply and also help mitigate seawater intrusion which is working its way into that basin.

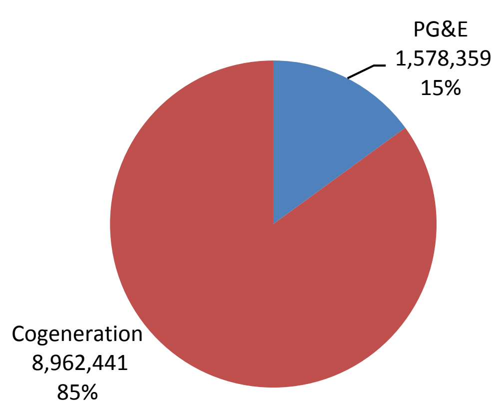
## Energy Profiles

MRWPCA provided energy and wastewater flow data to the Study Team for its calculations of energy profiles. Energy is provided to MRWPCA by PG&E. Energy data included: monthly TOU and/or demand data for their main pump stations, and select interval data (15-minute increment) for large facilities and pump stations. MRWPCA has a cogeneration plant that provides energy to the RTP; however detailed data was not available on this facility. Total energy used by the RTP was reported to have a consistent load of 1200 kW; demand is first met with energy supplied by the cogeneration system, and supplemented with energy from PG&E. The Study Team subtracted the imported PG&E power from the base load of 1200 kW and assumed that the remaining amount was from cogeneration. Wastewater influent flows were provided per minute for each day of the year for the RTP in units of MGD. The Study Team calculated an average flow per day from this data to be used as the total daily influent to the RTP. Monthly flows for the SVRP were provided in units of MGD. Wastewater flow rates through individual pumps were not available, thus the Study Team applied the total influent to the RTP to each of the pump stations for energy profile purposes. Energy data was not provided for recycled water distribution pumps.

The energy intensity of each facility type within the Monterey Regional Water Pollution Control Agency is presented in Figure 2. The energy intensity data includes energy supplied by both PG&E and RTP's cogeneration facility. The Study Team calculated that the RTP gets approximately 85 percent of its annual energy from cogeneration as illustrated by Figure 3.

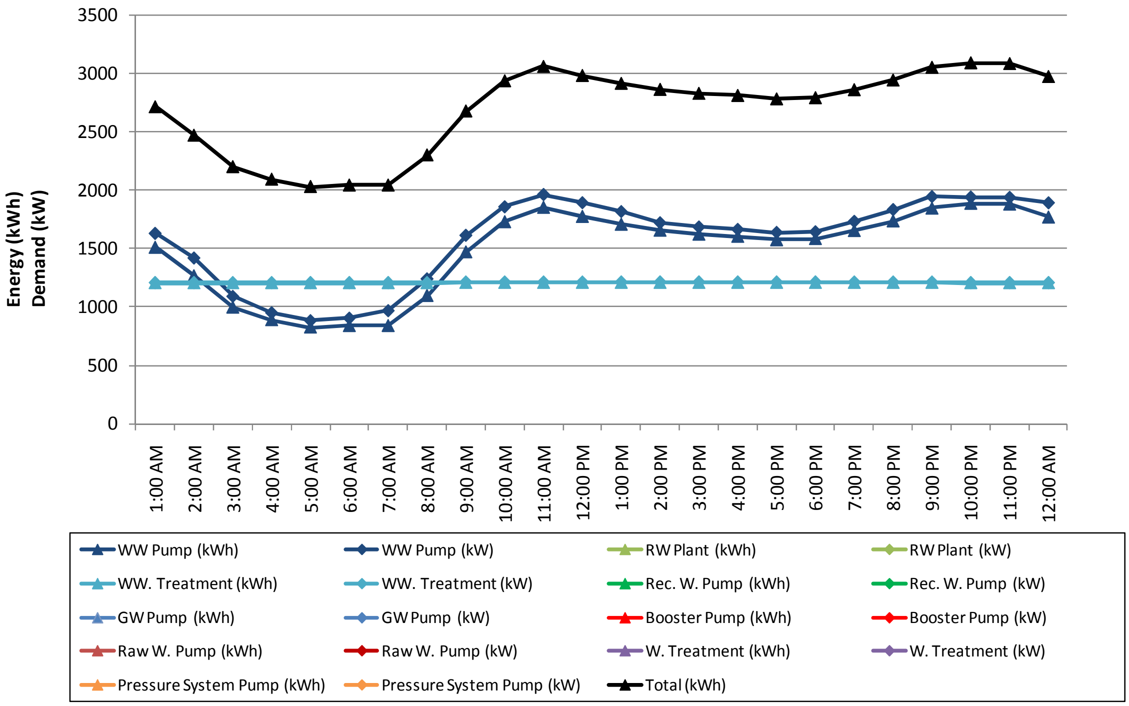



## Figure 2: MRWPCA Monthly Energy Intensity by Facility Type



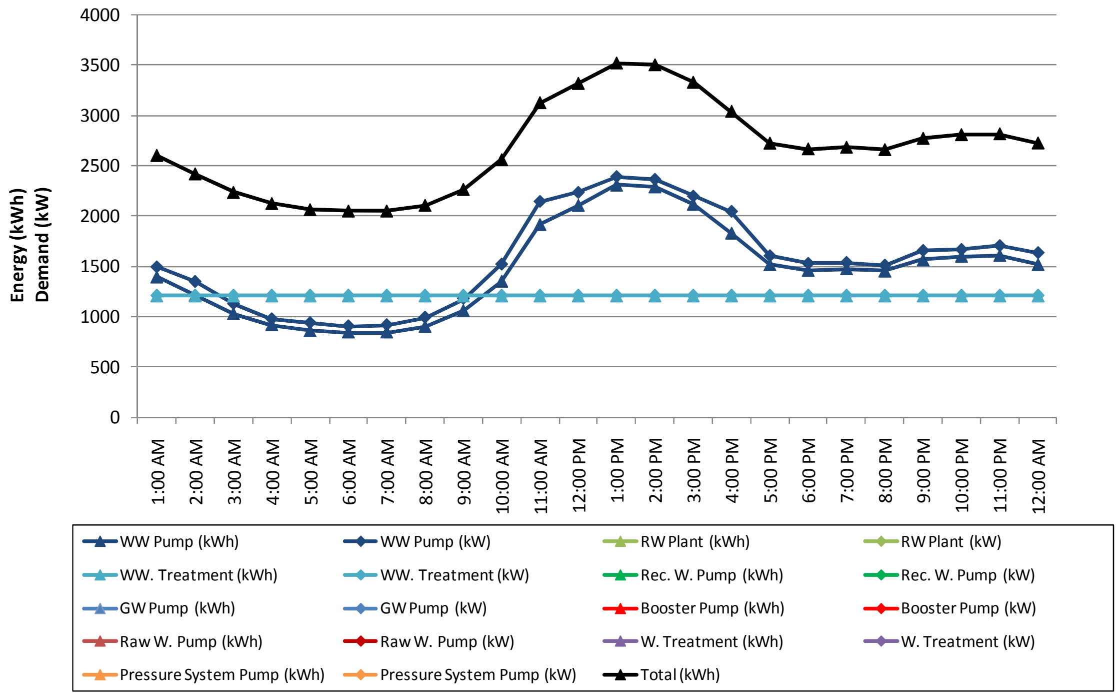

## Figure 3: RTP 2008 Energy Use by Source (kWh)

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by the Monterey Regional Water Pollution Control Agency is for wastewater treatment.



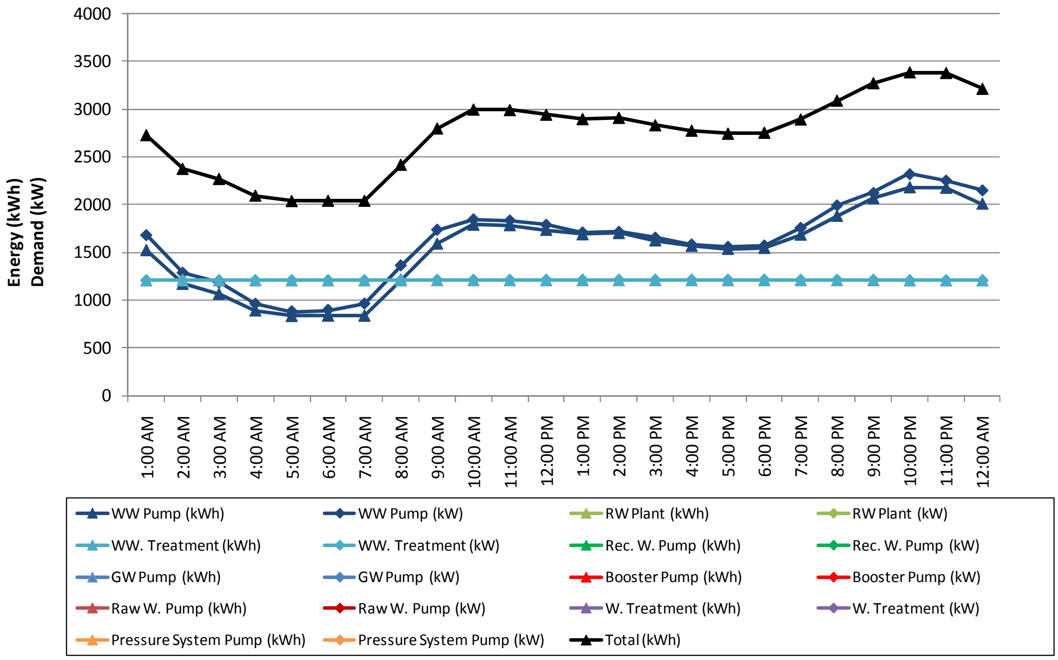

| | |
|---|---|
| **Date** | 7/8/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Wastewater Pumps* | 1,601 |
| *Wastewater Treatment* | 1,207 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



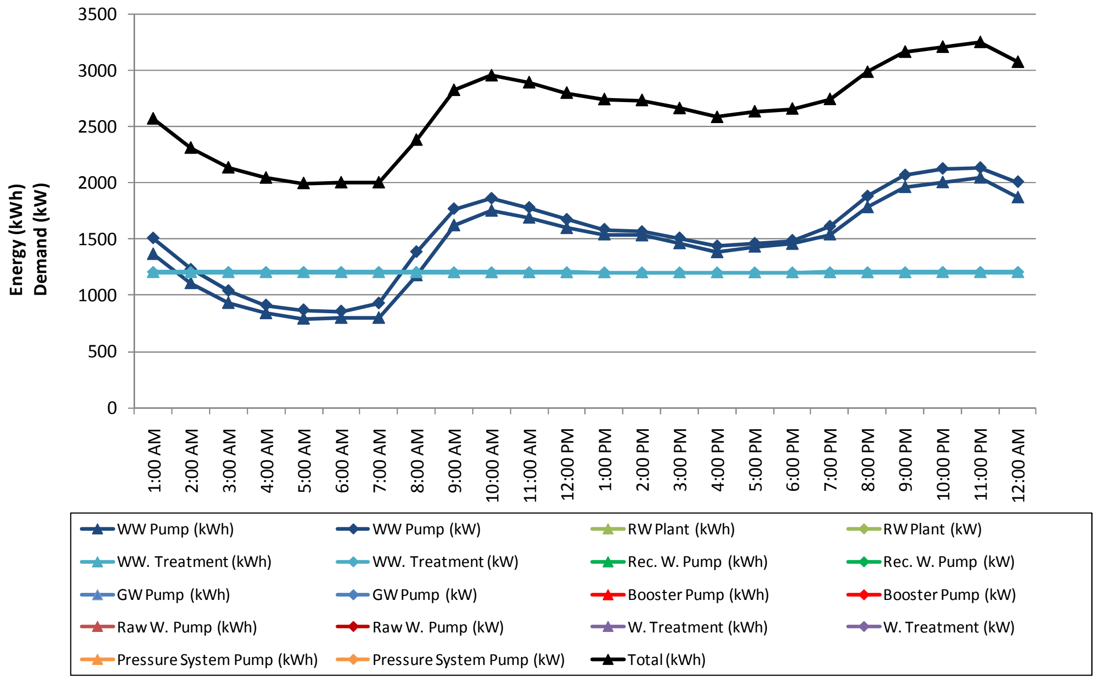

| | |
|---|---|
| **Date** | 8/24/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Wastewater Pumps* | 1,823 |
| *Wastewater Treatment* | 1,206 |

**Figure 5: 24-Hour Energy Profile: Summer High Wastewater Flow Day**



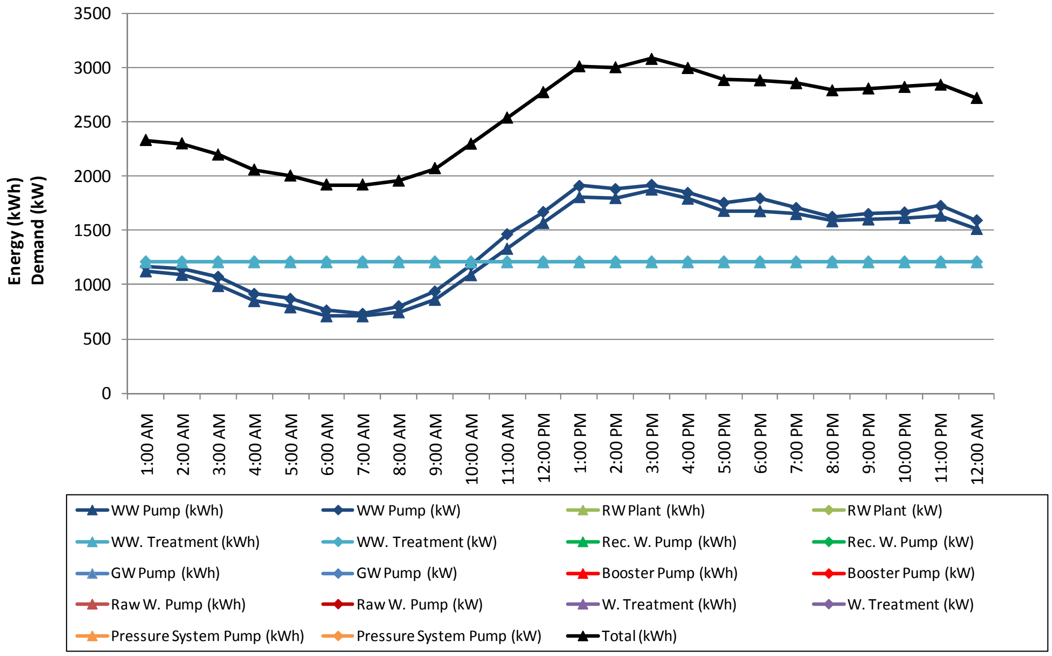

| | |
|---|---|
| **Date** | 5/12/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Wastewater Pumps* | 1,576 |
| *Wastewater Treatment* | 1,207 |

**Figure 6: 24-Hour Energy Profile: Summer Average Wastewater Flow Day**



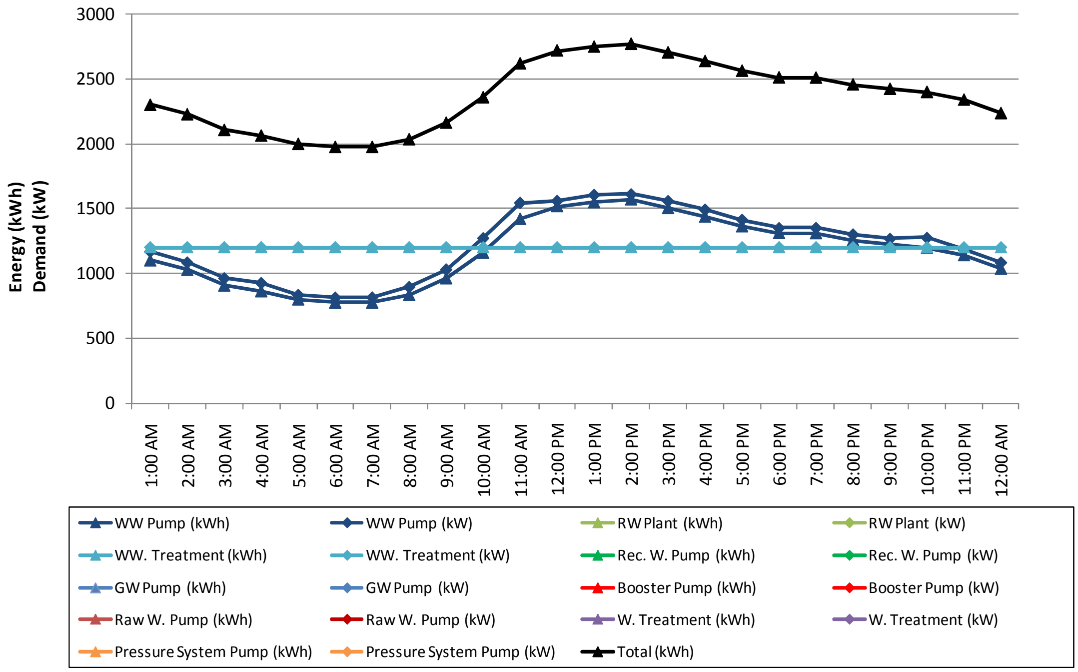

| | |
|---|---|
| **Date** | 5/6/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Wastewater Pumps* | 1,425 |
| *Wastewater Treatment* | 1,202 |

**Figure 7: 24-Hour Energy Profile: Summer Low Wastewater Flow Day**



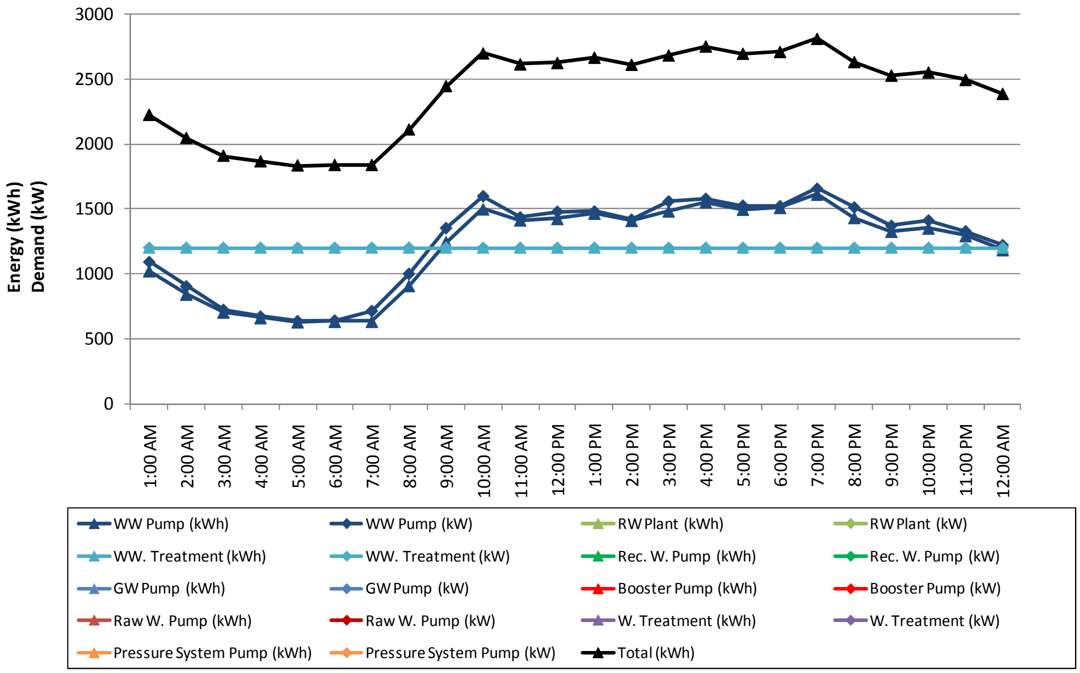

| | |
|---|---|
| **Date** | 1/27/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Wastewater Pumps* | 1,784 |
| *Wastewater Treatment* | 1,207 |

**Figure 8: 24-Hour Energy Profile: Winter High Wastewater Flow Day**




| **Date** | 12/13/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Wastewater Pumps* | 1,432 |
| *Wastewater Treatment* | 1,200 |

**Figure 9: 24-Hour Energy Profile: Winter Average Wastewater Flow Day**




| **Date** | 12/5/2008 |
|---|---|
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Wastewater Pumps* | 1,512 |
| *Wastewater Treatment* | 1,200 |

**Figure 10: 24-Hour Energy Profile: Winter Low Wastewater Flow Day**

## Current Infrastructure Related Energy Efficiency Projects

MRWPCA has multiple current and future infrastructure related energy efficiency projects. Some examples include:

- Solar Power Project (current project): Construction began in January 2010 on a 1.1 MW photovoltaic array at the RTP to provide power to the SVRP.
- Digester Hot Water Loop Replacement (current project): This project will replace the hot water loop from MRWPCA's Cogeneration Building to the Digester Building including installation of four new spiral heat exchangers.
- Class A/B Water System Upgrades (future project): The Class A and B water systems at the RTP have had pressure and system control issues. This study will look at the existing systems and provide recommendations for upgrades.
- Headworks Wet Scrubber Replacement (future project): The wet scrubbers at the Headworks require intensive maintenance to remain in working order. Staff is looking into available alternative technologies to design and install a less maintenance-intensive system.

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Bill Young, Operations Manager - Monterey Regional Water Pollution Control Agency. Interviewed by Lacy Cannon (GEI) on July 28, 2009.

Brad Hagemann, Assistant General Manager - Monterey Regional Water Pollution Control Agency. Interviewed by Lacy Cannon (GEI) on July 28, 2009.

## Natomas Central Mutual Water Company (NCMWC)


### Summary

| | | | |
|---|---|---|---|
| **Primary function** | Agricultural Water | | |
| **Segment of Water Use Cycle** | Supply | | |
| **Hydrologic Region** | Sacramento River | **DEER Climate Zone** | 12 (64%) and 11 (36%) |
| **Quantity of water (2008)** | Diversions: 51 MGD | Wholesaled: 8.9 MGD<br>Recycled: 31 MGD | |
| **Number of Customers** | Total: 280 | **Service Area Size** | 51.9 Sq miles |
| **Distinguishing Characteristics** | The Company's service area includes the Sacramento Municipal Airport and several residential developments, which are proposed in response to continued growth within and adjacent to the Sacramento area. NCMWC has three main pump stations located on the Sacramento River. The Company also diverts water from the Natomas Cross Channel, which is located along the northern boundary of the Company. Diversion waters from the Cross Channel subsequently flow from north to south, and water diverted from the Sacramento River generally flow from west to east or south. | | |
| **Key Energy Driver(s)** | The majority of the NCMWC's energy is used by pumping plants. NCMWC owns groundwater wells, but they are rarely used for water supply.<br>• Water Supply- 6 pump stations divert agricultural water<br>• Recycled Water Deliveries – A recirculation system consists of 30 pumping stations | | |
| **Water/Wastewater Treatment Technology** | N/A – no treatment performed | | |
| **Water Resources** | Maximum Base Supply: 98,200 AF, Maximum CVP: 22,000 AF, Recirculated Tailwater: 35,000 AF | | |
| **Marginal Water Supplies** | Short Term: Groundwater, recaptured tailwater, and surplus Project Water<br>Long Term: Conjunctive Use Programs, Conservation and Reuse | | |
| **Energy Service Provider** | PG&E | | |
| **Observed Energy Intensities** | **Segment** | **Lower Range** | **Upper Range** |
| | Raw Water Pump | 2 kWh/Mgal | 12 kWh/Mgal |

## Background Information

Natomas Central Mutual Water Company (NCMWC) is a private, not-for-profit corporation representing the interests of its 280 member/shareholders. For more than 80 years, Natomas has provided irrigation water, at cost, to its shareholders for agriculture use – reliably managing and delivering a resource that has helped preserve habitat and spur growth. Shareholders include farmers, developers, pioneering families, the Natomas Basin Conservancy, the city and county of Sacramento and more. NCMWC is governed by an elected seven-member Board of Directors representing the area's varied interests. Local resource management protects historic surface and individual overlying groundwater rights, keeping the water for use where it's meant to be used – in northern California. Table 1 summarizes general information about NCMWC.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Agricultural Water |
| **Hydrologic Region** | Sacramento River |
| **Region Type** | Central Valley |
| **Energy Service Provider** | PG&E |
| **DEER Climate Zone** | 12 (64%) and 11 (36%) |
| **Service Area Size** | 51.9 Sq miles |
| **Number of Customers in 2008** | 280 |
| **Distribution Topology** | Flat |

Primary sources of information on Natomas Central Mutual Water Company include: NCMWC's public website, water and energy data provided by NCMWC, and NCMWC's 2008 Draft Regional Water Management Plan. A detailed list of references is located at the end of this section.

### Climate

The summers consist of warm, dry days and mild, pleasant nights. During the winter "rainy season" (November through February), over half the total annual precipitation falls, yet rain in measurable amounts occurs only about ten days monthly during the winter.

The average high temperature ranges from 57.4°F in the winter to 91.7°F in the summer. The average low temperature ranges from 42.1°F in the winter to 60.0°F in the summer. The average annual precipitation is 19.87 inches.

### Demographics

NCMWC primarily provides water to agricultural users, and serves approximately 280 landowners. About 65.5 percent of NCMWC's service area is irrigated. In addition to agricultural land, NCMWC's service area includes the Sacramento Municipal Airport, several residential developments, and Natomas Basin Habitat land. Rice is the predominant crop in NCMWC's service area, followed by tomatoes and sugar beets, which are alternated with wheat and safflower. Agriculture in the region has been under increasing pressure to convert to urbanized, residential use due to growth in the Sacramento area. However, annual cropping patterns have remained fairly consistent over the past few decades, and associated water requirement needs and diversions have been more a function of water-year type and climate than changes in cropping patterns.

NCMWC is not a signature to the Natomas Basin Habitat Conservation Plan (NBHCP), but most of the NBHCP lands lie within NCMWC's service area and receive water from NCMWC. The NBHCP has been prepared to address long-term habitat needs for the giant garter snake, the American peregrine falcon, the valley elderberry longhorn beetle, and multiple other state- and federal-listed or threatened species. The preparation of the NBHCP underscores the continuing resource agency concern with the continued urban development of lands within the NCMWC service area, which currently provide valuable habitat for a number of sensitive species. Adoption and implementation of this habitat conservation plan has placed additional constraints on both agricultural and M&I water use, including deliveries of water in the winter and cropping requirements. However, implementation of the NBHCP is expected to limit the amount of additional NCMWC lands that could be converted to urban use.

## Water Sources

NCMWC's supply is entirely made up of surface water; see Figure 1 for the distribution of sources.

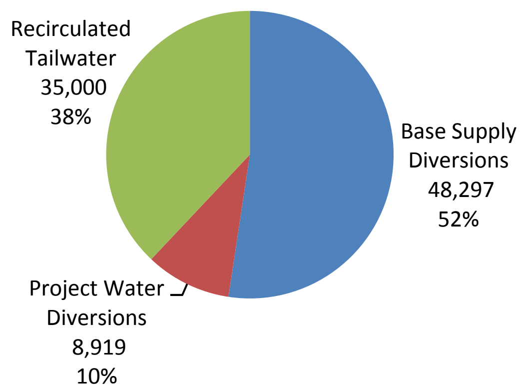



**Figure 1: 2008 Distribution of Sources**

### Groundwater

In order to maintain an exceptional balance of existing assets, NCMWC is engaged in the conjunctive use of surface and groundwater supplies. However, although landowners within the service area operate groundwater wells, NCMWC does not currently have any active groundwater wells.

### Local Raw Surface Water

The NCMWC surface water supply entitlement is currently addressed in a contract with the U.S. Bureau of Reclamation entered into in 2006; Contract No. 14-16-200-0885A-R-1 (Contract No. 0885A-R-1). The new contract was entered into in 2006 with Reclamation and NCMWC. This contract provides for an agreement between NCMWC and Reclamation on NCMWC's diversion of water from the Sacramento River during the period April 1 through October 31 of each year.

Contract No. 0885A-R-1 provides for a maximum total of 120,200 AF/yr, of which 98,200 ac-ft is considered to be Base Supply and 22,000 ac-ft is CVP water (Project Supply). Base Supply Diversions and Project Water Diversions can only be made during the year from April 1 to October 31. The contract also provides that additional Project Supply can be purchased if surplus water is available.

### Recycled Water

In recent years, NCMWC has relied heavily upon tailwater as an alternate supply to its Sacramento River entitlement. The source of this tailwater has been primarily from inside of the Company, although some tailwater is available from the lands on the western edge of the Company which are adjacent to the Sacramento River (approximately 7,000 acres). High groundwater levels in much of the Company service area also contribute inflow to the drains. Approximately 35,000 ac-ft of tailwater are used annually. Continued reuse and recycling efforts are expected to be influenced by an increasing need to manage salinity, pH, and other constituents that affect crop productivity and sustainability.

### Marginal Water Supply

The Study Team identified both short- term and long-term marginal supplies for NCMWC. Short-term marginal supply within the NCMWC service area is groundwater, recycled tailwater, and surplus Project Water. Long-term marginal supply will likely be the same sources, with increased conservation, reuse, and conjunctive use programs.

There are approximately 61 privately owned wells and two NCMWC-owned wells within its boundaries. These wells are used in conjunction with the river pumps and recycling pump to meet irrigation needs on an as-needed basis. Contract No. 0885A-R-1 provides that additional Project Supply can be purchased if surplus water is available.

The energy intensity range of NCMWC's marginal supply is summarized in Table 2. The energy intensity represents the embedded energy for all activities prior to the water reaching NCMWC's distribution system.

**Table 2: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short Term | Groundwater[a] | 576 kWh/MG |
| | CVP (project water)[b] | 0 kWh/MG |
| Long Term | Conjunctive Use/Conservation/Reuse[c] | 0 kWh/MG |

a) EI for Sacramento River hydrologic region from Study 1 groundwater analysis.

b) CVP supply is above the Delta where water is conveyed via gravity. No energy intensity is associated with this source.

c) EI for conjunctive use and conservation deemed to be nil; reuse primarily of tailwater also deemed to be nil.

## Water Demand

Annual cropping patterns have remained fairly constant over the last few decades, other than in response to farm programs in the early 1980s. Associated water requirement needs and associated diversions have therefore been more a function of water-year type and climate than changes in cropping.

In response to increasingly stringent limitations on burning, some of the Company's rice-growing landowners flood a portion of their fields to clear their land of leftover rice straw by allowing the rice stubble to decompose. Approximately 5,780 acres were flooded in 1999 and 6,700 acres were flooded in 2004, a trend that is expected to continue or increase, assuming other options (including the sale of stubble for ethanol production) are not determined to be more economically feasible. This practice provides additional winter habitat for waterfowl above that which has been available within the Sacramento Valley since the development of agriculture.

Up to 6,700 acres of rice stubble were flooded in 2004, with associated winter habitat benefits to migratory waterfowl that use the area as part of the Pacific Flyway. The flooding of rice fields in the spring and summer provides wetlands habitat during these periods for waterfowl and terrestrial species.

Rice fields that are not flooded also provide habitat for waterfowl and upland birds as resting areas. Of these lands, the Natomas Basin Conservancy manages approximately 1,031 acres of environmental or wetlands areas within the Company. By 2020 is anticipated that NCMWC will have 2,500 acres of managed marsh/wetlands, and an additional 4,500 acres of agricultural land owned and operated by the Natomas Basin Conservancy.

## System Infrastructure and Operations

The NCMWC distribution system consists of pipelines, pumps and more than 50 miles of canals (Figure 2).

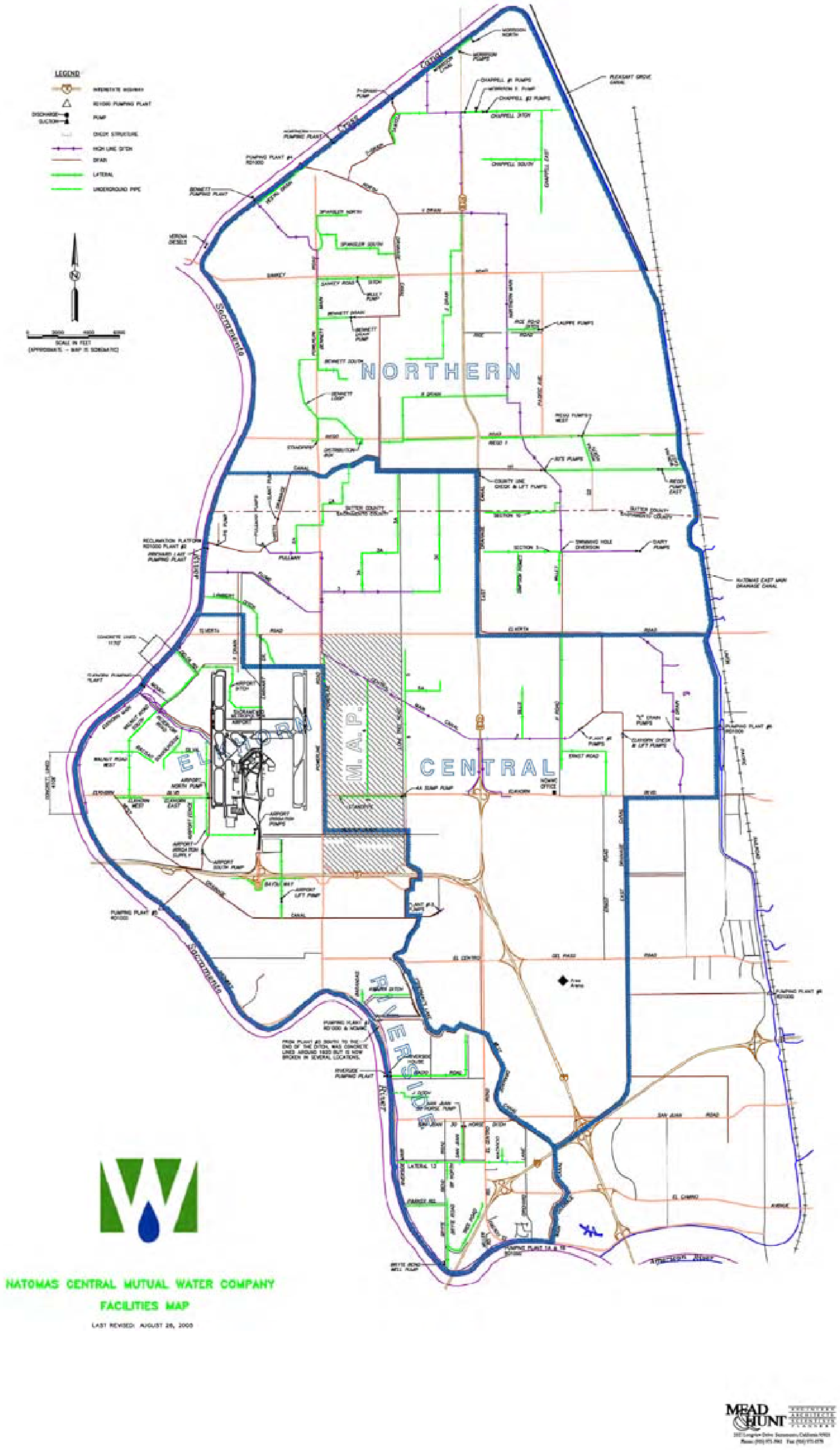



**Figure 2: Natomas Central Mutual Water Company Facilities Map**

**Table 3: Infrastructure Summary**

| | |
|---|---|
| **Number of Pumping Stations** | |
| ***Diversions*** | 5 |
| ***Drain/Recirculation*** | 30 |
| **Number of Drainage Canals** | 4 |
| **Turnouts** | 400+ |

### *Distribution*

Diversion waters from the Cross Channel subsequently flow from north to south, and water diverted from the Sacramento River generally flow from west to east or south. NCMWC has three pumping plants to divert water from the Sacramento River and the Natomas Cross Channel. A separate 75-cfs capacity pump at the Elkhorn Pumping Plant supplies landscape irrigation water for the Sacramento Metropolitan Airport.

The Company completed the installation of a recirculation system in 1986, to improve water quality for the City of Sacramento and increase overall efficiency within the Company boundaries. The recirculation system includes 30 pumping stations at various locations that recapture water for reuse either directly into fields or back into the main irrigation canals.

NCMWC is drained by four main drainage canals: Natomas East Main Drainage, North Drainage, East Drainage, and West Drainage Canals. The Natomas East Main Drainage Canal drains directly into the Sacramento River, just north of its confluence with the American River. The West Drainage Canal and the East Drainage Canal join in the south and drain to the Sacramento River in the southern portion of the Company via a drain pump.

## System-wide Operation Strategy

Water requirements are typically highest during the summer months (July and August) due to the requirements of rice and the area's hot, dry climate. The vast majority of irrigation water requirements are met through the contract surface water supply, although groundwater is used in drought years on an individual grower basis, as well as per agreements with the Company.

There are approximately 61 privately owned wells and two NCMWC-owned wells within its boundaries. These wells are used in conjunction with the river pumps and recycling pump to meet irrigation needs on an as-needed basis.

NCMWC does not meter individual customer turnouts. The Company's current water rate structure does not require the field staff to measure and record the total quantity of water delivered to each turnout. Its rate structure is an annual flat rate, per-acre charge for rice and wild rice crops, with a modified, annual flat rate, per-acre charge for other crops. The modified flat rate varies according to the number of times water is applied to a crop. Crops applying water more often are charged more per acre (unrelated to measurement). The Company also provides a discount to growers extracting their own irrigation water from the drains.

The Company's internal drain pumps and secondary lift pumps are not equipped with any type of measuring device. Delivered water volumes from these facilities are estimated based on power consumption and pump efficiency data. This method is also used to estimate the outflow amounts from Reclamation District 1000's (RD 1000) drainage pumps into the Sacramento River. Only RD 1000 has the ability to discharge water back into the river. RD 1000 is a special district formed by the California State legislature which operates and maintains the levee systems in the Natomas Basin.

During a normal irrigation season, no agricultural drainage water returns to the Sacramento River until after the end of the rice irrigation season (between August 15 and September 1). During the growing season, drains are managed by NCMWC to deliver water. RD 1000 manages the in the off season (after October 1), when most drainage is returned to the Sacramento River.

### Infrastructure Changes

NCMWC proposes to develop a conjunctive water management program that would provide the flexibility to pump and convey groundwater in lieu of some of its surface water supply. This program would be implemented in phases. The initial phase would involve installation of six new wells and installation and upgrade of the infrastructure to connect the new wells and 13 existing wells to NCMWC's conveyance system. The proposed production wells would likely have capacities that range from 2,500 to 3,500 gpm. This project would help NCMWC meet the following objectives:

- Increase Company water supply reliability and flexibility
- Increase in-stream flows during dry years
- Increase in-basin water supply reliability and flexibility
- Help meet the requirements of the Phase 8 Settlement Agreement

## Energy Profiles

NCMWC provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy data provided included: monthly energy bill from PG&E and SMUD and monthly TOU data for booster pumps. Water flow data was provided as an annual accounting summary on a monthly time-step. Water flow rates through individual booster pumps were not available, thus the Study Team applied the total flow patter to each booster pump station for energy profile calculation purposes.

Energy is provided to NCMWC by PG&E and SMUD. SMUD energy is used to power 26 distribution pumps and other distribution facilities. PG&E energy is used to power 15 pumping and other distribution facilities.

Some abnormal spikes in demand were noticed for several facilities; records were double checked for possible error but none were found, thus these anomalies remain in the database. The 3-day peak demand results were not affected by these anomalies in demand.

The energy intensity of raw water diversion pumping within Natomas Central Municipal Water Company is presented in Figure 3. Energy Intensity is only report for the months of April – October as these are the months during which diversions are made.

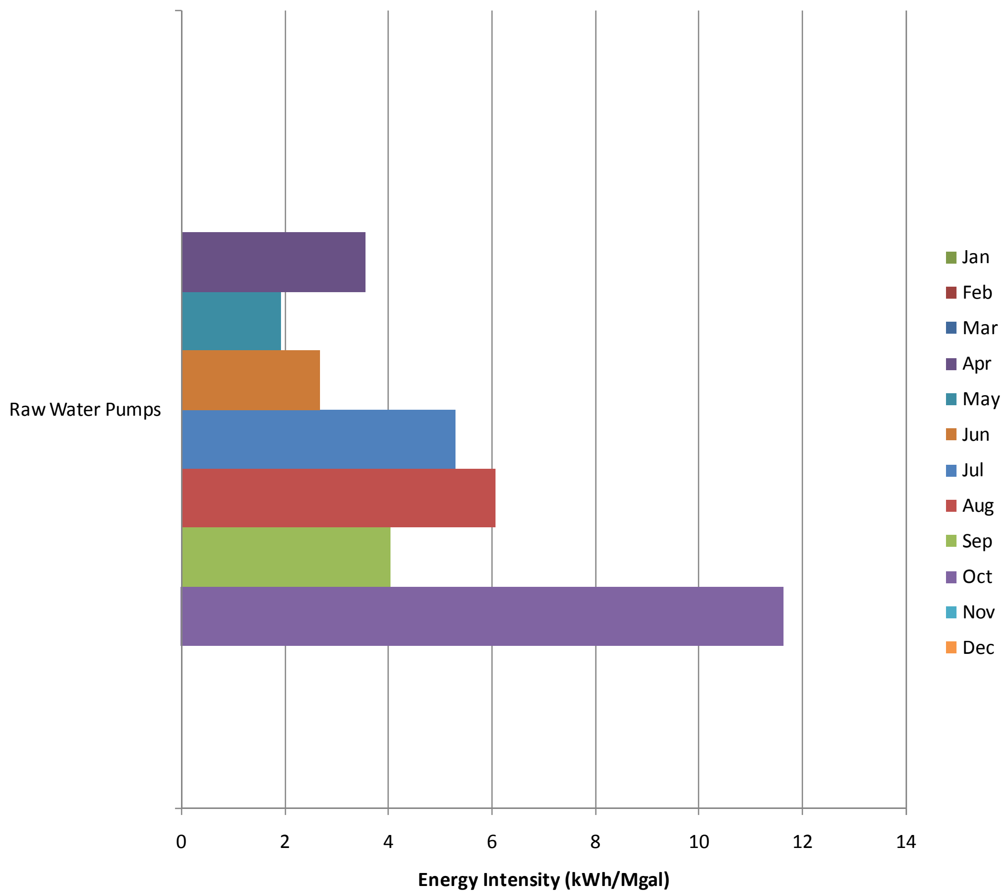
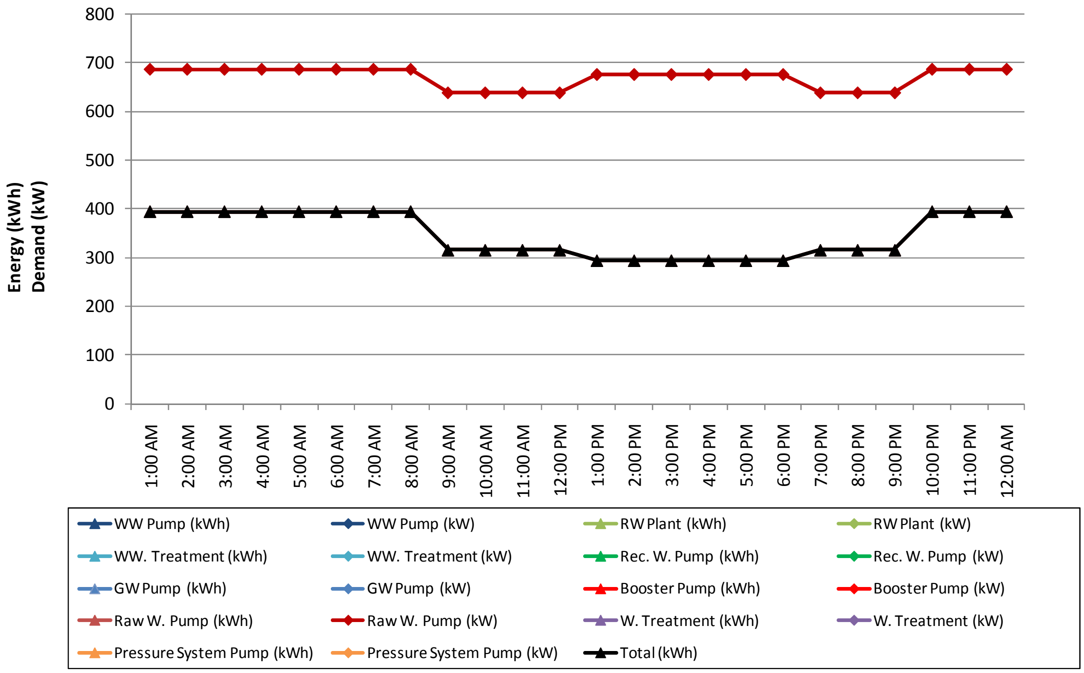


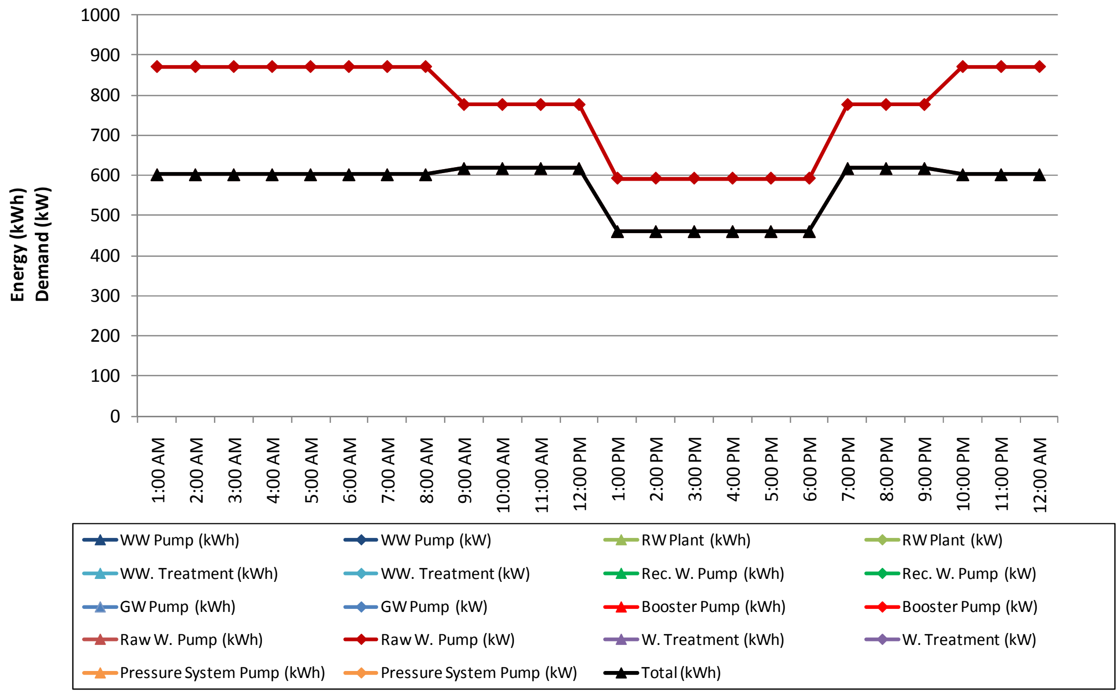

**Figure 3: NCMWC Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. All energy accounted for in this study is consumed by raw water pumps.



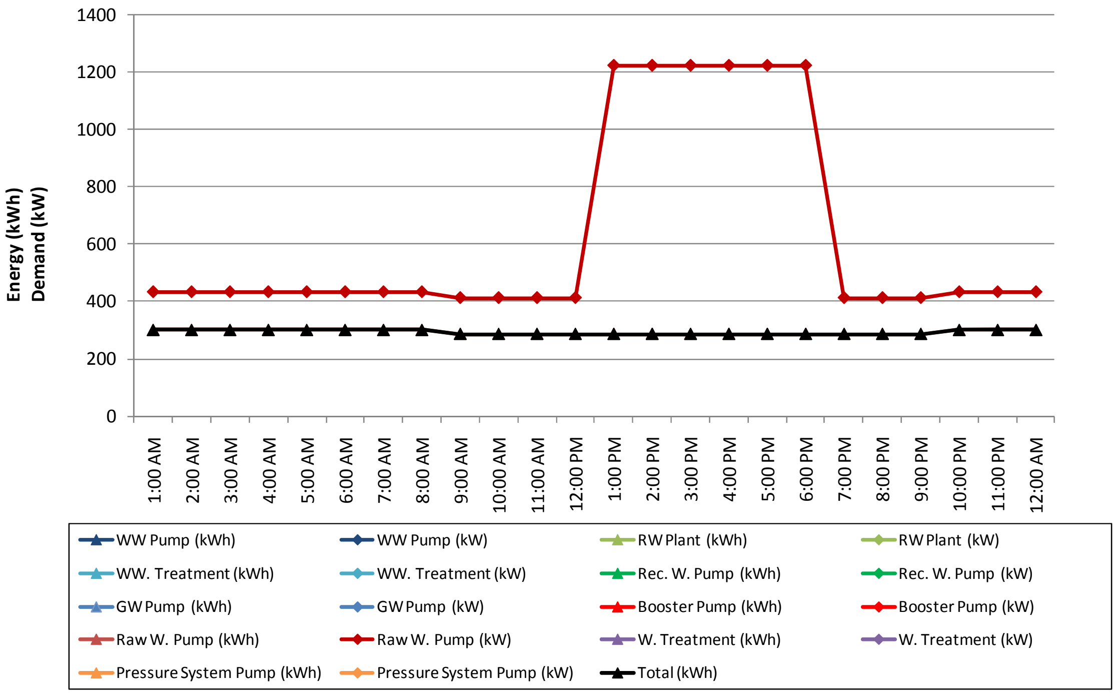

| | |
|---|---|
| **Date** | 7/8/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Raw Water Pump* | 294 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



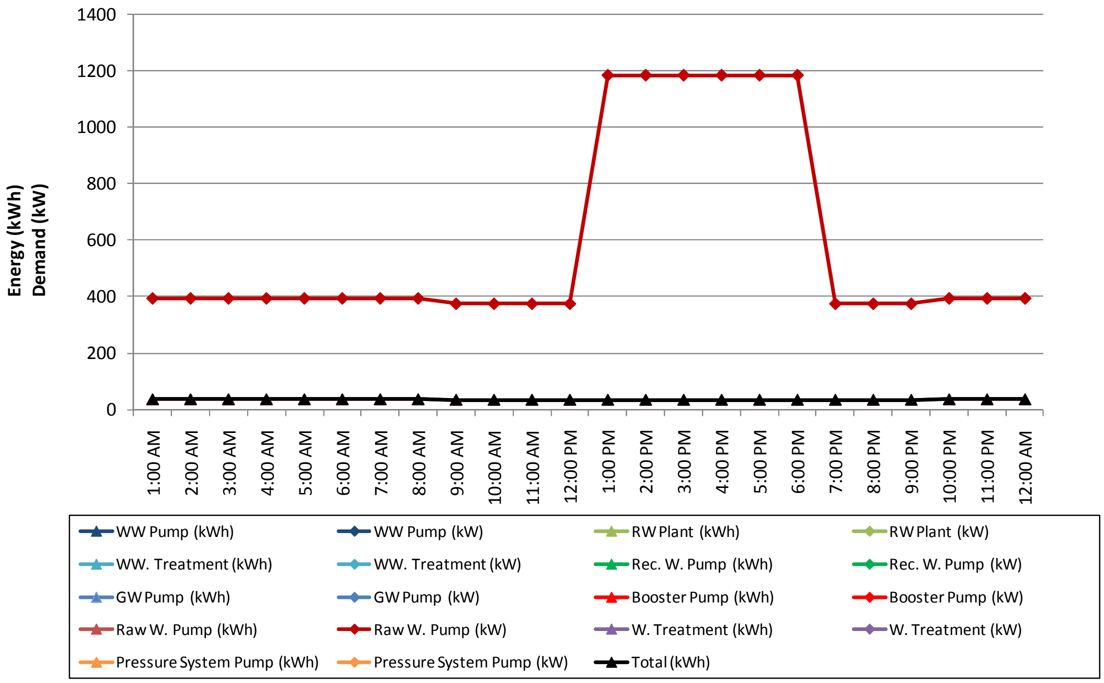

| | |
|---|---|
| **Date** | 5/1/2008 |
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Raw Water Pump* | 460 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



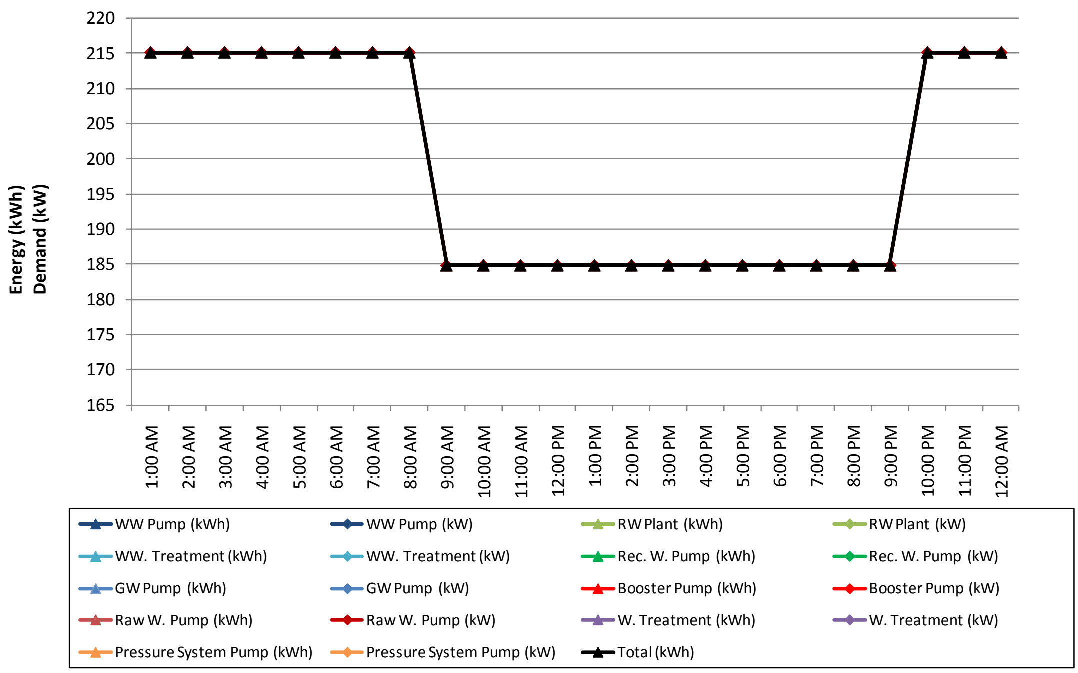

| | |
|---|---|
| **Date** | 9/30/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Raw Water Pump* | 287 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



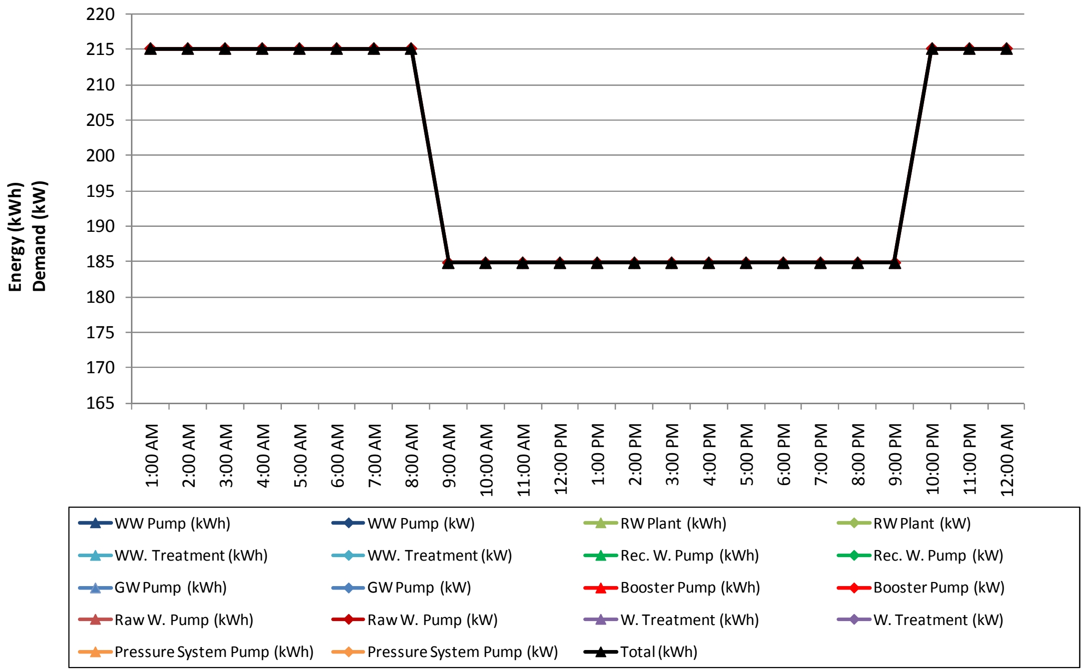

| | |
|---|---|
| **Date** | 10/1/2008 |
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Raw Water Pump* | 34 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



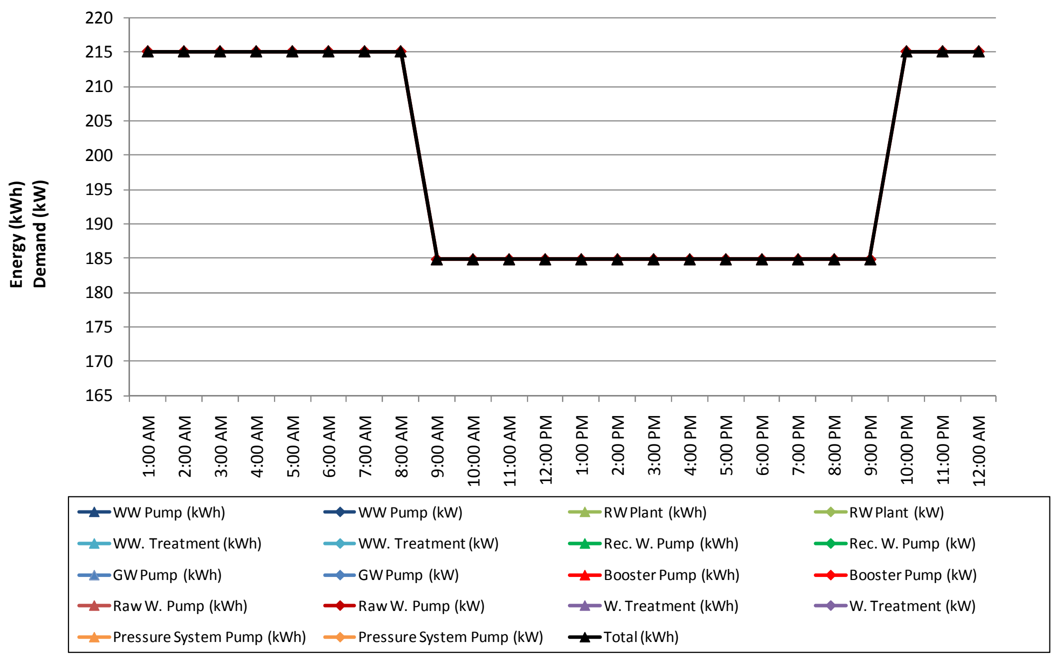

| | |
|---|---|
| **Date** | 4/1/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Raw Water Pump* | 185 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| **Date** | 4/1/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Raw Water Pump* | 185 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| **Date** | 4/1/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Raw Water Pump* | 185 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

The American Basin Fish Screen and Habitat Improvement Project involves the construction of a new 434-cfs pump station on the Sacramento River near Sankey Road. Each of the five pumps in the station will independently draw water through a positive-barrier fish screen, pump the water over the levee, and discharge it into the proposed new Sankey Highline Canal. NCMWC's current system raises the water surface in the Natomas Cross Canal to draw water through two existing pumping plants. This canal runs into the Sacramento River approximately 1,000 feet upstream of the proposed pumping plant. The increase in efficiency from replacing the existing diversion system with the single new facility would save 1,400 ac-ft of water annually.

The SCADA Project for the Natomas Basin proposes to install and operate a SCADA system in the Natomas Basin. SCADA would continuously collect flow data at selected locations to better direct the flow of irrigation water throughout the basin. The system would extend beyond NCMWC boundaries to include neighboring Reclamation District 1000 (RD 1000). Benefits include increased public safety, reduced power use, and increased water savings, estimated at 4,000 to 5,000 AF/yr.

## Sources

Natomas Central Mutual Water Company. “2008 Water Account Records.”

Natomas Central Mutual Water Company. http://www.natomaswater.com/Default.asp. Accessed November 19, 2009.

Natomas Central Mutual Water Company. Draft 2008 Regional Water Management Plan Annual Update Preface. April 9, 2009.

National Weather Service Forecast office Sacramento, CA. Climate of Sacramento. http://www.weather.gov/climate/local_data.php?wfo=sto. Accessed November 17, 2009.

“Natomas Facilities Map.” Provided by Natomas Central Mutual Water Company

# Oceanside, City of

## Summary

<table>
<tr><td>Primary functions</td><td colspan="3">Urban Water, Urban Wastewater, Recycled Water</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Supply, Treatment, Distribution, Wastewater Treatment, Recycled Water Production</td></tr>
<tr><td>Hydrologic Region</td><td>South Coast</td><td>DEER Climate Zone</td><td>7</td></tr>
<tr><td>Quantity of water/ wastewater (2008 Total)</td><td>Water Treated: 7,233 MG<br>Water Distributed: 7,777 MG<br>Waste Water Treated: 5,354 MG</td><td colspan="2">Desalting Facility<br>679 MG Pumped<br>543 MG Produced</td></tr>
<tr><td>Number of Customers</td><td>Total Water: 43,574 (2005)</td><td>Service Area Size</td><td>42 Sq miles</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">The City of Oceanside supplies retail potable water primarily to the City of Oceanside. Distribution topography is moderate. Oceanside treats brackish water from the Mission Basin at its Mission Basin Desalting Facility which accounts for about 7% of the city's water supply. The city reclaims wastewater at the San Luis Rey Wastewater Treatment Plant and uses it to irrigate the Oceanside Municipal Golf Course.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3">• Water Supply & Treatment - Mission Basin Desalting Facility uses significant energy to treat brackish ground water from the Mission Basin.<br>• Wastewater Treatment - aeration blowers and effluent pumps are reported to be the greatest energy consumers on the wastewater side.<br>• Wastewater Treatment - centrifuges at the San Luis Rey WWTP.</td></tr>
<tr><td>Water/Wastewater Treatment Technologies</td><td colspan="3">Weese Filtration Plant: filtration/chlorine<br>Mission Basin Desalting Facility: Reverse Osmosis<br>San Luis Rey Wastewater Treatment Plant: tertiary, water reclamation plant<br>La Salina Wastewater Treatment Plant: secondary</td></tr>
<tr><td>Water Resources</td><td colspan="3">The city purchases about 93% of its water from the San Diego County Water Authority who imports water from MWD. About 7% of Oceanside's water supply is groundwater from the Mission Basin.</td></tr>
<tr><td>Marginal Water Supplies</td><td colspan="3">Short-Term: Imported water from SDCWA<br>Long-Term: Purchase additional imported water, expansion of the Weese Filtration Plant, add more wells to increase groundwater supply, currently have a pilot seawater desalination project, purchase water from the proposed Carlsbad Ocean Desalination project.</td></tr>
<tr><td>Energy Service Provider</td><td colspan="3">SDG&E</td></tr>
<tr><td rowspan="6">Observed Energy Intensities (kWh/Mgal)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Groundwater/Desalination</td><td>1,117</td><td>2,009</td></tr>
<tr><td>Water Treatment</td><td>43</td><td>86</td></tr>
<tr><td>Water Distribution</td><td>134</td><td>247</td></tr>
<tr><td>Wastewater Treatment</td><td>1,062</td><td>1,105</td></tr>
<tr><td>Wastewater Lift Stations</td><td>383</td><td>497</td></tr>
</table>

## Background Information

Oceanside is a full-service city providing water and wastewater services through its Water Utilities Department. The Water Division operates and maintains the city's water distribution system. The department also reclaims wastewater at the San Luis Rey Wastewater Treatment Plant (WWTP) and uses it to irrigate the Oceanside Municipal Golf Course. The Water Division operates and maintains over 500 miles of waterlines that distribute water throughout the city, and 12 reservoirs with a capacity of 50.5 million gallons.

The Department's Wastewater Division collects, treats and disposes of all of the Oceanside's sewage at the San Luis Rey Wastewater Treatment Plant and the La Salina Wastewater Treatment Plant. All sewage is treated to levels set by the Environmental Protection Agency. The San Luis Rey plant serves areas east of I-5 and the La Salina plant treats sewage from areas west of I-5, downtown, and along the coast. Staff is responsible for operating and maintaining over 450 miles of pipelines and 30 lift stations.

Table 1 summarizes information about the City of Oceanside.

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water, Urban Wastewater |
| **Hydrologic Region** | South Coast |
| **Region Type** | Coastal |
| **Energy Service Provider** | SDG&E |
| **DEER Climate Zone** | 7 |
| **Service Area Size** | 42 Sq miles |
| **Service Area Population in 2005** | 175,085 |
| **Number of Customers in 2005** | 43,574 |
| ***Residential*** | 40,081 |
| ***Commercial/Industrial*** | 1,431 |
| ***Agricultural*** | 107 |
| **Distribution Topology** | Moderate |

Primary sources of information on the City of Oceanside include: City of Oceanside 2005 Urban Water Management Plan, Interview with City of Oceanside Water Utilities Division Managers, and the City of Oceanside website.

### Climate

Temperatures range from the mid to upper 60s in the spring and summer and from the mid to upper 50s in the winter. Most of the precipitation in the area occurs between December and March; average precipitation amounts to 10.4 inches per year.

### Demographics

Population in the city’s service area is expected to grow nearly 10 percent in the next 20 years as shown in Table 2.

**Table 2: Projected City of Oceanside Service Area Population**

| Year | Population |
|---|---|
| 2000 | 161,039 |
| 2005 | 175,085 |
| 2010 | 187,491 |
| 2015 | 193,681 |
| 2020 | 199,870 |
| 2030 | 206,607 |

## Water Sources

The city obtains its water primarily from imported surface water. About 7 percent of the city's supply comes from groundwater from the Mission Basin and is treated at the Mission Basin Desalting Facility. Distributions can vary slightly from year to year given the availability of sources and demand; data from 2008 is presented in Figure 1 and Table 3 presents historical water supply of the City of Oceanside.

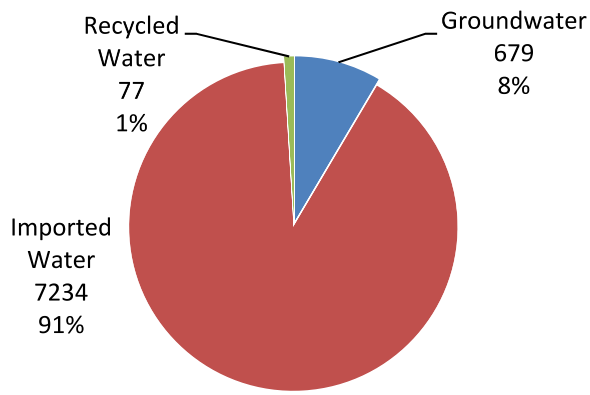



**Figure 2: 2008 Distribution of Sources (MG)**

**Table 3: Historical Water Supplies**

| Supply Source | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | Average | % |
|---|---|---|---|---|---|---|---|---|
| SDCWA Treated | 10,877 | 10,775 | 9,676 | 11,397 | 9,101 | 12,117 | 10,657 | 33% |
| SDCWA Untreated (WFP) | 19,530 | 20,586 | 19,334 | 21,527 | 20,578 | 20,288 | 20,307 | 55% |
| Treated Groundwater | 2,367 | 2,421 | 2,123 | 2,463 | 3,085 | 2,684 | 2,524 | 7% |
| Recycled Water | 113 | 135 | 146 | 191 | 89 | 95 | 128 | 0.3% |
| **Total** | **34,886** | **35,917** | **33,280** | **37,580** | **34,856** | **37,188** | **33,616** | **100%** |

### Groundwater and Desalination

The city gets about 7 percent of its total water supply from local groundwater sources. The city has groundwater pumping rights to pump 7,130 AFY from the Mission Basin, but currently only pumps about 2,524 AFY. Because this is a brackish groundwater supply, the pumped groundwater is treated at the Mission Basin Desalting Facility. This facility has a current capacity of 2.2 MGD and uses a reverse osmosis treatment process to remove salts from the water. Oceanside plans to expand the Mission Basin Desalting Facility's capacity to 6.37 MG. The desalinated water is blended into the distribution system for potable water use. The city plans to add new wells in the future and pump and treat their full allotment of 7,130 AFY.

There are approximately six wells in operation and two new wells planned for development in the near future. Well depths are relatively shallow ranging from about 160 to 170 ft and from about 215 to 230 ft near the Mission Basin Desalting Facility. The city does not have production records per well available.

### Recycled Water

The city reclaims approximately 300,000 gallons of wastewater per day at the San Luis Rey Wastewater Treatment Plant. The wastewater is treated to Title 22 requirements for unrestricted use with tertiary filters and chlorination. The reclaimed water is used to irrigate the Oceanside Municipal Golf Course and augments Whelan Lake. Oceanside plans to expand the San Luis Rey WWTP. The first phase will provide system upgrades to accommodate existing demands. The second phase will expand the system with a new tertiary plant that will supply 40 percent of the recycled water demands in the northeastern service area. The city is evaluating the use of recycled water for groundwater recharge. Reclaimed water is not wholesaled to other agencies.

### Imported Water

The majority of the city's water supply is imported surface water from the San Diego County Water Authority (SDCWA). The SDCWA imports water from the Metropolitan Water District of Southern California (MWD). MWD obtains water from the Colorado River and the State Water Project.

Raw imported water is delivered to and treated at the Weese Filtration Plant, which has a plant capacity of 25 MGD, before it is released into the city's distribution system.

Treated imported water directly enters the system at San Francisco Peak at the southeast end of the Oceanside's service area, accounting for approximately one-third of the city's supply.

### Marginal Water Supply

The Study Team identified both short-term and long-term marginal supplies for Oceanside. Short-term marginal supply is a mix of supplies though mostly consists of SDCWA imports. Long-term marginal supply includes additional imported water, increased raw water volume through the expanded Weese Filtration Plant, increased groundwater supply, and desalinated water. The city also plans to be 50 percent self-reliant by the year 2030, according to management and operations staff.

Oceanside does not view any particular supply as its short term marginal supply source because most of their supply is delivered as requested by SDCWA. The city currently has reservoir storage of 50.5 MG with peak demands of 46.6 MG, indicating that the reservoirs are operated near capacity. According to operations and management staff, Oceanside has about a day's worth of supply. The city has transfer agreements with neighboring urban water suppliers for local emergency situations.

Oceanside plans to increase their groundwater supply by adding new wells and expanding the Mission Basin Desalting Facility.

For the long term, Oceanside plans to purchase additional imported water, expand the Weese Filtration Plant, and include desalinated seawater into their supply. Oceanside is currently running a seawater desalination pilot operation. They plan to construct a 10 MGD local desalination facility to be operable by 2020 for use by the city. In addition, the city plans to purchase water from the Carlsbad Desalination Project, due to be operational by the end of 2012.

The energy intensity range of Oceanside's marginal supply is summarized in Table 4. The energy intensity represents the embedded energy for all activities prior to the raw imported water reaching the Weese Filtration Plant, the treated imported water, and other sources reaching the distribution system. The city has an EI for water distribution ranging from 134-247 kWh/acre-ft, which has not been included in the EIs reported in Table 4.

### Table 4: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short Term | Treated Imports from SDCWA[a] | 6,912 kWh/MG |
| | Raw Imports from SDCWA[a] | 6,785 kWh/MG |
| Long Term | Treated Imports from SDCWA[a] | 6,912 kWh/MG |
| | Raw Imports from SDCWA[a] | 6,785 kWh/MG |
| | Brakish Groundwater[b] | 1,117-2,009 kWh/MG |
| | Seawater Desalinationc[c] | 12,276 kWh/MG |

a) Average Treated/Untreated EI for SDCWA from Study 1 results. Does not include EI range for distribution for the City based on Study 2 results.

b) Oceanside plans to add two new wells. The groundwater will be treated at the Mission Basin Desalting Facility. Well pumping and brackish treatment have a combined EI range from Study 2 results for the City of Oceanside.

c) Estimated from California Sustainability Alliance, 2008 for treatment only. Distribution not included in reported EI value.

## Water Demand

Oceanside serves nearly 46,000 customers, mostly residential, as summarized in Table 5. The corresponding projected water use in each sector is summarized in Table 6.

### Table 5: Historic and Projected Number of Customers by Type

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Residential | 36798 | 40,081 | 42,085 | 44,190 | 46,399 | 48,719 | 51,154 |
| Commercial and Industrial | 1431 | 1,951 | 2,049 | 2,151 | 2,259 | 2,371 | 2,490 |
| Landscape Irrigation | 941 | 1,131 | 1,188 | 1,247 | 1,309 | 1,375 | 1,443 |
| Ag. Irrigation | 107 | 146 | 153 | 161 | 169 | 177 | 186 |
| Government | 249 | 265 | 278 | 292 | 307 | 322 | 338 |
| **Total** | **39,526** | **43,574** | **45,753** | **48,040** | **50,442** | **52,964** | **55,613** |

**Table 6: Historic and Projected Water Demand (AFY)**

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Residential | 20,490 | 23,348 | 23,942 | 24,536 | 25,130 | 25,724 | 26,318 |
| Commercial and Industrial | 3319 | 3,458 | 3,546 | 3,634 | 3,722 | 3,810 | 3,898 |
| Landscape Irrigation | 5816 | 6,048 | 6,202 | 6,356 | 6,510 | 6,664 | 6,817 |
| Ag. Irrigation | 2913 | 2,442 | 2,504 | 2,566 | 2,628 | 2,691 | 2,753 |
| Government | 1323 | 1,204 | 1,235 | 1,265 | 1,296 | 1,327 | 1,357 |
| **Total** | **33,861** | **36,500** | **37,429** | **38,357** | **39,286** | **40,215** | **41,100** |

According to City of Oceanside estimates, the number of customers is expected to grow 21.5 percent from 2010 to 2030 increasing water demand by 9.8 percent. The increase in demand is uniform over every sector.

## System Infrastructure and Operations

Table 7 below summarizes the infrastructure operated by the city. The city has one treatment plant to treat raw imported surface water and one treatment plant to treat brackish groundwater. The system has 50.5 MG of storage. Oceanside has two wastewater treatment plants, the San Luis Rey Plant serves areas east of I-5 and the La Salina Plant serves areas west of I-5.

**Table 7: Infrastructure Summary**

| | |
|---|---|
| **Number of Groundwater Wells** | 6 |
| **Number of Reservoirs Operated** | 12 |
| **Miles of Distribution Piping** | 500 miles (waterlines)<br>450 miles (wastewater lines) |
| **Number of Plants** | |
| ***Treatment*** | 2 |
| ***Wastewater*** | 2 |
| ***Recycled Water*** | 1 (at San Luis Rey WWTP) |
| **System Wide Storage Capacity** | 50.5 MG |

### Sub-Regions within Agency

The city receives water from the SDCWA and local groundwater. Oceanside's water service area includes two water treatment plants; all source water is blended once it is released into the distribution system. The wastewater system is divided in two separate regions with two treatment plants, one on each side on I-5.

### Sub-Region 1: Water System

#### *Conveyance*

Some pumping is required to distribute water throughout the city's system. Most pumping occurs to move water from the Mission Basin Desalting Facility to the Wire Mountain Reservoir. The city's source water is blended once it is released into the distribution system.

### *Water Treatment Plants*

Raw water is delivered to the Weese Filtration Plant at the eastern edge of the Oceanside's service area from the SDCWA and is treated before it is released into the system. The Weese Filtration Plant has an original design capacity of 16.5 MGD, but is allowed to operate at 25 MGD with State Health Department approval.

The Mission Basin Desalting Facility, located near the western boundary of the city's service area, treats brackish groundwater using before it is released into the distribution system. The system uses reverse osmosis treatment technology to purify the water. There are four groundwater pumps co-located at the Mission Basin Desalting Facility and four groundwater pumps located off-site that provide source water for the facility. This facility has a capacity of 2.2 MGD.

### *Distribution*

The majority of this area is a moderate terrain, flattening out as it approaches sea level. The water distribution system consists of reservoirs, pumps, and pipe networks. According to management and operation staff, all treatment plants are operated 24/7 to keep up with demand.

## System Storage

Oceanside's storage system consists of 12 small reservoirs ranging from 1.5 to 5 MG and totaling 50.5 MG. According to operations and management staff, the reservoirs are not kept full and the average demand is 30 MG, and the peak daily demand is 46.6 MG, indicating that the reservoirs are operated near capacity. According to operations and management staff, the city has about a day's worth of supply.

## Sub-Region 2: Wastewater System

### *Wastewater Collection*

The San Luis Rey WWTP serves customers east of I-5 and receives influent flows from 15 of the city's 32 active lift stations. The La Salina WWTP serves customers west of I-5 and receives influent flows from 17 of Oceanside's 32 lift stations. The collection system consists of 32 lift stations and pipe networks. According to management and operation staff, the waste water treatment facilities are operated 24/7 to keep up with demand.

### *Wastewater and Recycled Water Treatment Plants*

The San Luis Rey WWTP has a current capacity of 10.7 MGD and serves about 70 percent of the city's wastewater service area. The San Luis Rey WWTP uses activated sludge treatment technology to treat wastewater to secondary treatment standards. A tertiary filter and chlorination are used to treat some of the wastewater to tertiary standards for use as recycled water. The San Luis Rey WWTP currently has 0.7 MGD of permitted tertiary treatment capacity. About 300,000 gallons per day of recycled wastewater is produced at the San Luis Rey WWTP. The recycled water is used for irrigation at the Oceanside Municipal golf course and is used to augment the natural drainage for the Whelan Lake bird sanctuary. The San Luis Rey WWTP has four effluent storage ponds.

The La Salina WWTP has a current capacity of 5.5 MGD. The La Salina WWTP uses activated sludge treatment technology to treat wastewater to secondary treatment standards for discharge to the ocean. The La Salina WWTP does not currently have storage for treated effluent; treated effluent is directly discharged to the ocean.

### System-wide Operation Strategy

According to management and operations staff, the system is operated to meet demand, which means that the water and wastewater treatment facilities are operated 24/7.

### Infrastructure Changes

Oceanside plans to expand the capacity of the Mission Basin Desalting Facility to 6.37 MGD. The city also plans to purchase desalinated seawater from the Carlsbad Desalination Project once it is operational. The Weese Filtration Plant will be expanded to treat an additional 12.5 MGD for a total plant capacity of 37.5 MGD.

In 2009, cogeneration at the San Luis Rey WWTP became operational. Cogeneration will supply about 540 kW of electricity, which accounts for about 20 percent savings for Oceanside. As of 2009, the La Salina WWTP is currently under rehabilitation.

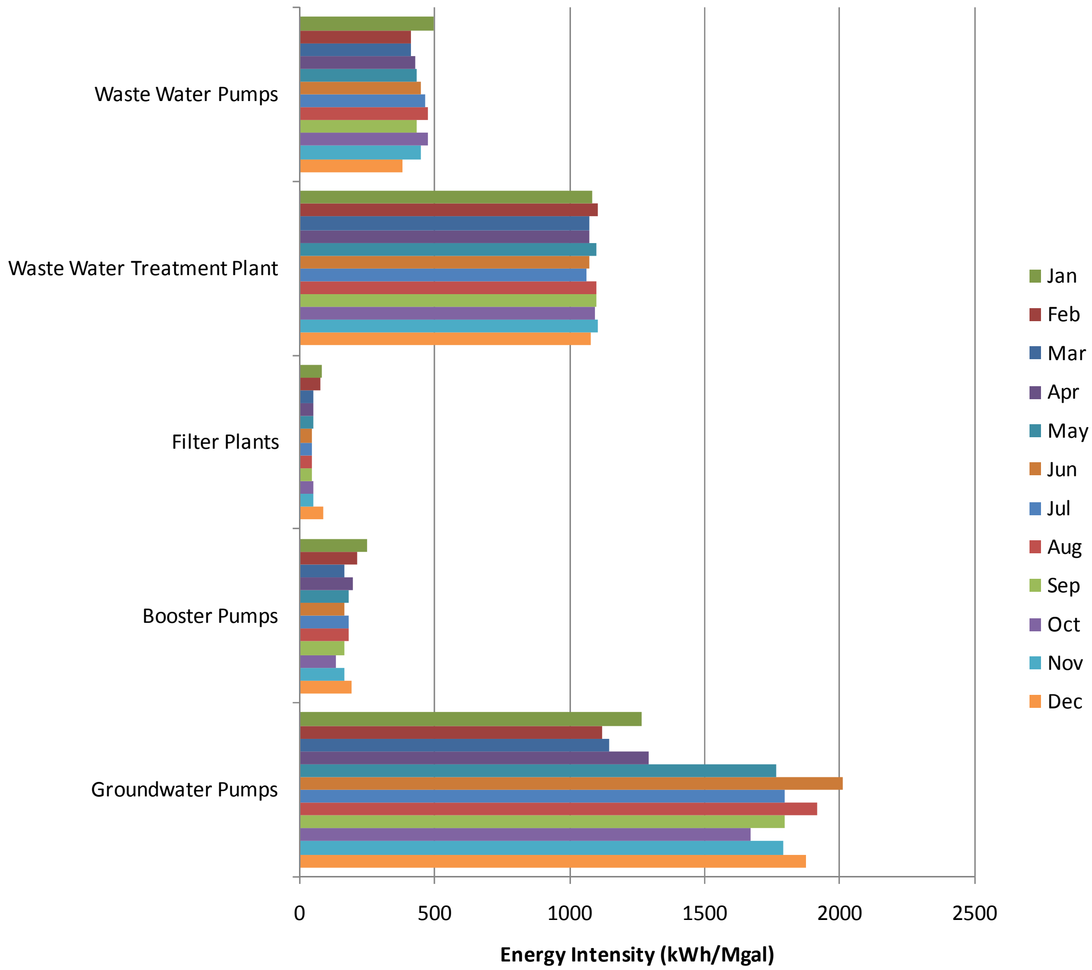
## Energy Profiles

The City of Oceanside provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy data provided included access to the City's energy data through a Third Party Authorization Agreement between the City of Oceanside, SDG&E, and the Study Team. Energy data was downloaded as metered (monthly, TOU, 15-minute interval) from SDG&E's online portals. Also, additional data requests were filed between the Study Team and SDG&E to supplement data not available for download online. Water flow data was provided on a monthly basis for the Weese Filtration Plant and the Mission Basin Desalting Facility. There are four groundwater pumps co-located at the Mission Basin Desalting Facility that are included in the facility's energy data making it impossible to distinguish energy use between the pumps and the plant. Because of this "combined data" the energy use associated with the desalting facility is classified under "groundwater pumps". Daily flows were provided for both the San Luis Rey and the La Salina Wastewater Treatment Plants. An annual quantity of treated water purchased from SDCWA was provided in units of acre-ft.

The annual treated water flow was proportioned to the energy data for the facilities near San Francisco Peak to obtain a daily flow pattern. Water flow rates were not available through individual booster pumps through the water distribution system, and therefore the treated water produced from the Weese Filtration Plant, the treated groundwater produced from the Mission Basin Desalting Facility, and the purchased treated water imported from the SDCWA was combined and applied to each booster pump station for energy profile calculation purposes.

Wastewater flows were not available per lift station; therefore the total raw influent to each wastewater treatment plant was applied to each lift station in the service area for each plant.

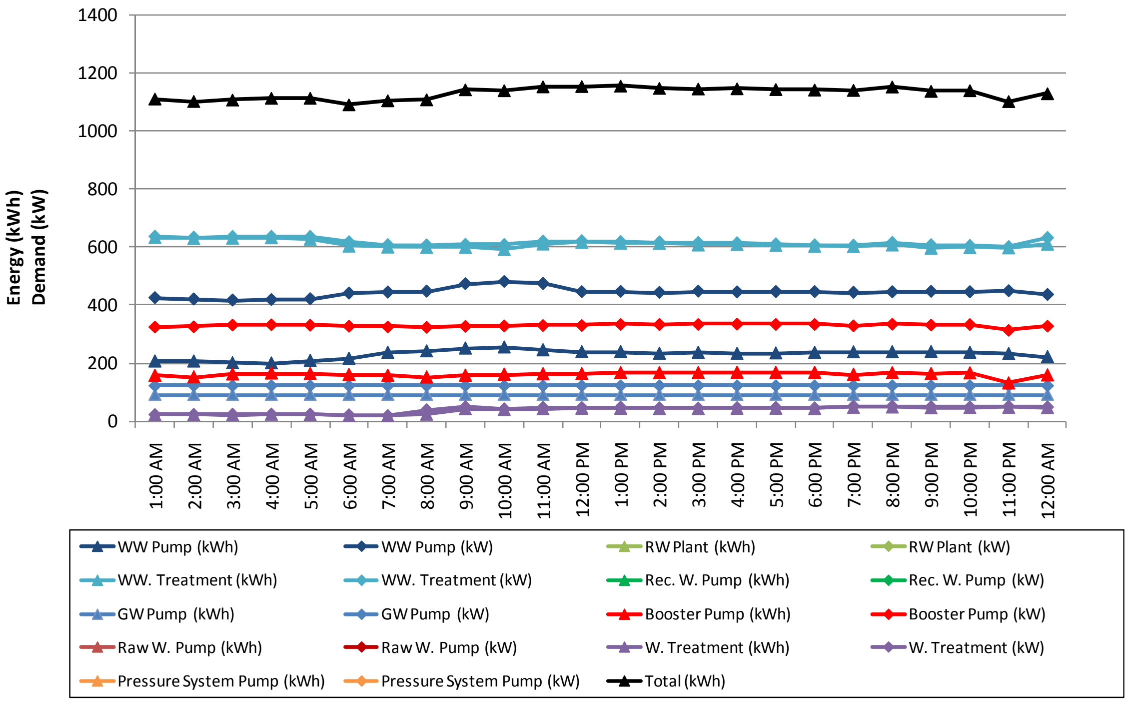
The energy intensity of each facility type within the City of Oceanside is presented in Figure 3.




Groundwater energy intensity includes energy use by the Mission Bay Desalting Facility

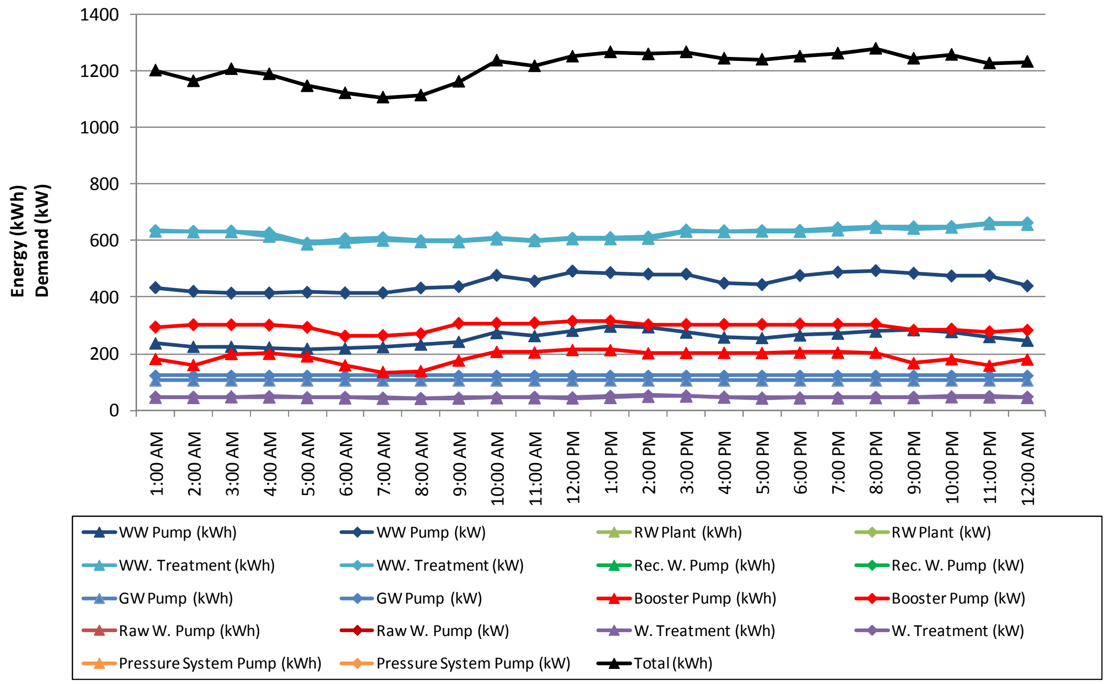
### Figure 3: Oceanside Monthly Energy Intensity by Facility Type

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by the City of Oceanside is for wastewater treatment.



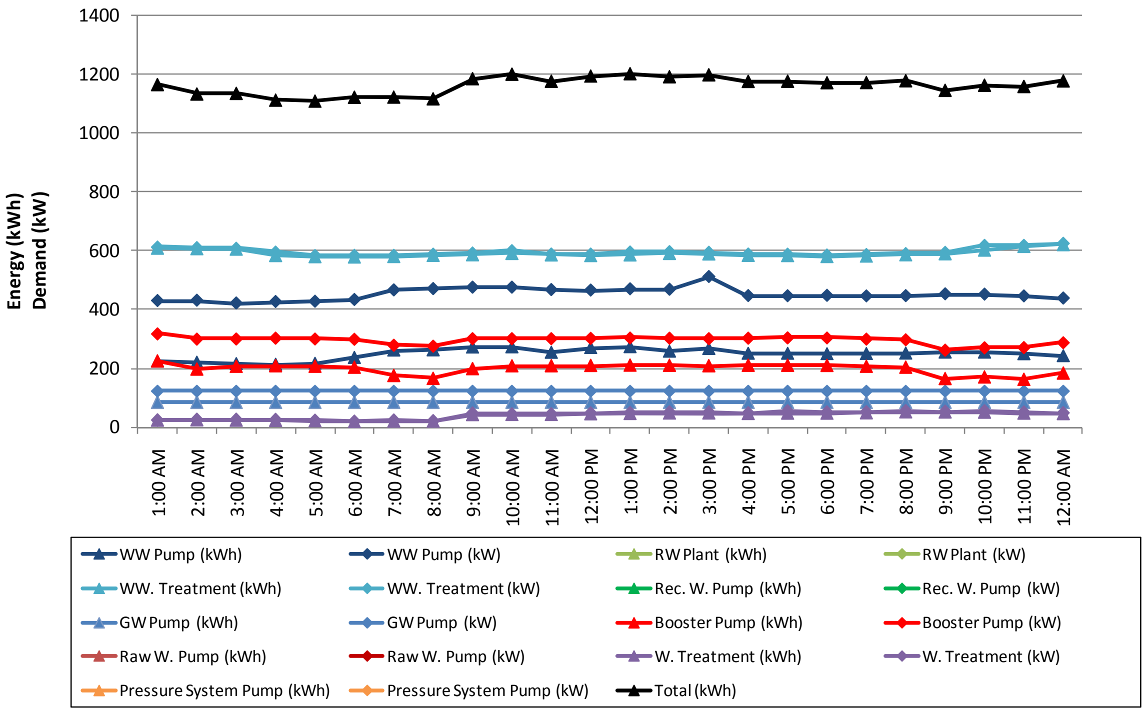

| **Date** | 6/20/2008 |
|---|---|
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater/Desalination* | 91 |
| *Booster Pumps* | 167 |
| *Water Treatment* | 45 |
| *Wastewater Pumps* | 234 |
| *Wastewater Treatment* | 609 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



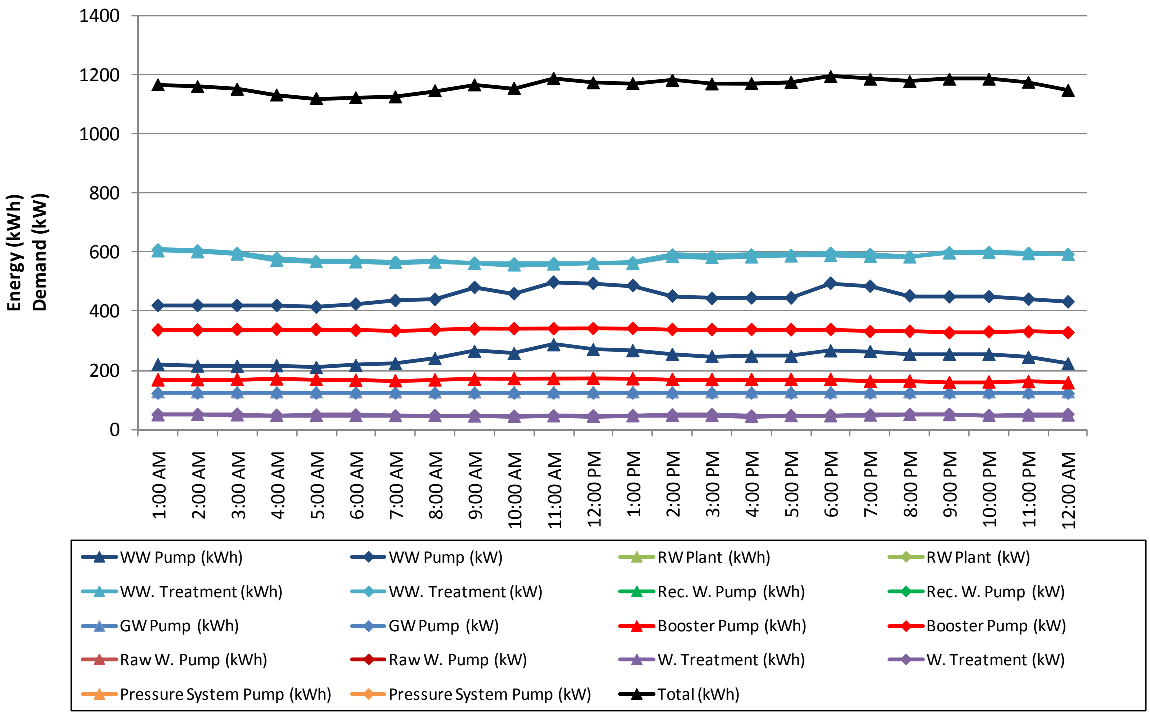

| | |
|---|---|
| **Date** | 9/1/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater/Desalination* | 105 |
| *Booster Pumps* | 203 |
| *Water Treatment* | 47 |
| *Wastewater Pumps* | 263 |
| *Wastewater Treatment* | 632 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



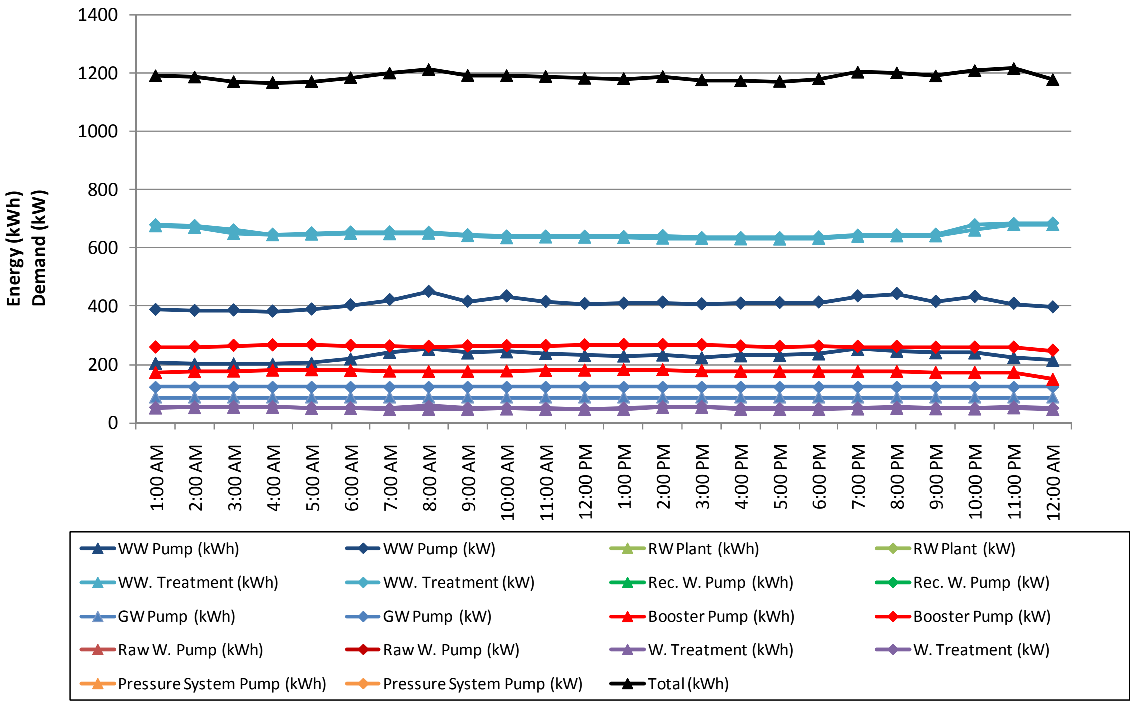

| **Date** | 7/31/2008 |
|---|---|
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Groundwater/Desalination* | 85 |
| *Booster Pumps* | 209 |
| *Water Treatment* | 47 |
| *Wastewater Pumps* | 255 |
| *Wastewater Treatment* | 587 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



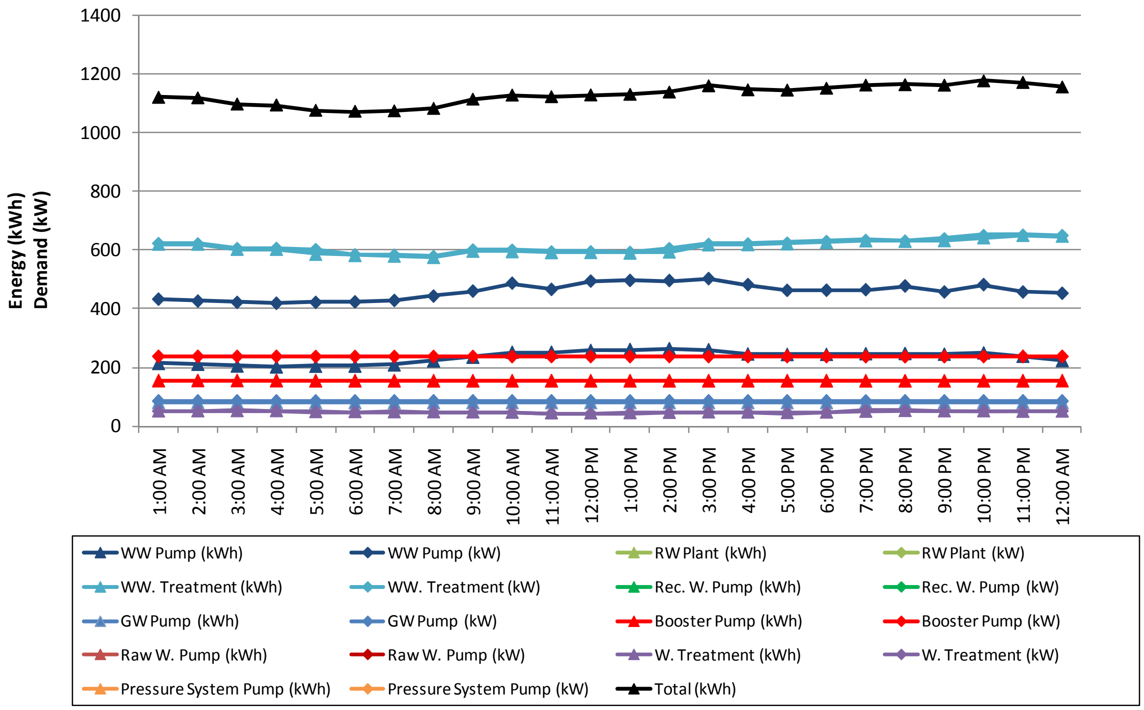

| | |
|---|---|
| **Date** | 6/1/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater/Desalination* | 126 |
| *Booster Pumps* | 169 |
| *Water Treatment* | 45 |
| *Wastewater Pumps* | 248 |
| *Wastewater Treatment* | 584 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



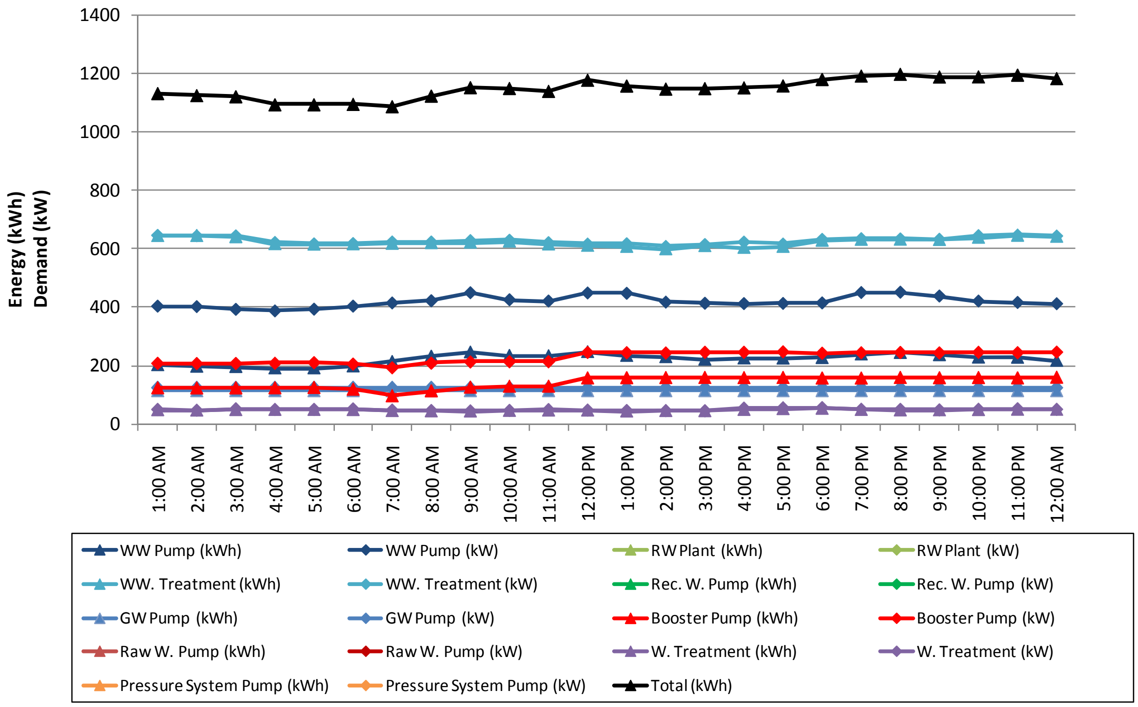

| **Date** | 4/1/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater/Desalination* | 86 |
| *Booster Pumps* | 177 |
| *Water Treatment* | 50 |
| *Wastewater Pumps* | 229 |
| *Wastewater Treatment* | 631 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| **Date** | 3/1/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater/Desalination* | 81 |
| *Booster Pumps* | 155 |
| *Water Treatment* | 45 |
| *Wastewater Pumps* | 250 |
| *Wastewater Treatment* | 619 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| **Date** | 12/1/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater/Desalination* | 115 |
| *Booster Pumps* | 159 |
| *Water Treatment* | 49 |
| *Wastewater Pumps* | 224 |
| *Wastewater Treatment* | 607 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

The City of Oceanside has several ongoing projects to improve energy efficiency. As of 2009, the city has constructed a cogeneration energy system at the San Luis Rey WWTP, which will supply about 540 kW, resulting in about a 20 percent savings for the city. The city plans to release an RFP for a solar energy supply system. Oceanside participates in the SDCWA "20-Gallon Challenge" water conservation initiative that encourages customers to reduce water use by 20 gallons per person per day. The city currently has a seawater desalination pilot research and development project.

## Sources

City of Oceanside Urban Water Management Plan, November 2005.

City of Oceanside. Interview with Greg Blakely, Water Utilities Division Manager; and Mark Anderson, Water Utilities Division Manager, interviewed by Lacy Cannon (GEI), October 21, 2009.

City of Oceanside. Public website. http://www.ci.oceanside.ca.us/Datarelation.aspx?Content=10. Accessed February 8, 2010.

# Orange County Sanitation District (OCSD)

## Summary

<table>
<tr><td>Primary functions</td><td colspan="4">Urban Wastewater</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="4">Wastewater Treatment</td></tr>
<tr><td>Hydrologic Region</td><td colspan="2">South Coast</td><td>DEER Climate Zone</td><td>6 and 8</td></tr>
<tr><td>Quantity of wastewater</td><td colspan="4">Treated: 230 MGD (typical daily treatment)</td></tr>
<tr><td>Number of Customers</td><td colspan="2">Total: 911,152<br>Residential/Commercial: 910,637<br>Industrial: 515</td><td>Service Area Size</td><td>471 Sq miles</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="4">The Orange County Sanitation District (OCSD) treats wastewater from customers in Orange County. OCWD operates two treatment plants. Most of the treated effluent is combined and pumped through a five-mile, 10-foot diameter, ocean outfall pipe. Some secondary effluent is pumped to the Orange County Water District (OCWD) where it enters the Advanced Water Purification Facility (AWPF) and is recycled for groundwater recharge operations.  OCSD and OCWD jointly built the AWFP.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="4">• Wastewater Collection – A flat collection area and treatment plants located near the ocean require little collection energy use<br>• Wastewater Treatment- Significant energy is used by the OCSD's two wastewater treatment plants</td></tr>
<tr><td>Water/Wastewater Treatment Technologies</td><td colspan="4">Reclamation Plant No. 1 (Wastewater): Primary treatment, secondary treatment<br>Treatment Plant No. 2 (Wastewater): Primary treatment, secondary treatment</td></tr>
<tr><td>Wastewater Sources</td><td colspan="4">80% Residential, 20% Non-Residential</td></tr>
<tr><td>Marginal Water Supply</td><td colspan="4">N/A</td></tr>
<tr><td>Energy Service Providers</td><td colspan="4">SCE, SCG</td></tr>
<tr><td rowspan="3">Observed Energy Intensities (kWh/MGal)</td><td>Segment</td><td colspan="2">Lower Range</td><td>Upper Range</td></tr>
<tr><td>Wastewater Collection</td><td colspan="2">3</td><td>6</td></tr>
<tr><td>Wastewater Treatment</td><td colspan="2">1,120</td><td>1,314</td></tr>
</table>

## Background Information

The Orange County Sanitation District (OCSD) operates the third largest wastewater agency west of the Mississippi River. OCSD treats and disposes of, or reclaims, the wastewater generated by 2.5 million people living and working in central and northwestern Orange County. Table 1 provides additional information about OCSD.

Primary sources of information include: OCSD's Budget and Financial Reports, OCSD's public website, OCSD's 2009 Updated GWMP, water and energy data for 2008 provided by OCSD, and population projections made by the Center for Demographic Research "Fiscal Year 2009-10 Budget Update."

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Wastewater, Recycled Water |
| **Hydrologic Region** | South Coast |
| **Region Type** | Southland |
| **Energy Service Provider** | SCE, SCG |
| **DEER Climate Zone** | 8 (66%) and 6 (34%) |
| **Service Area Size** | 471 Sq miles |
| **Service Area Population (2008)** | 2,539,990 |
| **Number of Customers in 2008** | 911,152 |
| ***Residential/Commercial*** | 910,637 |
| ***Industrial*** | 515 |
| **Distribution Topology** | Flat |

### Climate

The climate in the county is mild, with an average rainfall of 13 inches. The mean temperature ranges from a minimum of 48 degrees to a maximum of 76 degrees.

### Demographics

OCSD serves a large urban population; approximately 2.5 million people live or work in the OCSD service territory. According to OCSD estimates, service area population is expected to grow 9.5 percent from 2010 to 2030. Table 2 compares the historic and projected population, housing, and employment growths in the OCSD's service area.

#### Table 2: Projected Growth of Population, Housing and Employment, Orange County, 2003-2035

| | 2003 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Population | 2,999,319 | 3,059,950 | 3,314,948 | 3,451,757 | 3,533,935 | 3,586,285 | 3,629,540 |
| Housing | 997,614 | 1,014,331 | 1,073,751 | 1,106,607 | 1,122,905 | 1,136,564 | 1,144,314 |
| Employment | 1,568,407 | 1,615,936 | 1,755,167 | 1,837,771 | 1,897,352 | 1,933,058 | 1,960,633 |

## Wastewater Sources

Each day the OCWD treats approximately 230 million gallons of wastewater. About 80 percent of the wastewater comes from residential customer originating from sinks, toilets, showers, laundry, and dishwashers. The remainder comes from business including retail stores, restaurants, manufacturers, hotels, offices, and other industries.

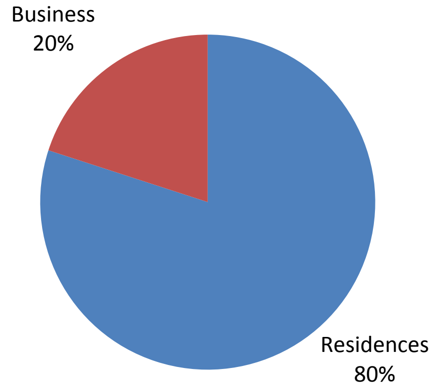



**Figure 1: Typical Distribution of Wastewater Sources (MGal/day)**

## System Infrastructure and Operations

OCSD operates two wastewater treatment plants and a system of sewers and wastewater collection pumps. Table 3 summarizes the key pieces of infrastructure in OCSD's system. Figure 2 illustrates OCSD's infrastructure locations in relation to the service area.

OCSD jointly developed the Advanced Water Purification Facility (AWPF) with OCWD. OCWD operates the AWPF and recycled secondary treated water from OCWD for use in groundwater recharge operations. This section will not discuss the AWPF in detail, see the section on OCWD for more detail and data.

**Table 3: Infrastructure Summary**

| | |
|---|---|
| **Miles of Sewers** | 568 |
| **Number of Plants** | |
| ***Wastewater Treatment*** | 2 |
| **Number of Pump Stations** | 16 |

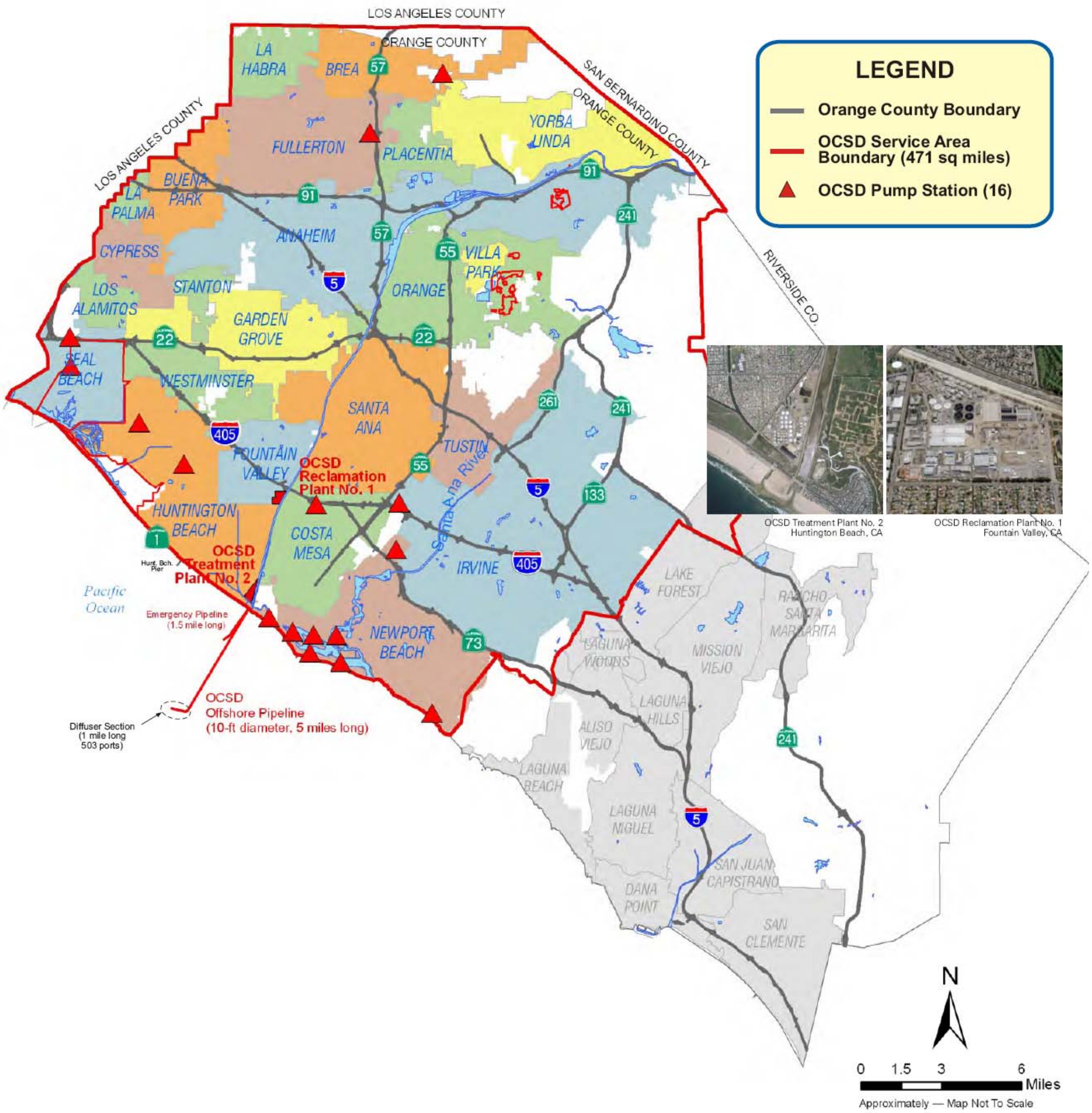



**Figure 2: OCWD Infrastructure**

### *Wastewater Collection*

Wastewater is collected from 16 pump stations or gravity sewers in outlying areas that total 471 square miles. The majority of wastewater pumps are located in the coastal areas where gravity flow is not sufficient to transport wastewater to the treatment plants. Few pumps are needed inland where higher elevations drive wastewater flows toward the treatment plants.

### *Wastewater Treatment Plants*

OCWD operates two wastewater treatment plants. Reclamation Plant No. 1, located in Fountain Valley, has a primary treatment capacity of 204 MGD and a secondary treatment capacity of 110 MGD. Treatment Plant No. 2, located in Huntington Beach, has a primary treatment capacity of 168 MGD and a secondary treatment capacity of 90 MGD. The total primary treatment capacity of the two facilities is 372 MGD. The total secondary treatment capacity of the two facilities is 200 MGD. During times of high flow some water must bypass the secondary treatment because secondary treatment capacity is smaller than primary treatment capacity.  OCSD has a long-term construction plan in place to increase secondary treatment capacity.  Figures 3 and 4 illustrate the process flows for OCSD Plant 1 and Plant 2, respectively.

Approximately 50 to 90 million gallons per day of secondary treated wastewater is sent to the AWPF for recycling. The remaining treated wastewater is discharged through the ocean outfall about five miles offshore.

Both wastewater treatment plants make use of biodigesters to generate natural gas from solid waste. The biogas is used to generate electricity that powers a portion of the operations for each plant.  OCSD Plant 1 has six generators (five engines and one steam turbine); typical operation utilizes three to four generators at a time, though sometimes five or six are used.  OCSD Plant 2 has three generators (all are engines); typical operation utilizes two of these at a time, although sometimes all three are used.

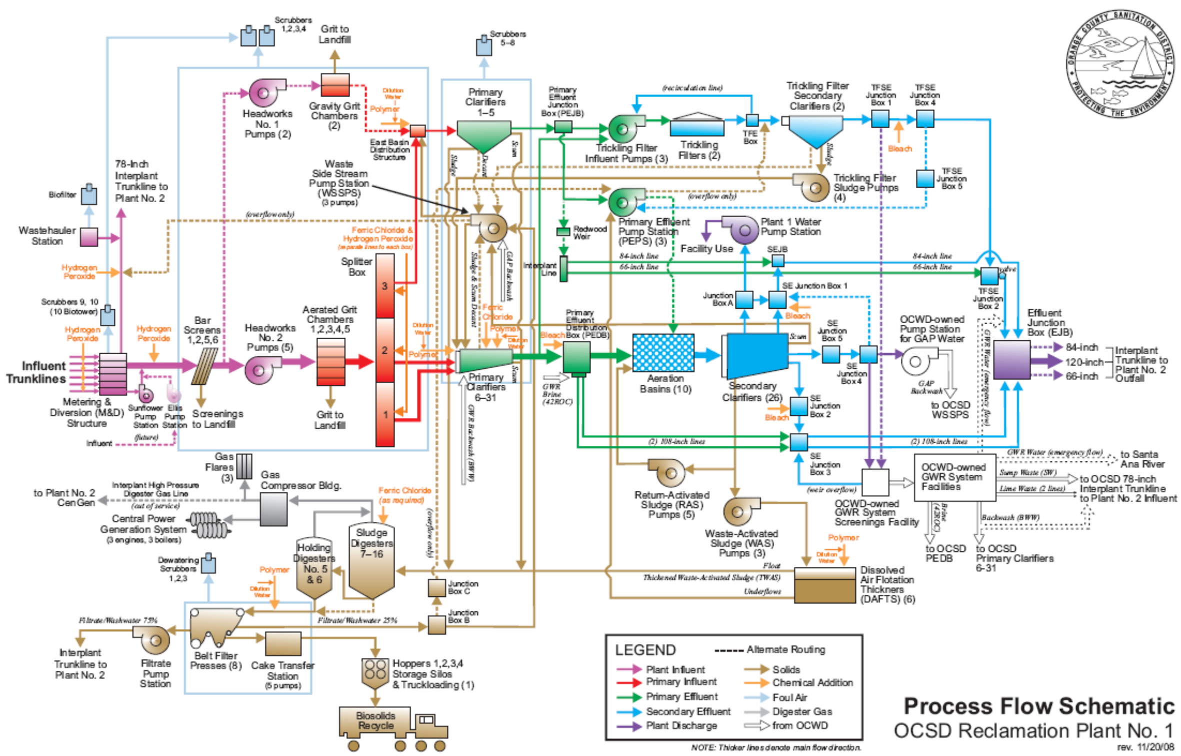



**Figure 3: OCWD Plant 1 Process Diagram**

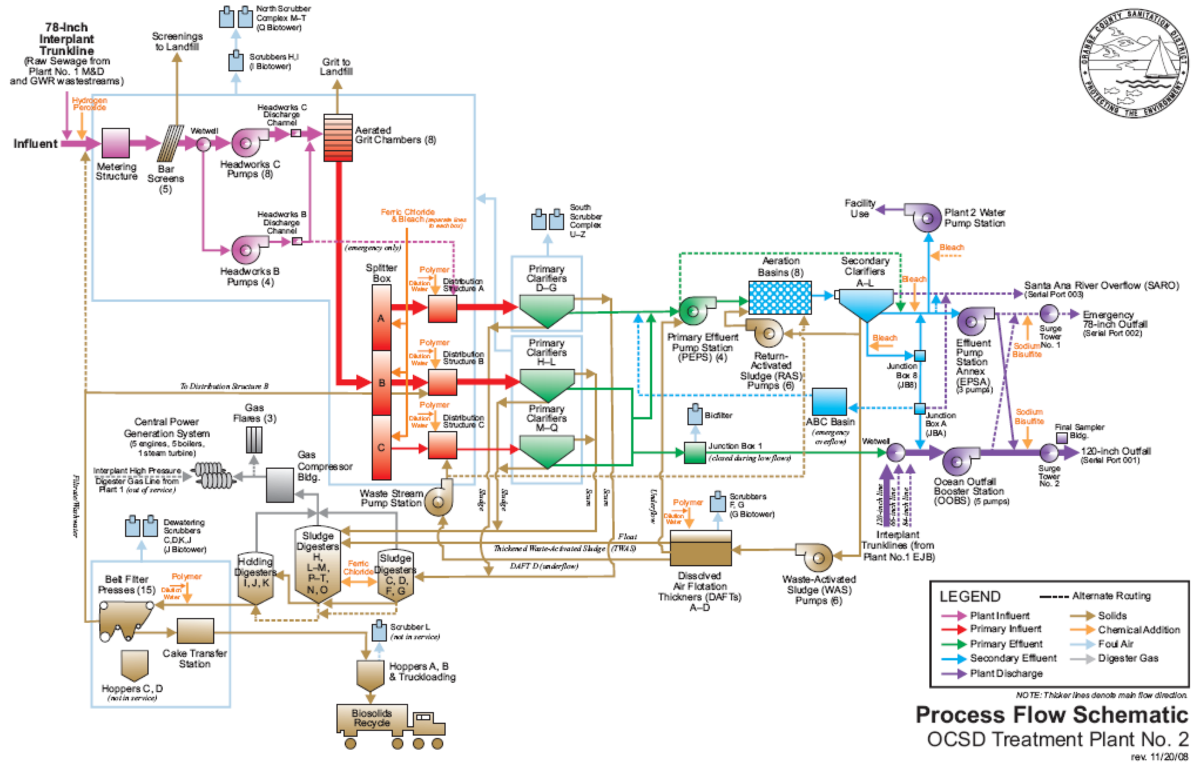



Figure 4: OCWD Plant 2 Process Diagram

## System-wide Operation Strategy

OCSD must operate subject to the wastewater influent that flows to its plants. OCSD cannot store wastewater for significant time and must treat it as is continually arrives at its plants. Wastewater influent follows a diurnal pattern throughout the day. Influent is relatively constant for much of the day, though flows drop during 3 a.m. and 10 a.m., the time that corresponds to decreased water use during the night time. This decrease is shifted from the actual decrease in water use as it takes several hours for wastewater to travel from customers to the treatment plants.

OCSD operates under an ocean discharge permit issued by US Environmental Protection Agency and the Santa Ana Regional Water Quality Control Board. This permit is renewable every five years and was last issued in December 2004.

### Infrastructure Changes

OCSD was engaged in several infrastructure projects during 2008, some of these projects directly affect the Study Team's data.

OCSD is replacing fifteen different headworks structures and associated piping at Plant 2. The project began in 2005 and is scheduled to be complete in June 2010. Discussion with staff indicated that this project along with other ongoing projects (including some at Plant 1) caused a temporary stop in energy data collection at various times in the year. Full energy data for the entire 2008 calendar year was not provided to the Study Team.

OCSD is engaged in a long-term project to expand secondary treatment capacity at its treatment plants. These construction activities do not affect the Study Team's data.

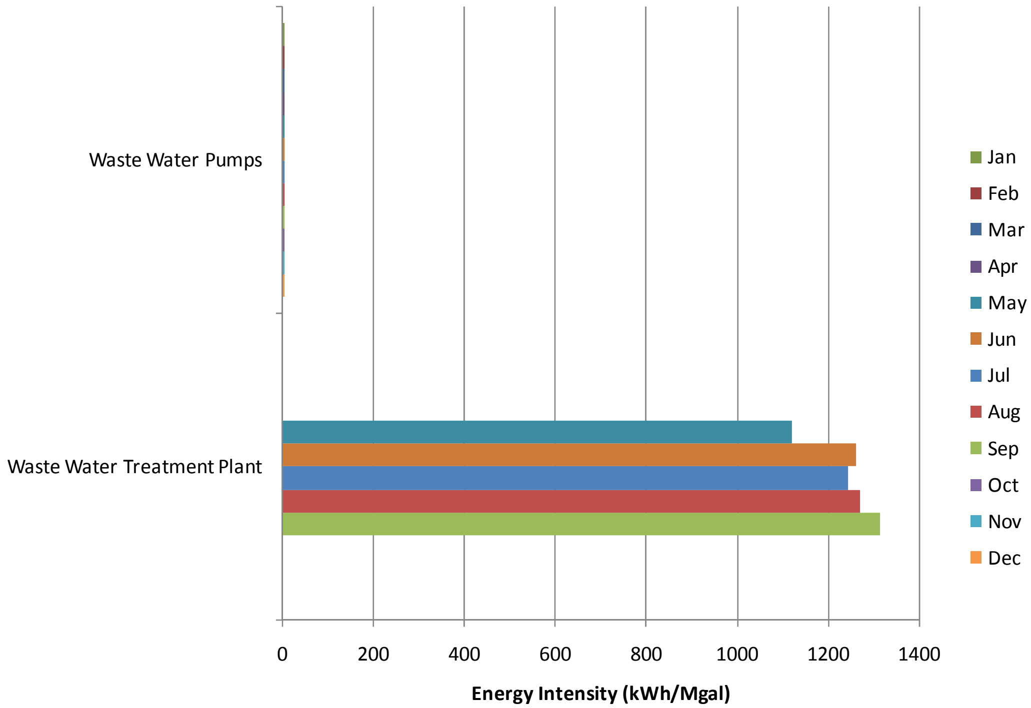
## Energy Profiles

OCSD provided the Study Team with energy data and water flow data. Energy data came in the form of hourly data for treatment plants and monthly data for wastewater collection pumps. Flow data came in the form of total daily influent to each plant.

Energy data was obtained from OCSD, it is collected and maintained by OCSD staff using an energy monitoring system. Energy is generated at each plant using biodigesters and electric generators, additional energy is purchased from SCE. Data was provided to the Study Team detailing the hourly energy production for each generator in each treatment plant and the hourly energy purchased from SCE.

Flow data was only provided at the two treatment plants. Flow through each wastewater collection pump was not recorded by OCSD. Thus the Study Team applied the total wastewater influent flow pattern to each booster pump station for energy profile calculation purposes. The energy and flow data was processed by the Study Team to determine the energy intensity of each facility type and the hourly energy profiles presented in this section.

The energy intensity of each facility type within Orange County Sanitation District is presented in Figure 5. Energy intensity represents the total energy required by all facilities regardless of the source of energy (SCE or on-site generation). Energy intensity for wastewater collection pumps is less than 10 kWh/MG due to the flat terrain and minimal pumping required. Energy intensity for wastewater treatment plants could only be calculated during the months of May through September. These were the only months for which complete data was supplied to the Study Team. The lack of complete data was discussed earlier in the Infrastructure Changes section.




Note: Energy Intensity of Wastewater Pumps ranges from 3-6 kWh/MG

### Figure 5: OCSD Monthly Energy Intensity by Facility Type

OCSD generates energy at wastewater treatment plants using biogas digesters. Only a portion of the energy consumption at each plant is met by these self-generating activities. Additional electricity is purchased from SCE. Figure 6 displays the distribution of energy sources for each plant in a typical summer month.

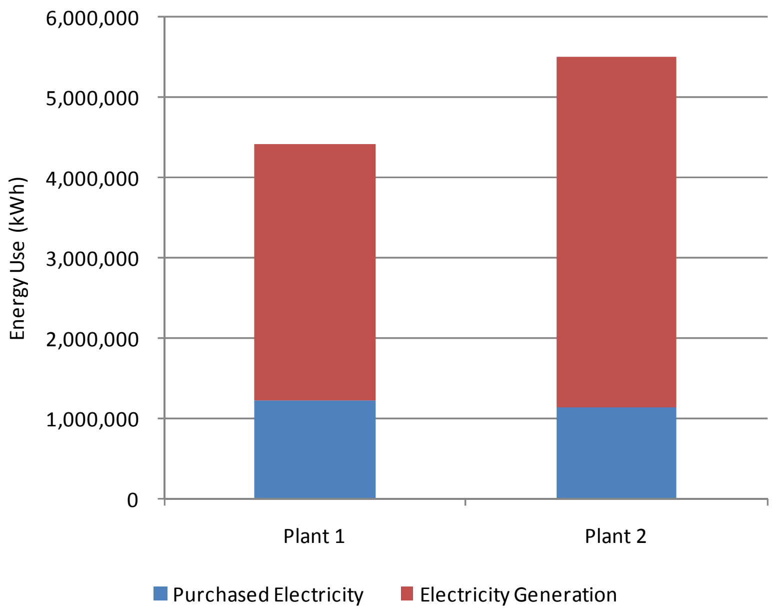
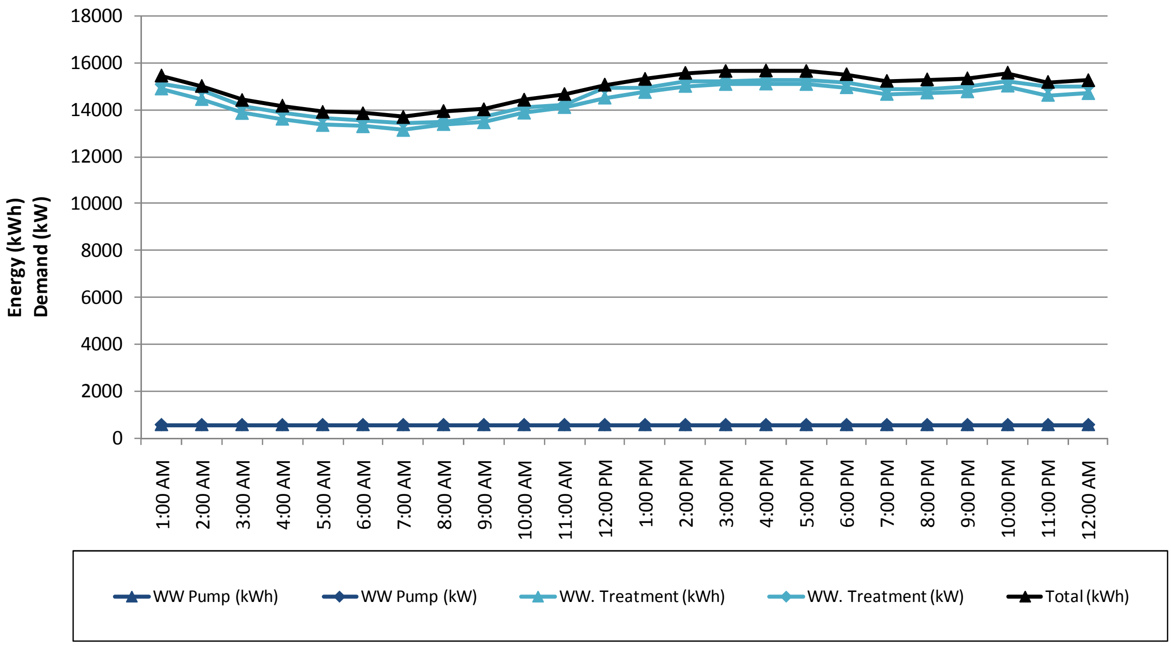


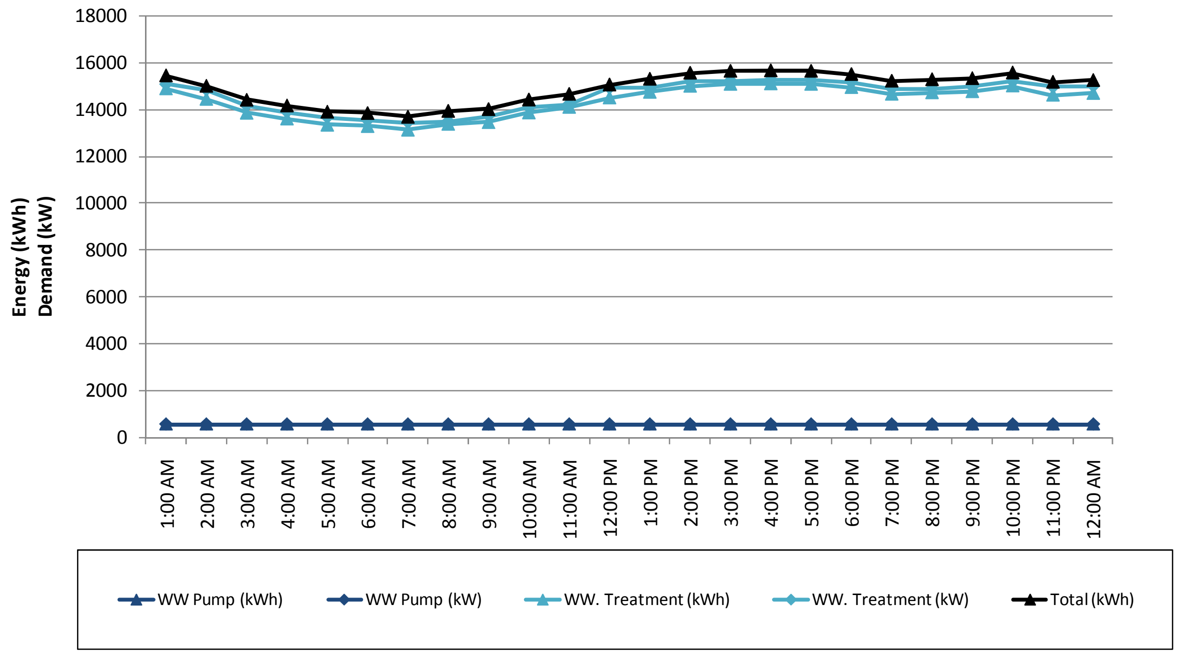

**Figure 6: Treatment Energy Use by Source – Typical Summer Month (July)**

Hourly Energy profiles and peak energy demand is documented in Figures 7 through 11. Due to limited energy data during the winter season, only the Winter Average Water Demand Day profile could be produced. The majority of energy used by Orange County Sanitation District is used by wastewater treatment plants.



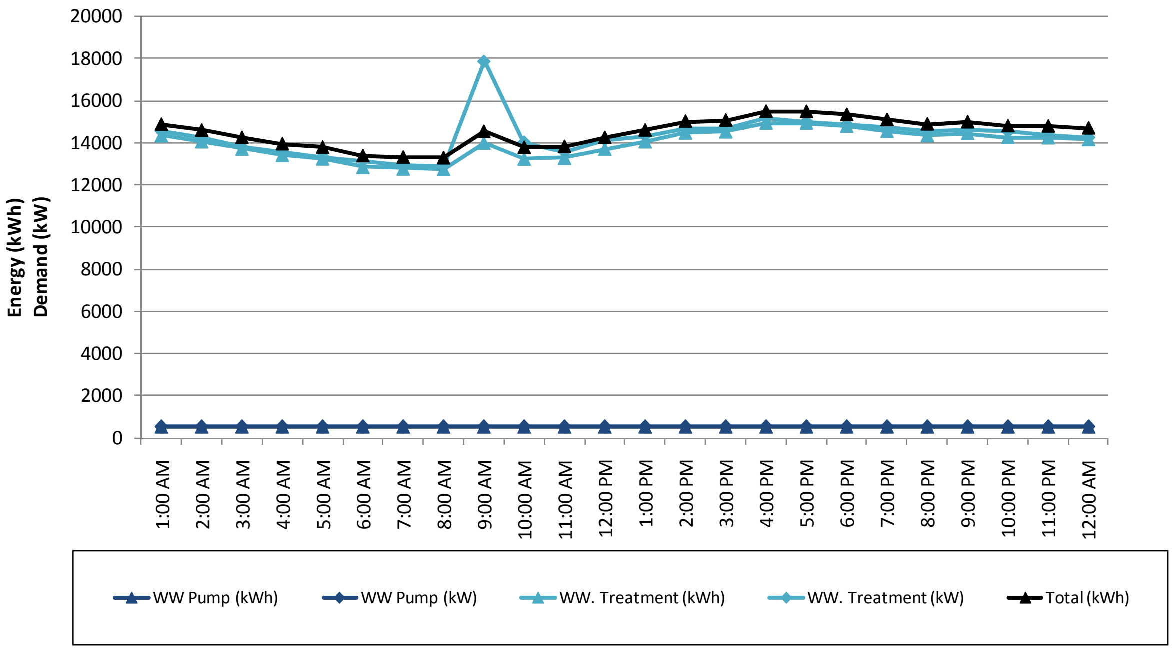

| | |
|---|---|
| **Date** | 6/20/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Wastewater Collection Pumps* | 562 |
| *Wastewater Treatment* | 15,080 |

**Figure 7: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



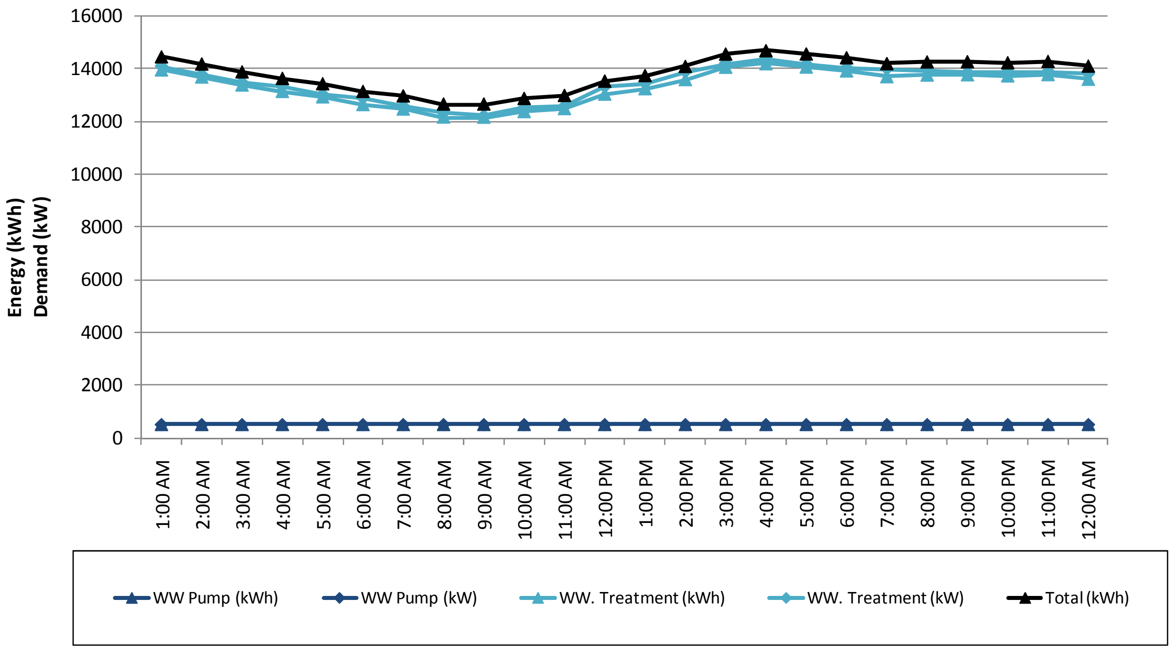

| | |
|---|---|
| **Date** | 6/20/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Wastewater Collection Pumps* | 562 |
| *Wastewater Treatment* | 15,080 |

**Figure 8: 24-Hour Energy Profile: Summer High Water Demand Day**



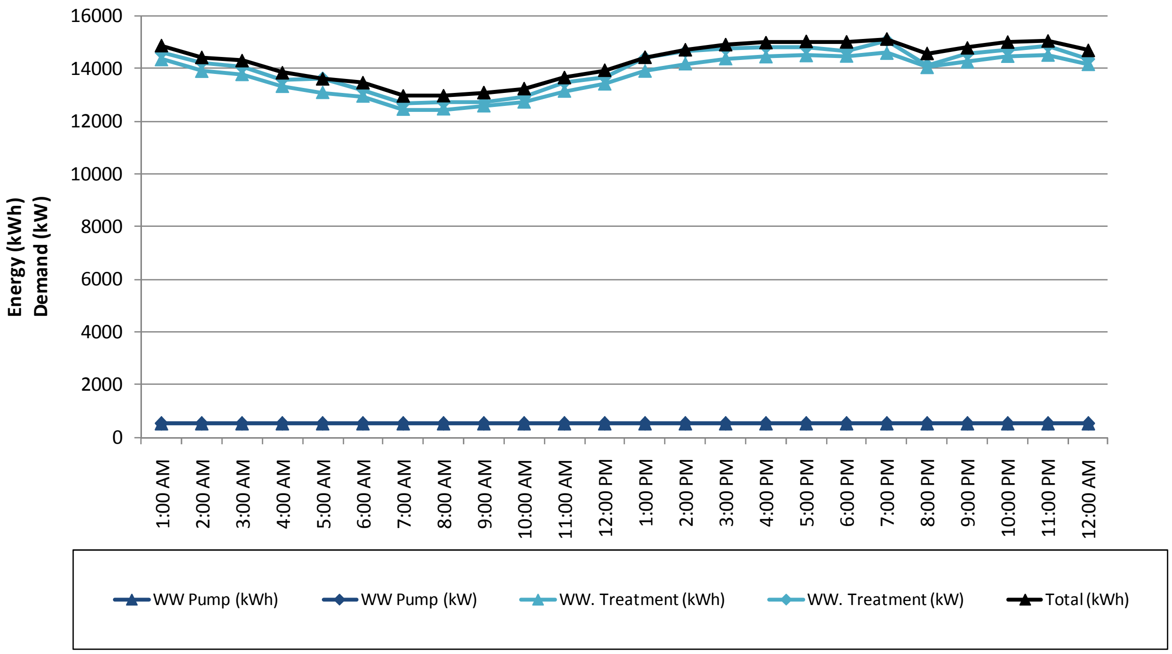

| | |
|---|---|
| **Date** | 7/26/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Wastewater Collection Pumps* | 531 |
| *Wastewater Treatment* | 14,804 |

**Figure 9: 24-Hour Energy Profile: Summer Average Water Demand Day**




| | |
|---|---|
| **Date** | 8/31/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Wastewater Collection Pumps* | 505 |
| *Wastewater Treatment* | 14,108 |

**Figure 10: 24-Hour Energy Profile: Summer Low Water Demand Day**




| | |
|---|---|
| **Date** | 5/18/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Wastewater Collection Pumps* | 527 |
| *Wastewater Treatment* | 14,450 |

**Figure 11: 24-Hour Energy Profile: Winter Average Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

Several renewable energy and energy efficiency projects are in planning or construction stages at OCSD. OCSD's Construction Capital Improvement Program (CIP) is an 18-year plan that began in 2002 with approximately 114 improvement projects. The total estimated cost is $2.5 billion. The goals of the project are:

- Major rehabilitation of existing headworks, primary treatment, secondary treatment, ocean pipeline pumping, and biosolids handling facilities at both plants
- Replace or rehabilitate 16 of OCSD's sewage pump stations
- Achieve secondary treatment standards

Additionally, OCSD partnered with EnerTech Environmental to convert biosolids waste from treatment plants into solid biofuel. The facility began operating at full capacity in December 2008.

## Sources

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OCSD. *Orange County Sanitation District Facts and Key Statistics*

# Orange County Water District (OCWD)

## Summary

<table>
<tr><td>Primary functions</td><td colspan="3">Raw Water, Wholesale (Urban), Recycled Water</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Supply, Recycled Water Treatment, Groundwater Recharge</td></tr>
<tr><td>Hydrologic Region</td><td>South Coast</td><td>DEER Climate Zones</td><td>6 and 8</td></tr>
<tr><td>Quantity of Water (2008)</td><td colspan="3">Groundwater Demand by Member Agencies: 368,000 AF/yr<br>Total Groundwater Recharge: 258,000 AF/yr<br>Recycled Water Production: 28,000 AF/yr</td></tr>
<tr><td>Number of Customers</td><td>23 Member Agencies</td><td>Service Area Size</td><td>350 Sq miles</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">The Orange County Water District (OCWD) manages a groundwater basin covering approximately 350 square miles underlying the north half of Orange County. OCWD supplies recharge water to the basin from local surface water, imported water, and highly treated recycled water from the Groundwater Replenishment (GWR) System Advanced Water Purification Facility (AWPF). The AWPF is one of the most advanced recycled water facilities in the world; constructed in partnership with Orange County Sanitation District. Recycled water is used to replenish the groundwater basin and to maintain a seawater intrusion barrier.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3">• Water Supply – Water is diverted from the Santa Ana River into recharge ponds with relatively low energy use<br>• Recycled Water – Significant energy is needed to run Reverse Osmosis and Microfiltration systems in the AWPF<br>• Recycled Water Distribution – significant energy is needed to inject water into the ground and pump it to recharge basins</td></tr>
<tr><td>Wastewater/Recycled Water Treatment Technologies</td><td colspan="3">Groundwater Replenishment System (Recycled Water): Microfiltration, Reverse Osmosis, Ultraviolet Light with Hydrogen Peroxide (Advanced Oxidation)</td></tr>
<tr><td>Water Resources</td><td colspan="3">Santa Ana River, Santiago Creek, imported water from various sources (including MWD via MWDOC), storm flows, secondary treated wastewater effluent from Orange County Sanitation District</td></tr>
<tr><td>Marginal Water Supply</td><td colspan="3">Short Term: Local Surface Water<br>Long-Term: Recycled water (additional capacity to be built at the GWR system) and Storm Water (additional capture and percolation facilities)</td></tr>
<tr><td>Energy Service Providers</td><td colspan="3">SCE, SCG, City of Anaheim</td></tr>
<tr><td rowspan="7">Observed Energy Intensities (kWh/MG)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Recycled Water Treatment*</td><td>3,161</td><td>3,771</td></tr>
<tr><td>Microfiltration</td><td>756</td><td>839</td></tr>
<tr><td>Reverse Osmosis</td><td>1,483</td><td>1,784</td></tr>
<tr><td>UV light Treatment</td><td>288</td><td>336</td></tr>
<tr><td>Seawater Intrusion Barrier</td><td>575</td><td>668</td></tr>
<tr><td>Recycled Water Transport</td><td>944</td><td>1,122</td></tr>
</table>

*Includes: filter screens, microfiltration, reverse osmosis, UV, decarbonator, lime system, and miscellaneous treatment processes.

## Background Information

OCWD's primary responsibility is managing the vast groundwater basin under northern and central Orange County that supplies water to agencies and residents within the area. OCWD supplies recharge water to the basin from local surface water, imported water, and highly treated recycled water from the GWR System's Advanced Water Purification Facility (AWPF). OCWD receives its imported water from Municipal Water District of Orange County (MWDOC) who is a member agency of Metropolitan Water District of Southern California (MWD). The AWPF was constructed in partnership with Orange County Sanitation District (OCSD) and is one of the most advanced recycled water facilities in the world. It takes in secondary treated wastewater from OCSD and treats it to beyond potable water standards. The purified water produced is used both to replenish the groundwater basin and to develop and maintain a seawater intrusion barrier to protect the quality of the basin. See Table 1 for additional information on OCWD.

Primary sources of information for this section include OCWD's 2009 Groundwater Management Plan, water and energy data for 2008 provided by OCWD, supplemental energy data provided by SCE, and interviews with staff at OCWD. A detailed list of references is located at the end of this section.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Raw Water Wholesale (Urban), Recycled Water |
| **Hydrologic Region** | South Coast |
| **Region Type** | South Coast |
| **Energy Service Providers** | SCE, SCG, City of Anaheim |
| **DEER Climate Zone** | 8 (66%) and 6 (34%) |
| **Service Area Size** | 350 Sq miles |
| **Service Area Population** | 2.37 million (as of Jan 2010) |
| **Number of Member Agencies** | 23 |
| **Distribution Topology** | Flat |

### Climate

The average seasonal rainfall in the OCWD service area for the five-year period (from July 1, 2003 to June 30, 2008) was 12.2 inches, which is slightly less than the historical annual average of 13.4 inches.

From March through May average temperatures range from 53.2°F to 67.3°F, from June through August average temperatures range from 62.0°F to 74.5°F, and from December through February average temperatures range from 48.1°F to 65.5°F.

### Demographics

OCWD serves a largely urban population. Population within the service area is expected to increase from the 2.37 million people to approximately 2.55 million people by the year 2030, see Table 2.

Expanding through annexing additional land has been a major factor in the growth of OCWD in the past. From 1933 to present, OCWD's area has grown from 162,676 acres to over 229,000 acres. Annexation requests by the City of Anaheim, Irvine Ranch Water District, and Yorba Linda Water District, if approved, could further expand the District's boundary and increase groundwater demands.

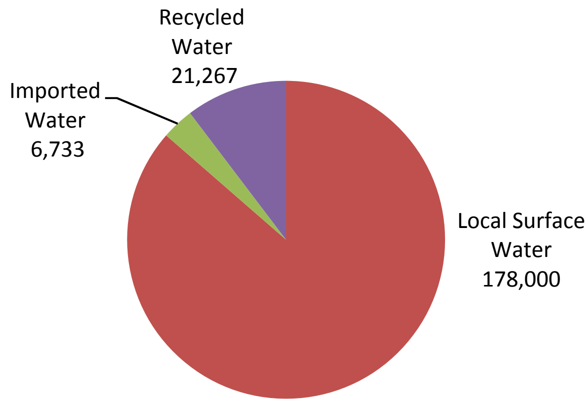
**Table 2: Projected OCWD Service Area Population**

| Year | Population |
|---|---|
| 2010 | 2,376,000 |
| 2015 | 2,446,000 |
| 2020 | 2,485,000 |
| 2025 | 2,511,000 |
| 2030 | 2,529,000 |
| 2035 | 2,548,000 |

Source: 2009 Groundwater Management Plan and adjustments suggested by OCWD Staff.

## Water Sources

For the purposes of this study, the Study Team defines supply for OCWD as the water used to recharge the Orange County groundwater basin. OCWD recharges the groundwater basin using its supply that includes local surface water, highly treated recycled water, and imported water. In addition to these sources, the groundwater basin is also naturally recharged from local precipitation and percolation of surface water; the energy requirements for this source will not be discussed in this report as they are relatively small. Figure 1 illustrates the approximate distribution of supply in 2008.




Data Sources: 2009 Groundwater Management Plan, Data on AWPF supplied by OCWD
Notes:
1. Local Surface and Imported water reported for water year 2007-08
2. Recycled water reported for CY 2008
3. Recycled water is not representative of current output as production did not reach normal operation until late 2008

**Figure 1: 2008 Distribution of Sources (AF/Yr)**

### Local Raw Surface Water

The largest supply of surface water to OCWD is its diversion from the Santa Ana River, it accounts for approximately 70 percent of recharge supplies in 2008. The Santa Ana River Watershed is the largest in Costal Southern California, covering 2,800 square miles. The Santa Ana River begins in the San Bernardino Mountains, crossing central Orange County before emptying into the Pacific Ocean. Along the river, water is stored above Prado Dam located east of Orange County. The dam is operated by the Army Corps of Engineers (ACOE) primarily to provide flood control. Through a cooperative agreement with the OCWD, the ACOE allows for some temporary storage behind the dam for water conservation purposes. Water released at Prado Dam naturally flows downstream into Orange County and percolates through the river's 300 to 400 foot-wide unlined channel bottom. Further downriver, OCWD facilities divert water from the river into percolation ponds to actively recharge the basin.

Santiago Creek is the second source of surface water to OCWD; it makes up less than 10 percent of the recharge water supply. Separate recharge facilities from those in Anaheim are located in the City of Orange along the Santiago Creek.

Water from both sources does not require any treatment by OCWD. Groundwater pumped from the basin by member agencies typically does not require treatment, other than disinfection.

### Recycled Water

OCWD recycled water is supplied by the GWR System's Advanced Water Purification Facility (AWPF), a plant jointly constructed with Orange County Sanitation District (OCSD) and operated by OCWD. Secondary treated wastewater from OCSD's Plant #1 is sent to the AWPF for further processing by OCWD. OCWD purifies the water using microfiltration, reverse osmosis, and UV light with hydrogen peroxide. Purified water is used both to replenish the groundwater basin and to develop and maintain a seawater intrusion barrier to protect the quality of the basin. Less than 3 percent of the GWRS water recharged is estimated to be lost to the ocean for seawater intrusion control. The remaining 97 percent serves as a recharge supply to the basin.

### Imported Water

OCWD has several standing agreements with various agencies to import water to its service territory. The import sources and methods of import are listed below.

#### *Metropolitan Water District*

OCWD receives imported water from MWDOC who is a member agency of MWD and can obtain water in three different ways:

1. Raw water from either the Colorado River Aqueduct or the State Water Project can is delivered to Anaheim Lake for groundwater recharge
2. Treated water from Diemer Water Treatment Plant is injected into the basin at the seawater barrier
3. Treated water is delivered directly to OCWD's groundwater producer's in-lieu of drawing on OCWD groundwater.

In 2008, OCWD did not receive any raw water from MWD due to water shortage conditions.

#### *Western Municipal Water District*

Water can be transferred by Western MWD to OCWD from two sources via the Santa Ana River:

1. Surplus groundwater can be released into the Santa Ana River in Riverside County above Prado Dam
2. Purified water from Arlington Desalter is released to Santa Ana River above Prado Dam.

Water from both sources is then diverted from the Santa Ana River at OCWD's recharge facilities.

### *San Bernardino Valley Municipal Water District*

Surplus groundwater can be released into the Santa Ana River in San Bernardino, water flows down the Santa Ana River and is then diverted at OCWD's recharge facilities.

## Marginal Water Supply

Future water supply for OCWD includes both recycled and surface water. In the short term, local surface water from the Santa Ana River and Santiago Creek is OCWD's marginal supply. In the long term, OCWD's marginal supply includes expanded use of recycled water and additional capture of storm water from the Santa Ana River. Although the AWPF is running at near full capacity, its design allows for a doubling of capacity in the future.

The energy intensity range of OCWD's marginal supply is summarized in Table 3. The energy intensity represents the embedded energy for all activities prior to the water reaching the surface of OCWD's Recharge Facilities.

**Table 3: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short Term | Local Surface Water[a] | 30 kWh/MG |
| Long Term | Recycled Water from AWPF[b] | 3,161 – 3,771 kWh/MG |

a) Study Team estimate from Study 1

b) From OCWD data analysis combining recycled water production and recycled water transport energy intensities

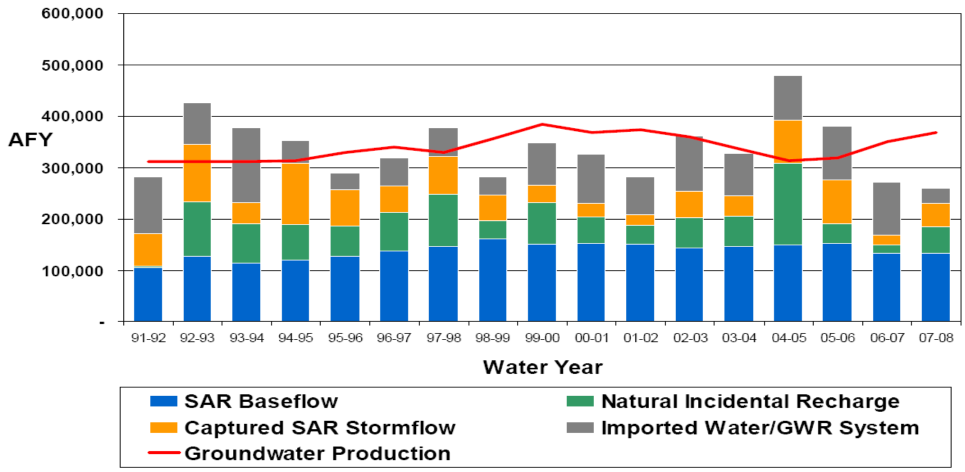
# Water Demand

Water demand is projected to increase 10.6 percent between 2010 and 2030, see Table 4. These demand estimates are used by OCWD in its Groundwater Management Plan but originate from estimates by the Municipal Water District of Orange County (MWDOC). MWDOC's service territory extends beyond that of OCWD; however, this demand estimate is for the OCWD territory.

**Table 4: Projected Water Demand (AF/Yr)**

| Year | 2009 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Demand (AF/Yr) | 491,000 | 500,000 | 519,000 | 538,000 | 548,000 | 553,000 |

As OCWD manages a groundwater basin, its recharge supply does not need to equal the groundwater demand of its member agencies. The ability to store water allows OCWD's supply to exceed its groundwater demand in wet years and vice-versa in dry years. Figure 2 illustrates this with historic recharge and groundwater withdrawal data.




Source: OCWD Groundwater Management Plan, 2009

Bars indicate the total water recharged in the basin by source.

SAR = Santa Ana River

Groundwater production = Demand for groundwater

**Figure 2: Historic Demand and Supply (Groundwater Recharge)**

## System Infrastructure and Operations

To recharge its groundwater basin, OCWD operates a complex system of diversions, dams, basins, and plants.  OCWD currently operates 1,067 acres of recharge facilities adjacent to the Santa Ana River and its main Orange County tributary, Santiago Creek.  Additional water from the AWPF is used to recharge the basin as well as maintain a seawater instruction barrier.  Table 5 provides additional details on OCWD infrastructure.

**Table 5: Infrastructure Summary**

| | |
|---|---|
| **Number of Reservoirs Operated** | 1 |
| **Number of Recharge Basins** | 18 |
| **Number of Plants** | 2 |
| ***Groundwater Replenishment System*** | 1 |
| ***Green Acres Project*** | 1 |
| **Water Diversion System** | |
| ***Pumps*** | 19 |
| ***Inflatable Dams*** | 4 |
| **Seawater Barrier Injection Wells** | 36 |

## Sub-Divisions within Agency

For the purposes of this study, the service area of OCWD will not be divided into sub-regions.  Figure 3 depicts the infrastructure connections in the OCWD system.

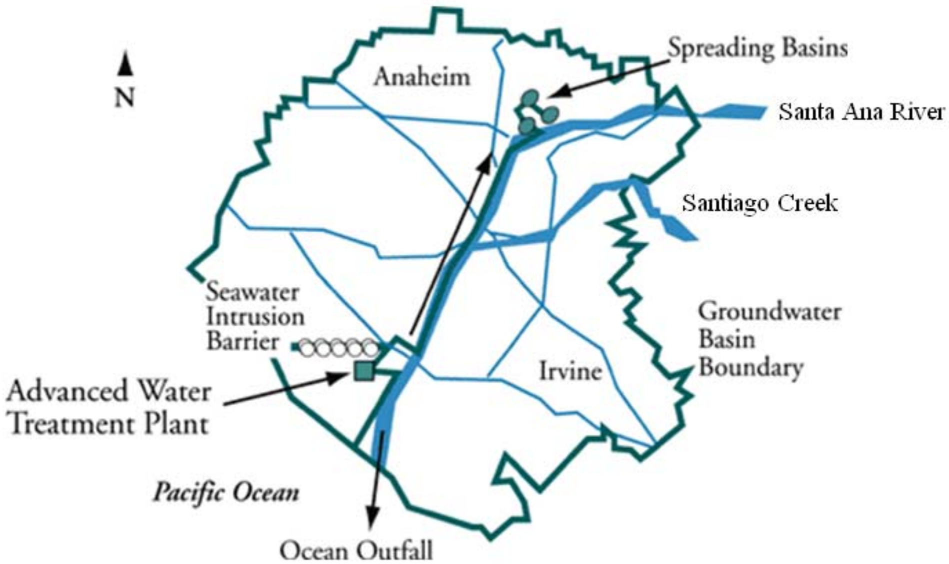



**Figure 3: OCWD Infrastructure Map**

### *Conveyance*

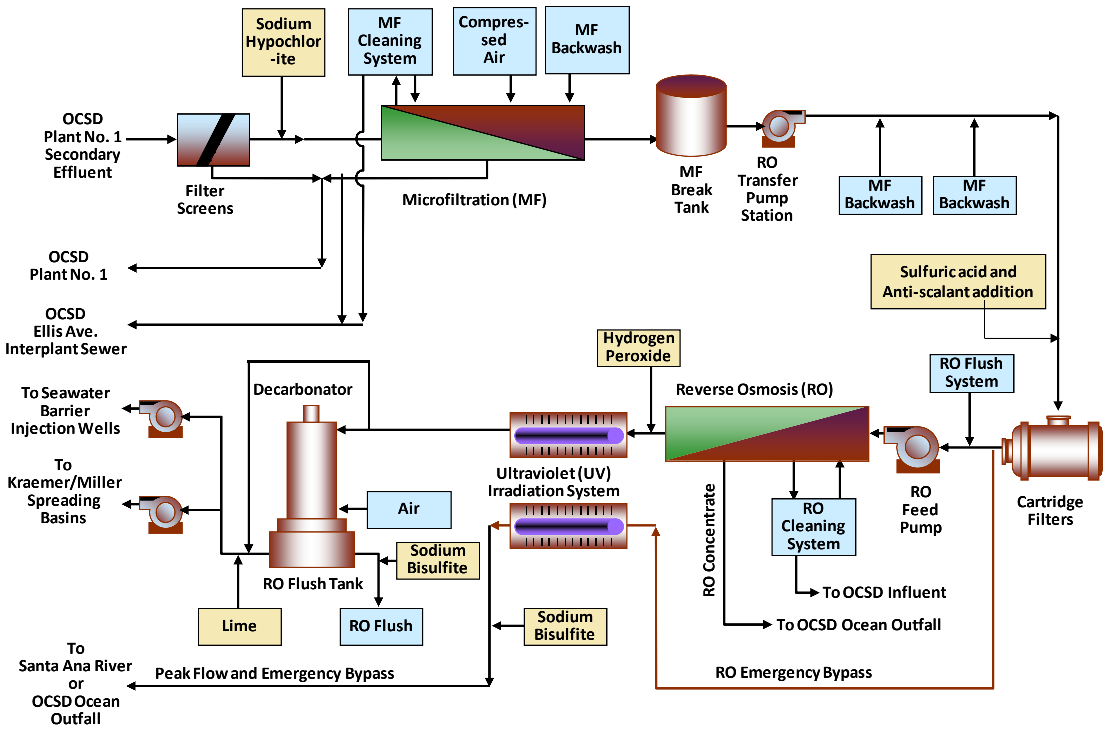
Surface water flows via gravity in the Santa Ana River and Santiago Creek to reach OCWD's service area. Water is diverted from the Santa Ana River within OCWD's service area using a system of gates and two large inflatable dams along the Santa Ana River. The diverted water is distributed to one of several groundwater recharge basins, some basins are at higher elevations requiring water to be pumped.

### *Recycled Water Plants*

OCWD operates two recycled water facilities; the Advanced Water Purification Facility (AWPF) and the Green Acre's Project (GAP) plant.

The AWPF was jointly constructed by OCWD and OCSD. It has the capacity to produce 70 MGD of highly treated recycled water. Secondary treated water from the adjacent OCSD wastewater treatment plant is the influent to the AWPF. This water undergoes a series of treatment processes including microfiltration, reverse osmosis, and ultraviolet light with hydrogen peroxide at the AWPF. Figure 4 illustrates the main processes of the plant. These treatment processes produce water that exceeds potable water standards in the State of California.

Construction on the AWPF was completed in late 2007 and it became operational in January 2008. It replaced Water Factory 21 that had been injecting recycled water blended with groundwater in the seawater intrusion barrier since 1976. Production at the AWPF started at a low level in January 2008 ramping up to full production by August 2008.




Note: Only main plant processes are illustrated, additional pumps and minor processes are excluded for clarity

## Figure 4: AWPF Process Diagram

The GAP plant provides small amounts of recycled water (up to 7.5 MGD) to local golf courses, lawns, and industries during the summer months. The GAP plant is co-located with the AWPF and also uses water from OCSD as its influent. The water is further processed using the following tertiary treatment steps of flocculation, sedimentation, filtration, and chlorination. This treatment plant will ultimately be replaced by the AWPF microfiltration process. Limited data was collected by the Study Team on this facility.

### *Recycled Water Distribution*

Water from the AWPF is used by OCWD to recharge groundwater basins and maintain a seawater intrusion barrier.

To recharge groundwater from surface water facilities, water must be pumped 13 miles uphill from the AWPF to percolation ponds. Water is pumped at the AWPF and enters pipelines that run adjacent to the Santa Ana River until it reaches recharge basins in Anaheim, see Figure 3. Only one set of pumps, located at the AWPF, is needed to transport the water in the pipeline to the recharge basins.

To maintain the seawater intrusion barrier, recycled water is pumped into the ground through 36 injection wells. The wells are located close to the AWPF and are supplied by pumps located at the plant, see Figure 3 and Figure 4.

## System Storage

OCWD estimates that approximately 500,000 AF of operating storage is available in the basin. Drawing the groundwater levels below this amount increases the risk of physical damage such as seawater intrusion or the potential for land subsidence. OCWD, in cooperation with the ACOE, is permitted to temporarily store up to 13,000 AF of storm flows behind Prado Dam, which has an overall capacity of 26,000 AF. The temporary storage agreement allows for a controlled release of that water at a rate compatible with the OCWD's groundwater recharge operations.

### System-wide Operation Strategy

OCWD operates its groundwater basin in order to "protect and increase the basin's sustainable yield in a cost effective manner." OCWD monitors the groundwater taken out each year to ensure that the basin is not overdrawn, refills the basin, and carries out an assessment program to pay for operating expenses and the cost of imported replenishment water.

The AWPF is one aspect of the OCWD's groundwater replenishment activities. Staff has indicated that the plant is currently running at 90 percent capacity and its daily water production level is relatively constant. OCSD Reclamation Plant #1, the source of water for the AWPF, has a fixed capacity to treat water to secondary levels. There is little seasonal change in its ability to supply recycled water for groundwater replenishment activities. This is a source that will generally be 100 percent utilized by OCWD.

The OCSD Reclamation Plant #1 operates at various levels throughout the day based on the diurnal pattern of influent waters. The GWR System's AWPF operates on a similar diurnal pattern. It is the goal of the GWR Systems' AWPF to run at a constant level. This will be possible only after the installation of flow equalization tanks.

### Infrastructure Changes

OCWD's completion of the AWPF in early 2008 directly affects the Study Team's data. Production at the AWPF started at a low level in January 2008 ramping up to full production by August 2008 and is evident in the data supplied to the Study Team. OCWD staff indicated that the plant did not reach full operating capacity until late 2008. The plant currently operates at near maximum capacity regardless of the time of year. However, referencing data from 2008, staff indicated that operations in November and December are most reflective of typical monthly operation.

## Energy Profiles

OCWD provided the Study Team with data only pertaining to the Advanced Water Purification Facility. OCWD staff indicated that this facility accounts for more than 90 percent of the agency's energy consumption. While OCWD monitors energy and water flow data for most other facilities including the river diversion system and the GAP plant, limited resources and time prevented transmittal of this data. Discussions between OCWD staff and the Study Team revealed data regarding the AWPF was the most important, accounted for the most energy use, and was the easiest to transfer given time and resource constraints.

Energy data was available from OCWD and SCE. OCWD provided monthly summary energy consumption data for major processes within the AWPF (ex: microfiltration and associated pumps, reverse osmosis and associated pumps, etc.). SCE provided 15-minute interval data for the AWPF facility as a whole. This includes the GAP facility, groundwater barrier pumps, recycled water transport pumps, and administrative facilities. Interval data at the process level is monitored by OCWD; however discussions revealed collecting and transferring the data to the Study Team would be too resource intensive for OCWD staff.

Flow data was provided by OCWD and came in the form of daily water flow through each process of the AWPF. It provided data on total plant influent, influent and effluent of microfiltration, influent and effluent of reverse osmosis, flow through UV systems, and flow to both the groundwater recharge and the seawater barrier operations.

The energy and flow data was processed by the Study Team to determine the monthly energy intensity by process type and the total plant hourly energy profile presented in this section.

The energy intensity of each process within OCWD's AWPF is presented in Figure 5. Additional processes included in this figure are the groundwater recharge and seawater barrier pumps. The total energy intensity for the AWPF includes: filter screening, microfiltration, reverse osmosis, UV treatment, decarbonatation, lime injection, and miscellaneous treatment processes (non-administrative). Of these, only microfiltration, reverse osmosis, and UV treatment are itemized separately in Figure 5 as they are of particular interest.

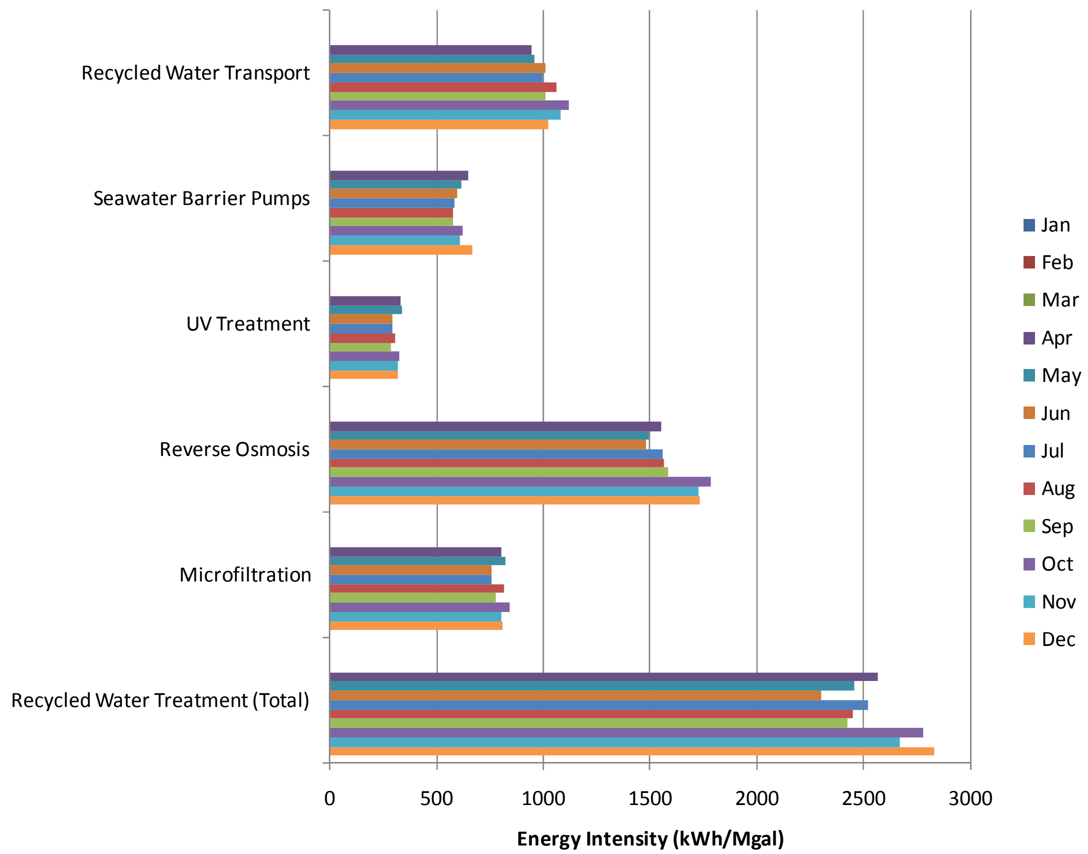



**Figure 5: OCWD AWPF Energy Intensity by Process**

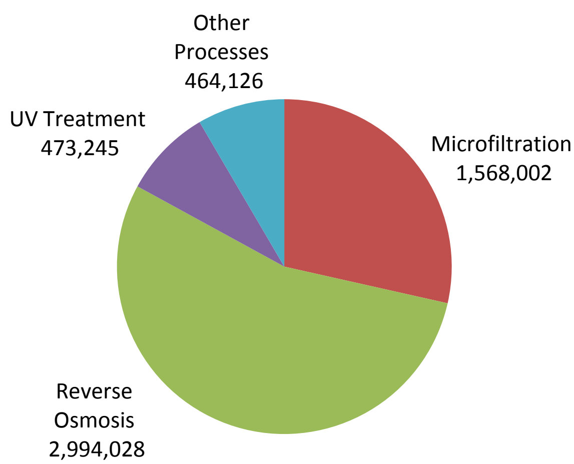
The energy intensity range of OCWD's MWDOC Imports is summarized in Table 6. The energy intensity represents the embedded energy for all activities prior to the water reaching OCWD's service territory boundary.

### Table 6: Energy Intensity Range for Marginal Supplies

| Import Source | Description | Energy Intensity Range |
|---|---|---|
| MWDOC | Imported treated water from MWDOC (ultimately from MWD)[a] | 7,418 kWh/MG |

a) Study Team estimate based on average energy intensity of MWD Imports (from Study 1), includes treatment energy use by MWD's Diemer WTP. Does not include any energy possibly used by MWDOC

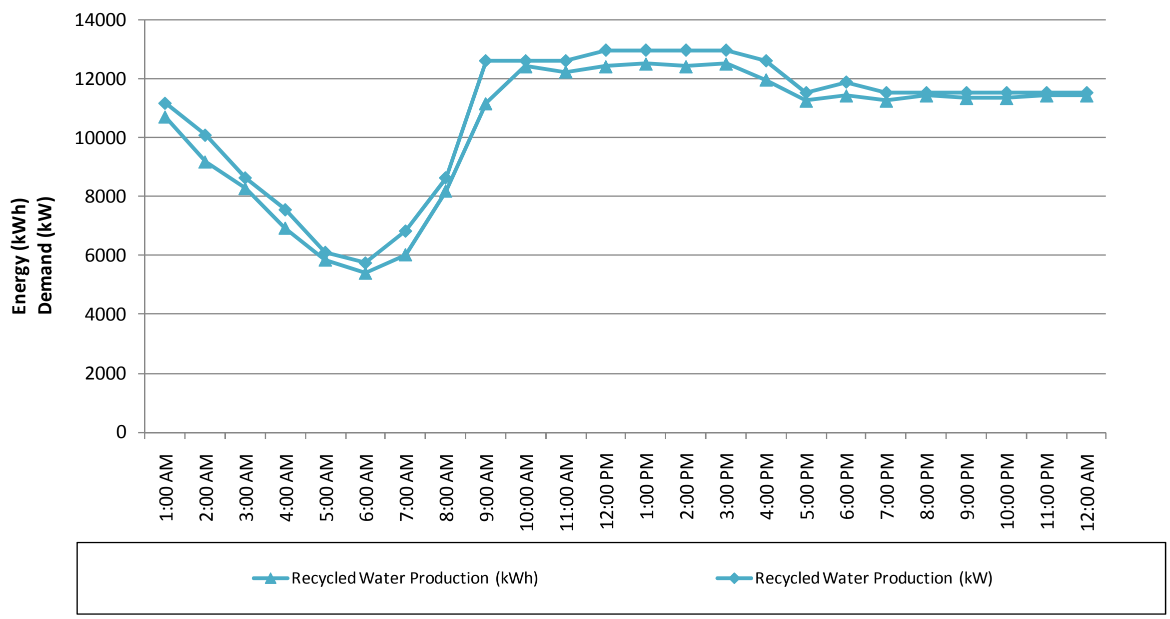
The majority of energy used by OCWD is for the AWPF. Within the AWPF the majority of energy is used for reverse osmosis. Figure 6 illustrates the distribution of energy use by facility type in a typical month.




### Figure 6: Energy Use by Function (kWh) - December 2008

Hourly energy profile and peak energy demand is documented in Figure 7. Only the Winter High Water Demand Day is shown. This is because AWPF did not reach full operating capacity until late winter; see the Infrastructure Changes section for more details. Staff indicated that typical operation today entails running the plant at its maximum capacity. Profiles can be developed for the summer months but they are not representative of typical operation.

The hourly energy profile represents all energy consumption by the OCWD premises. This includes the AWPF, the GAP plant, and administrative facilities. The Study Team was unable to reliably separate these components on an hourly basis. However, the majority of energy consumption is attributed to the AWPF, thus the overall profile of the energy use is indicative of operations at the AWPF.




| **Date** | 10/20/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Recycled Water Production* | 11,910 |

**Figure 7: 24-Hour Energy Profile: Winter High Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

OCWD is currently studying the expansion of capacity at the AWPF. OCSD's Plant #1 is expanding its capacity to treat water to secondary standards thus increasing the amount of potential influent to the AWPF.

## Sources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Shivaji Deshmukh, Groundwater Replenishment System Program Manager - OCWD. Personal communication. October 28th, 2009

Western Regional Climate Center. "Los Angeles Monthly Climate Summary" http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?calosa. Accessed December 2009

William T. Hunt, Executive Director, Operations – OCWD. Personal communication. June 2009 – November 2009.

# Rancho California Water District (RCWD)

## Summary

| | | | |
|---|---|---|---|
| **Primary functions** | Urban Water, Agricultural Water, Urban Wastewater | | |
| **Segments of Water Use Cycle** | Supply, Distribution, Wastewater Treatment, Recycled Water Production | | |
| **Hydrologic Region** | South Coast | **DEER Climate Zone** | 10 |
| **Quantity of water (or wastewater)** | Water Distributed: 69.5 MGD | Recycled: 3.25 MGD<br>Pumped: 22.7 MGD | |
| **Number of Customers (2008)** | Total: 41,986<br>Domestic: 36,069<br>AG-Domestic: 710<br>Agricultural: 970<br>Others: 4,237<br>Sewer: 17,407 | **Service Area Size** | 154.7 Sq miles |
| **Distinguishing Characteristics** | RCWD is a local, independent Special District, providing retail potable water and wastewater collection and treatment to its customers in Temecula, Murrieta, and unincorporated areas southwest of Riverside County. Topography is hilly with elevations ranging from 900 to 1,200 feet above sea level at the valley floor. RCWD pumps water to a maximum elevation of 2,850 feet for some pressure zones in its service area. In the surrounding foothills, the elevations range from 1,200 to 2,900 feet above sea level, with slopes often greater than 20%. | | |
| **Key Energy Drivers** | • Water Supply – significant energy is used by groundwater pumps to pump water from wells.<br>• Water Distribution – Water is pumped to five pressure zones with an elevation difference of up to nearly 2000 ft.<br>• Wastewater Treatment- Energy is used to treat wastewater to tertiary levels for reuse. | | |
| **Water/Wastewater Treatment Technologies** | Santa Rosa Water Reclamation Facility (Recycled Water): microfiltration, reverse osmosis, tertiary treatment<br>Temecula Valley Regional Water Reclamation Facility (operated by RCWD): microfiltration, reverse osmosis, tertiary treatment | | |
| **Water Resources** | 25-40% Groundwater, 60-70% Imported Water, <5% Recycled Water | | |
| **Marginal Water Supplies** | Short-term: Imported water<br>Long-term: increased recycled water projects (using microfiltration and reverse osmosis), increased groundwater recharge, increased imported water through existing turnouts | | |
| **Energy Service Provider** | SCE | | |
| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
| | Groundwater | 1,971 | 2,324 |
| | Water Distribution | 1,166 | 1,423 |
| | Recycled Water | 992 | 1,292 |

## Background Information

Table 1 summarizes information about Rancho California Water District (RCWD). RCWD is a local, independent "Special District," organized and operating pursuant to the California Water Code. RCWD serves a population of about 110,000 people in Temecula/Rancho California. About 109,123 people (39,186 service connections) received potable water from RCWD and received potable water from RCWD. Their wastewater system has about 17,407 service connections. RCWD has 52 production wells and pumps groundwater from the Temecula and Pauba groundwater basins. RCWD purchases treated imported water from MWD for distribution to its customers and untreated imported water from MWD for groundwater replenishment. RCWD treats wastewater at its Santa Rosa Reclamation Facility to tertiary standards for reuse. The Temecula Valley Regional Water Reclamation Facility (TVRWRF) is operated by Eastern Municipal Water District (EMWD) and treats wastewater to tertiary standards for reuse. RCWD uses recycled water to meet landscape irrigation demands. See Figure 1 for a map of the District.

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water, Agricultural Water, Urban Wastewater |
| **Hydrologic Region** | South Coast |
| **Region Type** | Southland |
| **Energy Service Provider** | SCE |
| **DEER Climate Zone** | 10 |
| **Service Area Size** | 154.7 Sq miles |
| **Service Area Population** | 109,123 |
| **Number of Customers in 2008** | 39,186 |
| ***Domestic*** | 36,069 |
| ***AG-Domestic*** | 710 |
| ***Agricultural*** | 970 |
| ***Other*** | 4,237 |
| **Distribution Topology** | Hilly |


**Figure 1: Rancho California Water District Service Area Map**

Primary sources of information on Rancho California Water District include RCWD's 2009 Financial Report, the 2007 Upper Santa Ana Integrated Regional Water Management Plan, RCWD's public website, and RCWD's 2005 Urban Water Management Plan. A detailed list of references is located at the end of this section.

## Climate

The climate within the RCWD service area is Mediterranean with hot, dry summers and cool, wet winters. Summer daytime temperatures are in the mid-80 to high-90 degree range. Winter daytime temperatures are mild, averaging in the mid-60 degree range. The region's average monthly maximum temperature is 80.63 degrees. The region receives about 10.75 inches of rain annually.

## Demographics

Table 2 shows population and housing trends for the RCWD service area.

**Table 2: Current and Projected Demographics for RCWD Service Area**

| Year | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| **Total Population** | **109,123** | **121,324** | **134,184** | **145,631** | **155,772** | **165,151** |
| **Housing** | | | | | | |
| **Single-Family** | 27,518 | 31,717 | 35,409 | 39,384 | 43,101 | 46,152 |
| **Multi-Family** | 6,336 | 7,084 | 8,223 | 8,951 | 9,652 | 10,923 |
| **Total Housing** | **33,856** | **38,802** | **43,633** | **48,336** | **52,754** | **57,075** |
| **Total Employment** | **33,836** | **43,848** | **52,947** | **62,273** | **71,656** | **81,277** |

## Water Sources

RCWD's current water supply sources include local groundwater, imported water from MWD, and recycled water. Historically, groundwater has supplied between 25 to 40 percent of the total water supply and imported water has supplied between 60 to 70 percent. Recycled water has provided less than 5 percent of the total water supply. Figure 2 summarizes RCWD's water supplies for Fiscal Year 2007/2008. (Fiscal year water supply data were used to illustrate the breakdown of supply because it is the most current data available.)

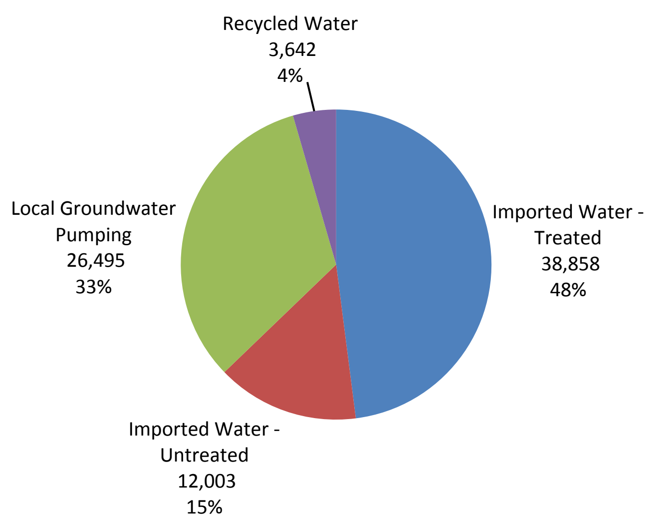



**Figure 2: FY2007/2008 Distribution of Sources (AF)**

### Groundwater

RCWD relies on eight groundwater basins for its local water supply. The amount of groundwater produced annually from these basins varies depending on rainfall, recharge, and the amount and location of pumping. According to RCWD's groundwater model, the average natural inflow for all eight basins is 41,000 AFY when no artificial recharge is occurring and the natural outflow is 6,600 AFY. Table 3 shows the location and number of existing groundwater wells within RCWD.

**Table 3: Existing Production Wells**

| Pressure Zone | Basin | No. of Production Wells |
|---|---|---|
| 1305 | Pauba Valley | 16 |
| | Lower Mesa | 3 |
| | North Murrieta | 3 |
| | San Gertrudis | 4 |
| | South Murrieta | 2 |
| | Wolf Valley | 3 |
| 1380 | Pauba Valley | 5 |
| | Lower Mesa | 3 |
| 1610 | Upper Mesa | 5 |
| | Lower Mesa | 1 |
| 1790 | Palomar | 1 |
| 1500 | North Murrieta | 2 |

Groundwater basin inflows occur through a variety of processes including the following:

- Areal recharge - deep percolation of direct precipitation on the ground surface that eventually recharges the aquifers within the basins
- Return flow - portion of water applied to the ground surface that reaches the groundwater as a result of deep percolation; sources of return flow include agricultural, domestic, and commercial irrigation
- Stream percolation - the stream loses water to the aquifer because of a higher hydraulic head in the stream than in the aquifer
- Underflow - flow from one basin to another
- Artificial recharge - spreading imported water at the Valle del los Caballos spreading basins

Natural basin outflows also occur in several ways:

- Evapotranspiration - direct evaporation from surface water and bare soil as well as the transpiration of water by plants such that the water is not available for groundwater recharge
- Gaining streams – the stream gains water because the hydraulic head in the stream is lower than the head in the aquifer
- Underflow - flow from one basin to another

### *Groundwater Recharge with Imported water and water from Vail Lake*

RCWD purchases imported water from the Metropolitan Water District of Southern California (MWD) and delivers it from the San Diego aqueduct turnout EM-19 to the Valles de los Caballos (VDC) recharge basins. In the past, the VDC recharge basins have provided up to 16,000 AFY of artificial groundwater recharge.

RCWD stores local runoff in Vail Lake. The storage capacity of the lake is approximately 40,000 AF with a surface area of 1,000 acres.

### *Water Quality*

RCWD continually monitors the water quality of its eight groundwater basins and 54 wells. Every year RCWD conducts over 2,000 tests for water quality on each of its wells and throughout the distribution system. Sampling at RCWD's wells between 2002 and 2004 has indicated that the primary MCL standard of 2 mg/L for Fluoride has ranged between 0.2 and 7.6. Fluoride occurs in the groundwater basins as a result of natural erosion. Well sampling ranges reflect the highest reading and lowest reading from all of RCWD's wells and do not reflect average readings for all the wells. After well water is extracted it is blended with other well water and imported MWD water. The distribution system average level of fluoride was 0.4 mg/L, well below the MCL. Well sampling has also indicated that the secondary MCL of 50 ug/L for manganese has ranged between non-detect and 250 ug/L. Secondary MCLs are set based upon aesthetics and odor and are not set based on health standards. Non-detect measurements occur when a sample has concentrations below the detectable range of measurement instruments. Manganese is present in the groundwater as a result of leaching from natural deposits. Sampling in the distribution system has indicated that blending reduces the manganese concentration to the non-detect level.

### Local Raw Surface Water

RCWD owns and operates 37 storage reservoirs and one surface reservoir, Vail Lake. The storage capacity of Vail Lake is 50,000 acre-feet and it is used to help recharge groundwater, using natural runoff.

### Recycled Water

Recycled water is produced from two facilities, the Santa Rosa Water Reclamation Facility (SRWRF) operated by RCWD, and the Temecula Valley Regional Water Reclamation Facility (TVRWRF) operated by EMWD. Both plants treat wastewater to Title 22 standards. Currently, RCWD is maximizing recycled water from these two plants to meet landscape irrigation demands (see Table 4). Additional recycled water from TVRWRF could be used if advanced treatment beyond Title 22 standards was applied. As a result, not all of the recycled water from TVWRF is beneficially used and must be discharged to Temescal Creek.

#### Table 4: Current Recycled Water Uses (AFY)

| User Type | Treatment Level | 2005 Consumption |
|---|---|---|
| Landscape | Title 22 | 11,400 |
| Agriculture | Title 22 | 194 |
| **Total** | | **6,691** |

### Imported Water

RCWD is a member agency to both EMWD and Western Municipal Water District of Riverside County (WMWD), which are member agencies to MWD. MWD is the regional water wholesaler for Southern California. Imported water, treated and untreated, is received through six MWD turnouts (three in each of EMWD's and WMWD's service areas).

### Marginal Water Supply

The Study Team identified both short-term and long-term marginal supplies for RCWD. Short-term marginal supply is increased imports from MWD. Long-term marginal supply includes groundwater, recycled water, and increased imports and water transfers.

Table 5 summarizes RCWD's planned water supplies through 2030.

### Table 5: Planned Water Supplies (AFY)

| Water Supply Sources | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Imported Water (MWD) | | | | | |
| Treated | 39,310 | 32,410 | 20,010 | 14,100 | 20,700 |
| Untreated | 15,500 | 28,500 | 38,500 | 38,500 | 38,500 |
| Local Groundwater Pumping | 38,000 | 38,000 | 56,000 | 56,000 | 56,000 |
| Recycled Water | 7,890 | 9,090 | 9,890 | 24,300 | 25,200 |
| Total | 100,700 | 108,000 | 124,400 | 132,900 | 140,400 |

#### *Groundwater*

Increased pumping and groundwater recharge is necessary to compensate for higher demands as growth in the area increases. Up to 18 new groundwater wells will be constructed. The Pauba Valley sub-basin will experience the gain in groundwater pumping, as this is the sub-basin that receives recharge from imported water (see Table 6).

### Table 6: Groundwater Pumping in RCWD Service Area (AFY), Current and Projected

| Sub-Basin Name | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Pauba | 22,216 | 27,766 | 27,766 | 45,766 | 45,766 | 45,766 |
| South Murrieta | 1,881 | 260 | 260 | 260 | 260 | 260 |
| Lower Mesa | 5,966 | 3,646 | 3,646 | 3,646 | 3,646 | 3,646 |
| North Murrieta | 1,289 | 404 | 404 | 404 | 404 | 404 |
| Wolf Valley | 2,536 | 1,566 | 1,566 | 1,566 | 1,566 | 1,566 |
| San Gertrudis | 4,480 | 4,056 | 4,056 | 4,056 | 4,056 | 4,056 |
| Upper Mesa | 13 | 76 | 76 | 76 | 76 | 76 |
| Palomar | 567 | 226 | 226 | 226 | 226 | 226 |
| **Total** | **38,948** | **38,000** | **38,000** | **56,000** | **56,000** | **56,000** |
| % of Total Water Supply | 51% | 38% | 35% | 45% | 42% | 40% |

#### *Imported Water*

To support the increase in groundwater pumping, a new untreated (raw) water connection is being built by MWD, called EM-21. Once constructed, it will increase the ability for RCWD to recharge the groundwater basin and maximize a vital local resource. MWD may also increase treated imported water capacity for use by RCWD and others by constructing a new imported water line from its Skinner Treatment Plant or a new treatment plant that is being explored.

#### *Recycled Water*

RCWD plans to construct a microfiltration/reverse osmosis (MF/RO) facility to treat recycled water so it can be used to meet western area agricultural demands currently using treated imported water. Because of the waste or brine produced by the advanced treatment, 15 percent of the water is lost. Therefore, the new recycled water supply is 13,600 AFY (see Table 7).

### Table 7: Projected Use of Recycled Water in RCWD Service area (AFY)

| User Type | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Landscape | 7,700 | 8,900 | 9,700 | 10,500 | 11,400 |
| Agriculture | 190 | 190 | 190 | 13,800 | 13,800 |
| **Total** | **7,890** | **9,090** | **9,890** | **24,300** | **25,200** |

The energy intensity range for RCWD's marginal supply is summarized in Table 8. The energy intensity represents the embedded energy for all activities prior to the water reaching RCWD's distribution system, reservoirs, or customers. The EI ranges for marginal supplies in Table 8 include all energy use prior to water entering RCWD's distribution system. RCWD's EI range, computed from Study 2 data, for distribution would add an additional 1,116-1,423 kWh/MG to these values.

### Table 8: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term and Long-term | Imported Raw Water from MWD[a] | 7,377 kWh/MG |
| | Imported Treated Water from MWD[a] | 7,499 kWh/MG |
| Long-term | Groundwater[b] | 1,971-2,324 kWh/MG |
| | Recycled Water (Microfiltration and Reverse Osmosis)[b] | 2,873 – 3,436 kWh/MG |

a) Imported water from MWD average blend of CRA and SWP water. Embedded EI ($EI_{SWP}+EI_{CRA}+EI_{MWD}+EI_{MWDtreatment}$) for raw and treated water from Study 1 results, not including EI from Study 2 for RCWD distribution.

b) Range of EI for microfiltration and reverse osmosis treatment estimated from Study 2 results for Orange County Water District (treatment plant energy intensity minus Ultraviolet Light treatment energy intensity)

## Water Demand

According to Rancho California Water District estimates, water demand is expected to increase 35 percent from 2010 to 2030 (see Table 9). The majority of the increase in demand occurs from the single-family domestic sector.

### Table 9: Average Consumptive Water Demands in RCWD Service Area (Historic and Projected)

| Year | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| **Agriculture/AG Domestic Demands** | 33,900 | 35,900 | 38,000 | 40,000 | 41,000 | 44,000 | 46,000 |
| **Single-Family Domestic** | 21,700 | 25,500 | 29,300 | 33,000 | 36,800 | 40,600 | 44,300 |
| **Multi-Family Domestic** | 1,400 | 1,900 | 2,300 | 2,800 | 3,200 | 3,700 | 4,200 |
| **Commercial/ Institutional** | 3,500 | 4,100 | 4,800 | 5,400 | 6,100 | 6,700 | 7,400 |
| **Landscape/ Golf Course** | 8,300 | 8,700 | 9,100 | 9,500 | 9,900 | 10,300 | 10,800 |
| **Total** | **68,800** | **76,100** | **83,500** | **90,700** | **97,000** | **105,300** | **112,700** |

## System Infrastructure and Operations

Table 10 summarizes the key pieces of RCWD's physical infrastructure.

**Table 10: Infrastructure Summary**

| | |
|---|---|
| **Number of Groundwater Wells** | 44 |
| **Number of Reservoirs Operated** | 38 |
| **Storage Reservoirs** | 37 |
| **Surface Reservoirs** | 1 |
| **Miles of Distribution Piping** | 900 |
| **Number of Plants** | 1 |
| ***Wastewater*** | 1 |
| **System-wide Storage Capacity** | 50,424 AF |

### *Wastewater and Recycled Water Treatment Plants*
RCWD and EMWD both collect wastewater within their systems and treat it at two water reclamation facilities: the Santa Rosa Water Reclamation facility (SRWRF), operated by RCWD; and the Temecula Valley Regional Water Reclamation Facility (TVRWRF), operated by EMWD. Both treatment plants treat wastewater to Title 22 standards. Both treatment plants currently provide tertiary wastewater treatment.

SRWRF has a current capacity of 5 mgd or approximately 5,598 AFY. The plant collects flow from areas within portions of RCWD's service area, Murrieta County Water District (MCWD), and a portion of Elsinore Valley Municipal Water District (EVMWD). The MCWD area is expected to have the greatest population grown leading to an increase in flows from 851 AFY in 2005 to 3,663 AFY in 2030, or 0.76 mgd to 3.3 mgd. The portion of EVMWD's service area served by this facility is expected to have the least growth increasing from 1,535 AFY in 2005 to 1,647 AFY in 2030 or 1.4 mgd to 1.5 mgd.

### *Distribution*
The elevation of the valley floor ranges from 900 to 1,200 feet above sea level; however, RCWD pumps water to a maximum elevation of 2,850 feet for some pressure zones in its service area. In the surrounding foothills, the elevations range from 1,200 to 2,900 feet above sea level, with slopes often greater than 20 percent.

### System Storage
RCWD owns and operates 37 storage reservoirs and one surface reservoir, Vail Lake. The storage capacity of Vail Lake is 50,000 AF and it is used to help recharge groundwater using natural runoff. The available storage is widely varied at Vail Lake, but averages out to be 30,900 AF. State permits prohibit storage and require inflow to pass through Vail Lake to Temecula Creek from May through October.

## System-wide Operation Strategy
RCWD purchases treated imported water from MWD at a rate of about $500/AF and untreated water from MWD at a rate of roughly $200/AF and takes delivery through 6 turnouts (three in each of EMWD's and Western Municipal Water District's (WMWD) service areas).

RCWD's delivery mix is about 36 percent agricultural, 40 percent domestic, and 24 percent other. RCWD provides about 30 percent of its demand with groundwater. Untreated recharge water is purchased from MWD, which accounts for about 1/3 of the groundwater delivered. Groundwater is recharged through RCWD's Vail Lake reservoir and other spreading grounds. Purchased treated water is used to meet the majority of demand, but with shortages in supply and increasing rates, RCWD is investigating other supply sources and considering drastic conservation measures. Recycled water is currently used to meet the remaining demand for irrigation and agricultural uses.

### Infrastructure Changes

During fiscal year 2007-2008, RCWD completed the construction of a 3.5 million gallon Tucalota water storage reservoir.

During fiscal year 2007-2008, RCWD continued with completing the design of the Vail Lake Pump Station and Transmission Main Project, which will provide an opportunity to transfer untreated imported water from MWD for long-term storage in Vail Lake.

During fiscal year 2007-2008, RCWD started construction of the Vail Dam Repair Project, which consist of replacing the outlet gates, valves, and piping of Vail Dam which was constructed in 1948.

## Energy Profiles

RCWD provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy data provided included monthly billing summaries for calendar year 2008, energy data as metered from SCE for all facilities, and monthly natural gas use. Water flow was provided on a monthly time-step in units of acre-feet. Flow was provided per well both potable and non-potable production wells. Monthly flows were also provided per booster pump for both the potable booster pumping stations and the non-potable booster pumping station. Total monthly flows to the Santa Rosa Water Reclamation Facility were also provided. Because the data were provided on a one-to-one basis (one facility-one energy record), the groundwater and reclaimed water data were processed per facility. An annual total purchased treated water quantity was obtained from the 2007/2008 Comprehensive Annual Financial Report.

Figure 3 illustrates the range of observed energy intensities in RCWD's facilities. Groundwater pumps are the most energy intensive facility type.

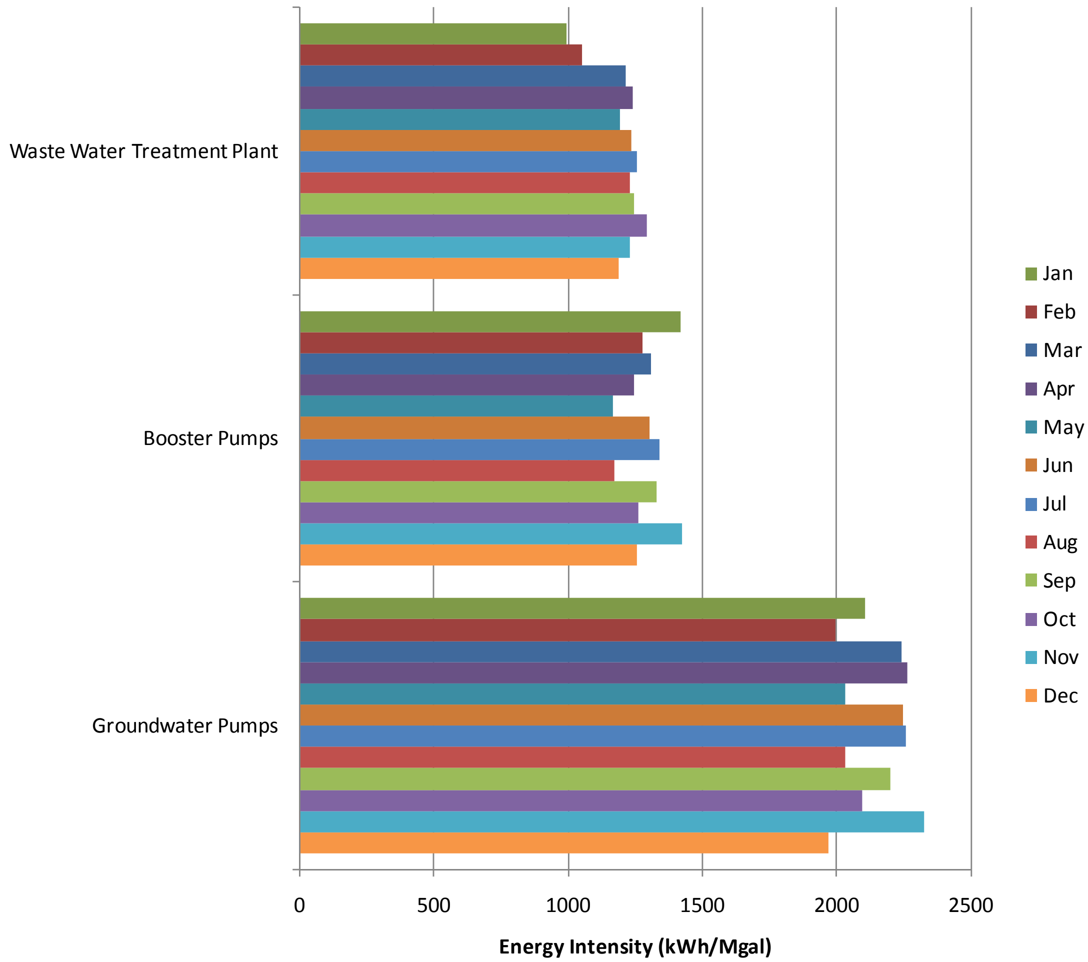
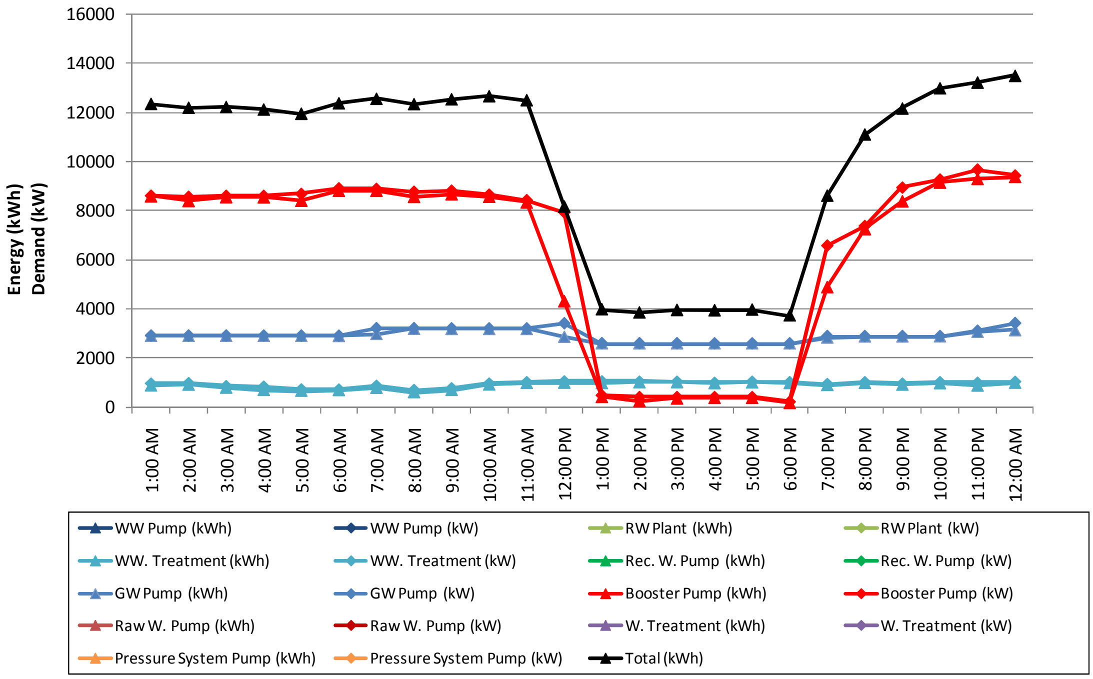


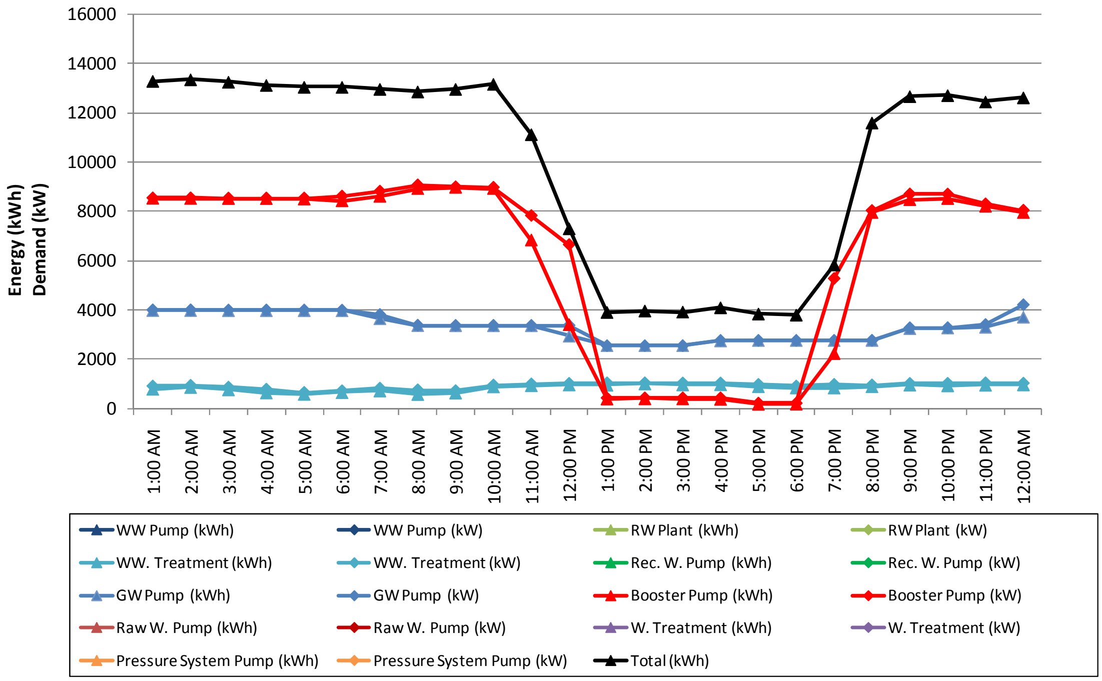

**Figure 3: RCWD Monthly Energy Intensity by Facility Type**

Hourly energy profiles and peak energy demand is documented in Figures 4 through 10. The largest energy consuming facilities are booster pumps.



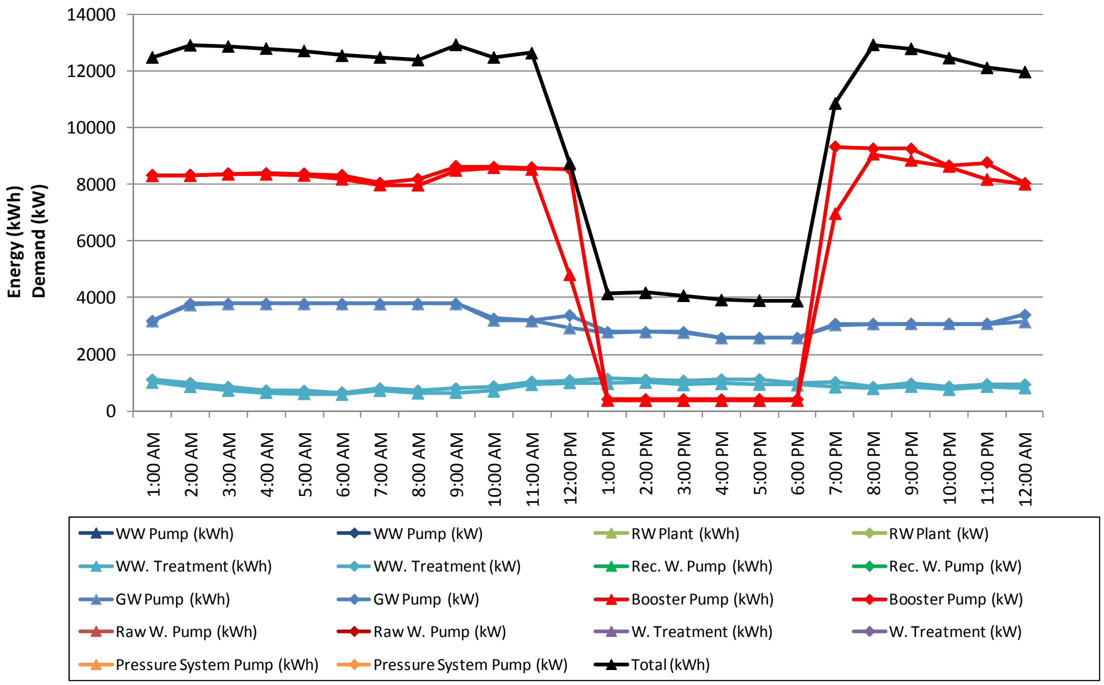

| **Date** | 6/20/2008 |
|---|---|
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,578 |
| *Booster Pumps* | 374 |
| *Wastewater Treatment* | 993 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



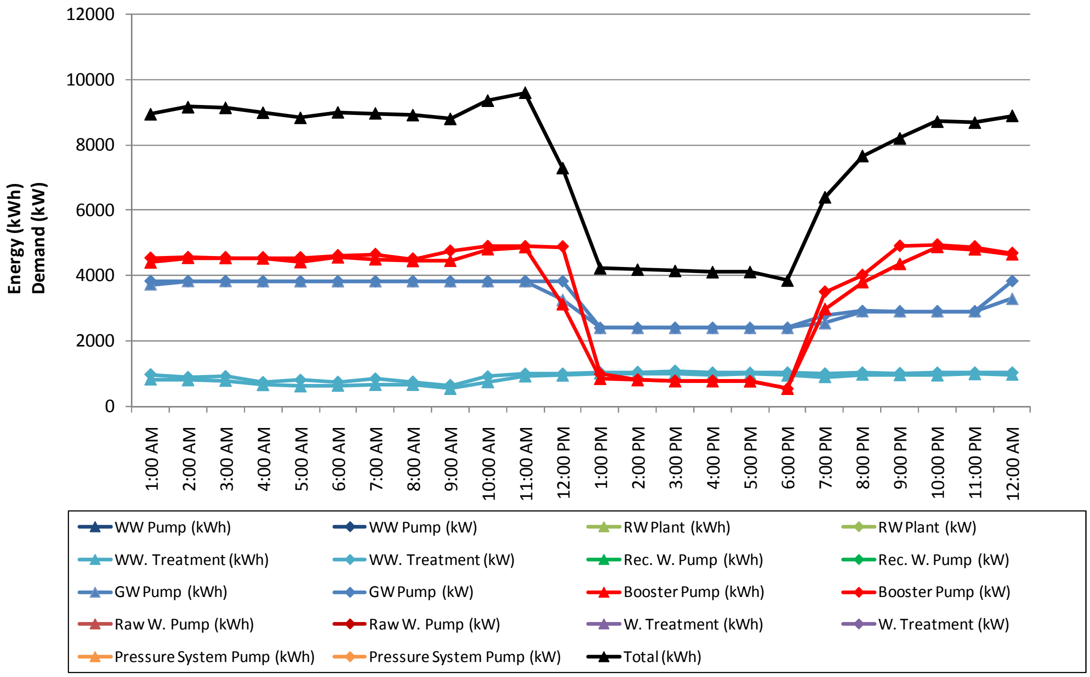

| **Date** | 8/1/2008 |
|---|---|
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,686 |
| *Booster Pumps* | 320 |
| *Wastewater Treatment* | 944 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



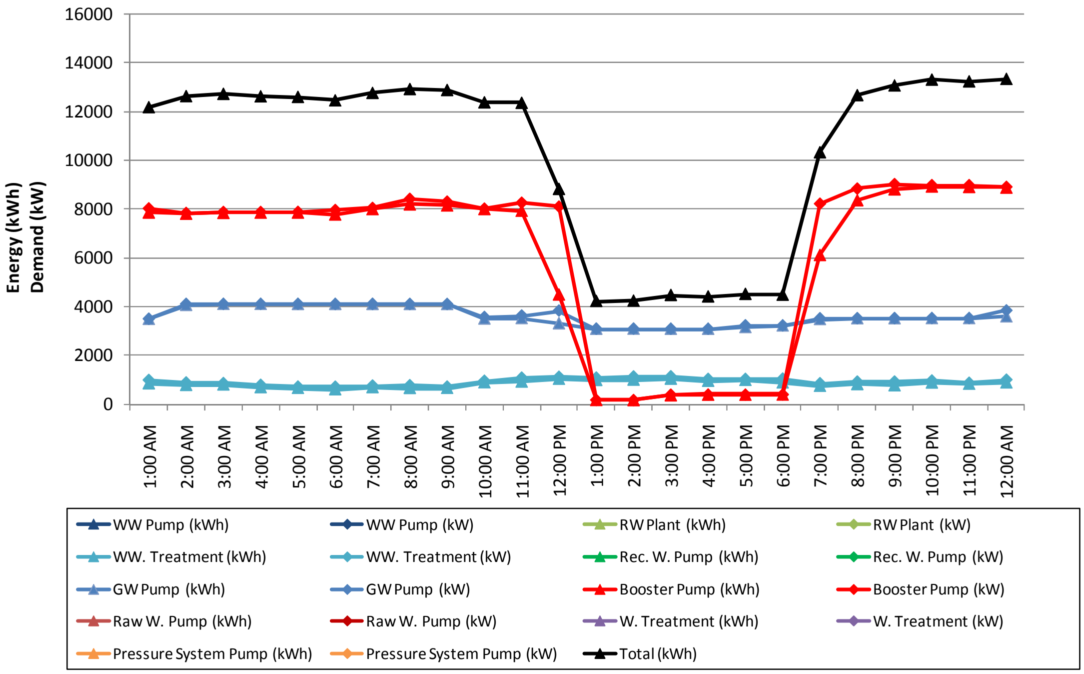

| **Date** | 9/30/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,639 |
| *Booster Pumps* | 381 |
| *Wastewater Treatment* | 944 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



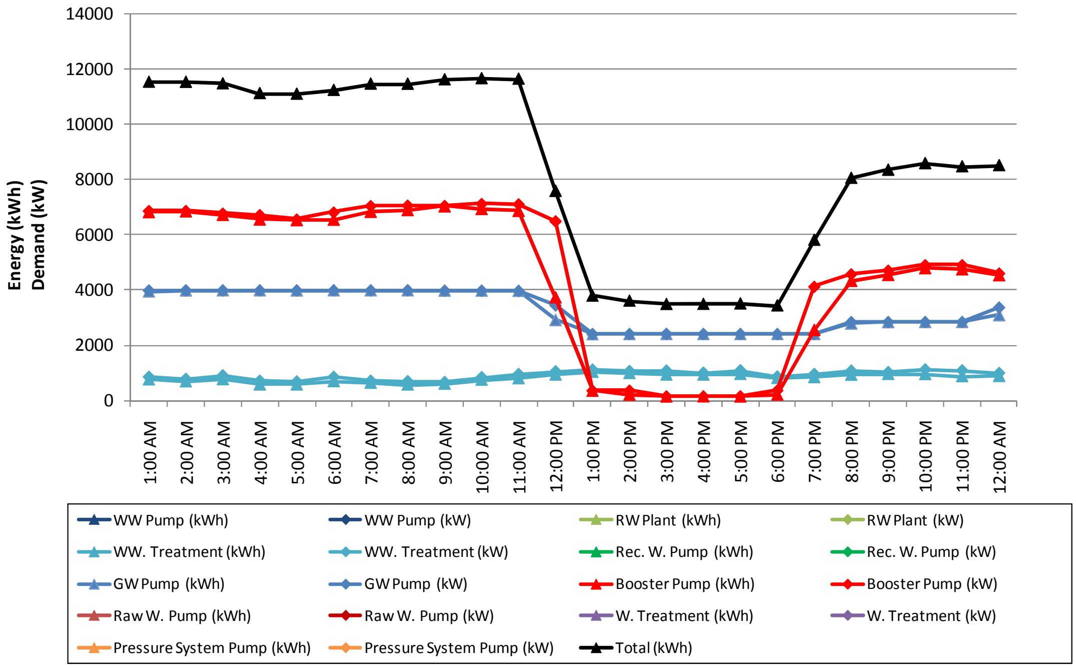

| | |
|---|---|
| **Date** | 6/1/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,393 |
| *Booster Pumps* | 753 |
| *Wastewater Treatment* | 978 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



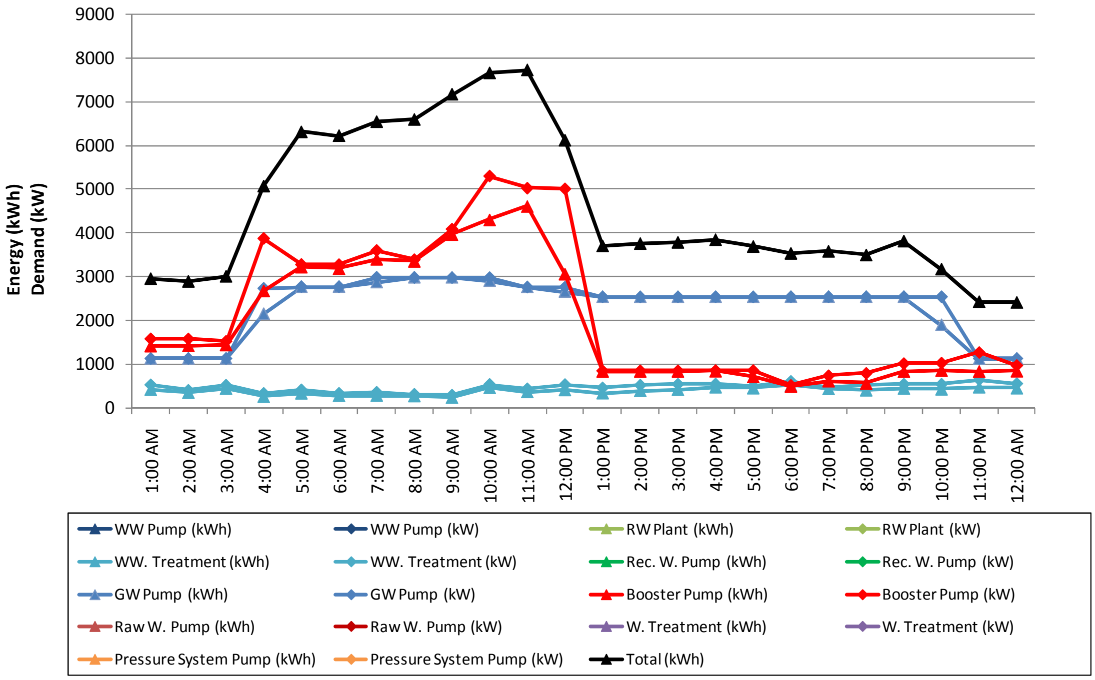

| **Date** | 10/1/2008 |
|---|---|
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 3,099 |
| *Booster Pumps* | 373 |
| *Wastewater Treatment* | 984 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 11/1/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,413 |
| *Booster Pumps* | 145 |
| *Wastewater Treatment* | 933 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| **Date** | 1/1/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,526 |
| *Booster Pumps* | 798 |
| *Wastewater Treatment* | 449 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

During fiscal year 2007-2008, RCWD entered into a Power Purchase Agreement with SunPower Corporation for a 1.0 MW photovoltaic solar power facility. The solar power facility will supply approximately 30 percent of the total power load for the SRWRF while reducing carbon emissions by 2.5 million pounds annually and providing a cumulative energy savings of $6.8 million dollars over 20 years.

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Rancho California Water District. “2005 Update of the Urban Water Management Plan,” December 2005.

Rancho California Water District. “Addendum to 2005 Update of the Urban Water Management Plan,” March 2007.

# San Gabriel Valley Water Company (SGVWC)

## Summary

| | | | |
|---|---|---|---|
| **Primary functions** | Urban Water, Recycled Water Production | | |
| **Segments of Water Use Cycle** | Supply, Treatment | | |
| **Hydrologic Region** | Southland | **DEER Climate Zone** | 9 |
| **Quantity of Water** | Distributed: 46,146.4 acre-ft (groundwater distributed) | | |
| **Number of Customers** | Fontana: 42,000 connections<br>Los Angeles: 48,000 connections | **Service Area Size** | N/A |
| **Distinguishing Characteristics** | The San Gabriel Valley Water Company (SGVWC) produces, distributes, and sells water an urban area east of Los Angeles. It consists of two divisions: the Fontana and Los Angeles Divisions. The Los Angeles Division has 3 systems and 16 pressure zones. Pumping plan elevations range from 101 to 1,215 feet. | | |
| **Key Energy Driver(s)** | • Groundwater Pumping: significant energy is used for groundwater pumping<br>• Distribution: energy is used for booster pumps and raw water pumps | | |
| **Water/Wastewater Treatment Technologies** | Sandhill Surface Water Treatment Plant (Water):<br>The Fontana Division has a LEED certified energy efficient surface water treatment plant; began operation in December of 2008. | | |
| **Water Resources** | SGVWC's water resources include groundwater, surface water, and purchased water. | | |
| **Marginal Water Supplies** | Short Term: increase groundwater pumping, purchase water<br>Long-Term: increase storage, increase imported water | | |
| **Energy Service Provider** | SCE | | |
| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
| | Groundwater | 1,989 | 3,014 |
| | Booster Pumps | 37 | 141 |
| | Raw Water Pumps | 5 | 104 |

## Background Information

The San Gabriel Valley Water Company (SGVWC) produces, distributes, and sells water through two division, the Fontana and the Los Angeles districts. The Fontana District serves approximately 42,000-metered services in the Cities of Fontana, Rancho Cucamonga, and Rialto and vicinity, San Bernardino County. The Los Angeles District serves approximately 48,000-metered services in the Cities of Arcadia, Baldwin Park, El Monte, City of Industry, Irwindale, La Puente, Montebello, Monterey Park, Pico Rivera, Rosemead, San Gabriel, Santa Fe Springs, South El Monte, West Covina, Whittier, and vicinity, Los Angeles County. Most of their supply comes from groundwater pumped from the Main San Gabriel Basin and the Central Basin.

Primary sources of information on San Gabriel Valley Water Company include: Schematics, interviews with staff at SGVWC, and the Fontana Water Company's 2005 Urban Water Management Plan, and the California Public Utilities Commission website. A detailed list of references is located at the end of this section. An Urban Water Management Plan for SGVWC's Los Angeles Division was not available at the time of this study. Generally, very limited information was available on SGCWC; as a result, this profile is sparse.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water |
| **Hydrologic Region** | South Coast |
| **Region Type** | Southland |
| **Energy Service Provider** | SCE |
| **DEER Climate Zone** | 9 |
| **Number of Customers in 2006** | Fontana: 42,000 metered connections<br>Los Angeles: 48,000 metered connections |
| ***Residential*** | Fontana: 81.6%<br>Los Angeles: Not available |
| ***Commercial/Industrial*** | Fontana: 7.8%<br>Los Angeles: Not available |
| ***Public Authority/Other*** | Fontana: 10.6%<br>Los Angeles: Not available |
| **Distribution Topology** | Moderate |

### Climate

SGVWC's service area generally has hot, dry summers and mild winters with moderate amounts of rainfall.

### Demographics

Population growth trends were not available.

## Water Sources

SGVWC gets the majority of its water from groundwater sources. SGVWC distributes about 2,500 acre-ft of recycled water annually, not show in Figure 1. The data shown in Figure 1 is a representation of the Fontana District data from the 2005 UWMP only; data for the Los Angeles District was not available.

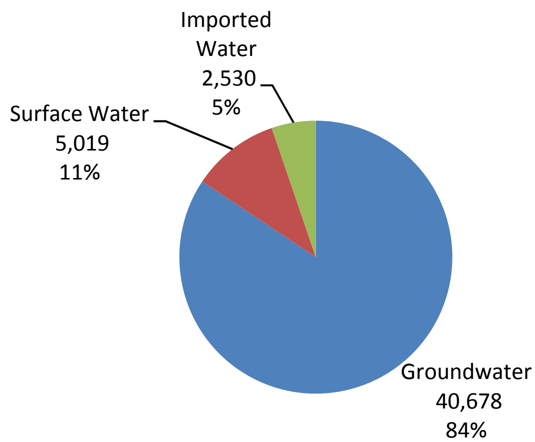



**Figure 1: 2008 Distribution of Sources for the Fontana District (AF)**

## Groundwater

SGVWC pumps groundwater from adjudicated groundwater basins. They have about 20,000 AF in water rights, but withdraw about twice that amount on an annual basis. Over-pumping of groundwater is made up for through water replenishment. SGVWC pays a fee to replenish water. Water Replenishment is pooled and billed through the Water Master.

Wells are typically 250 ft to groundwater though have dropped about 50 ft over the past couple of years due to drought conditions.

The Fontana Division produces water from wells in the Chino Basin, Lytle Basin, Rialto Basin, an Unnamed Basin, and from surface water flow diverted from Lytle Creek. The Company also purchases untreated State Water Project water from San Bernardino Valley Municipal Water District. The Fontana Division also has emergency interconnections with Cucamonga Valley Water District's (CVWD) water distribution system to purchase water, when available, but only for limited emergency purposes.

The Fontana Division has 33 active wells.

## Groundwater Replenishment

The amount of groundwater that needs to be replenished varies from year to year. SGVWC purchases replenishment water from MWD. Replenishment in the San Gabriel and Chino basins is based on a percentage of the water pumped. In general, replenishment requirements are about 50 percent of production.

## Local Raw Surface Water

The Fontana District treats local surface water to supply its customers. Limited information was available as the source and treatment requirements for this water. The treatment facility was recently constructed and became operational in late 2008.

## Recycled Water

Recycled water facilities owned by Upper San Gabriel and operated by SGVWC produces about 2,500 acre-ft annually. SGVWC has recycled water customers in both the Main San Gabriel Basin and the Central Basin in its Los Angeles County division. Recycled water is made available by San Gabriel for landscape irrigation and other non-potable purposes. Fontana Water Company will provide similar service when infrastructure is constructed and recycled water becomes available, via the Central Basin MWD's 30-inch-pipe.

### Imported Water

Most of the imported water requirements for SGVWC are through MWD for groundwater replenishment.

### Marginal Water Supply

SGVWC identified both short and long term marginal supply sources. In the short term, additional demand can be met by additional groundwater pumping and imported raw surface water from MWD. It should be noted that overpumping of groundwater rights results in increased need for groundwater replenishment, which is supplied by raw imported water from MWD. In the long term, SGVWC has the ability to increase imported water and plans to add storage in the future.

The energy intensity range of SGVWC's marginal supply is summarized in Table 2. The energy intensity represents the embedded energy for all activities prior to the water reaching SGVWC's customers.

**Table 2: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short Term/Long Term | Groundwater[a] | 1,989-3,014 kWh/MG |
| | Imports from MWD[b] | 6,198 – 6,777 kWh/MG |
| Long Term | Imports from MWD[c] | 6,228 – 6,807 kWh/MG |

a) EI range from Study 2 results for SGVWC.

b) EI for average blend of SWP and CRA water for MWD from Study 1 plus allowance for treatment based on Study 2 observed range.

c) Imports from MWD and treatment plus estimated storage energy from Study 1..

## Water Demand

Based on the 2005 Fontana UWMP projections, water demand will increase approximately 29 percent between 2010 and 2025. Population projections were not available.

**Table 3: Projected Peak Water Demands (MGD) Fontana (LA District not available)**

| | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| Average Day Demand | 43.4 | 48.2 | 52.7 | 57.8 | 62.5 |
| Peak Season Demand[a] | 56.4 | 62.7 | 68.5 | 75.1 | 81.2 |
| Peak Day Demand[b] | 73.8 | 82.0 | 89.5 | 98.2 | 106.2 |
| Peak Hour Demand[c] | 108.5 | 120.5 | 131.7 | 144.4 | 156.2 |

a) Peak season demand = 1.3 x average day demand

b) Peak day demand = 1.7 x average day demand

c) Peak hour demand = 2.5 x average day demand

### Table 4: Historic and Projected Water Demand (AF/Yr)

| Customer Type | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| Fontana Water Company[a] | 48,646 | 54,027 | 59,071 | 64,787 | 70,055 |
| Los Angeles | Not available | | | | |

a) Projected peak water demand

## System Infrastructure and Operations

Table 5 below summarizes the infrastructure operated by SGVWC. SGVWC operates and maintains a complex system of groundwater pumps, water transmission, treatment, and storage facilities to supply potable water to its customers.

### Table 5: Infrastructure Summary

| | |
|---|---|
| **Number of Groundwater Wells** | 36 - Fontana; 37 - Los Angeles |
| **Number of Water Storage Tanks** | 16 - Fontana; 38 - Los Angeles |
| **Number of Plants** | |
| ***Treatment*** | 1 |
| **System Wide Storage Capacity** | 39.64 MG - Fontana<br>42.07 MG - Los Angeles |

### Sub-Regions within Agency

There are two different large systems; Los Angeles County and Fontana in San Bernadino area. San Gabriel Valley Water Company primarily uses groundwater, but has recently built a surface water treatment plant in Fontana to treat raw imported water. The Fontana system utilizes groundwater from 4 basins and the LA system primarily uses water from the San Gabriel basin. They also utilize some SWP water.

### *Sub-Region 1: Los Angeles*

#### *Supply Conveyance*

Groundwater is pumped from the 37 wells in the Los Angeles District and pumped to short term storage tanks prior to distribution. No treatment is required in the Los Angeles District.

#### *Distribution*

Booster pumps and pressure controlling facilities distribute the pumped groundwater to elevations throughout the Los Angeles District ranging from El. 101 ft to El. 750 ft.

The B6, B5, and 8 plants pump constantly, 24 hours a day, 7 days a week, at about 16,000 gpm to provide a hydraulic barrier to prevent contamination. These facilities are located on top of a Superfund site and SGVWC is working with the EPA on the cleanup.

### Sub-Region 2: Fontana District

#### *Conveyance*

Groundwater is pumped from the 36 wells in the Fontana District and pumped to short term storage tanks prior to distribution. Raw imported water is treated at the new water treatment facility and blended in the distribution system.

#### *Treatment Plants*

Surface water is treated at SGVWC's recently constructed treatment plant; part of a LEED certified building.

#### *Distribution*

Booster pumps and pressure controlling facilities distribute the pumped groundwater and treated surface water to elevations throughout the Fontana District ranging from about 1,079 ft to 2,460.5 ft.

### System Storage

SGVWC does not currently own or operate any surface storage facilities. SGVWC has 52 relatively small storage tanks with a combined capacity of about 81.7 MG.

### System-wide Operation Strategy

SGVWC's system is operated to meet demand. SGVWC pumps groundwater from adjudicated groundwater basins. They have about 20,000 acre-ft in water rights, but pump about twice that to meet demand. Overpumping of groundwater is made up through water replenishment. SGVWC pays a fee for water replenishment, which is pooled and billed through the Water Master. The groundwater pumps come on through a hierarchy of efficiency and are operated to meet demand. SGVWC typically pumps at night during off-peak hours, unless there is an unforeseen need, such as fires.

### Infrastructure Changes

The surface water treatment plant in Fontana began operation in December of 2008. Energy use and water flow data for this facility was not available due to the recent completion of the facility. The completion of the treatment plant will shift the supply from groundwater pumping to the surface water plant.

## Energy Profiles

SGVWC provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy data provided included: hard copies of monthly energy data for raw water pumps, booster pumps, and groundwater pumps. Water flow data was provided on a monthly time-step per well or well group in units of hundreds of cubic feet (CCF). Energy is provided to SGVWC by SCE.

The energy intensity of each facility type within SGVWC is presented in Figure 2.

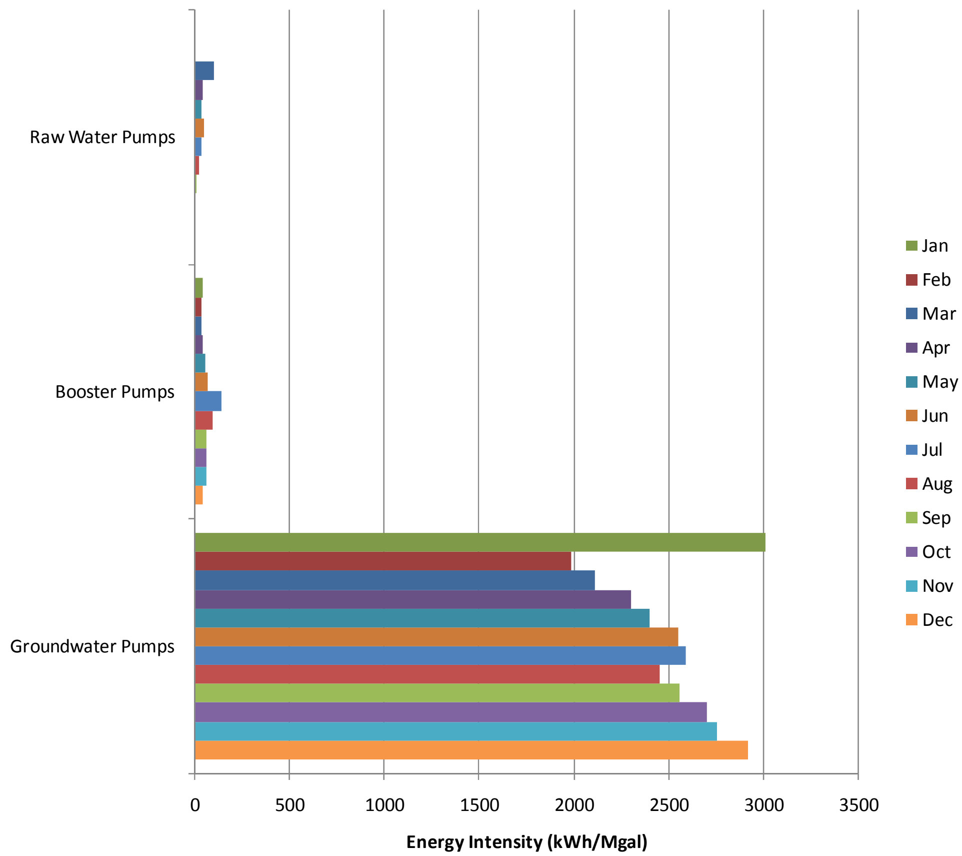
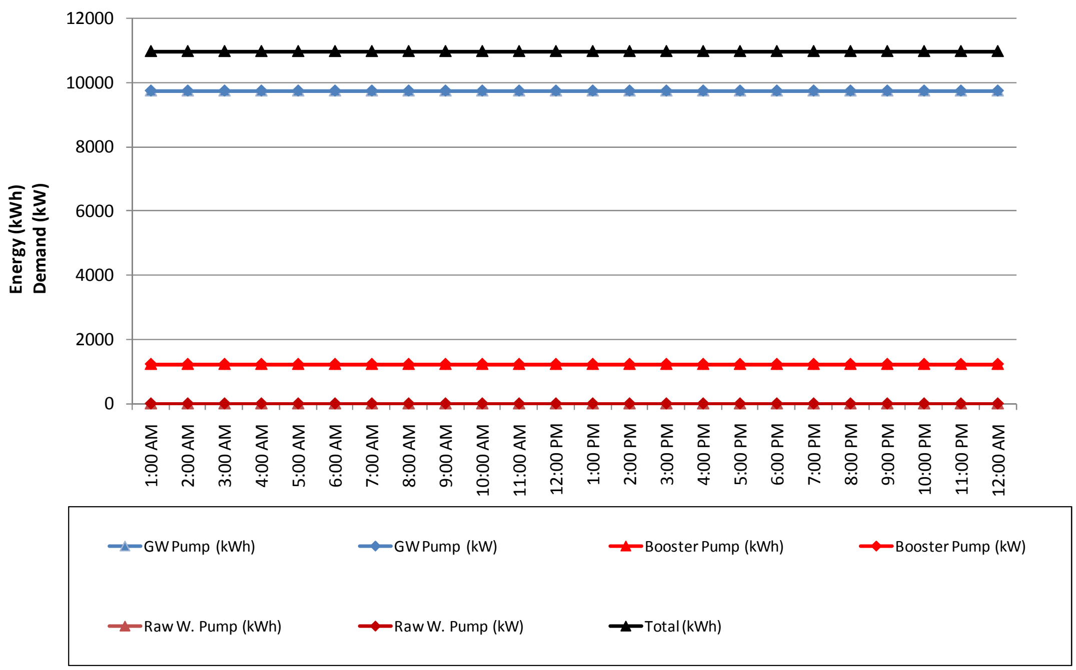


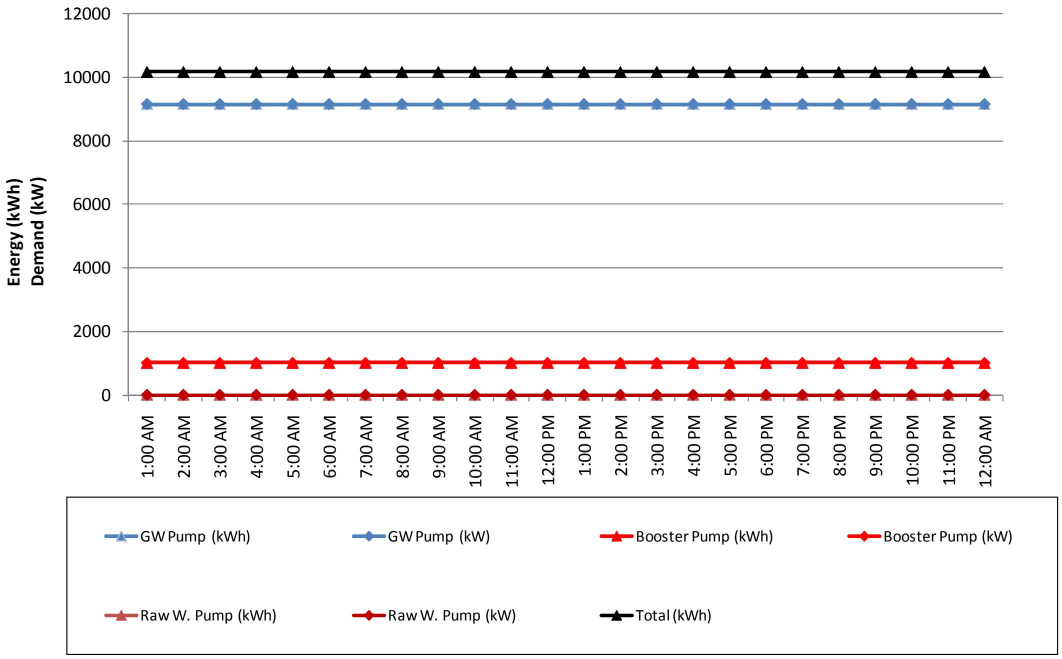

**Figure 2: SGVWC Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 3 through 9. The majority of energy used by SGVWC is for groundwater pumping.



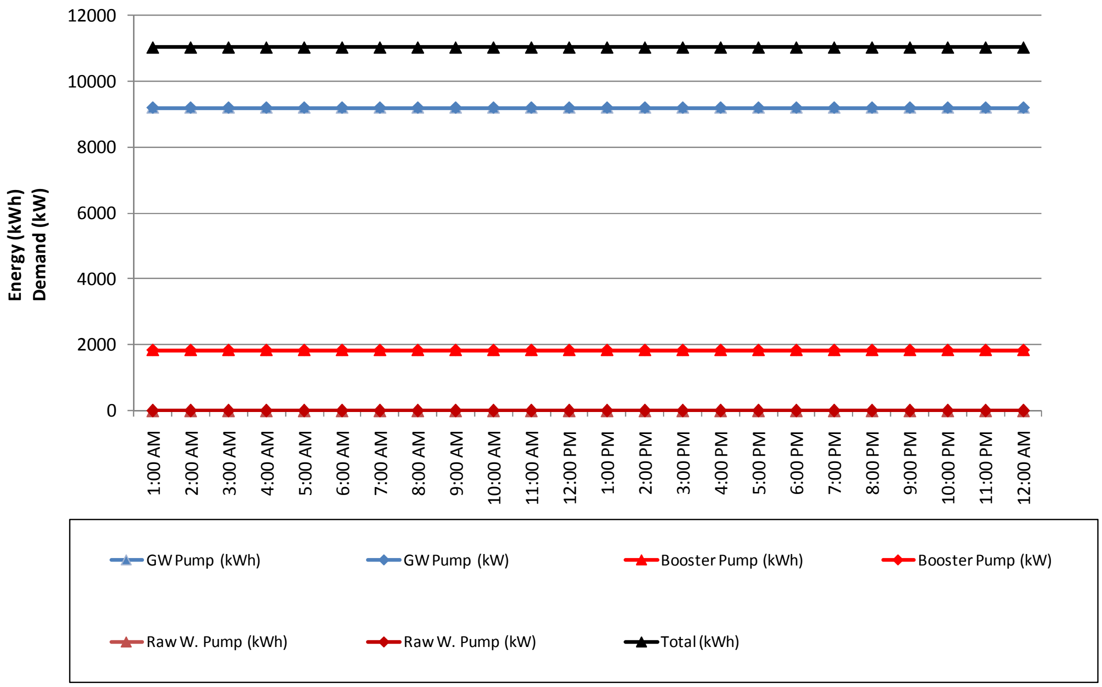

| | |
|---|---|
| **Date** | 6/20/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 9,750 |
| *Booster Pumps* | 1,223 |
| *Raw Water Pump* | 3 |

**Figure 3: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



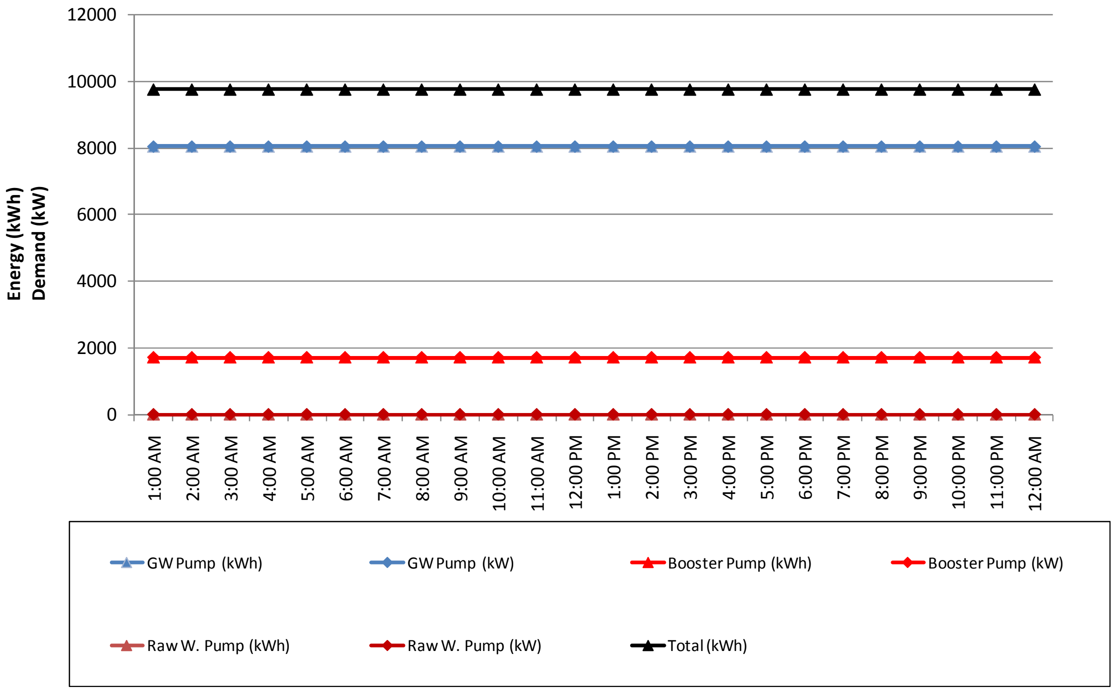

| | |
|---|---|
| **Date** | 6/1/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 9,148 |
| *Booster Pumps* | 1,019 |
| *Raw Water Pump* | 2 |

**Figure 4: 24-Hour Energy Profile: Summer High Water Demand Day**



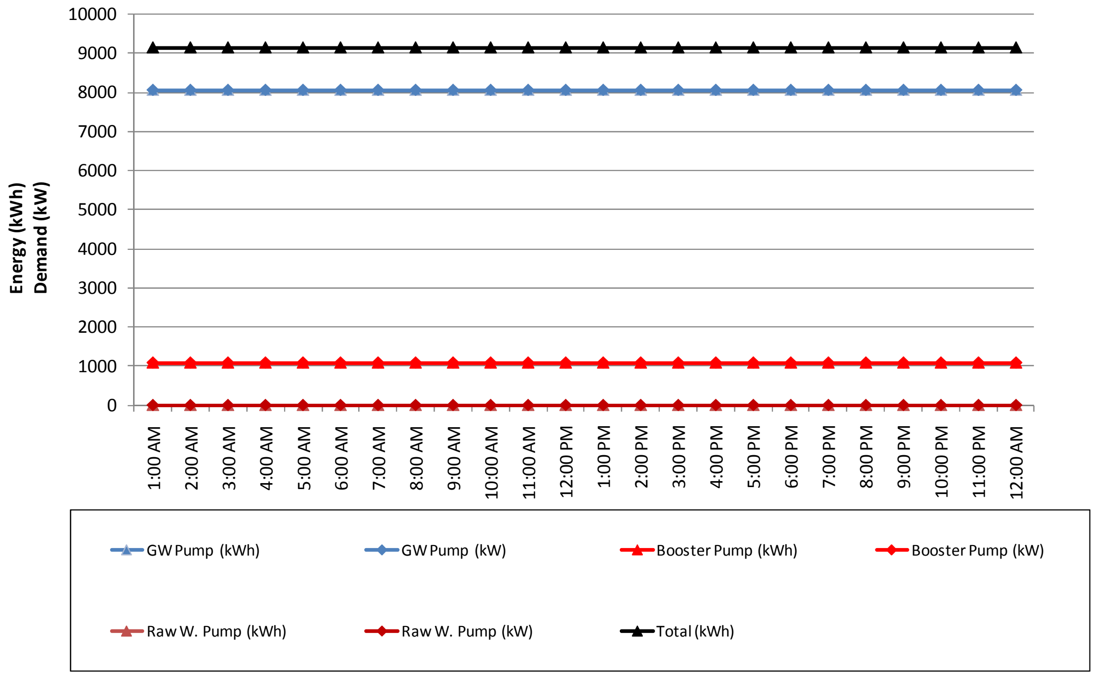

| **Date** | 7/1/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 9,202 |
| *Booster Pumps* | 1,832 |
| *Raw Water Pump* | 3 |

**Figure 5: 24-Hour Energy Profile: Summer Average Water Demand Day**



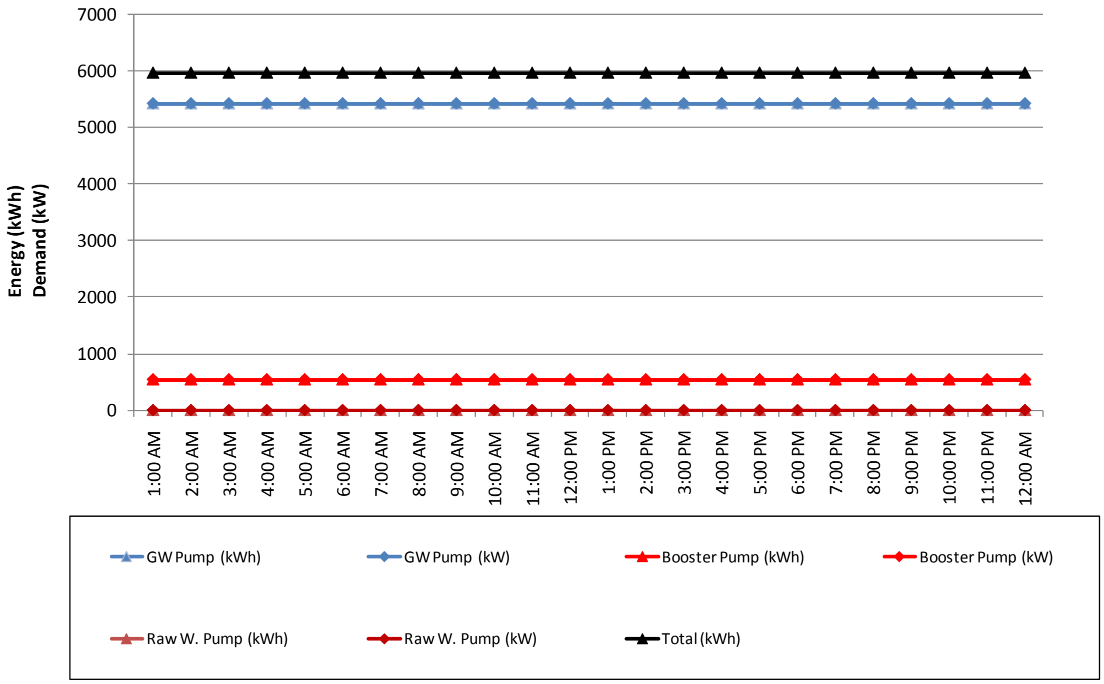

| | |
|---|---|
| **Date** | 8/1/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 8,046 |
| *Booster Pumps* | 1,713 |
| *Raw Water Pump* | 1 |

**Figure 6: 24-Hour Energy Profile: Summer Low Water Demand Day**



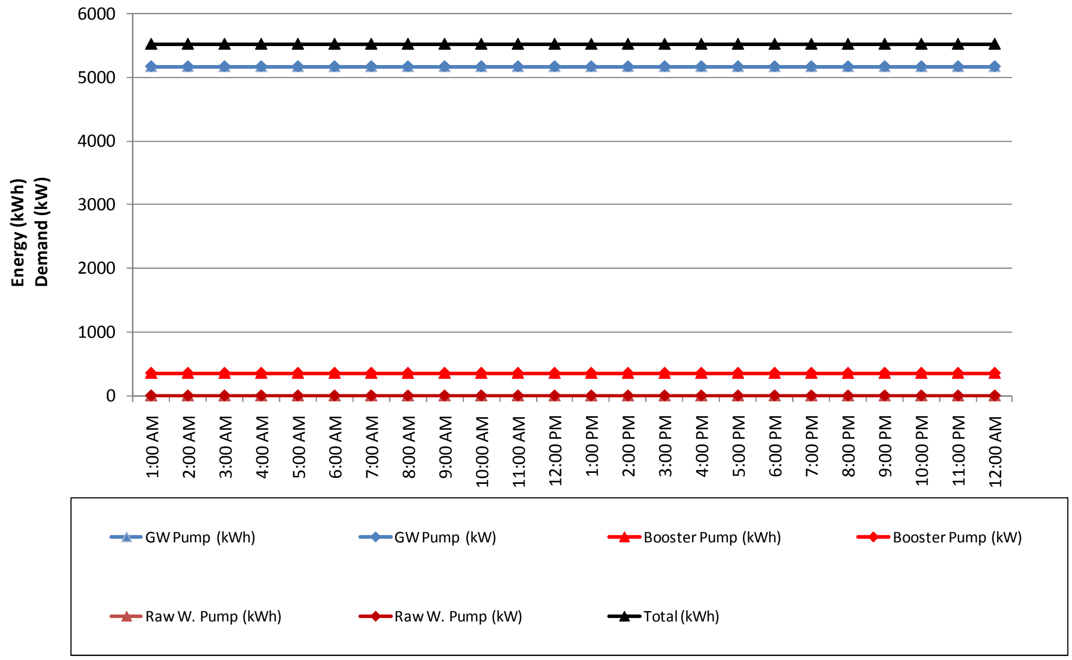

| | |
|---|---|
| **Date** | 5/1/2008 |
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Groundwater* | 8,058 |
| *Booster Pumps* | 1,080 |
| *Raw Water Pump* | 2 |

**Figure 7: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 3/31/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater* | 5,426 |
| *Booster Pumps* | 540 |
| *Raw Water Pump* | 1 |

**Figure 8: 24-Hour Energy Profile: Winter Average Water Demand Day**




| **Date** | 12/1/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater* | 5,167 |
| *Booster Pumps* | 353 |
| *Raw Water Pump* | 0 |

**Figure 9: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

SGVWC has an aggressive water conservation program which relies on voluntary participation and high efficiency retrofits. SGVWC regularly maintains and upgrades pump stations with energy efficient retrofits and they work closely with SCE to maintain energy efficient facilities. The new surface water treatment plant in the Fontana District is a LEED certified energy efficient building. In coordination with the Upper San Gabriel Valley Water District, SGVWC is utilizing about 2,500 acre-ft annually of recycled water. The Upper San Gabriel Valley Water District owns the recycled water treatment facilities, and SGVWC operates the system.

## Sources

San Gabriel Valley Water Company. Los Angeles County Division Schematic. September 3, 2009.

Arrighi, Dan, Water Resources Manager, SGVWD, Nicholson, R., Vice President, SGVWC, LoGuidice, F., Vice President Engineering and Operations, SGVWC. Interviewed by: Lacy Cannon (GEI) Bill Bennett (GEI). August 24, 2009 and September 9, 2009

Fontana Water Company, Urban Water Management Plan, Amended as of December 2005.

California Public Utilities Commission Website. Accessed March 12, 2010. http://docs.cpuc.ca.gov/published/Agenda_resolution/55692-01.htm

## San Jose Water Company (SJWC)

### Summary

<table>
<tr><td>Primary functions</td><td colspan="3">Potable Water, Urban</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Supply, Treatment, Distribution</td></tr>
<tr><td>Hydrologic Region</td><td>San Francisco Bay</td><td>DEER Climate Zone</td><td>4</td></tr>
<tr><td>Quantity of Water</td><td colspan="3">Treated by Agency: 6.56 MGD (Ave. for 2008); 10.79 MGD (5-year avg.)<br>Total Distributed: 134 MGD (Ave. for 2008); 132.6 MGD (5-year avg.)</td></tr>
<tr><td>Number of Customers</td><td>2005 Total: 214,774<br>Residential: 193,106<br>Commercial: 19,626<br>Other: 2,042</td><td>Service Area Size</td><td>138 square miles</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">SJWC supplies retail potable water to a single distribution system with sixty pressure zones in the communities of San Jose, Los Gatos, Saratoga, Campbell, Cupertino and Monte Sereno. SJWC has three sources of water (groundwater, local surface water and wholesale treated water purchased from the Santa Clara Valley Water District). Each zone is served by at least two sources of water. The topography is characterized by a valley floor, which slopes northward to San Francisco Bay, surrounded by two mountain ranges. SJWC serves customers in both the valley and the foothills.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3">The majority of energy is consumed by supply and distribution facilities<br>• Water Supply – Significant energy is used for groundwater pumping<br>• Water Treatment – Local surface water requires treatment at one of two plants<br>• Water Distribution – Majority of system is fed by gravity, with booster pumps replenishing tanks at night</td></tr>
<tr><td>Water Treatment Technologies</td><td colspan="3">Montevina Plant : Direct Filtration, with sodium hypochlorite disinfectant<br>Saratoga Plant : Microfiltration, with sodium hypochlorite disinfectant</td></tr>
<tr><td>Water Resources</td><td colspan="3">2008 Supply Distribution: 49% Imported, 46% Groundwater, 5% Local Surface Water.</td></tr>
<tr><td>Marginal Water Supply</td><td colspan="3">Each zone is served by at least two sources of supply.<br>Short Term: Increase groundwater pumping.<br>Long Term: Increase groundwater well capacity.</td></tr>
<tr><td>Energy Service Provider</td><td colspan="3">PG&E</td></tr>
<tr><td rowspan="6">Observed Energy Intensities (kWh/MG)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Groundwater Pump</td><td>1,452</td><td>1,866</td></tr>
<tr><td>Booster Pump (large zone)</td><td>589</td><td>1,104</td></tr>
<tr><td>Water Treatment</td><td>167</td><td>515</td></tr>
<tr><td>Raw Water Pump</td><td>10</td><td>444</td></tr>
<tr><td>Pressure System Pump</td><td>1,587</td><td>2,724</td></tr>
</table>

## Background Information

The San Jose Water Company (SJWC) is the largest investor- owned urban water system, serving a single location, in the United States. SJWC provides potable water to nearly one million residents of Santa Clara County in north-central California (a.k.a., the south San Francisco Bay area) . It serves the growing urban area: the City of San Jose and surrounding communities (including the towns of Campbell, Cupertino, Los Gatos, Saratoga and Monte Sereno). See Table 1 for additional information on SJWC.

Primary sources of information for this section include: SJWC's 2005 Urban Water Management Plan, SJWC's 2008 System Design Capacities Report, water and energy data for 2008 provided by SJWC, and interviews with staff at SJWC. A detailed list of references is located at the end of this section.

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water Agency |
| **Hydrologic Region** | San Francisco Bay |
| **Region Type** | Coastal |
| **Energy Service Provider** | PG&E |
| **DEER Climate Zone** | 4 |
| **Service Area Size** | 138 sq miles |
| **Service Area Population** | 1,000,000+ |
| **Number of Customers in 2005** | 214,774 |
| **Residential** | 193,106 |
| **Commercial/Industrial** | 19,695 |
| **All Other** | 1,973 |
| **Distribution Topology** | Ranges Flat to Hilly |

## Climate

Temperatures range from the mid-60s to the high 80s (Fahrenheit) in spring and summer and range from the mid-40s to the mid-50s in the winter. Most of the precipitation in the area occurs between November and March with December and January typically being the wettest months; average precipitation amounts to 14.1 inches of rain per year.

## Demographics

SJWC serves a large urban population in the city of San Jose. Population in SJWC's service area is expected to grow nearly 25 percent in the next 20 years as shown in Table 2.

### Table 2: Projected SJWC Service Area Population

| Year | Population |
|---|---|
| 2000 | 880,000 |
| 2005 | 955,000 |
| 2010 | 1,000,100 |
| 2015 | 1,050,100 |
| 2020 | 1,100,500 |
| 2025 | 1,200,000 |
| 2030 | 1,250,500 |

## Water Sources

SJWC obtains it water primarily from imported surface water, ground water, and local surface water. Figure 1  shows the approximate breakdown of supply sources.  Their distributions can vary year to year given availability of each source and demand; data from 2008 is presented in Figure 1.

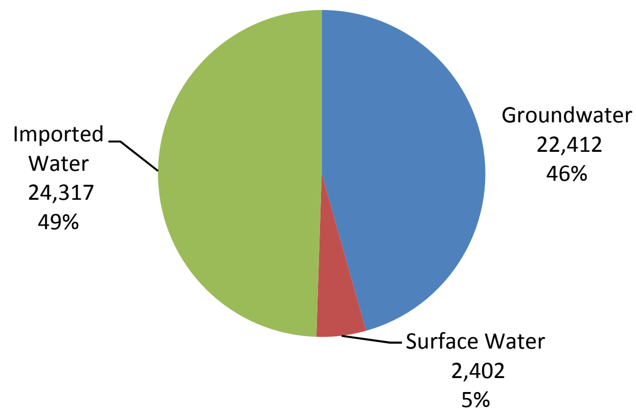



**Figure 1: 2008 Distribution of Sources (Million Gallons)**

### Groundwater

SJWC typically gets 40 to 60 percent of its total water supply from local groundwater sources. Approximately 110 wells pump water from aquifers managed by the Santa Clara Valley Water District (SCVWD).  Aquifers are recharged naturally by rainfall and artificially by a system of local reservoirs and percolation ponds, operated by SCVWD.

Older SJWC groundwater pumping stations are co-located with booster pumps and a storage tank. Groundwater (GW) is pumped when the storage tanks reach a critical low level and pumps turn off then tanks reach a “full” level.  Booster pumps draw water from the local storage tanks and deliver groundwater to zone reservoirs in the distribution system.  Booster pumps are managed by an automatic supervisory control and data acquisition (SCADA) system, which fills the zone reservoirs when level reaches a prescribed trigger point low-level; SCADA turns off booster pumps when the zone reservoirs reach their full setting.  This system encourages most groundwater pumping to occur at night while the zone reservoirs are drawn down during the day.  However, demand and testing needs may alter this pattern.  SJWC’s newer GW pumping stations use “direct pumping,” thereby eliminating the need for booster pumps and a storage tank; directly entering the distribution system.  The older dual pumping systems (circa 1940 to 1970) were necessary because PG&E’s local electrical distribution grid at the time could not handle the current draw of a 300 HP direct pumped well.

There are 40 groundwater pumping stations, most with multiple wells on site.  Most wells were drilled to a depth of 800 feet and the pump set at 350 feet.  No treatment is needed for groundwater. Sodium hypochlorite is added at all groundwater pumping stations to comply with the State and Federal Groundwater Treatment Regulations.    Carbon dioxide is injected upstream of each hypochlorinator to prevent scaling in pipelines.

Because groundwater pumps, booster pumps and sodium hypochlorite injection systems are co-located, all the energy consumed for all devices is included in the energy data for that location.  It is impossible to distinguish between the multiple uses of energy based on the data provided (PG&E bills). However, most of the energy is used for pumping; sodium hypochlorite injection systems require very small amounts of electricity.

### Local Raw Surface Water

SJWC gets between 5 to 10 percent of its water from a 4,500 acre watershed (owned by SJWC) in the adjacent Santa Cruz Mountains; thus, water is gravity fed from surface reservoirs to the treatment plants. Additionally, two of eight creek intakes have pumps for conveyance to the treatment plants. This water is treated in one of two SJWC owned treatment plants (Montevina and Saratoga) that supply the local area; energy is consumed in the treatment process.

### Imported Water

Imported surface water from the SCVWD makes up 40- 60 percent of SJWC's water supply. The water is imported as wholesale treated water; it directly enters the distribution system with no additional need for treatment. A 70-year contract between the two parties was signed in 1971. There are daily and monthly volumetric restrictions on the deliveries that SJWC receives.

Imports received from SCVWD originate from numerous sources including local reservoirs, the State Water Project, and the Central Valley Project; both draw raw water from the Sacramento River Delta. SJWC receives its water through fourteen delivery points after the water is treated at one of three SCVWD operated treatment plants (Rinconada, Penitencia, and Santa Teresa).

### Marginal Water Supply

Future water demand will be met by additional groundwater pumping (short term marginal supply) and additional groundwater capacity can be obtained by drilling new wells to replace older, lower capacity wells (long term marginal supply). Additionally, imports from SCVWD are viewed as a short term marginal supply. The energy intensity range of San Jose Water Company's marginal supply is summarized in Table 3. The energy intensity represents the embedded energy for all activities prior to the water reaching the SJWC's distribution system.

**Table 3: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short Term | Groundwater[a] | 1,452 – 1,866 kWh/MG |
| | Treated Imports from SCVWD[b] | 3,308 – 3,735 kWh/MG |
| Long Term | Groundwater[a] | 1,462 – 1,866 kWh/MG |

a) Data from SJWC: 1452 - 1866 kWh/MG for pumping

b) 3035 kWh/MG for imports from CVP (Study 1), 3461 kWh/MG for imports from SWP (Study 1), 273 kWh/MG for treatment by SCVWD (Watts to Water Report, SCVWD)

Imported water from the SCVWD is the most expensive source of water that SJWC utilizes ($620/AF), see Table 4. Ground water is slightly less expensive; the majority of the cost of GW is the GW pumping tax ($520/AF), paid to SCVWD, plus electricity costs. Additional energy costs (<$100/AF) are small in comparison to the tax. Local surface water is the least costly; however, local surface water can only serve a limited geographic area with a limited supply.

### Table 4: SJWC Cost of Water Supply

| Supply | Cost $/AF |
|---|---|
| **SCVWD Imported Water** | $620 |
| **Ground Water** | $558-612 |
| **Surface Water from Montevina Filter Plant** | $112 |
| **Surface Water from Saratoga Filter Plant** | $525 |

Note: Groundwater includes $510/AF pump tax paid to SCVWD and energy costs, surface water treatment includes costs of running treatment plants (labor, power & chemicals)

## Water Demand

SJWC serves more than 210,000 customers, mostly residential, as summarized in Table 5. The corresponding projected water use in each sector is summarized in Table 6. Additional water, beyond that which is billed, is also consumed; this is known as unaccounted water. Unaccounted water includes authorized unmetered uses such as fire fighting, hydrant flushing and public use. Additional causes of unaccounted water also include inaccurate meter reading (both revenue meters and production meters), zone reservoir cleaning, malfunctioning valves, leakage, and theft. Unaccounted water and total water demand is summarized in Table 7.

According to SJWC's estimates, the number of customers is expected to grow 2 percent from 2010 to 2030 increasing water demand by 29 percent. The majority of the increase in demand occurs from the residential and business sector. During this same time period population in SJWC's service area is expected to grow 25 percent (Table 2).

### Table 5: Historic and Projected Number of Customers by Type

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Residential | 188,896 | 193,106 | 194,072 | 195,042 | 196,017 | 196,997 | 197,982 |
| Business | 19,696 | 19,626 | 19,725 | 19,823 | 19,922 | 20,022 | 20,122 |
| Industrial | 80 | 69 | 69 | 69 | 70 | 70 | 70 |
| Public Authority | 1,622 | 1,677 | 1,685 | 1,694 | 1,702 | 1,711 | 1,719 |
| Resale | 30 | 30 | 30 | 31 | 31 | 31 | 31 |
| Other | 251 | 266 | 268 | 269 | 270 | 272 | 273 |
| **Total** | **210,575** | **214,774** | **215,848** | **216,927** | **218,012** | **219,102** | **220,198** |

### Table 6: Historic and Projected Water Demand (AF/Yr)

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Residential | 86,509 | 86,772 | 93,051 | 99,887 | 107,512 | 114,155 | 120,751 |
| Business | 47,974 | 46,377 | 49,446 | 52,814 | 56,601 | 59,861 | 63,386 |
| Industrial | 1,135 | 645 | 783 | 924 | 1,073 | 1,213 | 1,262 |
| Public Authority | 8,381 | 8,387 | 8,931 | 9,528 | 10,201 | 10,780 | 11,417 |
| Resale | 739 | 774 | 824 | 880 | 942 | 995 | 1,054 |
| Other | 249 | 218 | 233 | 248 | 266 | 281 | 297 |
| **Total** | **144,987** | **143,175** | **153,269** | **164,281** | **176,594** | **187,284** | **198,168** |

### Table 7: Unaccounted Water and Total Water Demand (AF/Yr)

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| Customer Metered Demand | 144,987 | 143,175 | 153,269 | 164,281 | 176,594 | 187,284 | 198,168 |
| Unaccounted Water | 9,967 | 9,767 | 10,400 | 11,096 | 11,880 | 12,553 | 13,296 |
| **Total Demand** | **154,955** | **152,943** | **163,669** | **175,377** | **188,474** | **199,837** | **211,464** |

## System Infrastructure and Operations

SJWC has approximately one hundred water production and storage facilities within its distribution system. Table 8 summarizes the infrastructure operated by SJWC. SJWC has a large groundwater pumping infrastructure to supply a significant amount of water to its customers. Additionally, two water treatment plants treat local surface water; SJWC does not treat wastewater. The system has significant storage (approximately 1.5 days worth of average demand) allowing the majority of pumping to be performed off-peak.

### Table: Infrastructure Summary

| | |
|---|---|
| **Number of Groundwater Wells** | 108 |
| **Number of Surface Reservoirs Operated** | 5 |
| **Miles of Distribution Piping** | 2,450 |
| **Number of Treatment Plants** | 2 |
| **Total Number of Production & Storage Facilities** | 100 |
| **System Wide Storage Capacity** | 235 MG |

### Sub-Regions within Agency

SJWC receives water from three sources: local groundwater, SJWC owned local surface water, and SCVWD imported surface water. Figure 2 depicts the normal water source in each portion of the distribution system; however, as mentioned above, each zone can be served by at least two alternate sources of water, depending on season and unusual circumstances. In addition, SJWC currently has a 25-year lease (signed in 1997) to operate the City of Cupertino water system.

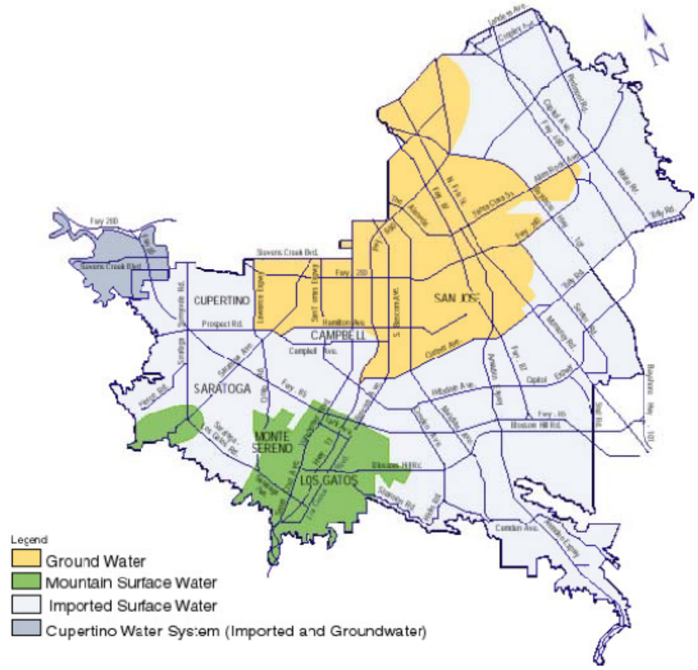



**Figure 2: SJWC Sources and Service Area**

## Sub-Region 1: Groundwater-Served Area

Groundwater wells supply water to the yellow-orange area in Figure 2. All but two of SJWC's groundwater stations are located within this area. In addition to GW pumps, these sites have co-located storage tanks, chemical injection facilities, and booster pumps.

### *Distribution*

The majority of this area has flat terrain; however this region contains downtown San Jose. Sufficient system pressure is required for water to reach the top of high-rises in the downtown area. Some pumps in the downtown area are operated 24-hours a day to serve the area's demand.

## Sub-Region 2: Local Surface Water-Served Area

The area served by mountain surface water is the green shaded area in Figure 2. Both of SJWC's water treatment plants are located in this region.

### *Conveyance*

Some pumping is required to transfer water between zone reservoirs; however, this is small when compared to energy consumption by groundwater pumping activities in SJWC's system.

### *Treatment*

Water is treated in one of two SJWC owned treatment plants (Montevina and Saratoga) that supply the local area. SJWC's impoundments in the Santa Cruz Mountains feed the plants. The Montevina Plant uses direct filtration (a traditional sand treatment technology) and has a capacity of 30 MGD; it serves the Los Gatos area. The Saratoga Plant uses microfiltration technology (installed in a 1993 retrofit) and has a 5 MGD capacity; it serves the Saratoga area.

### *Distribution*

The majority of this area consists of hilly terrain; however, this entire sub-division has a gravity fed distribution system. Inter-zone pumping of potable water is needed.

### Sub-Region 3: Imported Surface Water-Served Area

Imported treated surface water serves the light gray shaded area in Figure 2. This water is imported as treated water and directly enters SJWC's distribution system with no additional need for treatment. Most of SJWC's booster pump stations (those without groundwater wells) are located in this region.

### *Distribution*

This area ranges from flat to hilly. Inter-zone booster stations are used to distribute water throughout this sub-region. Additional pressure system pumps are required in some small areas. The pressure systems are used to provide additional pumping to deliver water to high spots in the system. Typically, each pressure system pump serves 4 to 5 residences that are higher than the surrounding customers.

### Sub-Region 4: Cupertino Water System Area

The Cupertino Water System serves the dark gray shaded area in Figure 2. SJWC currently has a 25-year lease (signed in 1997) to operate the City of Cupertino water system.

### *Distribution*

This area is mostly flat. One booster pump station is used to serve customers at higher elevations.

### System Storage

SJWC has a system wide storage capacity of 235 million gallons, although on average 138 million gallons is stored. This is enough to supply the service area with 1.5 days worth of water; however, this duration varies by region, as storage tanks are not distributed evenly throughout the service area. Although the system has ample storage capacity, it is operated such that it does not "coast" (draw down storage while no additions are made) for more than 6 hours at a time. Sufficient storage must be available at all times for fire fighting and emergency purposes.

### System-wide Operation Strategy

SJWC operates its system by pumping water during the "off-peak" electric tariff periods as much as possible (in an effort to be cost-effective), subject to the zone reservoir storage level requirements in the system. The ample storage and ability to "coast" for up to 6 hours allows SJWC to generally avoid pumping during the 6-hour "on-peak" electric tariff window during the summer months.

Sometimes pumps are operated during "on-peak" times, which are attributed to, water quality testing needs or unusual demand requirements.

Notable examples of "on-peak" demand requirements are the operation of $12^{th}$ Street, $17^{th}$ Street, and Grant groundwater pump stations. These operate constantly 24/7 to provide sufficient pressure to reach the top of high-rise buildings in downtown San Jose.

### Infrastructure Changes

In 2008, the Main Station (Santa Clara Street) and Delmas Station, groundwater facilities, were shut down and the property sold; these stations no longer produce water. This is reflected in the Study Team's data and does not adversely affect results. To recover the lost groundwater production, new wells were drilled and commissioned at Bascom, Meridian, Twelfth Street and Will Wool Stations between 2006 and 2008. In 2009, SJWC drilled new wells at Tully and Breeding Stations and placed these in service. In 2010, new wells were drilled and commissioned at Breeding and Will Wool Stations

Since 1999, the City of San José Municipal Water System has operated a waste water reclamation system and sells wholesale recycled water to SJWC. SJWC sells this recycled water to its customers for irrigation. SJWC is planning to install transmission lines in 2010 to distribute recycled water to additional customers. Although these infrastructure changes are in process, they will not be reflected in the data used for this study since its focus is.

## Energy Profiles

SJWC provided the Study Team with energy data from PG&E and measured water flow data. Energy data came in the form of monthly energy bills and some 15-minute interval data for all facilities. Each pump station had a single energy meter regardless of the number of pumps located at that site. Flow data came in the form of total daily water flow data through each pump and treatment plant. The energy and flow data was processed by the Study Team to determine the energy intensity of each facility type and the hourly energy profiles presented in this section.

The energy intensity of each facility type within the San Jose Water Company is presented in Figure 3. The energy intensity for water treatment plants in November was zero because SJWC reported no flow through either of their treatment plants during that time. December flow was extremely low and full energy data for the entire month was not available. Thus its value was removed from the plot as it does not represent the true energy intensity of water treatment operations.

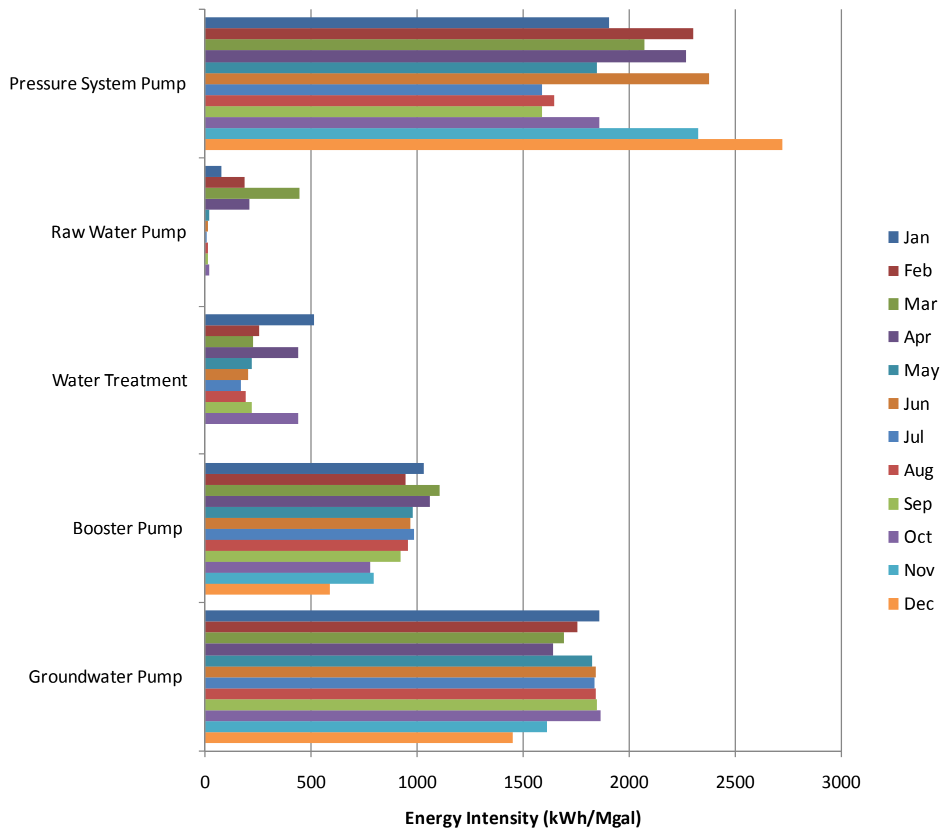
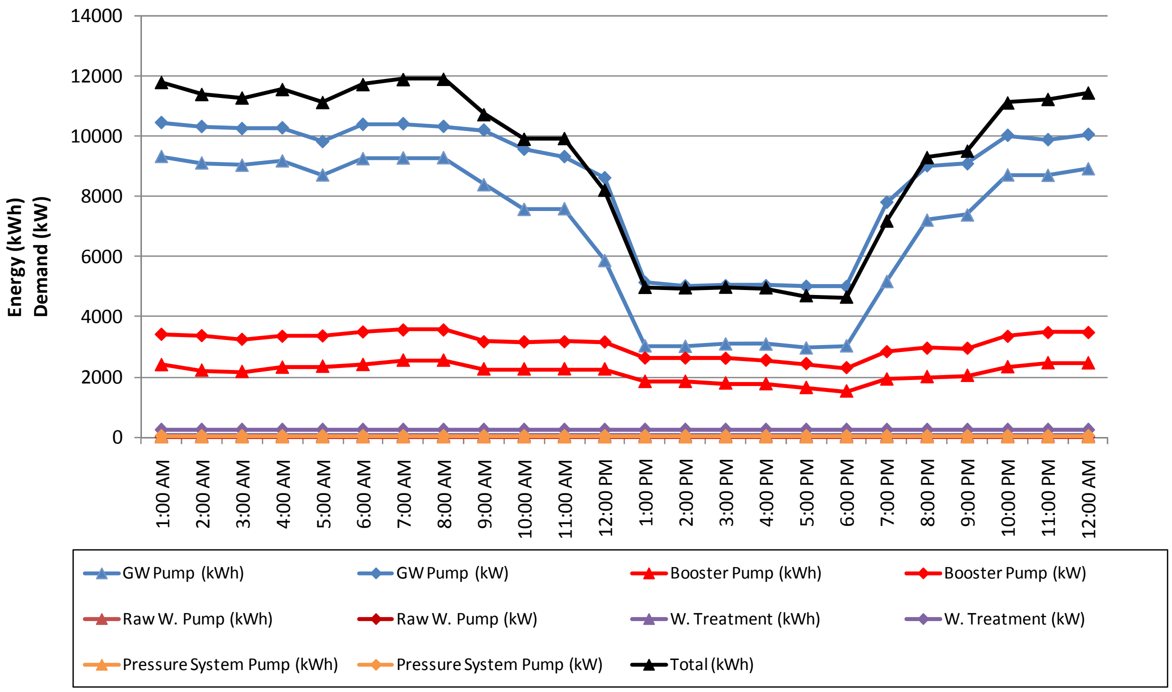


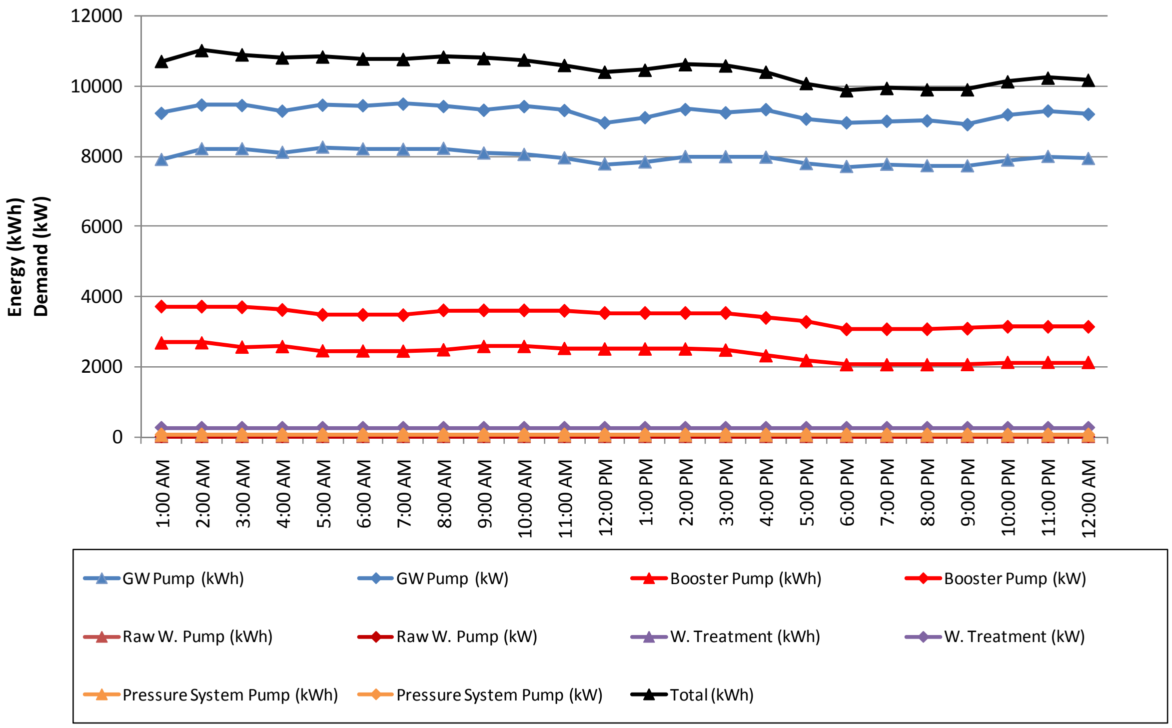

**Figure 3: SJWC Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by SJWC is for groundwater pumping as its major supply is groundwater. Significant energy is also used by booster pump stations to deliver treated water to customers at higher elevations and to downtown areas.



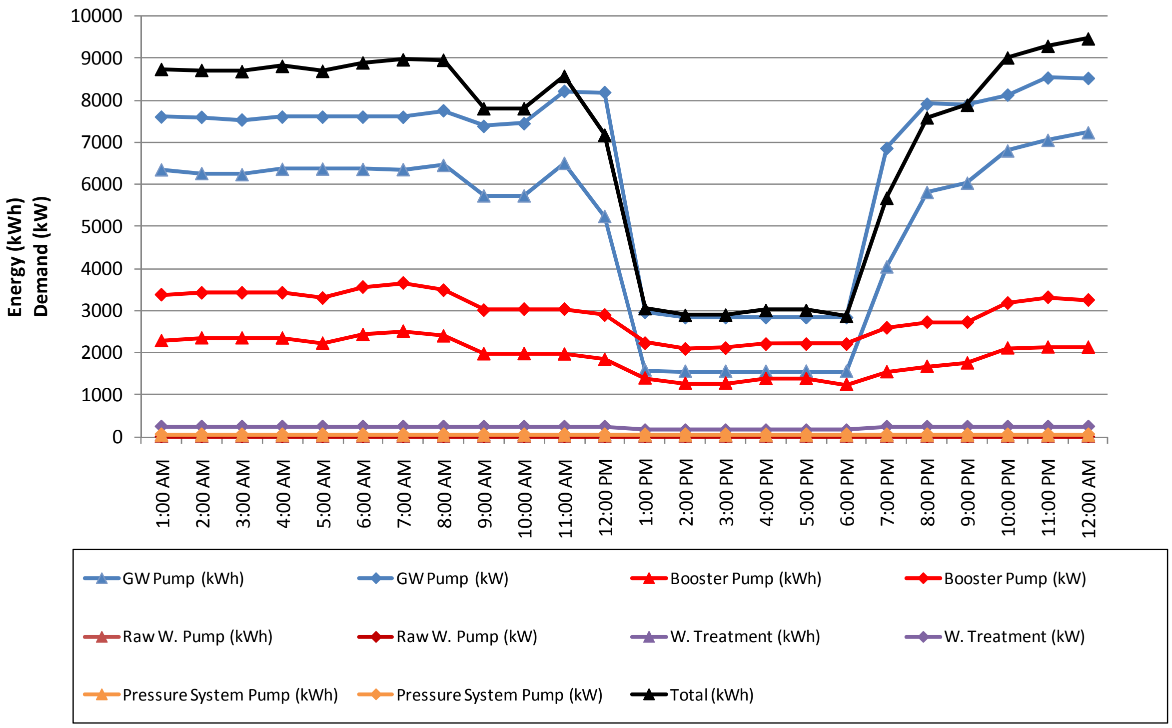

| **Date** | 7/8/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,038 |
| *Booster Pumps* | 1,150 |
| *Raw Water Pump* | 2 |
| *Water Treatment* | 34 |
| *Pressure System Pumps* | 18 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



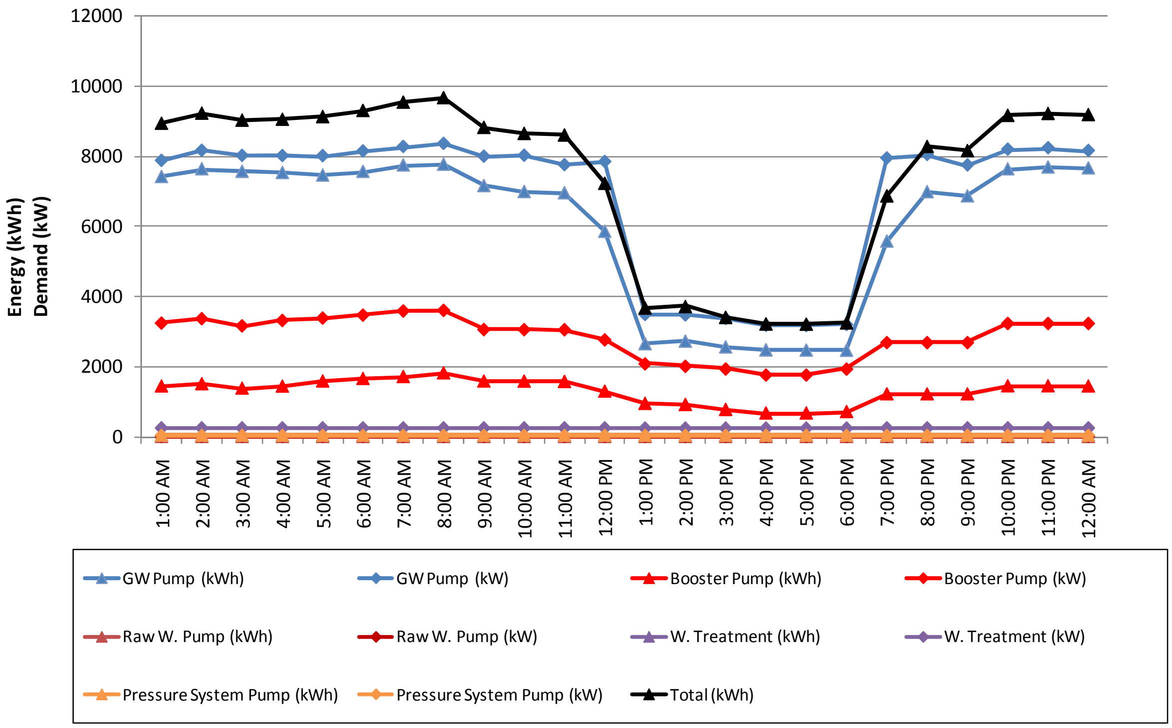

| | |
|---|---|
| **Date** | 6/21/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 7,910 |
| *Booster Pumps* | 2,324 |
| *Raw Water Pump* | 4 |
| *Water Treatment* | 73 |
| *Pressure System Pumps* | 47 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



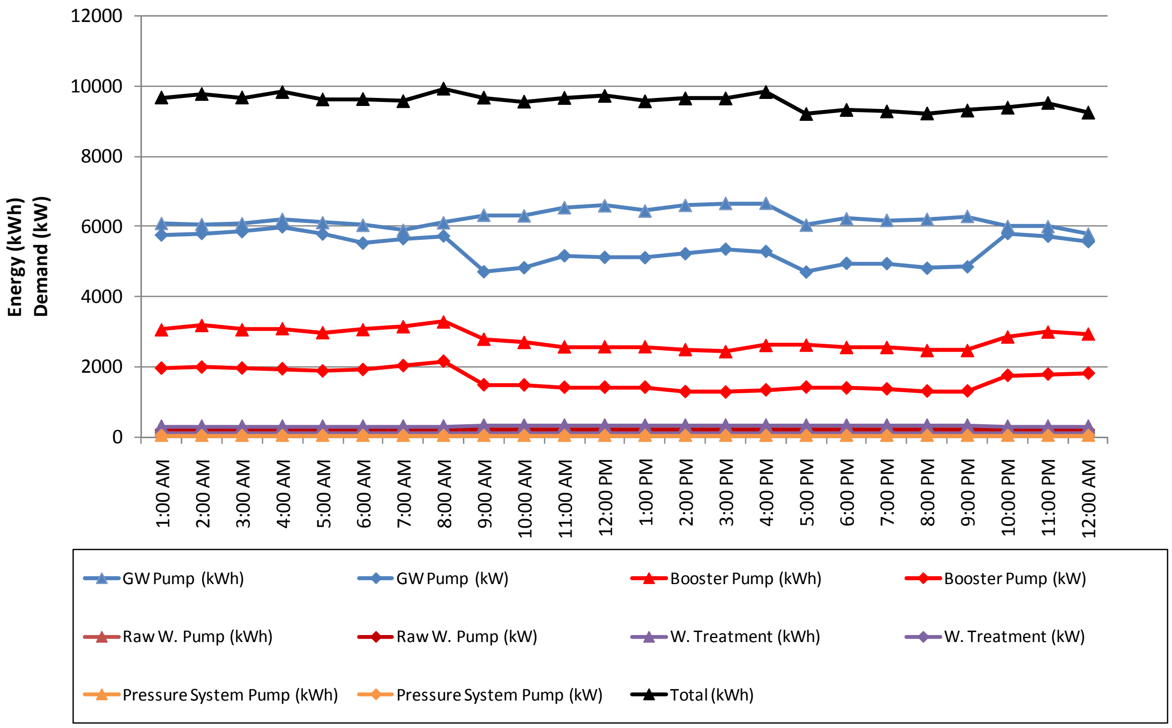

| **Date** | 8/5/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,548 |
| *Booster Pumps* | 1,340 |
| *Raw Water Pump* | 3 |
| *Water Treatment* | 39 |
| *Pressure System Pumps* | 48 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



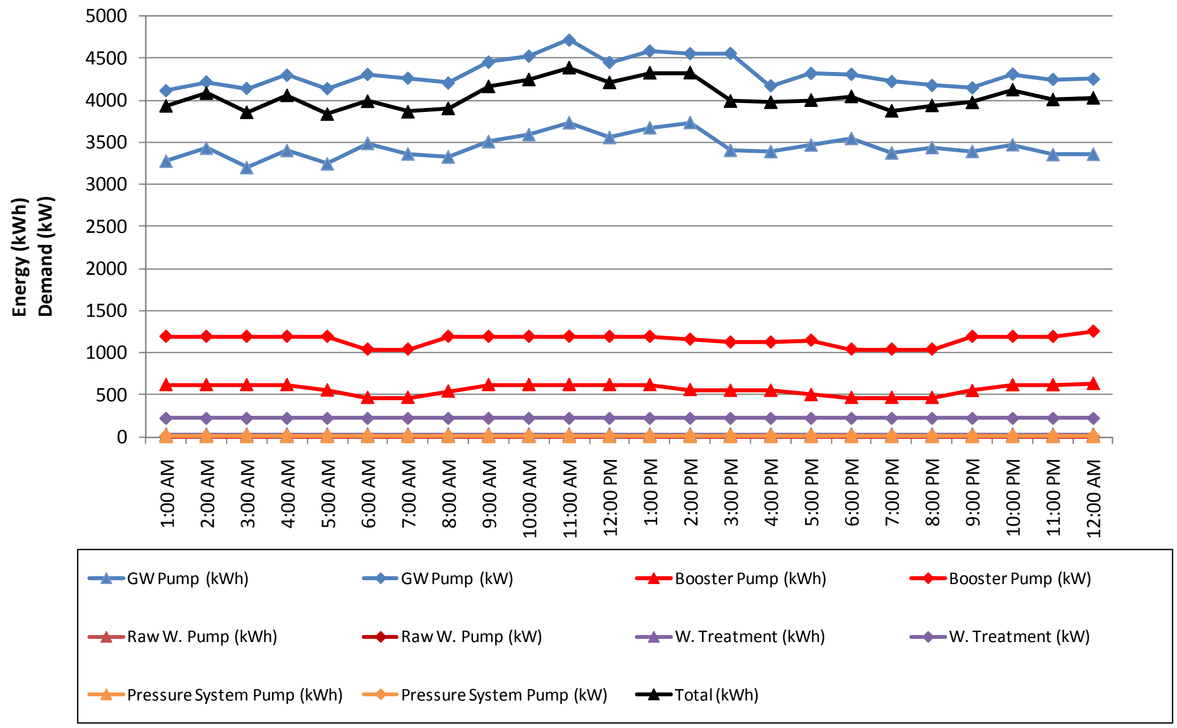

| | |
|---|---|
| **Date** | 10/1/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,504 |
| *Booster Pumps* | 698 |
| *Raw Water Pump* | 3 |
| *Water Treatment* | 51 |
| *Pressure System Pumps* | 37 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



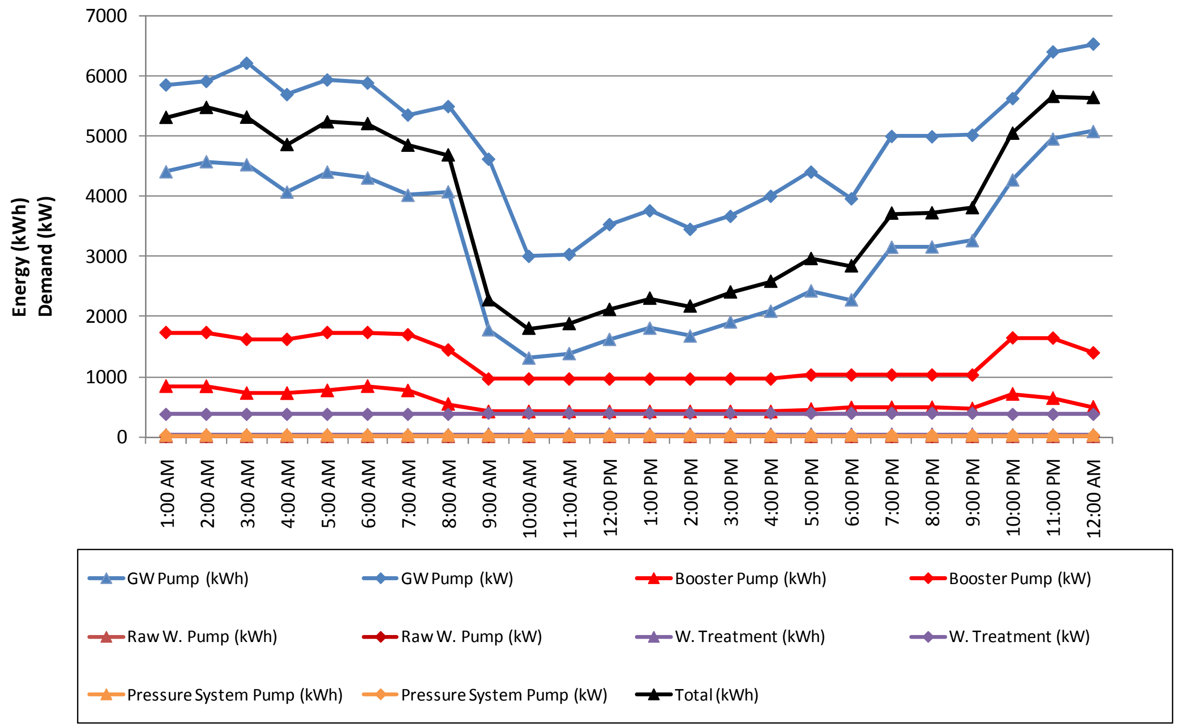

| **Date** | 4/28/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater* | 5,109 |
| *Booster Pumps* | 1,342 |
| *Raw Water Pump* | 194 |
| *Water Treatment* | 93 |
| *Pressure System Pumps* | 35 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| **Date** | 12/13/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 3,421 |
| *Booster Pumps* | 533 |
| *Raw Water Pump* | 0 |
| *Water Treatment* | 26 |
| *Pressure System Pumps* | 9 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 1/15/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,142 |
| *Booster Pumps* | 431 |
| *Raw Water Pump* | 15 |
| *Water Treatment* | 35 |
| *Pressure System Pumps* | 21 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

SJWC has several ongoing projects to improve groundwater pumping efficiency. Several options include rehabilitating old wells, or drilling new wells to replace old wells. SJWC has found that rehabilitating old wells works in the short term to increase flow, though its effects degrade quickly. From their experience, it is more effective and efficient to replace a well by shutting down an old well and drilling a new one nearby. In addition to well replacement and rehabilitation, SJWC is constantly upgrading motor controls centers and switchgear at groundwater pump sites.

## Sources


*San Jose Water Company 2005 Urban Water Management Plan*. San Jose Water Company. October 2005.

Tom Victorine, Director of Operations – San Jose Water Company. Interviewed August 7th, 2009 by Bill Bennett, Laurie Park, and Amul Sathe.

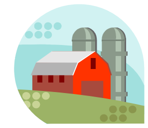
Ruben Hernandez, Operations Supervisor – San Jose Water Company. Interviewed August 7th, 2009 by Bill Bennett, Laurie Park, and Amul Sathe.

*San Jose Water System Design Capacities.* San Jose Water Company. April 2009.

*From Watts to Water (DRAFT)*. Santa Clara Valley Water District. 2009.

*Study 1: Wholesale Water Energy Intensity in California – DRAFT*, GEI Consultants and Navigant Consulting. 2010.

# Semitropic Water Storage District



## Summary

| | | | |
|---|---|---|---|
| **Primary function** | Agricultural Water | | |
| **Segment of Water Use Cycle** | Supply | | |
| **Hydrologic Region** | Central Valley | **DEER Climate Zone** | 13 |
| **Quantity of water** | Banked: 700,000 AF | | |
| **Number of Customers** | Total: 300 | **Service Area Size** | 345 Sq miles |
| **Distinguishing Characteristics** | Semitropic Water Storage District is located between the State Water Project and the Central Valley Project canals. This makes Semitropic's location ideal for groundwater storage and banking for many agencies in southern and central California. The area hosts eight or nine underground water storage and recovery facilities, including two of the largest in the world — the Semitropic Water Storage Bank and the Kern Water Bank. Semitropic owns 6.67 percent of the Kern Water Bank. | | |
| **Key Energy Drivers** | All energy use is for groundwater pumping | | |
| **Water/Wastewater Treatment Technology** | N/A – no treatment performed | | |
| **Water Resources** | In wet years, participating banking partners deliver their surplus water to Semitropic: Antelope Valley Water Bank: 23.3%, Semitropic's Contribution to SRWBA: 14.0%, Uncommitted (Used by all Customers): 5.7%, Not Available Until SRWBA has Committed: 7.0%, Rampage Vineyard (Reserved): 0.8%, Poso Creek Water Company: 2.8%, MWD-SC: 16.3%, Santa Clara Valley WD: 16.3%, Alameda County WD: 7.0%, Newhall Land and Farming Company: 2.6%, San Diego County Water Authority: 1.4%, Zone 7 Water Agency: 3.0%. | | |
| **Marginal Water Supply** | Short-term: Temporary water-service connections, water-pricing initiatives, connection of landowner wells to Semitropic's main conveyance system, interconnection of facilities with neighboring districts, purchase and importation of available water supplies, and implementation of the Semitropic Groundwater Banking Project.<br>Long-term: Groundwater Banking Project Expansion and additional banking partners. | | |
| **Energy Service Provider** | PG&E | | |
| **Observed Energy Intensities** | **Segment** | **Lower Range** | **Upper Range** |
| | Groundwater | 790 kWh/Mgal | 1,261 kWh/Mgal |

## Background Information

Semitropic Water Storage District is one of eight water storage districts in California and is the largest in Kern County. Semitropic delivers water to nearly 300 customers for the irrigation of approximately 140,000 acres for agricultural uses. Semitropic also supplies energy to a variety of users and provides groundwater banking and storage services. Established in 1958, Semitropic Water Storage District covers an area of more than 220,000 acres. It began as an irrigation district for the purpose of securing State Water Project supplies to reduce groundwater overdraft. Nearly 50 years later, Semitropic is still committed to providing a reliable water supply for irrigation and other agricultural uses. In addition, it has broadened its services to include not only surface water management, but also groundwater and energy management. Table 1 summarizes information about Semitropic.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Agricultural Water |
| **Hydrologic Region** | Tulare Lake |
| **Region Type** | Central Valley |
| **Energy Service Provider** | PG&E |
| **DEER Climate Zone** | 13 |
| **Service Area Size (if available)** | 343.75 Sq miles |
| **Service Area Population (if available)** | |
| **Number of Customers in 2008** | 300 |
| **Distribution Topology** | Flat |

Primary sources of information on Semitropic Water Storage District include: SWSD's public website and 2007-2008 financial reports. A detailed list of references is located at the end of this section.

### Climate

Average annual rainfall depends upon area, ranging from just under six inches on the valley floor to as much as 40 inches in the mountains. Spring comes early, with temperatures warm enough to start wildflowers blooming in mid to late February. Summers are warm, marked by low humidity and comfortable evening temperatures through September. Winter temperatures are relatively mild in the valley and desert. However, local climate is not the only factor in determining the agency's operations. Conditions upstream and downstream can affect banking operations considerably.

### Demographics

Semitropic Water Storage District provides water to customers for agricultural use only. The total land area within Semitropic is approximately 221,000 acres (or 345 square miles), with about 125,000 acres (or 195 square miles) irrigated. It is noted that the irrigated area varies from year to year, depending on many factors. Table 2 shows the crops grown throughout Semitropic (based on a 2008 crop survey):

**Table 2: 2008 Crop Acreage**

| Crops | Acres | Percentage |
|---|---|---|
| Alfalfa | 26,135.02 | 17.91% |
| Cotton | 5,306.38 | 3.64% |
| Duck Pond | 9,597.65 | 6.56% |
| Fruits | 1,647.58 | 1.13% |
| Grain/Pasture | 23,284.63 | 15.96% |
| Grapes | 4,799.72 | 3.29% |
| Nursery | 124.55 | 0.09% |
| Nut Crops | 58,049.11 | 38.78% |
| Vegetables | 4,849.63 | 3.32% |
| Waste & Miscellaneous land | 12,140.92 | 8.32% |
| ***Total Irrigated Acres*** | ***151,855.24*** | **100.00%** |
| **Undeveloped Native Vegetation** | ***64,037.26*** | |
| **Total District Acres** | ***220,581.98*** | |

## Groundwater

The main production zones beneath Semitropic are of good water quality; however, three areas of potentially poor quality are found within Semitropic and the groundwater basin; shallow groundwater, deep groundwater, and west-side groundwater. The high salinity shallow groundwater is only characteristic where there is perched water; however, the transition zone and saline water below the production zone are typical of the entire District.

Groundwater of poor quality also can be found in the main aquifer, particularly the deeper zones of the Tulare Formation. The depth to the base of fresh water varies significantly across Semitropic. Pockets of connate saline water may also be trapped in shallower zones under the Buttonwillow and Semitropic ridges. Semitropic has reviewed extensive geologic data so that District wells are constructed sufficiently above the saline boundary to maintain water quality.

Extractions within Semitropic area are by privately-owned wells and District-owned wells. Approximately two-thirds of Semitropic's irrigated area is partially dependent on surface water from Semitropic for its irrigation water supply. Landowners must maintain wells to meet irrigation demands when surface water supplies are limited or not available. Semitropic maintains wells to supplement the available surface supply to some District lands and for recovery of stored groundwater for return (to banking partners) in years of reduced surface water supplies. The remaining one-third of Semitropic's irrigated area relies exclusively on pumped groundwater. Semitropic's importation of surface water helps to support those landowners who continue to rely on pumped groundwater by reducing Semitropic's overall reliance on the underlying groundwater.

## Groundwater Banking

Established in 1958, Semitropic Water Storage District covers an area of more than 220,000 acres. It began as an irrigation district for the purpose of securing State Water Project supplies to reduce groundwater overdraft. The original water bank consisted of six banking partners who have delivered approximately 700,000 acre-feet of water to Semitropic, which is enough to supply about 1.4 million households with water for a year. Figure 1 shows the current banking partners and allocation of the 2.15 million AF (total storage capacity).

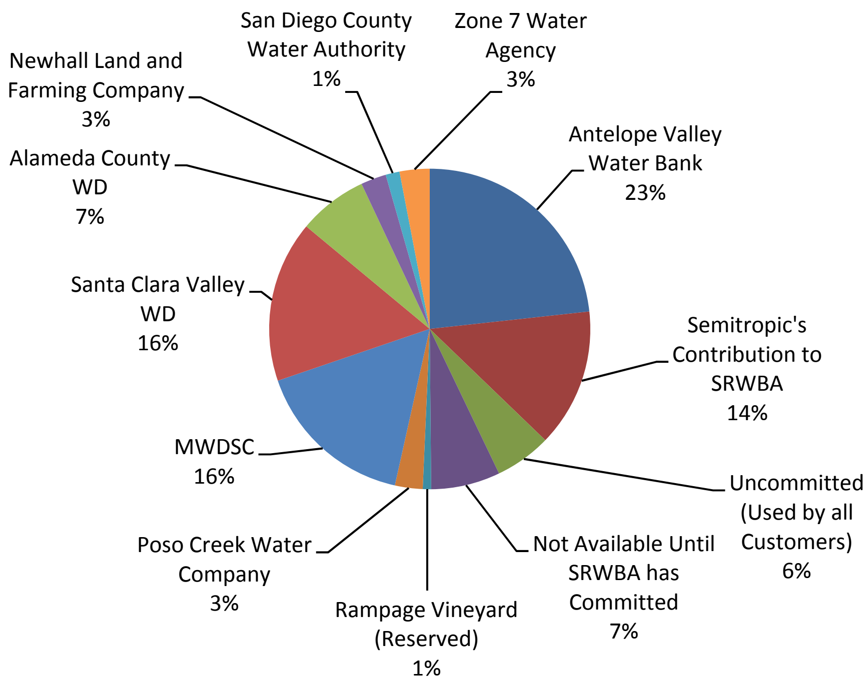



**Figure 1: 2008 Banking Partners and Storage Capacity Allocation**

Semitropic receives SWP or CVP surface water from its banking partners in years of ample supplies and delivers it to landowners for irrigation use in lieu of groundwater pumping. Groundwater which otherwise would have been pumped remains in storage, credited to the account of the banking partner. In times of surface water shortages, the water may be withdrawn by the banking partner. At that time, Semitropic will return the banked water to the California Aqueduct, either from its supply of SWP water, and/or by pumping of District and landowner wells.

Whenever necessary, Semitropic returns the stored water to the California Aqueduct for use by its partners either by exchanging its entitlement or by reversing the intake facility, which is called "pumpback." Through pumpback, Semitropic can deliver a maximum of 90,000 acre-feet of water per year into the California Aqueduct. The state would then deliver the water to the banking partners.

Banking project capabilities:

- Can store a total of 1.65 million acre feet – enough water to meet the yearly needs of approximately 3.3 million households.
- In a 50 percent State Water Project year, it can provide 356,500 acre-feet of dry year water supply.
- Can take 315,000 acre-feet per year of surplus wet-year water into storage.
- Helps supply drought-year water to more than 20 million people in Southern California and in the Bay Area — equivalent to 15 to 20 gallons per person per day.

At Semitropic, wet year and surplus water is stored in the groundwater basin primarily through in-lieu recharge. Semitropic delivers surface water to farmers for irrigation in-lieu (or instead of) pumping groundwater.  To a lesser extent, Semitropic also stores water through direct recharge. Throughout

Semitropic's service area, there are a number of recharge basins where water percolates to the groundwater basin.

### Imported water

Semitropic is a "member unit" of the Kern County Water Agency (KCWA), with whom Semitropic contracts for the importation of State Water Project water. Semitropic cooperates with KCWA in preserving and protecting surface water and groundwater in the basin.

### Marginal Water Supply

The Study Team identified both short-term and long-term marginal supplies for SWSD. Short-term marginal supply includes temporary water-service connections, water-pricing initiatives, connection of landowner wells to Semitropic's main conveyance system, interconnection of facilities with neighboring districts, purchase and importation of available water supplies, and implementation of the Semitropic Groundwater Banking Project. Long-term marginal supply includes expanding the Groundwater Banking Project and additional groundwater banking partners.

#### *Short-term*

Semitropic has implemented various measures over the years to promote (in-lieu) recharge, reduce overdraft, and to ameliorate the consequences of water supply deficiencies of the SWP. These measures have included:

- Temporary water-service connections (to deliver non-contract surface water, when available, in lieu of pumped groundwater).
- Water-pricing initiatives (which make the use of available surface water supplies competitive with the cost to pump groundwater).
- Connection of landowner wells to Semitropic's main conveyance system (which allows Semitropic to maximize the import of available surface water supplies early in the year by providing the ability to meet water delivery obligations to the Contract Water Service Area later in the year).
- Interconnection of facilities with Shafter-Wasco Irrigation District and Buena Vista Water Storage District (to facilitate mutually beneficial water banking and exchange arrangements with neighboring water districts).
- Purchase and importation of available water supplies (over and above Semitropic's SWP contract water).
- Implementation of the Semitropic Groundwater Banking Project to, among other matters, increase Semitropic's ability to purchase and import available water supplies (i.e., when facilities not in use for banking, District can use for its own purposes, giving it more absorptive capability; and banking revenue can be used to purchase water supplies).

#### *Long-term*

Enhancement of conjunctive-use activities will include pursuing an expansion of its Groundwater Banking Project. The expansion would provide for the construction of additional main conveyance and distribution facilities, which would increase Semitropic's capability to take advantage of waters of "opportunity" (when the facilities are not in use to satisfy water-banking obligations). This expansion is referred to as the Stored Water Recovery Unit.

Semitropic Water Storage Bank is currently looking for additional banking partners to share the benefits of the Stored Water Recovery Unit. Partners can include:

- existing banking partners
- public agencies
- metropolitan sub-agencies
- CALFED Environmental Water Account users
- private investors
- developers requiring assured water supply
- power companies requiring reliable generation cooling water

The energy intensity range of SWSD's marginal supply is summarized in Table 3. The energy intensity represents the embedded energy for all activities prior to the water reaching Semitropic Water Storage Bank and just after water is pumped out of the ground.

**Table 3: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short and Long-term | Groundwater (SWP)[a] | 2,079 - 2,550 kWh/MG |
| | Groundwater (CVP)[b] | 2,103 - 2,574 kWh/MG |
| | Groundwater (pumping only)[c] | 790-1,261 kWh/MG |

a) EI range includes Cumulative EI for SWP from the Banks Pumping Plant through Dos Amigos Pumping Plant (about 1,289 kWh/MG) from Study 1 plus the Semitropic WSD EI range for groundwater pumping.

b) EI range includes the Cumulative EI for CVP from the Tracy Pumping Plant through the Dos Amigos Pumping Plant (about 1,313 kWh/MG) from Study 1 plus the Semitropic WSD EI range for groundwater pumping.

c) EI range for Semitropic WSD groundwater pumping from Study 2 results only.

## Water Demand

Semitropic initially contracted with the Kern County Water Agency (KCWA) for an annual entitlement of 158,000 acre-feet of SWP water, which was subsequently reduced to 155,000 acre-feet in 1996. This is used to irrigate approximately 43,000 acres in its Contract Water Service Area (CWSA). Additional SWP supplies are available from time to time and are delivered to the CWSA and to a Temporary Water Service Area (TWSA) of about 29,000 acres. The total demand for irrigation water is on the order of 450,000 acre-feet each year. Any demand not met with imported supplies is met with pumped groundwater. Semitropic's current annual delivery capability is about 320,000 acre-feet and the ultimate objective is on the order of 400,000 are-feet. Farmers in the CWSA and TWSA maintain wells to supplement District deliveries and protect against shortages in the imported water supply. The Semitropic Groundwater Banking Project, implementation of which commenced in 1994, provides an intermittent supply of surface water to an additional 23,000, acres bringing the total area to which surface water can be delivered to about 95,000 acres. The remaining area of Semitropic includes about 43,000 acres which rely exclusively on groundwater, and about 83,000 acres which are not farmed.

## System Infrastructure and Operations

Since the Semitropic Water Storage District began its groundwater banking program more than 10 years ago, Semitropic has built or improved a number of facilities to make the program a success.

*Distribution*

Semitropic now features a number of storage, pumpback, pumping and recharge facilities.

In addition to the water banking aspects of the Project, distribution facilities which are being constructed as part of the Project can be used for non-banking purposes. In particular, these facilities will allow Semitropic to acquire KCWA Agricultural Pool Water, when available, and deliver it to District lands. The water banking facilities will also allow Semitropic to pump groundwater and deliver it for the benefit of farmers within Semitropic. Semitropic will be able to provide water to farmers who may have groundwater quality problems, peaking problems, well outages, and other emergency needs.

It is Semitropic's policy to not allow use of Semitropic's distribution facilities for the wheeling of groundwater when there are water supplies available to turn off wells.

### System Storage

SWSD has approximately 1.65 million acre-feet of total storage capacity. After groundwater banking, there are still approximately 450,000 acre-feet (or 150,000 shares) of storage available.

### System-wide Operation Strategy

Wet year and surplus water is conveyed to storage in the groundwater basin primarily by in-lieu deliveries. Farmers take imported water in lieu of pumping groundwater. The banked water is returned to the State Water Project (SWP) by the release of Semitropic's contract entitlement and/or by "pumpback" to the California Aqueduct at 300 cfs.

### Infrastructure Changes

Semitropic Water Storage District has permitted and is ready for construction of a second phase of the groundwater banking program.

This new unit, called the Stored Water Recovery Unit, will increase storage by 650,000 acre-feet to a maximum of 1.65 million acre-feet and increase recovery capacity by 200,000 acre-feet/year for a total guaranteed or pumpback capacity of 290,000 acre-feet/year. This means that the Semitropic Water Storage Bank, including its entitlement exchange capability of up to 133,000 acre-feet/year, will be able to deliver up to 423,000 acre-feet per year of dry year yield to the California Aqueduct. In a 50 percent year, the water bank's capacity is equivalent to about 18 percent of the entire State Water Project yield.

Semitropic proposes to acquire in fee approximately 4,000 acres of land for its proposed well field as part of its Stored Water Recovery Unit Project (SWRU). As of September 1, 2004, approximately 3,000 acres have already been acquired through voluntary sales by landowners.

The Cross Valley Canal (CVC) serves as the Kern County Water Agency's primary conduit for water deliveries to and from the California Aqueduct. Construction has commenced on the CVC Expansion Project. The project is the largest component of the Phase II Grant Program and includes construction of the CVC/Friant-Kern Canal Intertie (Intertie). CVC conveyance capacity will be expanded from 922 cubic feet per second (cfs) to 1,422 cfs (an increase of about 54 percent), plus an additional 500 cfs of capacity in the Intertie. Construction completion is scheduled for 2009.

## Energy Profiles

Semitropic WSD provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy data provided included: monthly solar generation data in units of kWh and total system interval (15-minute time increment) data in units of MW. Semitropic WSD has a single point of service with PG&E which supplies power to multiple generating stations, substations, and well fields. Only the PG&E energy data was included in the computations. PG&E accounts for the majority of energy use (see Figure 3) and was provided at a detailed time step while the solar accounts for a small portion of the energy use and was only provided on a monthly basis. The exclusion of the solar data does not adversely affect the energy intensity calculations or 24-hour energy profiles. Water flow rates and energy data were not available for individual groundwater pumps. Thus the study team applied the total flow to the total energy for the entire system.

The energy intensity of each facility type within Semitropic Water Storage District is presented in Figure 2. Figure 3 presents the annual distribution of energy sources for Semitropic Water Storage District.

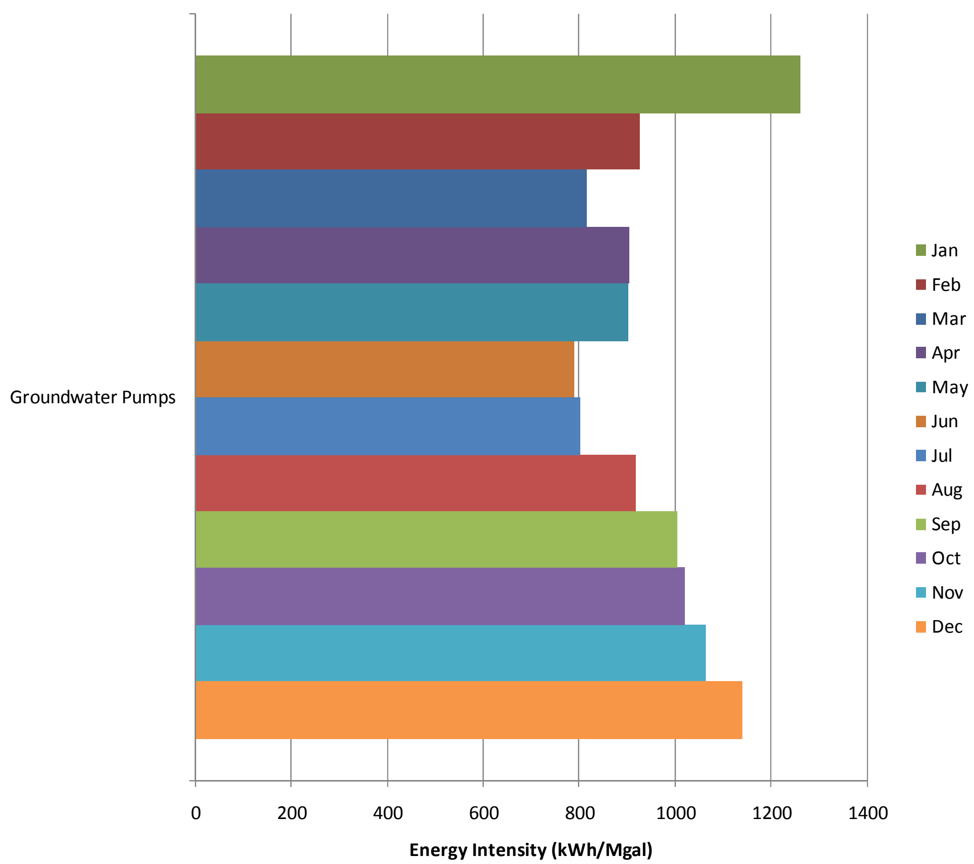



**Figure 2: SWSD Monthly Energy Intensity by Facility Type**

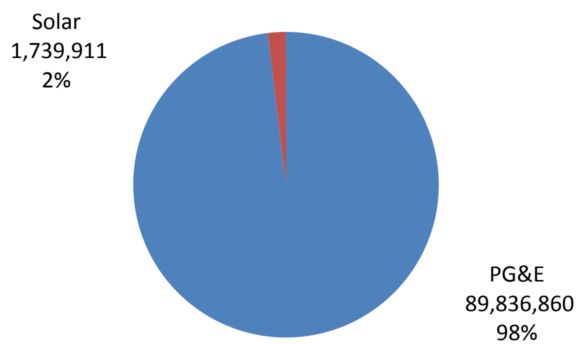
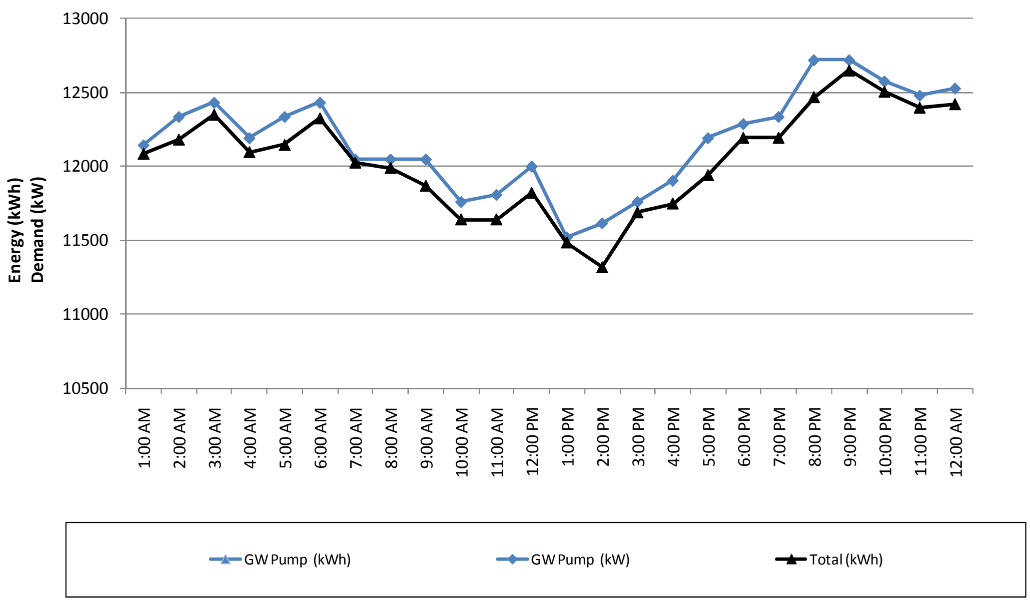


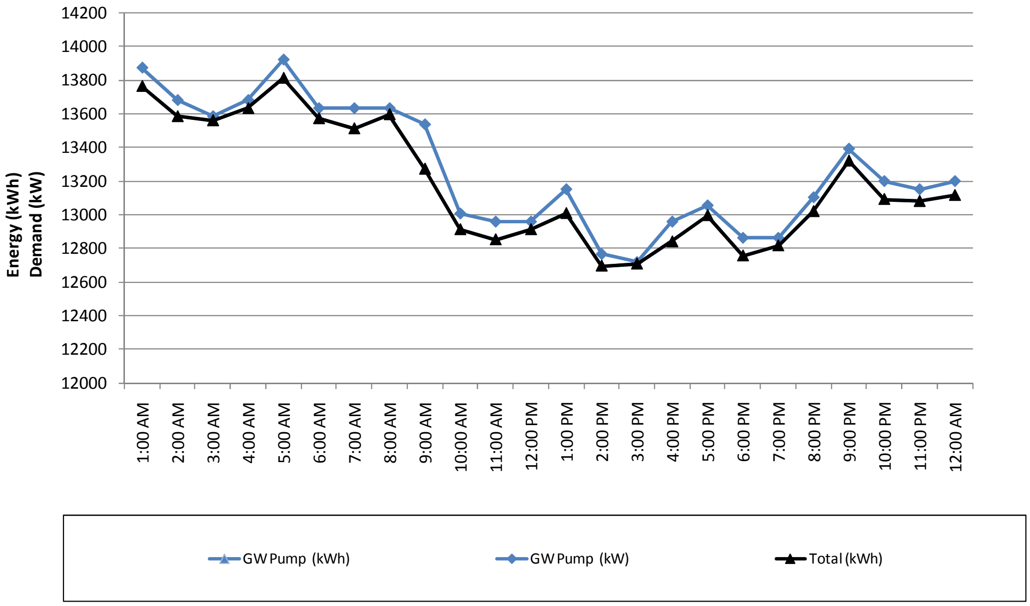

Figure 3: SWSD Annual Energy Consumption by Source (kWh)

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. The majority of energy used by Semitropic Water Storage District is for groundwater pumping.



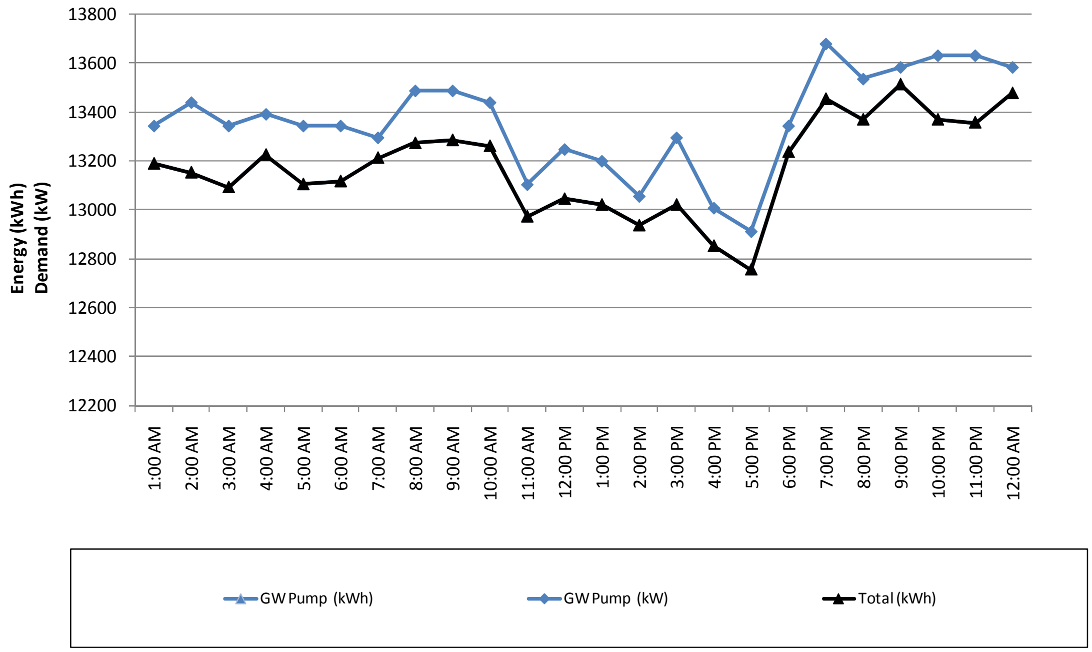

| **Date** | 7/8/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 11,792 |

Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day



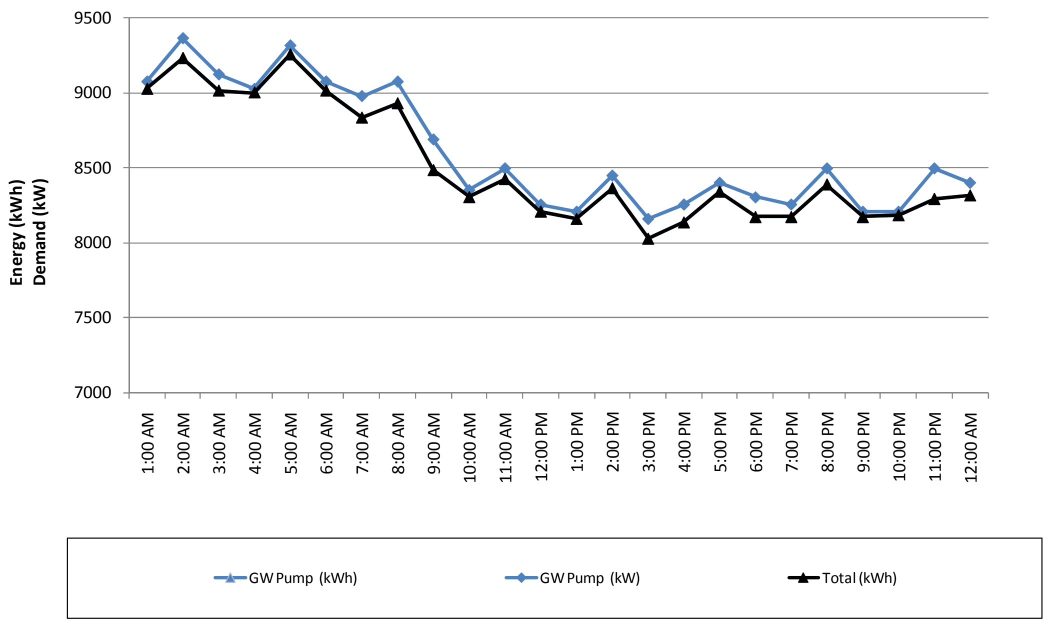

| | |
|---|---|
| **Date** | 7/11/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 12,848 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



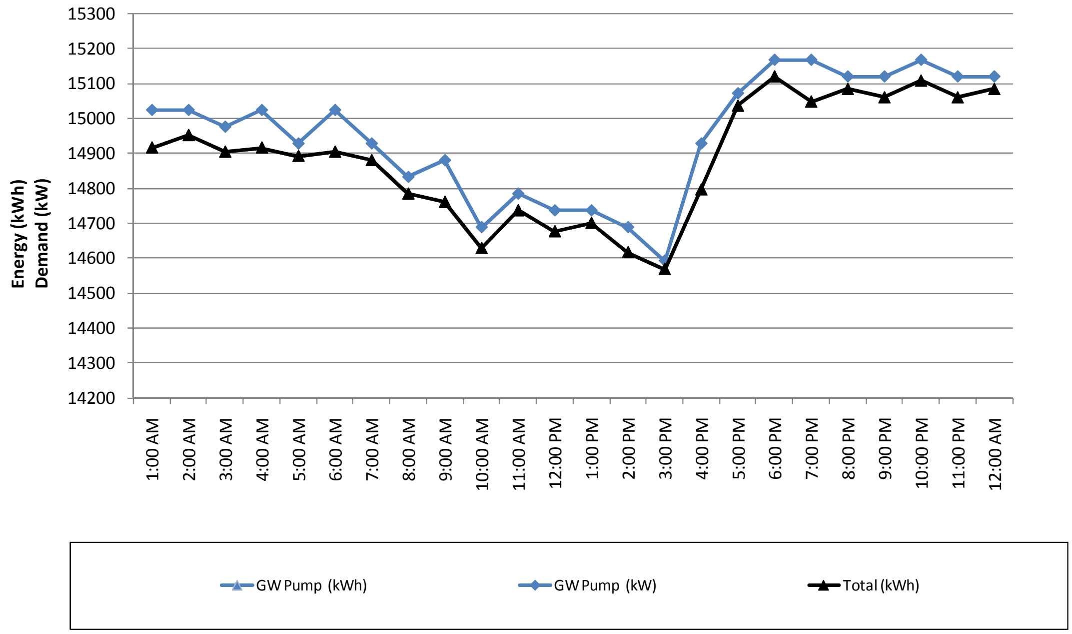

| | |
|---|---|
| **Date** | 9/30/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 12,876 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



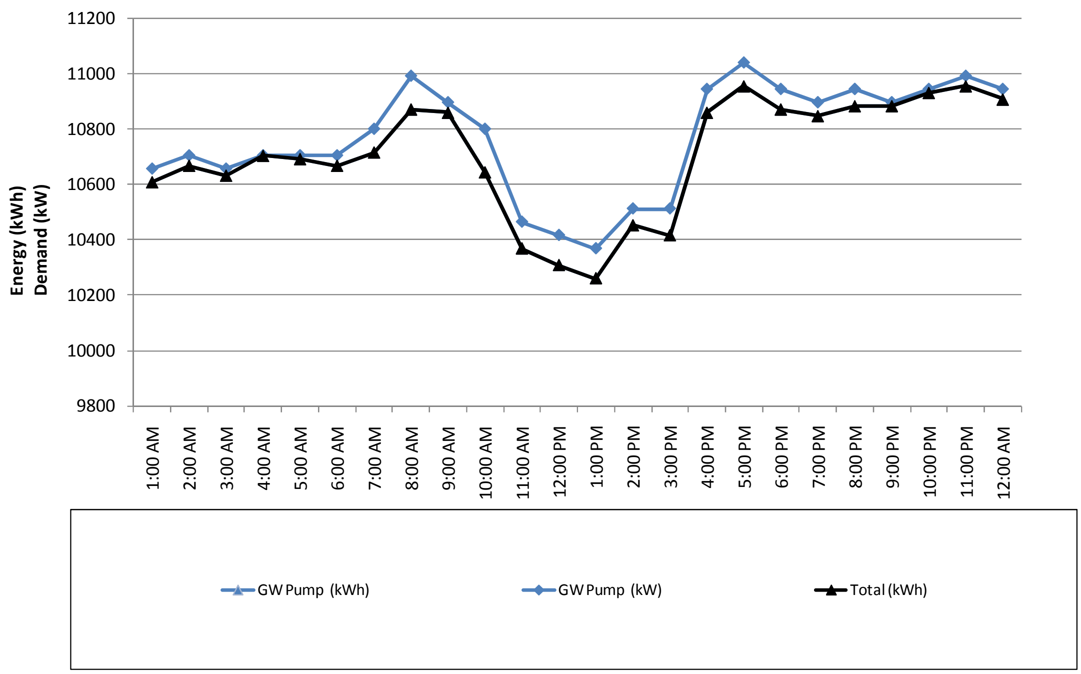

| | |
|---|---|
| **Date** | 5/25/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 8,168 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



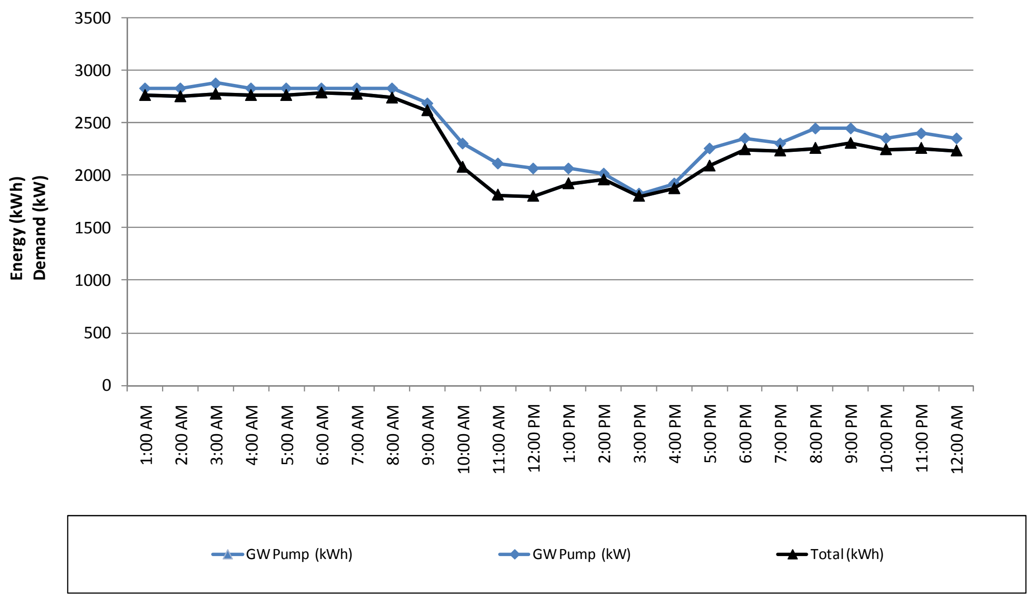

| | |
|---|---|
| **Date** | 11/6/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 14,800 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 1/5/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 10,744 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 2/24/2008 |
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,920 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

Semitropic has executed a contract with Shell Solar to construct a one-Megawatt (MW) Solar Generation Facility. The electricity generated will be one of a number of energy sources feeding Semitropic's distribution system, which powers the pumps that move water. One of the potential uses of the solar energy will be generation of hydrogen to fuel Semitropic's fleet of vehicles. Construction of the solar energy plant was completed in late 2004. The total construction cost is approximately $6 million, about half of which is funded through grants, lessening the financial impact on Semitropic.

The Goose Lake Project is a joint effort involving Ducks Unlimited, Buttonwillow Land and Cattle Co. (BL&C) and Semitropic Water Storage District. Some of the property will be used for capturing floodwater, surplus water and any other unregulated water source. Wells will be drilled on the property and used to recover banked or stored water and provide the wetlands water in dry years.

## Sources


Semitropic Water Storage District. http://www.semitropic.com/AboutUs.htm. Accessed 1/6/2010.

Semitropic Water Storage District. "Groundwater Management Plan". Volume 1. Adopted September 2003.

Kern County. http://www.kerncountyretirement.com/climate.asp. Accessed 1/6/2010.

Semitropic Water Storage District. “Combined Financial Statements December 31, 2008 and 2007”. Web. http://www.semitropic.com/FinancialStatements.htm. Accessed 1/6/2010.

Semitropic Groundwater Banking Program New Opportunities for Storage Brochure, undated.

# Sonoma County Water Agency (SCWA)

## Summary

<table>
<tr><td>Primary functions</td><td colspan="3">Urban Water, Agricultural Water, Urban Wastewater, Local Wholesale</td></tr>
<tr><td>Segments of Water Use Cycle</td><td colspan="3">Supply, Distribution, Wastewater Treatment, Recycled Water Production</td></tr>
<tr><td>Hydrologic Region</td><td>North Coast</td><td>DEER Climate Zone</td><td>2</td></tr>
<tr><td>Quantity of water and wastewater (2005)</td><td colspan="3">Surface Water Diversions: 49 MGD<br>Groundwater Produced: 3.5 MGD<br>Wastewater Treated: 5.1 MGD<br>Recycled: <5.1 MGD</td></tr>
<tr><td>Number of Customers (2005)</td><td>Total: 13<br>Water Contractors: 8<br>Other: 5</td><td>Service Area Size</td><td>N/A</td></tr>
<tr><td>Distinguishing Characteristics</td><td colspan="3">The Sonoma County Water Agency (SCWA) distributes Russian River water and groundwater to its water contractors and other customers. SCWA's service area covers a large part of Sonoma County, as well as the northern portion of Marin County. SCWA operates two recycled water facilities owned by local sanitation districts. The recycled water is not considered supply for SCWA, but is used to offset demand by its contractors. This study collected data from 2 of 8 wastewater treatment plants; both tertiary.</td></tr>
<tr><td>Key Energy Drivers</td><td colspan="3">• Water Supply – Water is pumped from beneath the Russian River, water is naturally filtered removing the need for treatment.<br>• Water Conveyance- Significant energy is used by system booster pump stations. Topography varies but is generally hilly.<br>• Recycled Water Deliveries – pumping is required to deliver treated recycled water</td></tr>
<tr><td>Wastewater Treatment Technologies</td><td colspan="3">Sonoma Valley County Sanitation District (Wastewater) and Airport/Larkfield Wikiup Sanitation Zone: Secondary treatment, tertiary treatment</td></tr>
<tr><td>Water Resources (2008)</td><td colspan="3">Surface Water Diversions: 93%, Agency Produced Groundwater: 7%</td></tr>
<tr><td>Marginal Water Supply</td><td colspan="3">Short-term: Russian River Diversions<br>Long-term: Conservation, recycled water, and enhanced local supplies.</td></tr>
<tr><td>Energy Service Provider</td><td colspan="3">PWRPA, PG&E</td></tr>
<tr><td rowspan="6">Observed Energy Intensities (kWh/MGal)</td><td>Segment</td><td>Lower Range</td><td>Upper Range</td></tr>
<tr><td>Groundwater Pumps</td><td>1,728</td><td>1,975</td></tr>
<tr><td>Booster Pumps</td><td>273</td><td>610</td></tr>
<tr><td>Wastewater Treatment</td><td>1,812</td><td>4,941</td></tr>
<tr><td>Waste Water Pumps</td><td>2</td><td>2</td></tr>
<tr><td>Recycled Water Pumps</td><td>210</td><td>509</td></tr>
</table>

## Background Information

The Sonoma County Water Agency (SCWA) was created as a special district in 1949 by the California Legislature to provide flood protection and water supply services to portions of Sonoma and Marin counties. In 1995, SCWA added water and wastewater to its responsibilities. SCWA diverts water from the Russian River and delivers it to 13 contractors in Sonoma and Marin counties. Table 1 summarizes information about the agency.

Primary sources of information on Sonoma County Water Agency include: SCWA's 2005 Urban Water Management Plan, water and energy data for 2008 provided by SCWA, SCWA's public website, and interviews with staff at SCWA. A detailed list of references is located at the end of this section.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water, Agricultural Water, Urban Wastewater, Local Wholesale |
| **Hydrologic Region** | North Coast |
| **Region Type** | Coastal |
| **Energy Service Provider** | PWRPA, PG&E |
| **DEER Climate Zone** | 2 |
| **Service Area Population (2005)** | 388,362 |
| **Number of Customers in 2008** | 13 |
| ***Water Contractors*** | 8 |
| ***Other*** | 5 |
| **Distribution Topology** | Flat to Hilly |

### Climate

Approximately 93 percent of the annual precipitation normally falls during the wet season, October to May, with a large percentage of the rainfall typically occurring during three or four major winter storms. Winters are cool and below-freezing temperatures seldom occur. Summers are warm and the frost-free season is fairly long. Average annual precipitation over the Russian River watershed is 41 inches, ranging from about 22 inches over the southern portion of the region to over 80 inches in the northern area. Average annual rainfall ranges from 21 to 30 inches within the Sonoma County service area. Temperatures range from 16° to 110°F.

### Demographics

Land use within the SCWA's service area is characterized as mostly suburban. Residential development is more densely concentrated in the cities of Santa Rosa, Rohnert Park, Petaluma, and Cotati, with Forestville, Sonoma, and Valley of the Moon having less concentrated development. In the north Marin County area, residential development is concentrated along Highway 101 and adjacent to San Pablo Bay.

Population and employment projections for each of SCWA's contractors are listed in Table 2. Total service area population is expected to grow 18 percent between 2010 and 2030. The largest population growth during this time period is expected in the City of Santa Rosa.

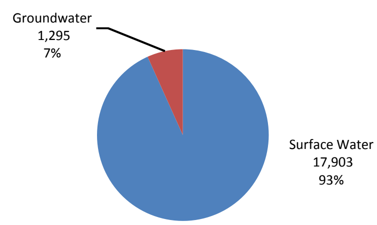
### Table 2: Population – Current and Projected

| Water Contractors | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| City of Cotati | 7,105 | 7,453 | 7,800 | 8,100 | 8,400 | 8,500 |
| North Marin Water District | 58,816 | 60,674 | 64,072 | 66,271 | 67,569 | 68,669 |
| City of Petaluma | 57,277 | 64,000 | 69,000 | 70,390 | 74,000 | 74,000 |
| City of Rohnert Park | 41,640 | 43,764 | 45,997 | 48,343 | 49,740 | 49,740 |
| City of Santa Rosa | 153,790 | 165,535 | 176,627 | 187,067 | 197,507 | 206,294 |
| City of Sonoma | 10,733 | 12,348 | 12,642 | 12,740 | 12,838 | 12,984 |
| Valley of the Moon Water District | 22,665 | 23,359 | 24,055 | 24,753 | 25,109 | 25,466 |
| Town of Windsor | 22,909 | 25,409 | 26,409 | 27,809 | 28,809 | 31,339 |
| **Other Customers** | | | | | | |
| California American Water Company | 8,295 | 8,562 | 8,829 | 9,096 | 9,228 | 9,370 |
| Forestville Water District | 2,166 | 2,266 | 2,367 | 2,467 | 2,558 | 2,649 |
| Kenwood | 999 | 1,031 | 1,062 | 1,094 | 1,115 | 1,132 |
| Lawndale | 312 | 331 | 350 | 369 | 415 | 432 |
| Penngrove | 1,655 | 2,238 | 2,559 | 2,977 | 3,185 | 3,385 |
| **Total** | **388,362** | **416,970** | **441,769** | **461,476** | **480,473** | **493,960** |

Source: SCWA 2005 UWMP, Table 3-2

## Water Sources

The majority of SCWA's supply is surface water from the Russian River. Additional supplies are obtained from local groundwater, see Figure 1.




### Figure 1: 2008 Distribution of Sources (MGal)

### Local Raw Surface Water

The Russian River provides most of the agency's water supply. Two federal projects impound the water supply that ultimately serves SCWA: the Coyote Valley Dam on the Russian River east of the city of Ukiah in Mendocino County (forming Lake Mendocino), and the Warm Springs Dam on Dry Creek (a tributary of the Russian River) northwest of the City of Healdsburg in Sonoma County (forming Lake Sonoma). SCWA was the local sponsor for the dams and partially financed their construction; thus, SCWA has the right to control releases from the water supply pools of both reservoirs.

Permits authorize SCWA to store up to 122,500 AF/yr of water in Lake Mendocino and up to 245,000 AF/yr of water in Lake Sonoma.

Once water is released it flows down river to SCWA's delivery point. SCWA diverts water from the river into percolation ponds using an inflatable dam. Water seeps into the ground through gravel and sand beds that naturally filter the water. SCWA draws water from beneath these pools using Raney groundwater collectors at SCWA's Wohler and Mirabel facilities. Permits allow SCWA to divert 180 cubic feet per second (cfs) of water from the Russian River, up to 75,000 AF/yr. The permits also establish minimum instream flow requirements for fish and wildlife protection and recreation. The agency meets the various instream flow requirements by making releases from Coyote Valley Dam and Warm Springs Dam.

After more than 10 years of studies, in 2008 the National Marine Fisheries Service (NMFS) issued a finding that some aspects of flood control and water supply operations threaten to jeopardize steelhead and coho but not Chinook. This jeopardy opinion means that SCWA and the Corps of Engineers must change the operations of the Russian River. The primary impact of this biological decision on water supply is that flows will be reduced from historical levels during summer months to reduce adverse habitat impacts on young fish populations by reducing the velocity of flows in the river. More information about the biological decision can be found at: http://www.scwa.ca.gov/rrifr/.

### Groundwater

Groundwater wells make up for a small portion of the supply for SCWA. The agency's three groundwater supply wells are located in the Santa Rosa Plain north, east, and southeast of Sebastopol. SCWA conducts a groundwater monitoring program of water levels in seventeen dedicated monitoring wells in the vicinity of its three water supply wells to assess the effects of these wells on local groundwater conditions. There are no existing legal constraints on SCWA's ability to use its groundwater supply.

### Recycled Water

SCWA does not supply recycled water to its contractors or other customers, but is involved with coordinating recycled water programs including funding for projects that offset SCWA water deliveries. Some of the SCWA contractors and other customers have developed recycled water plans in coordination with the wastewater treatment facilities within their local service areas. SCWA operates two recycled water facilities. These facilities are owned by the Airport-Larkfield-Wikiup Sanitation Zone and Sonoma Valley County Sanitation District. This recycled water is not considered part of SCWA's supply.

### Marginal Water Supply

The Study Team identified both short- and long-term marginal supplies for SCWA. The Russian River is SCWA's short-term marginal supply; it is the largest supply of water to SCWA and its diversion amount varies significantly by season to meet demand. Groundwater withdrawals are small and relative constant in comparison to Russian River diversions.

In the long-term, SCWA marginal supply includes increased conservation, additional use of recycled water, and enhanced local supply.

The energy intensity range of SCWA's marginal supply is summarized in Table 3. The energy intensity represents the embedded energy for all activities prior to the water entering SCWA's distribution system.

### Table 3: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Russian River Diversions[a] | 1,728-1,975 kWh/MG |
| Long-term | Recycled Water[b] | 3,466 kWh/MG |
| | Additional Local Supplies | unknown |

a) Energy associated with Wohler and Mirabel facilities, calculated by the Study Team using data supplied by SCWA.

b) Obtained from Study 1

## Water Demand

Table 4 summarizes projected wholesale water sales to SCWA water contractors and other customers from 2010 to 2030. Total demand is expected to increase 35 percent during this time period while population is projected to increase 18 percent (Table 2). The largest increase in demand is expected from Marin Municipal Water District.

### Table 4: Projected Demand for SCWA Water by Contractors and Customers (AF/Yr)

| Water Contractors | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| City of Cotati | 1,168 | 1,171 | 1,339 | 1,425 | 1,489 |
| North Marin Water District | 11,189 | 11,482 | 12,385 | 13,107 | 13,000 |
| City of Petaluma | 11,368 | 11,753 | 12,556 | 13,561 | 13,400 |
| City of Rohnert Park | 6,301 | 6,292 | 6,817 | 7,152 | 7,491 |
| City of Santa Rosa | 24,706 | 25,127 | 27,543 | 30,032 | 30,930 |
| City of Sonoma | 2,459 | 2,393 | 2,491 | 2,586 | 3,000 |
| Valley of the Moon Water District | 3,312 | 3,185 | 3,360 | 3,488 | 3,729 |
| Town of Windsor | 4,480 | 4,701 | 5,417 | 5,827 | 5,750 |
| **Other Customers** | | | | | |
| California American Water Company | 1,326 | 1,368 | 1,409 | 1,429 | 1,451 |
| Forestville Water District | 542 | 542 | 544 | 546 | 550 |
| Kenwood | 175 | 181 | 186 | 190 | 193 |
| Lawndale | 66 | 70 | 74 | 83 | 86 |
| Penngrove | 400 | 457 | 532 | 569 | 604 |
| Marin Municipal Water District | 6,915 | 6,790 | 11,300 | 12,800 | 14,300 |
| Direct Diverters | 0 | 0 | 2,448 | 3,671 | 4,895 |
| **Subtotal** | **74,407** | **75,512** | **88,401** | **96,467** | **100,869** |
| Unaccounted-for system losses | 3,104 | 3,341 | 3,635 | 3,845 | 4,000 |
| **Total** | **77,511** | **78,853** | **92,036** | **100,312** | **104,869** |

Source: SCWA 2005 UWMP, Tables 3-4 to 3-6

## System Infrastructure and Operations

SCWA operates a complex system of river diversion facilities, distribution pumps, pipelines, and tanks to deliver water to its customers. Table 5 summarizes the infrastructure operated by SCWA. Figures 2 and 3 depict the interconnections between SCWA facilities.

### Table 5: Infrastructure Summary

| | |
|---|---|
| **Number of Groundwater Wells** | 3 |
| **Number of Raney Collector Wells** | 6 |
| **Number of Reservoirs Operated** | 2 |
| **Miles of Transmission Piping** | 85+ |
| **Number of Plants** | |
| ***Recycled Water*** | 8 |
| **Number of Storage Tanks** | 17 |
| **System-wide Storage Capacity** | 129 MG |

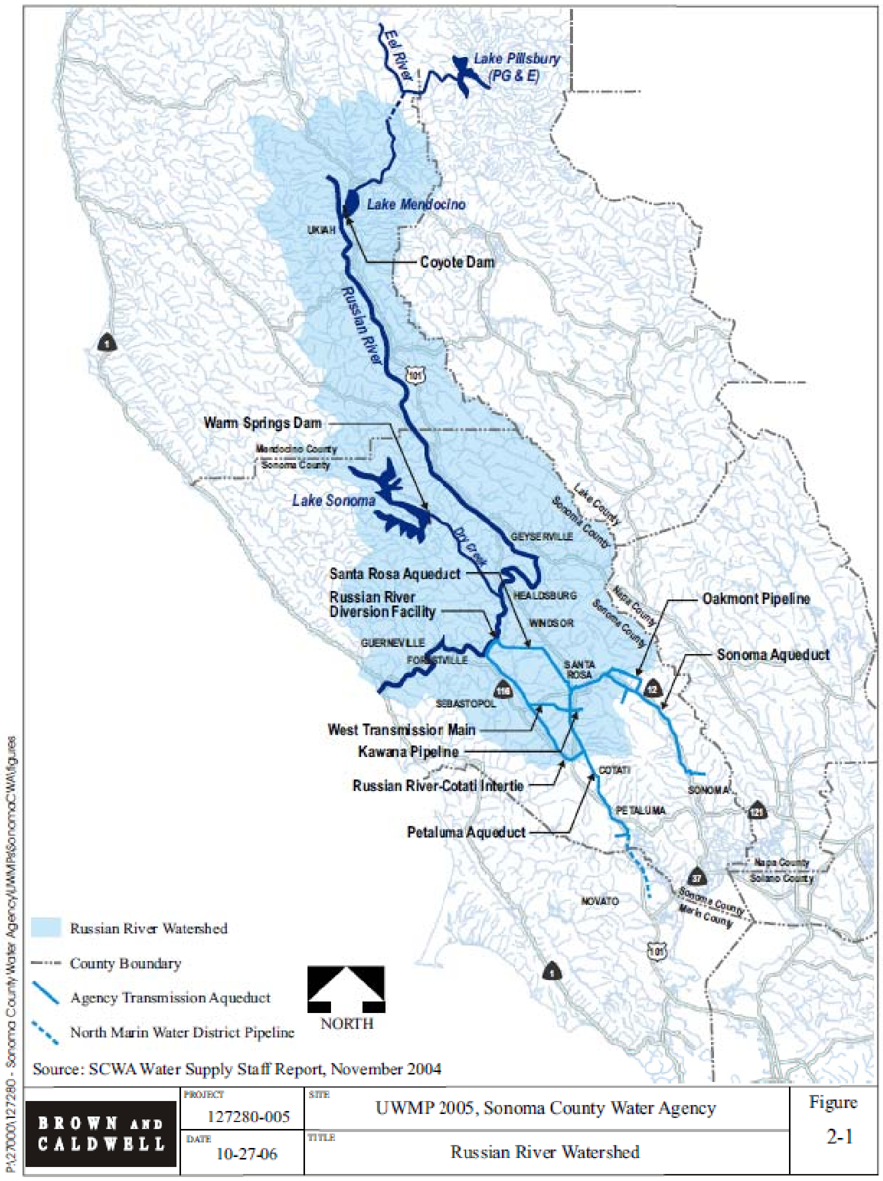



Figure 2: Russian River Watershed and SCWA Facilities

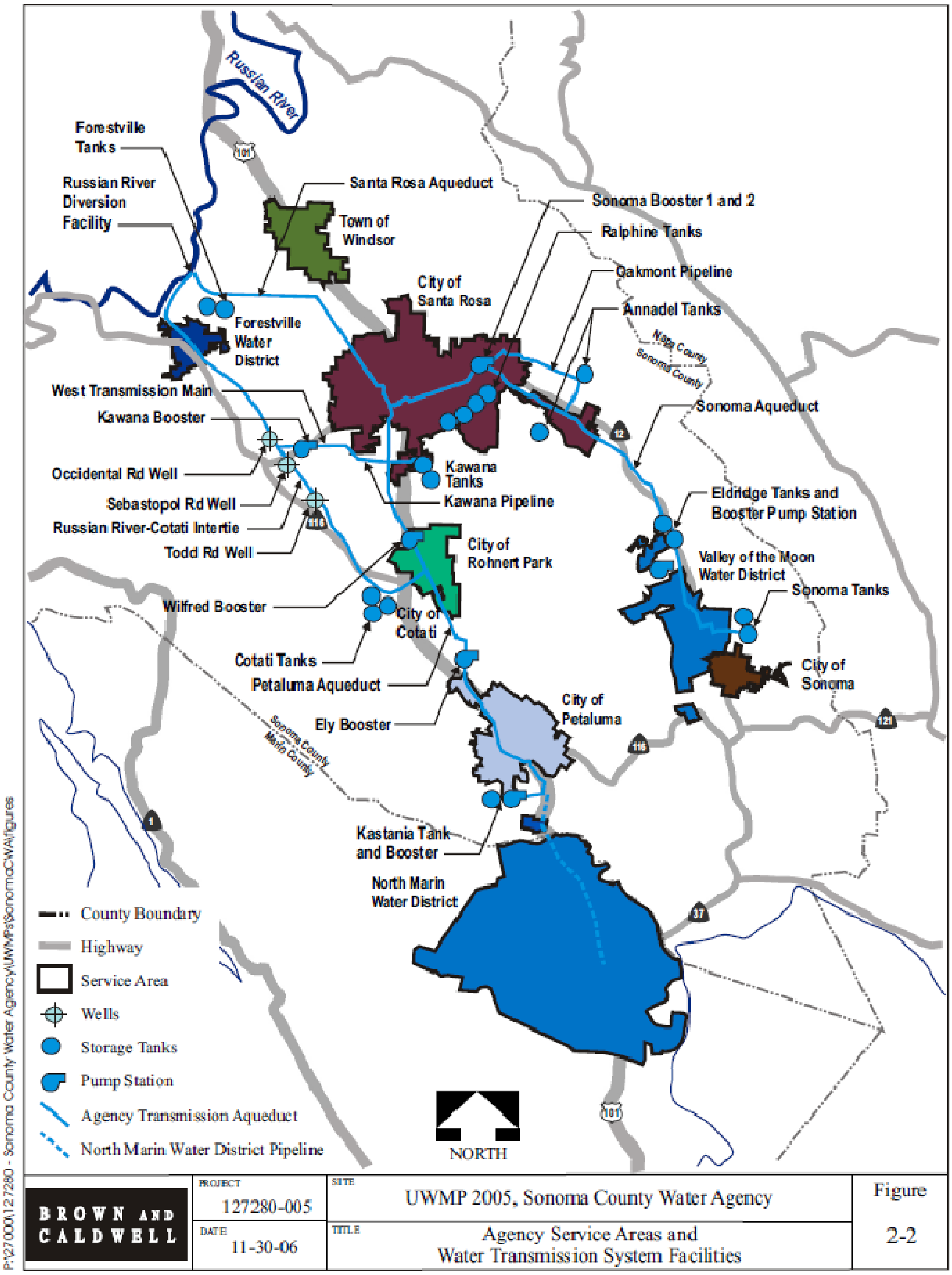



**Figure 3: SCWA Service Area**

## *Supply*

SCWA diverts from the Russian River (see Figure 3) into percolation ponds. SCWA operates six Raney collector wells in the Wohler and Mirabel areas adjacent to the Russian River to pump water from beneath the percolation ponds. The first two collector wells (Collectors 1 and 2) were constructed in the late 1950s in the Wohler area. Between 1975 and 1983, Collectors 3, 4, and 5 were constructed in the Mirabel area. Collector 6, located in the Wohler area, was completed in 2006. Each collector well consists of a 13 to 18 foot diameter concrete caisson extending approximately 60 to 110 feet into the aquifer. Horizontal perforated intake laterals extend radially from the bottom of each caisson into the aquifer. Each collector well houses two vertical turbine pumps that are driven by the electrical motors. In order to increase production capacity during peak demand months, the SCWA raises an inflatable dam at Mirabel; water pools behind the inflatable dam and is diverted into the infiltration ponds to recharge the aquifer below the collector wells. For the purposes of this study, the Study Team classifies the Raney collectors as groundwater pumps.

SCWA maintains and operates five electric generators at the Wohler and Mirabel facilities; these are used as standby backup power for the Raney pumps. Thus, SCWA ensures water supply to customers is even if there is a loss of power to these pumps.

SCWA also operates three major groundwater pumps. These wells are located on Sebastopol Road, Occidental Road and Todd Road and have capacities of 3.6 MGD, 2.3 MGD and 1.7 MGD

### *Treatment*

Minimal treatment is required by SCWA as supplies are of high quality due to the natural filtration process utilized by the diversion facilities. SCWA treats its water supplies by chlorination for residual disinfection. Sodium hydroxide is also added for pH adjustment. These chemicals are added at two chemical addition facilities at the Wohler and Mirabel facilities.

### *Distribution*

SCWA's transmission system extends from the Russian River diversion facilities located near Forestville to the Santa Rosa, Petaluma, and Sonoma valleys. The transmission system consists of over 85 miles of pipelines that range in diameter from 12 to 54 inches, 7 booster pump stations, and 17 storage tanks with a combined storage capacity of 129 million gallons. The major pipelines that comprise the system, illustrated in Figure 3, are the Santa Rosa Aqueduct (built in 1959), the Sonoma Aqueduct (built in 1963), the Petaluma Aqueduct (built in 1961), and the Russian River to Cotati Intertie (built in 1977). A pipeline owned and operated by the North Marin Water District receives water from the transmission system near the Kastania Tanks located near the border of Marin County with Sonoma County.

### *Wastewater and Recycled Water Treatment Plants*

Eight different sanitation zones and districts throughout SCWA service territory collect and treat wastewater: Occidental County Sanitation District, Russian River County Sanitation District, Sonoma Valley County Sanitation District, South Park County Sanitation District, Airport/Larkfield/Wikiup Sanitation Zone, Geyserville Sanitation Zone, Penngrove Sanitation Zone, Sea Ranch Sanitation Zone. SCWA operates all these plants except Sea Ranch Sanitation Zone and South Park Sanitation District. Three plants are tertiary: Sonoma Valley, Airport/Larkfield/Wikiup and Russian River; the rest are secondary. In addition, SCWA operated three recycled water plants owned by the Russian River County Sanitation District, the Sonoma Valley County Sanitation District and Airport/Larkfield/Wikiup Sanitation Zone.

South Park and Pengrove feed into sub-regional plants in SCWA's service area that are operated by local jurisdictions. For more information, see: http://www.scwa.ca.gov/sanitation-districts-and-zones/.

Two tertiary plants were included in Study 2 and profiled in this appendix:

- The Sonoma Valley County Sanitation District serves 4,500 acres and 17,027 Equivalent Single-Family Dwellings. Wastewater is treated up to tertiary treatment; the plant has a capacity of 3 MGD. Between May 1 and October 30 the recycled water is used for irrigation in vineyards and pastures. Between November 1 and April 30 recycled water is discharged into Schell Slough or Hudeman Slough. Wastewater is collected by two wastewater collection pumps and recycled water is distributed using six distribution pumps. The facility was recently outfitted with a 1MW solar array to power approximately 35 percent of the facility's energy needs.

- The Airport/Larkfield/Wikiup Sanitation Zone serves 2,100 acres and 3,464 Equivalent Single-Family Dwellings. Wastewater is treated up to tertiary treatment; the plant has a capacity of 900,000 gallons per day. All of the recycled water is used for irrigation. The facility was recently outfitted with a 500 kW solar array to partially power the facility.

### System Storage

SCWA has 17 treated water storage tanks with a combined storage capacity of 129 MG. The agency's major storage systems are the Raphine, Sonoma, Cotati, and Kastania tanks. The Study Team estimates at full capacity the system can store approximately 2.5 days worth of supply.

### System-wide Operation Strategy

The system is operated to maintain sufficient storage levels in tanks to ensure supply for customers.

SCWA operates the Raney collector system in two segments, the Mirabel and Wohler systems. Each contains three Raney collectors and one chlorination plant to treat water. Each primarily serves a different area. Water produced at Mirabel is sent to Petaluma and through the Kastiana pumps to Marin. Wohler mainly serves Santa Rosa and Sonoma, though it's intertied to serve Petaluma and Marin as well. Both Wohler and Mirabel have an emergency intertie between the two systems near the Russian River. If one set of pumps are inoperable the other can provided water in order to meet demand.

The booster pumps in the system are used mainly to add pressure to the transmission pipes and increase flow if needed. Pressure generated at the Mirabel and Wohler facilities are sufficient enough to transport water to almost all customers in the service area. When demand increases the flow and pressure generated by the Wohler and Mirabel pumps are not sufficient; the booster pumps are then enabled. Most booster pumps are designed with an aqueduct bypass; water can be boosted in pressure through the pump, or can bypass the pump and continue to flow. This operation is evident in the Study Team's data as will be discussed later.

### Infrastructure Changes

The Sonoma Valley County Sanitation District Tertiary Treatment Plant Upgrade was completed on June 30, 2008. Work included the construction of a 14 million gallon per day tertiary filter system, four vertical turbine pumps, chemical feed system (including meters, pumps and analyzers), and an electrical system. This change has little effect on the Study Team's data.

Construction also began to replace the backup generators at the Mirabel facilities. Construction began October 2008 though will not affect the Study Team's data as this facility is not regularly used.

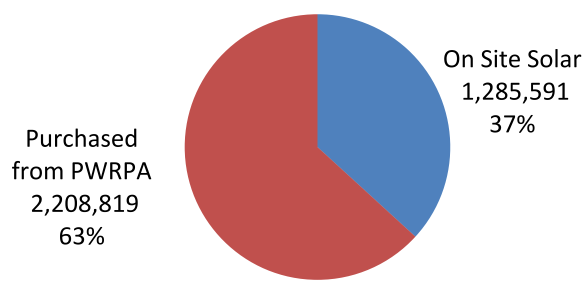
## Energy Profiles

SCWA provided energy and water flow data to the Study Team for its calculations of energy profiles. Energy and water flow data was collected and maintained by SCWA through a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system provided both energy and water flow data at hourly time step.

Energy data was available for each booster pump, groundwater well, the recycled water plant, wastewater pump, and recycled water pump. Energy data for the six Raney collectors were combined into two data sets, one for the Mirabel and one for the Wohler facility. Additional hourly data from the recycled water plant indicated the amount of energy that was generated from the solar array and the amount that was purchased from PWRPA.

Flow data was available for each booster pump, groundwater well, the recycled water plant, wastewater pump, and recycled water pump. Energy data for the six Raney collectors were combined into one data set representing the total water production for the system. When hourly energy and flow data for each booster pump was compared, the effect of pump bypass could be seen as pump had flow data for hours in which energy was not consumed. Ultimately, hourly flow data was more detailed than what was needed for the Study Team’s purposes. Daily totals were developed from the hourly data.

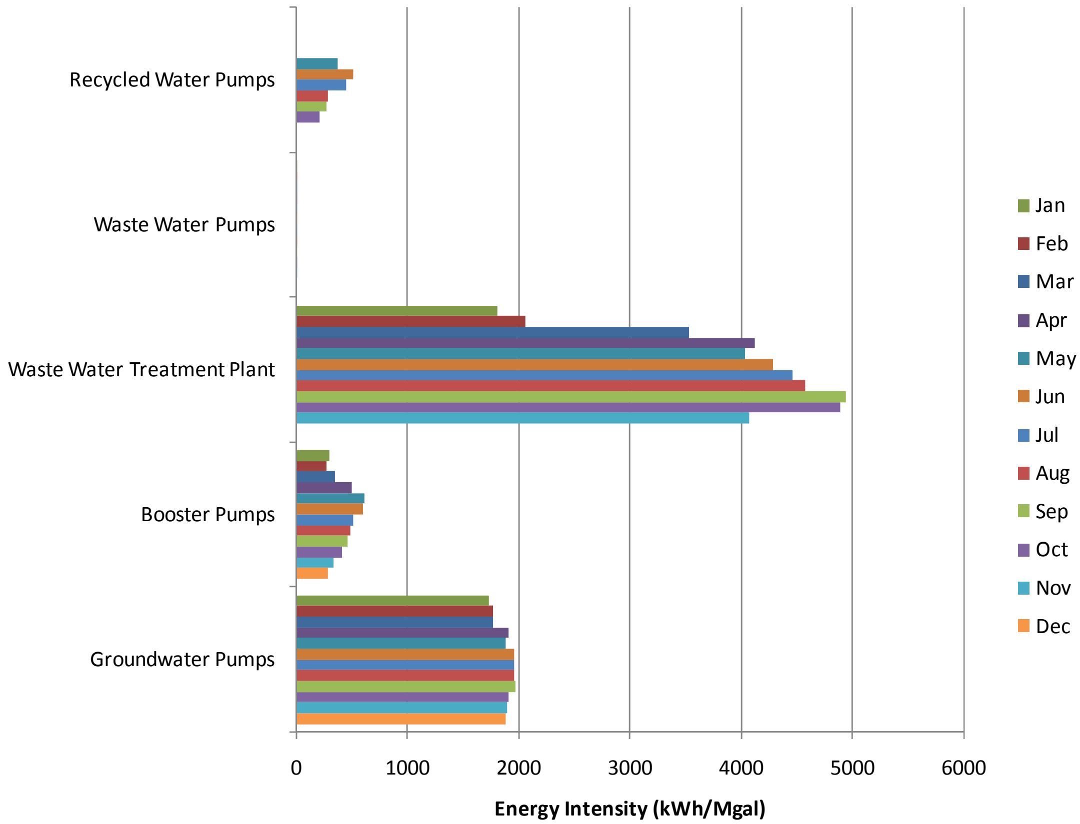
SCWA obtains the majority of its energy from PWRPA. PG&E powers the Mirabel and Wohler backup generators, the wastewater pumps, and one recycled water pump. A portion of the energy provided to the energy provided to the Sonoma Valley County Sanitation District Recycled Water Plant is supplied by on-site solar generation, see Figure 4. All other facilities obtain their energy from PWRPA.




Note: Detailed data was not available for January and February

**Figure 4: Recycled Water Plant Energy Supply, kWh (March – December)**

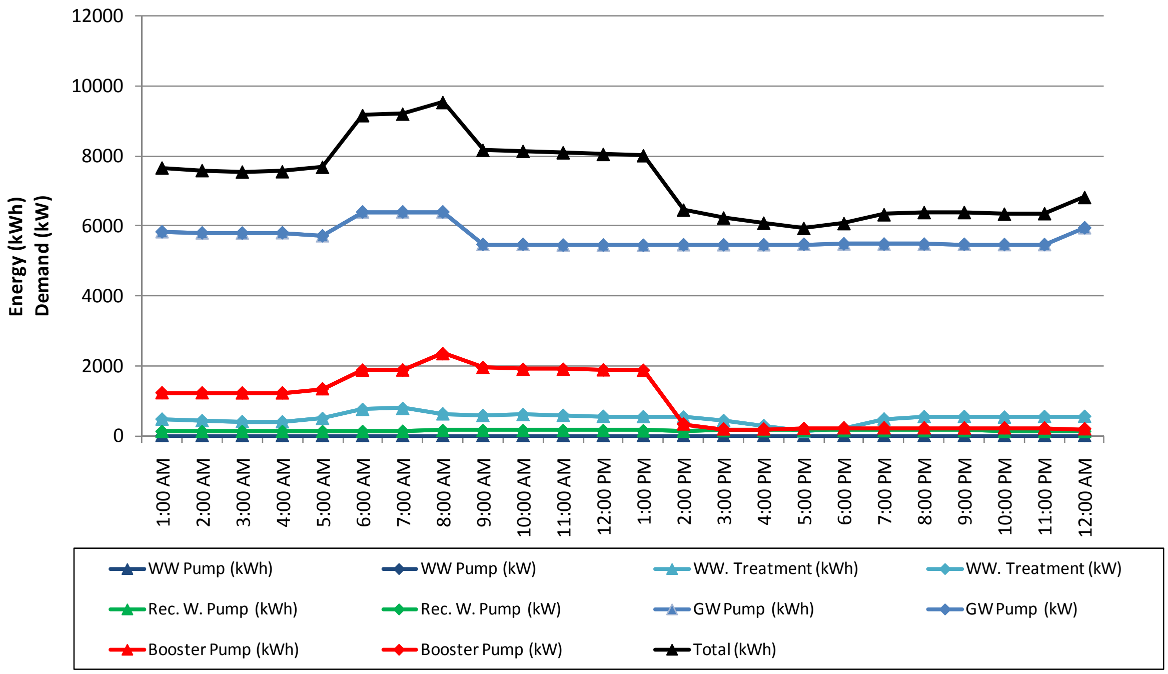
The energy intensity of each facility type within Sonoma County Water Agency is presented in Figure 5.




Note: The energy intensity of wastewater pumps is approximately 2 kWh/AF

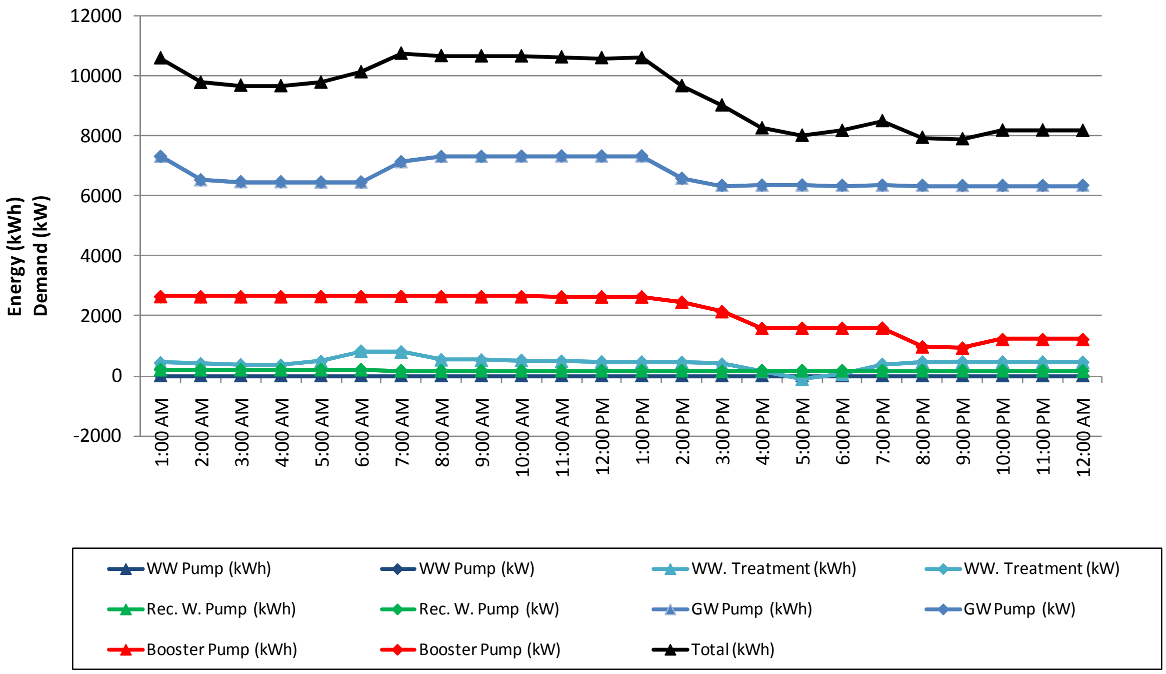
### Figure 5: SCWA Monthly Energy Intensity by Facility Type

Hourly Energy profiles and peak energy demand is documented in Figures 6 through 12. The majority of energy used by Sonoma County Water Agency is for groundwater pumping (including Russian River diversion)



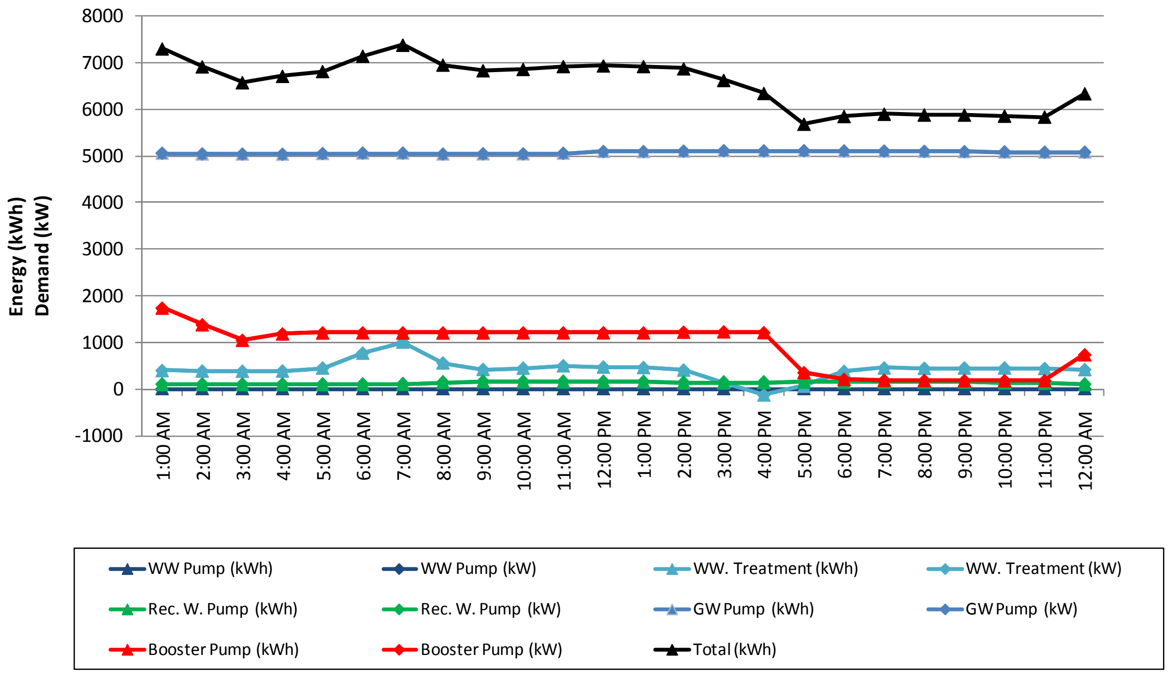

| | |
|---|---|
| **Date** | 7/8/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 5,464 |
| *Booster Pumps* | 189 |
| *Recycled Water Distribution* | 157 |
| *Wastewater Collection Pumps* | 0.2 |
| *Wastewater Treatment* | 282 |

**Figure 6: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



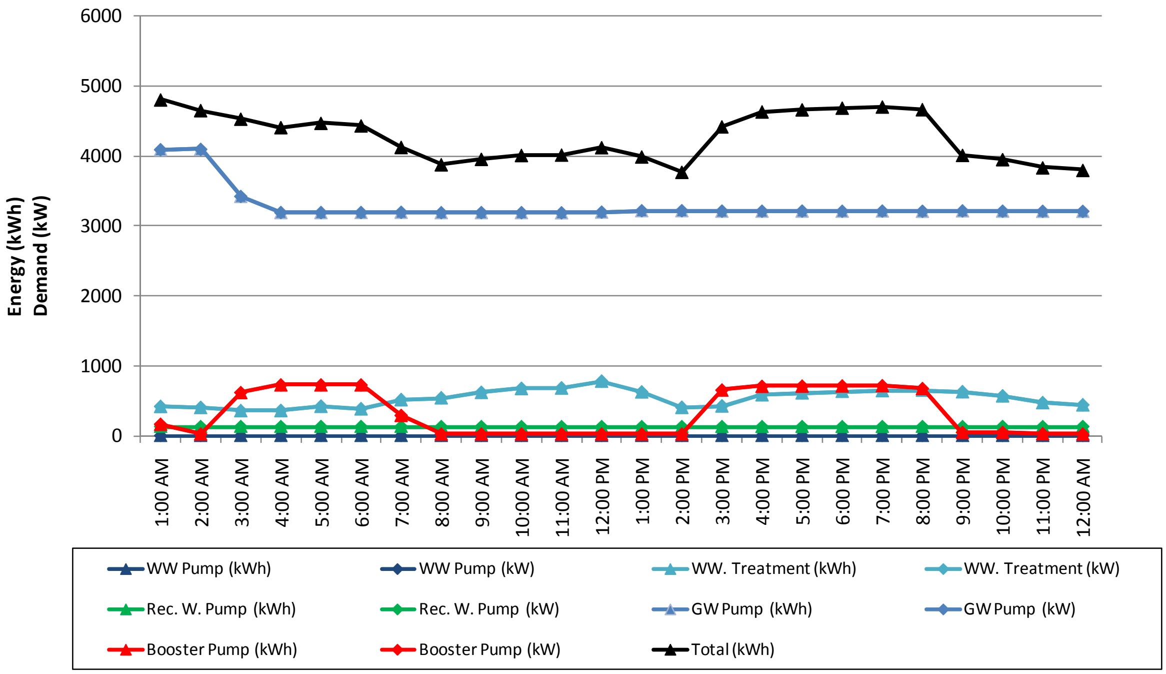

| | |
|---|---|
| **Date** | 5/16/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 6,339 |
| *Booster Pumps* | 1,784 |
| *Recycled Water Distribution* | 153 |
| *Wastewater Collection Pumps* | 0.2 |
| *Wastewater Treatment* | 149 |

**Figure 7: 24-Hour Energy Profile: Summer High Water Demand Day**



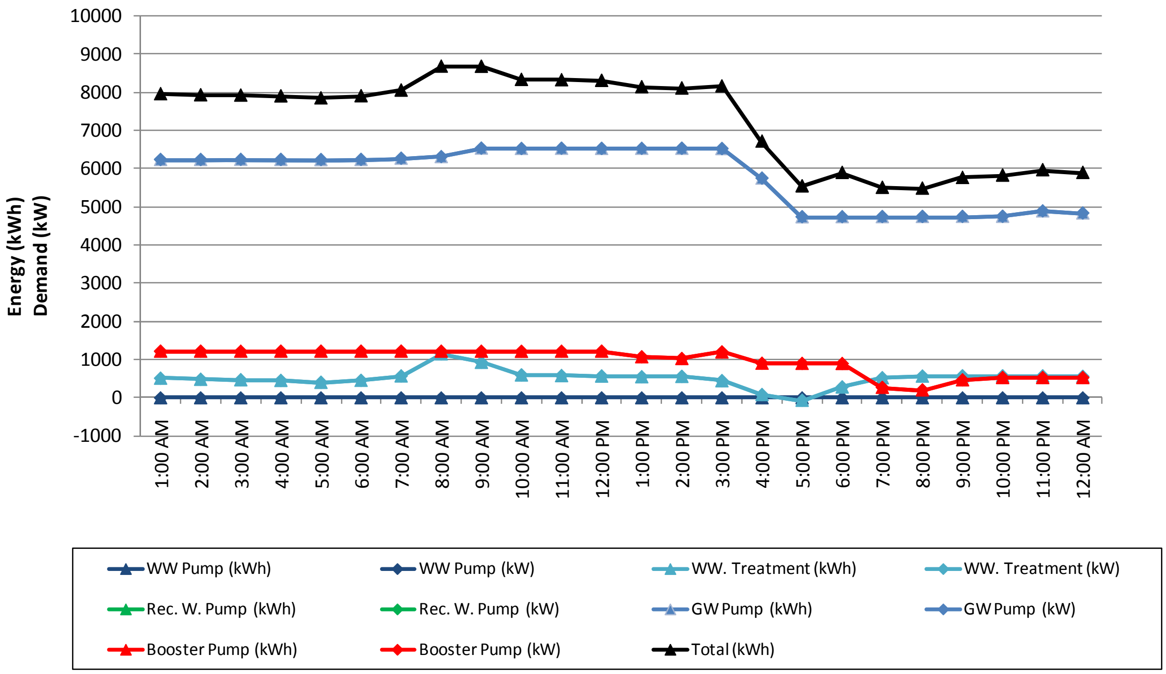

| **Date** | 8/9/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 5,106 |
| *Booster Pumps* | 935 |
| *Recycled Water Distribution* | 147 |
| *Wastewater Collection Pumps* | 0.2 |
| *Wastewater Treatment* | 28 |

**Figure 8: 24-Hour Energy Profile: Summer Average Water Demand Day**



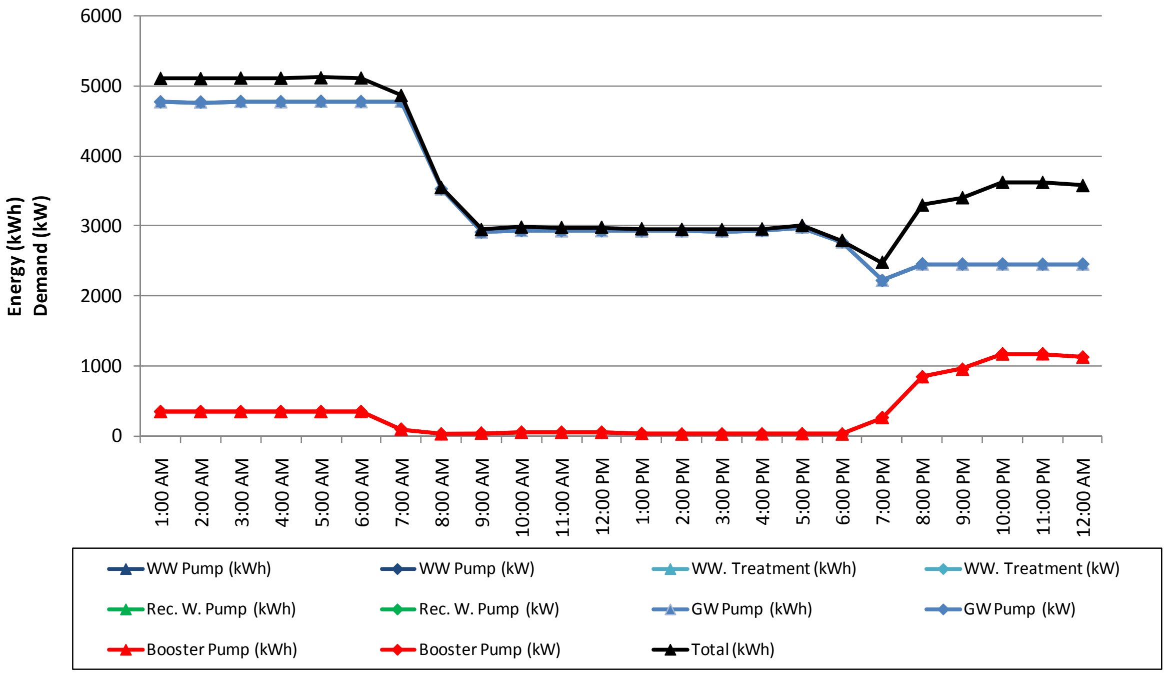

| | |
|---|---|
| **Date** | 10/5/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 3,208 |
| *Booster Pumps* | 693 |
| *Recycled Water Distribution* | 129 |
| *Wastewater Collection Pumps* | 0.2 |
| *Wastewater Treatment* | 540 |

**Figure 9: 24-Hour Energy Profile: Summer Low Water Demand Day**



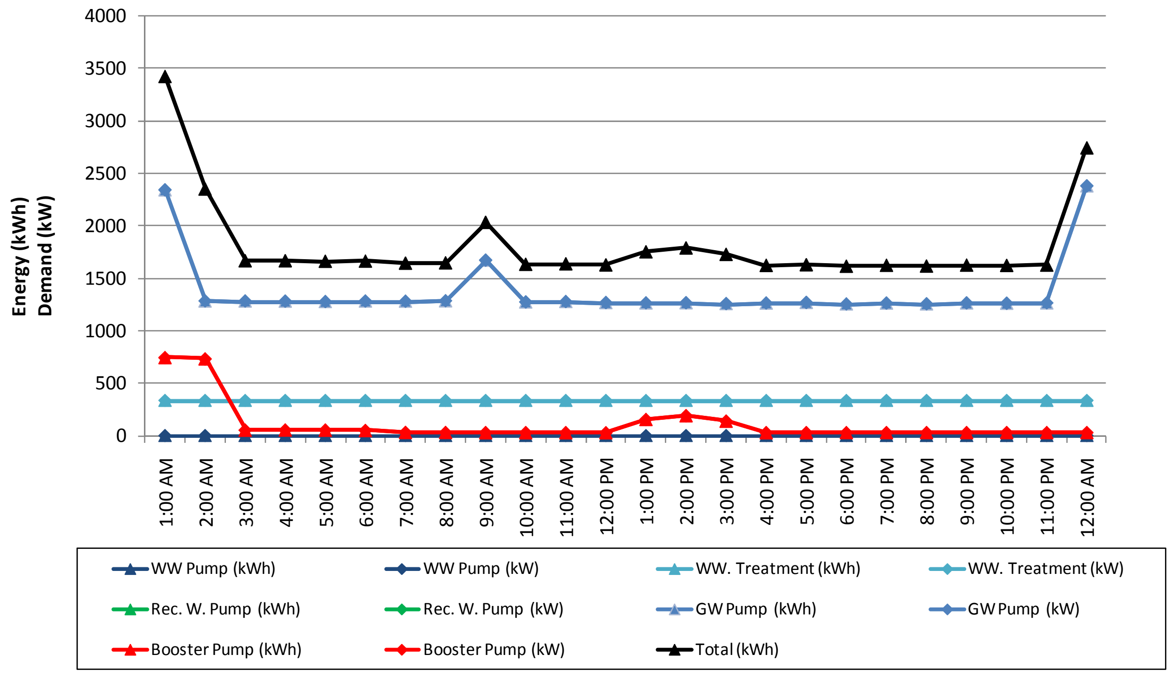

| **Date** | 4/14/2008 |
|---|---|
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Groundwater* | 5,659 |
| *Booster Pumps* | 995 |
| *Recycled Water Distribution* | 0 |
| *Wastewater Collection Pumps* | 0.3 |
| *Wastewater Treatment* | 146 |

**Figure 10: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 12/2/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,942 |
| *Booster Pumps* | 26 |
| *Recycled Water Distribution* | 0 |
| *Wastewater Collection Pumps* | 0 |
| *Wastewater Treatment* | 0 |

**Figure 11: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 2/20/2008 |
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,259 |
| *Booster Pumps* | 67 |
| *Recycled Water Distribution* | 0 |
| *Wastewater Collection Pumps* | 0.3 |
| *Wastewater Treatment* | 334 |

**Figure 12: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

The Mirabel Generator Replacement Project started October 13, 2008. The work consists of replacement of two generators, switchgear and transformer with two 2,500-kilowatt, 12,470 volt generators.

## Sources

SCWA. "2005 Urban Water Management Plan." December 2006.

SCWA. SCWA public website: http://www.scwa.ca.gov/about-us/. Accessed 12/28/2009.

Jim Zambenini, Operations Coordinator – SCWA. Interviewed September 8th, 2009 by Amul Sathe.

SCWA. "Future Water Supply Focuses on Conservation, Reuse." Press Release. Accessed 3/1/2010. http://www.scwa.ca.gov/lower.php?url=press-releases&article=future-water-supply-focuses-on-conservation-reuse-2009-09-15

# Suburban Water Systems (SWS)

## Summary

| | | | |
|---|---|---|---|
| **Primary function** | Urban Water | | |
| **Segments of Water Use Cycle** | Supply, Distribution | | |
| **Hydrologic Region** | South Coast | **DEER Climate Zone** | 9 |
| **Quantity of water (2008)** | Produced: 1.78 MGD<br>Distributed: 50.71 MGD | | |
| **Number of Customers (2005)** | Total: 74,700 connections<br>Residential: 54,202<br>Commercial: 14,851<br>Industrial: 1,165<br>Public Agencies: 4,482 | **Service Area Size** | 41.7 Sq miles |
| **Distinguishing Characteristics** | SWS meets most of its demand with groundwater. The SWS service area is currently divided into two main Districts: the San Jose Hills District, and the Whittier/La Mirada District. The San Jose Hills District is divided into five (5) operational service areas. The Whittier/La Mirada District is divided into four (4) operational service areas. | | |
| **Key Energy Drivers** | • Water Supply – Energy is used to pump water from wells in the service area.<br>• Water Treatment – The energy use for the addition of sodium hypochlorate for disinfection of groundwater at wells is negligible.<br>• Water Distribution – A significant amount of energy is used by booster pumps. | | |
| **Water/Wastewater Treatment Technology** | Plant 409 W-3 and Plant 410 W-1 (Central Basin): SWS adds sodium hypochlorate for disinfection.<br>Plant 121 W-1, Plant 142 W-2, Plant 151 W-2, Plant 147 W-3, Plant 201 W-4, Plant 201 W-5, Plant 201 W-7, Plant 201 W-8, Plant 201 W-9, Plant 201 W-10 (Main San Gabriel Basin): SWS adds sodium hypochlorate for disinfection. | | |
| **Water Resources** | Groundwater: 66.25%, Surface Water (CIC): 6.59%, Imported Water (Metropolitan Water District (MWD)): 10.33%, Purchased From Other Agencies: 16.82% | | |
| **Marginal Water Supplies** | Short-term: SWS has multiple interconnections with other water agencies to supplement groundwater supply and for emergency transfers.<br>Long-term: A groundwater treatment facility has been constructed to provide an average annual supply of about 11,300 acre-feet. SWS will receive about 8,200 acre-feet per year of fully treated water that will be used to supplement existing sources of supply. | | |
| **Energy Service Provider** | SCE, SCG | | |
| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
| | Groundwater | 1,254 | 1,619 |
| | Water Distribution | 801 | 1,081 |

## Background Information

Suburban Water Systems (SWS) is a retail water company that currently serves approximately 300,000 customers within its service area. Table 1provides a summary of the company. SWS has the legal right to pump groundwater from both the Main San Gabriel Basin and Central Basin and can purchase treated imported water from the Metropolitan Water District of Southern California (MWD) through its member agency, Upper San Gabriel Valley Municipal Water District (USGVMWD) and Central Basin Municipal Water District (CBMWD). SWS serves the Cities of Glendora, Covina, West Covina, La Puente, Industry, Walnut, Whittier, La Mirada, La Habra, and Buena Park, as well as sections of unincorporated Los Angeles County (including, Whittier, Valinda and Hacienda Heights) and Orange County. SWS' service area is divided into two separate water systems, the San Jose Hills District and the Whittier/La Mirada District.

Primary sources of information on SWS include: SWS' 2005 Urban Water Management Plan, SWS 2008 Energy Report provided by SWS, and interviews with staff at SWS. A detailed list of references is located at the end of this section.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Urban Water |
| **Hydrologic Region** | South Coast |
| **Region Type** | Southland |
| **Energy Service Provider** | SCE |
| **DEER Climate Zone** | 9 |
| **Service Area Size** | 41.7 square miles |
| **Service Area Population** | 300,000 |
| **Number of Customers in 2005** | Total: 74,700 |
| ***Residential*** | 54,202 |
| ***Commercial*** | 14,851 |
| ***Industrial*** | 1,165 |
| ***Public Agencies*** | 4,482 |
| **Distribution Topology** | Flat to hilly |

### Climate

The climate for SWS in the Los Angeles area consists of summers that are hot and dry with temperatures exceeding 90° Fahrenheit (°F). In the winter, evening low temperatures typically drop to 40 to 45° F, with winter daytime highs ranging from 60 to 70° F.

SWS' San Jose Hills District is within the Main Basin and the Whittier/La Mirada District is within the Central Basin, both of which have precipitation averaging less than 18 inches per year. Most of the precipitation falls during the months of December through March.

### Demographics

The total population served by SWS increased about 5 percent in the San Jose Hills District service area and about 5 percent in the Whittier/La Mirada District between 2000 and 2005. The population served by SWS was expected to have increased by an additional 5 percent by the year 2010, and another 10 percent by the year 2020 in both its San Jose Hills and Whittier/La Mirada Districts. The past, current, and projected population served by SWS is shown in Table 2. The projected population increase in SWS' service area is at a rate of one percent per year from 2000 through 2025.

**Table 2: Total Current and Projected Population Served by Suburban Water Systems**

| District | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| San Jose Hills District | 169,527 | 178,003 | 186,480 | 195,804 | 205,128 | 215,384 |
| Whittier/La Miranda District | 127,513 | 133,888 | 140,264 | 147,277 | 154,290 | 162,005 |
| **Total** | **297,040** | **311,891** | **326,744** | **343,081** | **359,418** | **377,389** |

## Water Sources

SWS gets the majority of its water from local groundwater sources, see Figure 1. Additional supply is obtained through purchases and imports from other agencies and surface water.

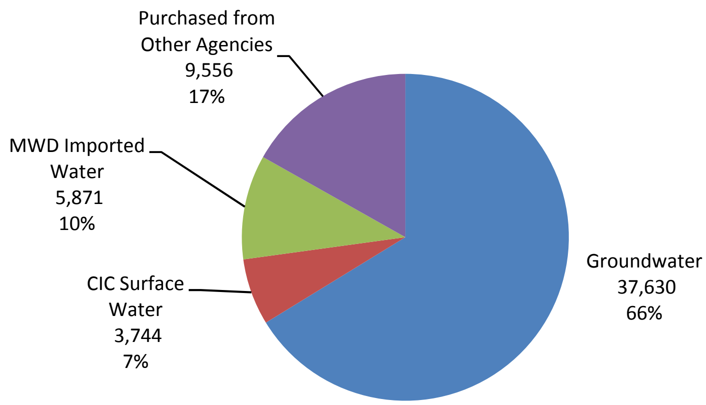



**Figure 1: 2008 Distribution of Sources (AF)**

### Groundwater

SWS has groundwater rights in the Main San Gabriel Basin (Main Basin) and in the Central Basin, both located in Los Angeles County.

Management of the water resources in the Main Basin is based upon Watermaster Services under two Court Judgments, the San Gabriel River Water Master, as a result of the Long Beach Judgment, and the Main San Gabriel Basin Watermaster, as a result of the Main Basin Judgment. SWS also participates in the Main Basin management described in the Main Basin Watermaster document entitled "Five-Year Water Quality and Supply Plan."

As a result of the Long Beach Judgment, the Main Basin is free to manage its water resources as long as it meets its downstream obligation to the Lower Area under the terms of the Long Beach Judgment. The Main Basin Judgment provides a means for replacing all annual extraction in excess of a Party's annual right to extract water with supplemental water. The Main Basin Watermaster establishes an Operating Safe Yield for the Main Basin and allocates pumping quantities to each Party. SWS has a prescriptive pumping right of 24,860.19 acre-ft/year (AFY) in the Main Basin and a pumper's share of 12.58 percent of the Operating Safe Yield. If SWS extracts water in excess of its right under the annual Operating Safe

Yield, it must pay an assessment for replacement water, which is sufficient to purchase one acre-ft of Supplemental Water to be spread in the Main Basin for each acre-ft of excess production.

Groundwater production in the Central Basin is restricted to adjudicated rights fixed by the Central Basin Judgment and managed by a court-appointed Watermaster. Under the Central Basin Judgment, water rights are fixed and do not vary year to year and water producers cannot exceed their water rights by more than 20 percent in any year, nor can they carryover more than 20 percent of their water rights for use in the following year. SWS Whittier/La Mirada District has a pumping right in the Central Basin of 3,721 AFY with an allowance to carryover 20 percent (744 AFY) in any one year to allow for variation in water demands because of the influence of weather.

SWS owns thirteen production wells located in the Main Basin that provide water to the San Jose Hills District. They are Wells 121W-1, 125 W-2, 126W-2, 139W-2, 139W-4, 139W-5, 139W-6, 140W-3, 140W-4, 140W-5, 142W-2, and 147W-3, 151W-2. Several of these wells are currently out of service because of groundwater contamination. Between 1995 and 2004, groundwater production at SWS' wells for the San Jose District ranged from 2,458 acre-feet per year (AFY) to 24,512 AFY.

SWS owns six production wells in the Main Basin and two production wells in the Central Basin that provide water to the Whittier/La Mirada District. SWS' Plant 201 Main Basin wells (201W-4, 201W-5, 201W-7, 201W-8, 201 W-9, 201W-10) provide water to the Whittier/La Mirada District. Between 1995 and 2004, groundwater production at SWS Plant 201 ranged from 11,402 AFY to 14,007 AFY. SWS recently drilled four new wells at Plant 201 W-7 to W-10. The capacity of each of the four new wells is about 3,500 gpm. Due to the size of the transmission main, the four new wells will supply a maximum of 10,000 gpm of water to SWS' Whittier/La Mirada District service area.

SWS has two production wells in the Central Basin (409 W-3 and 410 W-1). SWS can produce up to 3,721 AFY from the Central Basin. Currently, SWS Well 409W-3 is operating at a reduced rate as a result of historic low ground water levels. This well has an organic and inorganic color problem that is treated with pressurized mixed media sand filters, and requires the injection of ammonia, to chloraminate and minimize the creation of trihalomethanes (THMs). SWS Well 410W-1 requires injection of orthopolyphosphate to sequester iron and manganese. Between 1995 and 2004, groundwater production at the Plant 409 and Plant 410 well fields ranged from 800 AFY to 3,228 AFY.

As part of the EPA-sponsored Baldwin Park Operable Unit (BPOU), a groundwater treatment facility has been constructed to provide an average annual supply of about 11,300 acre-feet. SWS will receive about 8,200 AFY of fully treated water that will be used to supplement existing sources of supply. The high quality water will function as a source of blended water for SWS reactivate existing wells that have been temporarily shut off due to groundwater contamination.

SWS has stock in Covina Irrigating Company (CIC) and through that relationship has an agreement to receive water from CIC. SWS purchases groundwater that is supplied to the San Jose Hills district.

SWS purchases water from California Domestic Water Company (CDWC) to supply its Whittier/La Mirada District service area. CDWC's water supply sources include groundwater from the Main Basin. Between 1995 and 2004, water purchased from CDWC ranged from 6,650 AFY to 10,205 AFY. SWS also regularly purchases water from MWD in the Central Basin. Between 1995 and 2004, water purchased by SWS ranged from 925 AFY to 3,375 AFY.

### Imported Water

SWS uses treated imported water purchased from MWD to supplement its groundwater supply. The amount of MWD water purchase increased significantly in year 2000 when several of SWS's wells were taken out of service due to groundwater contamination. In addition, SWS purchased MWD water through Azusa Light and Water (ALW) at USG-8 beginning in 2002. Between 1995 and 2004, water purchased from MWD at USG-4 ranged from 0 AFY to 14,568 AFY. Between 2002 and 2004, water purchased from MWD at UGS-8 ranged from 236 AFY to 3,036 AFY.

SWS purchases treated water from La Puente Valley County Water District (La Puente VCWD) to supplement its groundwater supply, starting in 2001. Between 2001 and 2003, treated water purchased from LPVCWD ranged from 12 AFY to 1,191 AFY.

### Surface Water

In addition to the groundwater received from CIC that is used by SWS to supply its Covina Knoll and Glendora service areas, CIC also provides treated surface water from the San Gabriel River watershed to SWS . Between 1995 and 2004, water purchased from CIC ranged from 3,064 AFY to 8,726 AFY.

SWS can also purchase water from several other local water agencies including the City of Covina, City of Glendora, Rowland Water District, La Puente VCWD, Valencia Heights Water District, and Walnut Valley Water District (WVWD). In 2004, SWS purchased a total of 4,066 AFY.

SWS can also purchase water from the City of La Habra, City of Whittier, and San Gabriel Valley Water Company (SGVWC) to supplement its groundwater supply in the Whittier/La Mirada District. The water purchased from the SGVWC is used to provide water to a single customer, Shepherd Machinery Company, located at Rose Hills Road and the 605 Freeway. Between 1995 and 2004, the total production and purchase of SWS Whittier/La Mirada District ranged from 22,327 AFY to 25,985 AFY, with an average of 24,445 AFY.

### Marginal Water Supply

The Study Team identified both short-term and long-term marginal supplies for SWS. Short-term marginal supply is water provided through interconnections with other local water agencies. Long-term marginal supply is through increased groundwater production.

The management structures in the Main Basin and the Central Basin for groundwater pumping rights contribute to securing a reliable water supply for future demand. Based on past performance during an average year and a single dry year, SWS was able to provide a reliable supply of groundwater from the Main Basin to its customers.

SWS has projected that by 2025, production from the Main Basin wells is expected to increase to 38,138 AFY to meet projected population growth in both the San Jose Hills and Whittier/La Mirada Districts (22,138 AFY for San Jose District and 16,000 AFY for Whittier/La Mirada District). The increase in water demand is expected to be at the same rate as the increase in population. In addition, both SWS and USGVMWD maintain Cyclic Storage accounts to take advantage of years where there is surplus untreated imported water. Under a Cyclic Storage Agreement with the Main Basin Watermaster, SWS can store imported water in the Main Basin for up to five years to be used to offset future replacement water requirements. It is expected that the Main Basin will provide sufficient supply to meet projected groundwater demands.

SWS has projected that by 2025, production from the Central Basin wells is expected to increase to 2,381 AFY to meet projected population growth in the Whittier/La Mirada District, which is less than SWS' groundwater right in the Central Basin of 3,721 AFY. The increase in water demand is expected to be at the same rate as the increase in population. The Central Basin is an adjudicated basin and it is managed by a Watermaster. Since the adjudication water levels have stabilized, it is expected that the Central Basin will provide sufficient supply to meet projected groundwater demands.

In addition, SWS will receive about 8,200 AFY of fully treated water from the EPA-sponsored Baldwin Park Operable Unit, a groundwater treatment facility with the capacity to provide 11,300 AFY. SWS is also exploring the use of recycled water for groundwater recharge through the Groundwater Recharge Program, which would treat wastewater from Los Angeles County Sanitation Districts' (LACSD) San Jose Creek Water Reclamation Plant to groundwater recharge standards.

The energy intensity range of SWS's marginal supply is summarized in Table 3. The energy intensity represents the embedded energy for all activities prior to the water entering SWS' distribution system. The distribution system adds an additional 801 – 1,081 kWh/MG to the energy intensity.

#### Table 3: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Local Surface Water[a] | 30 kWh/MG |
| | Imported Raw Water[b] | 7,377 kWh/MG |
| | Imported Treated Water[b] | 7,499 kWh/MG |
| Long-term | Recycled Water[c] | 1,104-1,446 kWh/MG |
| | Groundwater[d] | 1,254-1,619 kWh/MG |

a) EI estimate for raw surface water operations obtained from Study 1, does not include distribution energy use.
b) Imported water from MWD average blend of CRA and SWP water. Embedded EI for raw and treated water from Study 1 results, not including EI from Study 2 for SWS distribution.
c) LACSD (San Jose Creek Water Reclamation Plant) EI range from Study 2 results.
d) SWS groundwater pumping EI range from Study 2 results.

## Water Demand

According to Suburban Water System estimates, as shown in Table 4 and Table 5, the number of customers is expected to grow 15.5 percent from 2010 to 2025 resulting in an increased water demand of 15.8 percent.

SWS will continue to use a combination of groundwater and water purchased from local water agencies as its future supplies over the next 20 years and these supplies have been determined to be adequate. According to SWS' projected water demand as seen in Table 3, SWS will have adequate water supplies in an average, single-dry and multiple-dry year sequence for the next 20 years.

#### Table 4: Historic and Projected Number of Customers by District

| District | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| San Jose Hills District | 169,527 | 178,003 | 186,480 | 195,804 | 205,128 | 215,384 |
| Whittier/La Mirada District | 127,513 | 133,888 | 140,264 | 147,277 | 154,290 | 162,005 |
| **Total** | **297,040** | **311,891** | **326,744** | **343,081** | **359,418** | **377,389** |

**Table 5: Historic and Projected Water Demand (AF/Yr)**

| District | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| San Jose Hills District | 26,578 | 28,332 | 29,749 | 31,236 | 32,798 | 34,438 |
| Whittier/La Mirada District | 24,232 | 20,519 | 21,545 | 22,622 | 23,753 | 24,941 |
| **Total** | **50,810** | **48,852** | **51,294** | **53,859** | **56,552** | **59,380** |

## System Infrastructure and Operations

Table 6 summarizes the infrastructure operated by Suburban. SWS operates and maintains a complex system of water transmission, groundwater pumping, distribution, and supply sources to supply potable water to its customers.

**Table 6: Infrastructure Summary**

| | |
|---|---|
| **Number of Groundwater Wells** | 17 |
| **Number of Plants** | |
| ***Treatment*** | 1 |
| ***Pumping*** | 30 electric; 7 gas |
| **System-wide Storage Capacity** | 198,000 ac-ft |

### Sub-Regions Within Agency

SWS water system is divided into two separate water systems, the San Jose Hills District and the Whittier/La Mirada District. The San Jose Hills District, shown in Figure 2, has a total of approximately 42,000 service connections within the Cities of Glendora, Covina, West Covina, La Puente, Industry, Walnut and unincorporated areas of Los Angeles County including Valinda and Hacienda Heights. The Whittier/La Mirada District, shown in Figure 3, has approximately 33,000 service connections within Cities of Whittier, La Mirada, La Habra and Buena Park and unincorporated areas of Los Angeles County and Orange County.

#### *Sub-Region 1: San Jose Hills District*

The San Jose Hills District is divided into five (5) operational service areas, which include the Hacienda Heights Service *Area* serving the *area* in the southerly part of the San Jose Hills District including the communities of Hacienda Heights and Industry; the La Puente Service Area, which covers the largest area including the Cities of Covina and La Puente; the West Covina Service Area on the easterly side in the City of West Covina and the Covina Knolls Service Area in the easterly side of West Covina; and the Glendora Service Area, which is in the City of Glendora.

As seen in Figure 2, the Tariff Zones increase with elevation. In Zone 547, wells pump 1,200 gpm to 3,500 gpm. Pump station 129 pumps 6,000 to 7,000 gpm.

#### *Sub-Region 2: Whittier/La Mirada District*

Figure 3 shows the Tariff areas of the Whittier/La Mirada District. The Whittier/La Mirada District is divided into four (4) operational services that include the West Whittier Service Area serving the area in the northwest part of the Whittier/La Mirada District; the Whittier Service Area, which covers the central part of the Whittier/La Mirada District; the Friendly Hills Service Area on the north and east side of the Whittier/La Mirada District, which includes the Murphy Ranch area and the East Whittier area in the City of Whittier; and the La Mirada Service Area in the south portion of the Whittier/La Mirada District includes the City of La Mirada and Buena Park.

There is a reservoir in the Whittier/La Mirada District at the base of in Friendly Hills that is the terminal storage reservoir for water produced and transmitted from the Plant 201 well field. From this reservoir pumps at Plant 231, 235, 236, 238 pump water north of Whittier Blvd. up the hill. Water is also pumped from this reservoir by pumps at Plant 216 south of Whittier Blvd. and into La Mirada.

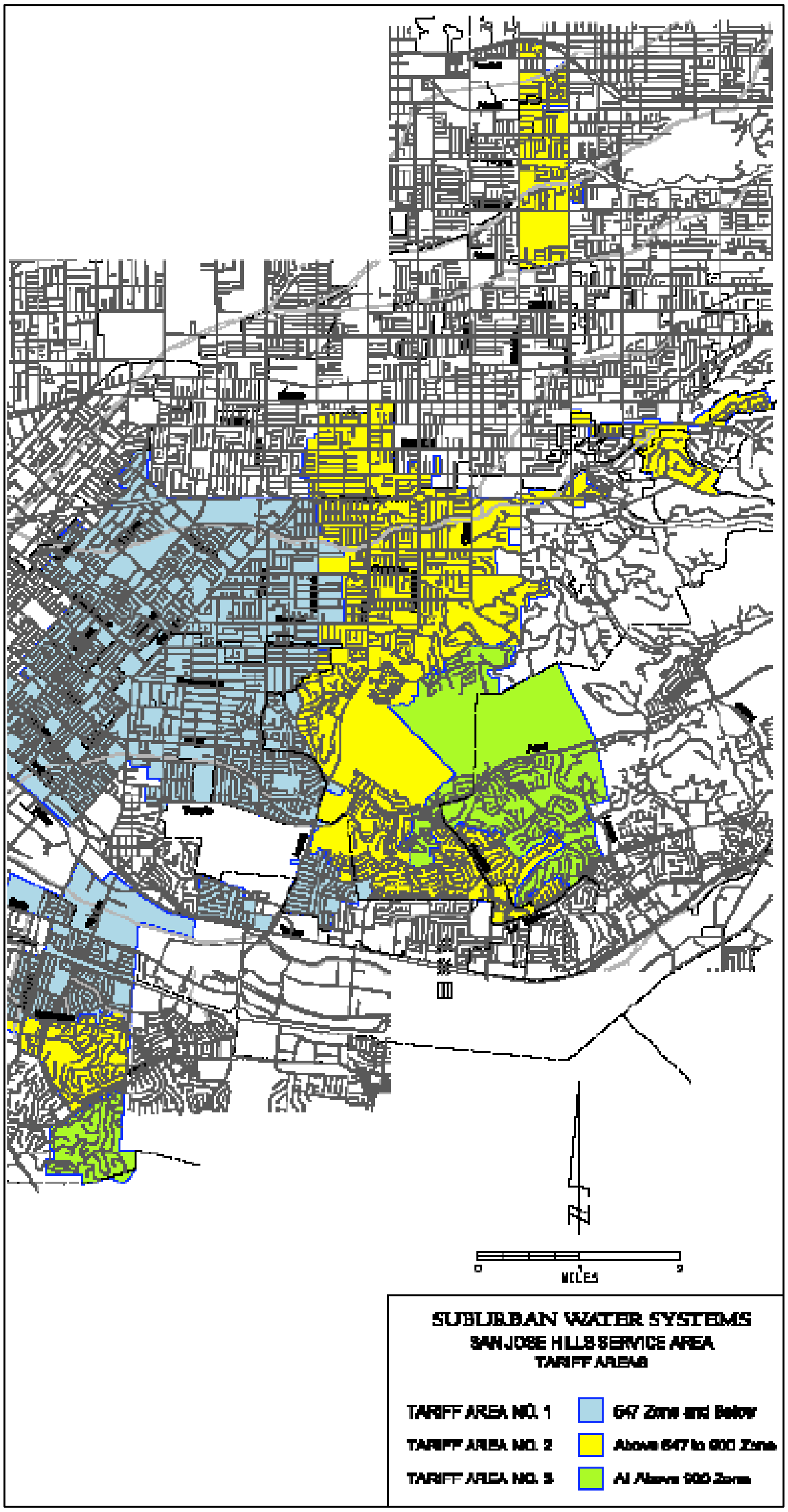



Figure 2: San Jose Hills Service Area

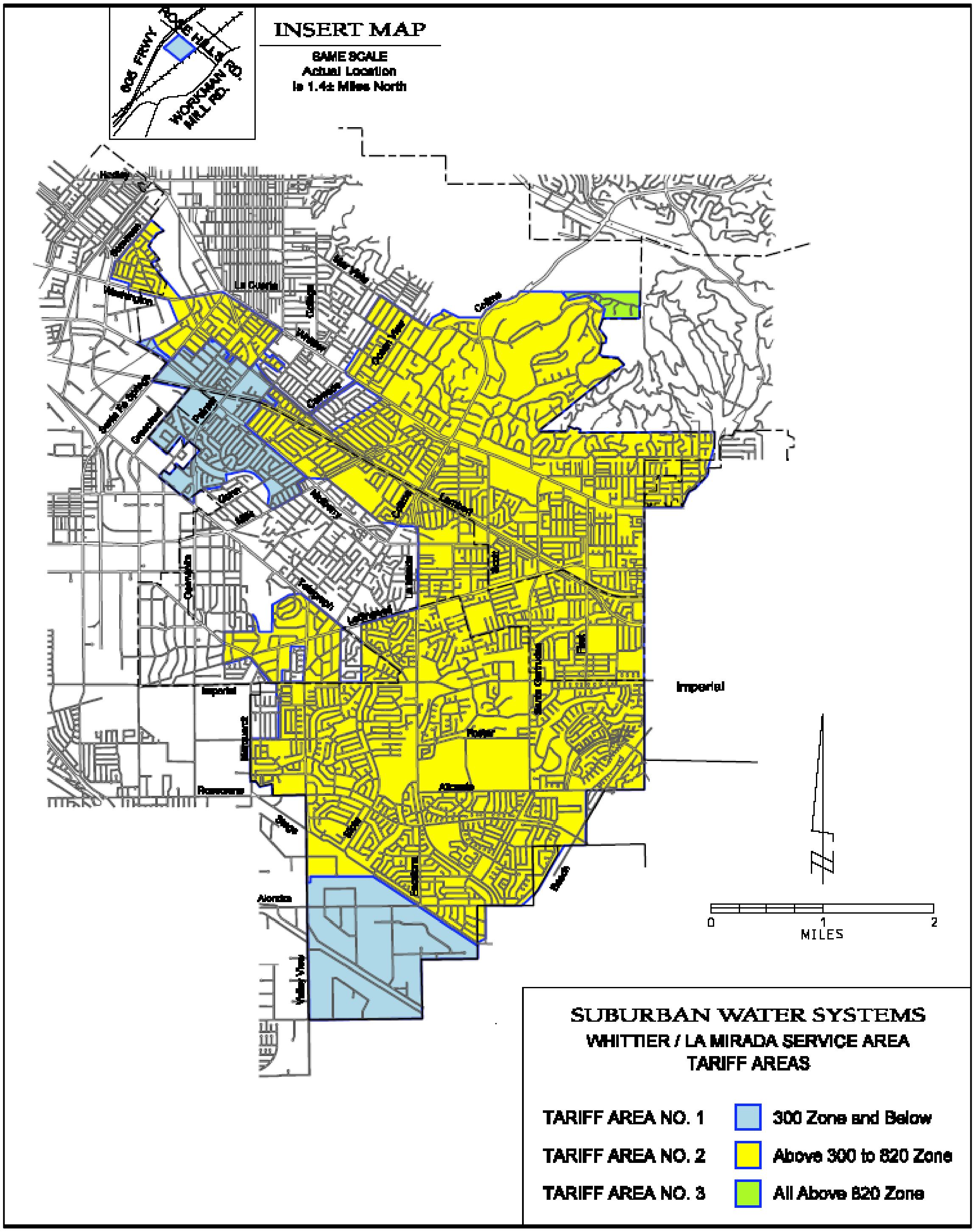



Figure 3: Whittier/La Mirada Service Area

### System Storage

The Main Basin Watermaster has entered into a Cyclic Storage Agreement with each of the three municipal water districts. One is with the MWD and the USGVMWD, which permits MWD to deliver and store imported water in the Main Basin in an amount not to exceed 100,000 acre-feet for future replacement water use. The second Cyclic Storage Agreement is with Three Valleys Municipal Water District and permits MWD to deliver and store 40,000 acre-feet for future replacement water use. The third is with San Gabriel Valley Municipal Water District and contains generally the same conditions as the agreement with MWD except that the stored quantity is not to exceed 40,000 acre-feet. In addition, SWS has a Cyclic Storage account and is allowed to store a maximum of 18,000 acre-feet at any given time. As of June 30, 2005, SWS had 1,369.98 acre-feet in its Cyclic Storage account.

### System-wide Operation Strategy

SWS meets most of its demand with groundwater through existing water rights in the Main Basin and Central Basins. Wells are pumped 24 hours per day to meet demand, with the exception of the EPA treatment plants that are operated to treat contaminated groundwater. SWS has multiple interconnections with local agencies to supplement groundwater supplies. SWS purchases treated imported water from MWD through the USGVMWD and CBMWD. This allocation is determined by MWD based on past historic use and SWS is charged for the allocation whether or not they use it, which serves as an incentive for SWS to use their MWD allocation.

SWS utilizes both electric and gas distribution pumps. Gas pumps are used for redundancy in the system in the case of a power outage. Gas pumps are also operated during peak hours in a “peak shaving” effort, this shifts the pumping loads from electric powered pumps to the gas powered pumps to reduce expensive on-peak electricity use.

The system can be run by either pumping water uphill from the basin to customers at higher elevation, or using water from MWD and gravity feed down the hill feeding customers along the way.

For two months in 2008 SWS purchased MWD water from USGVMWD in-lieu of pumping ground water at the request of the Main Basin Watermaster which reduced energy consumption because water is received at system pressure and did not have to pump water out of the ground. However, the “in-lieu” water is imported water, the embedded energy associated with that water is high. Tier 1 water is for immediate use and the cost is shared. Tier 1 water has an MWD rate structure such that the cost of maintaining a reliable supply is recovered, $73/acre-ft in 2008.

### Infrastructure Changes

Use of recycled water within SWS' San Jose Hills District is expected to commence by 2010. The City of Industry Regional Recycled Water Project is a planned multi-agency recycled water facility expansion including the City of Industry, SWS, the Rowland Water District, and the Walnut Valley Water District. Recycled water will be used for non-potable uses, such as irrigation by some of SWS' largest customers including a golf course and landfill.

## Energy Profiles

SWS provided energy and water production data to the Study Team for its calculations of energy profiles. Energy data included monthly energy and gas bills, interval data (15-minute time increment), and monthly energy data for wells and booster pumps. Water flow data was provided on a monthly basis for all groundwater wells and booster pumps. Thus the Study Team applied individual flows to each facility as indicated in the 2008 Energy Report. Water flow data was distributed on a daily basis to the energy data to compute daily flows proportional to the energy use at each facility. Electricity is provided to SWS from Southern California Edison. Natural gas is provided by Southern California Gas. SWS provided gas data in the format of monthly bills. Gas use per pump and per booster was available in units of therms. Gas use has not been included in the 24-hour energy profiles.

Gas is used by some of the groundwater pumping and distribution facilities operated by SWS. However, on an annual basis, significantly more electricity is provided to SWS facilities than gas as illustrated in Table 7.

**Table 7: 2008 Energy Use by Type of Energy**

| | |
|---|---|
| **2008 Electricity Use** | 290,583,362 kWh |
| **2008 Natural Gas Use** | 236,187 Therms |

The energy intensity of each facility type within Suburban Water Systems is presented in Figure 4.

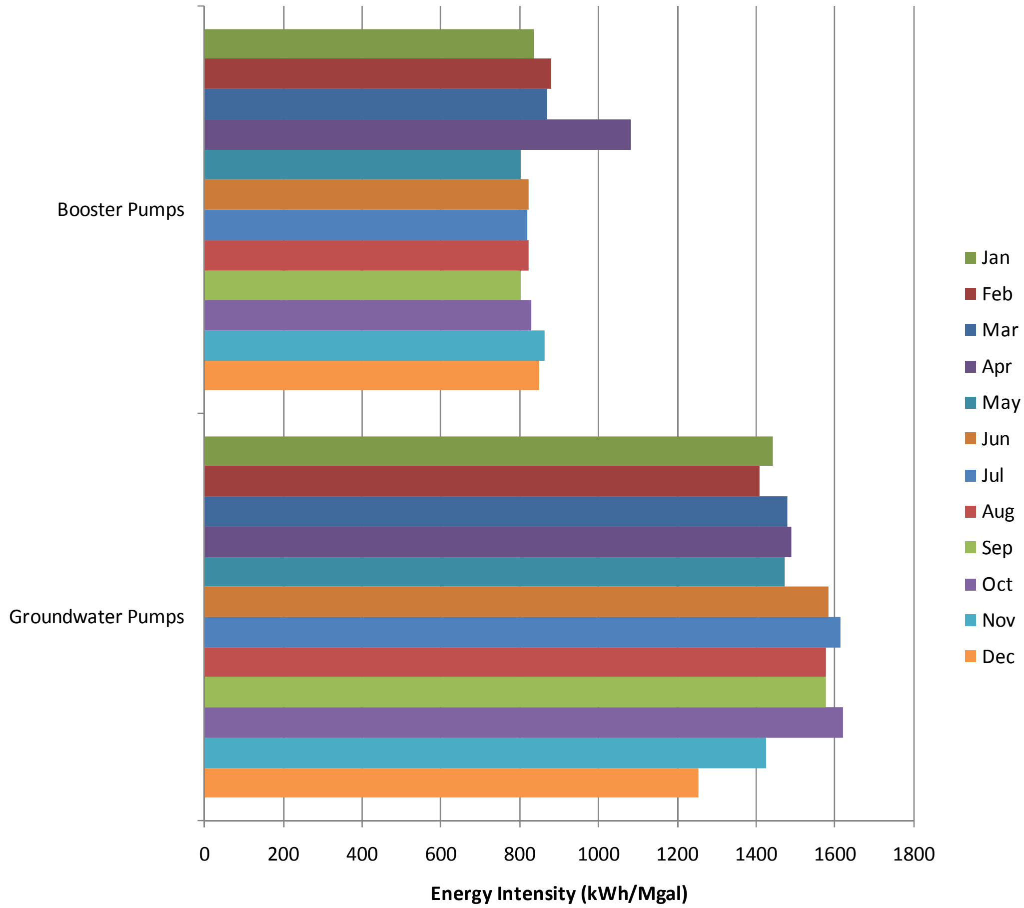
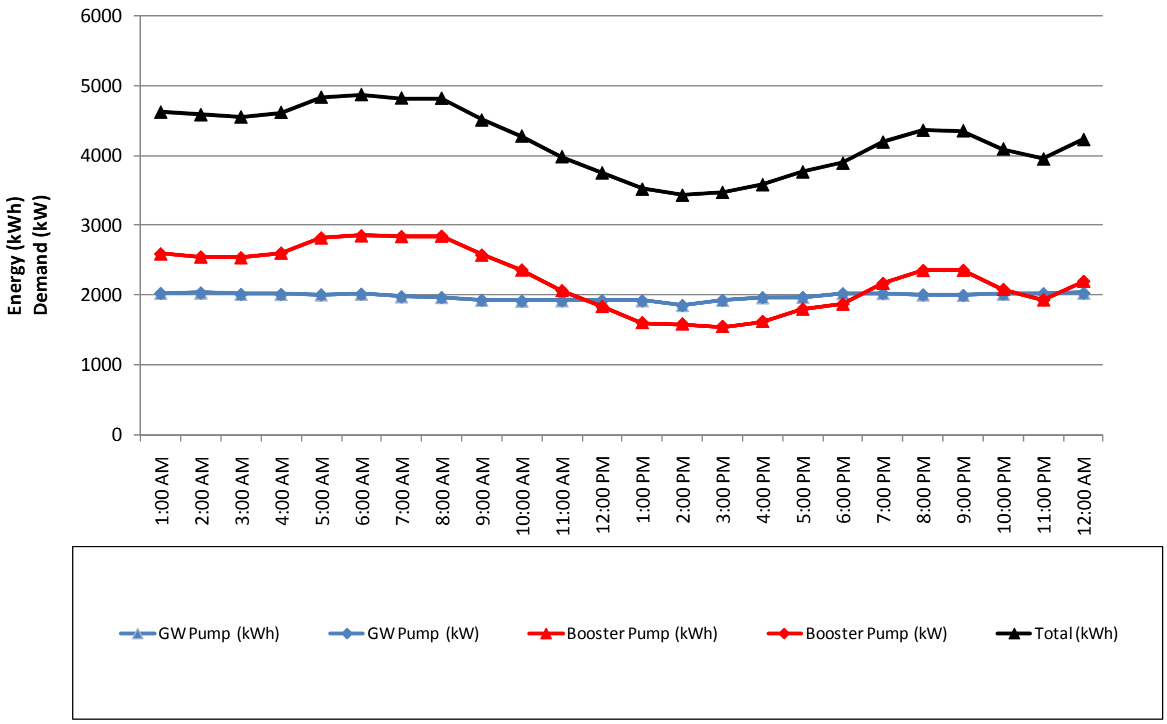


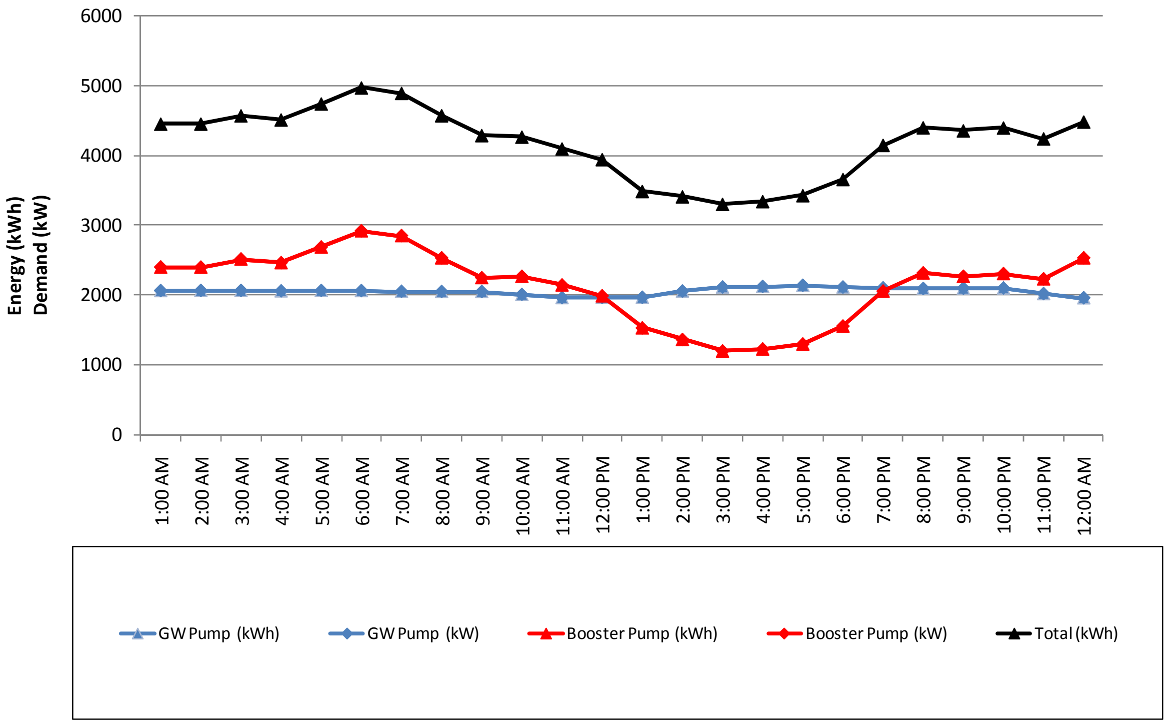

**Figure 4: SWS Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 5 through 11. The energy use is split almost evenly between groundwater pumps and booster pumps during most times of the year.



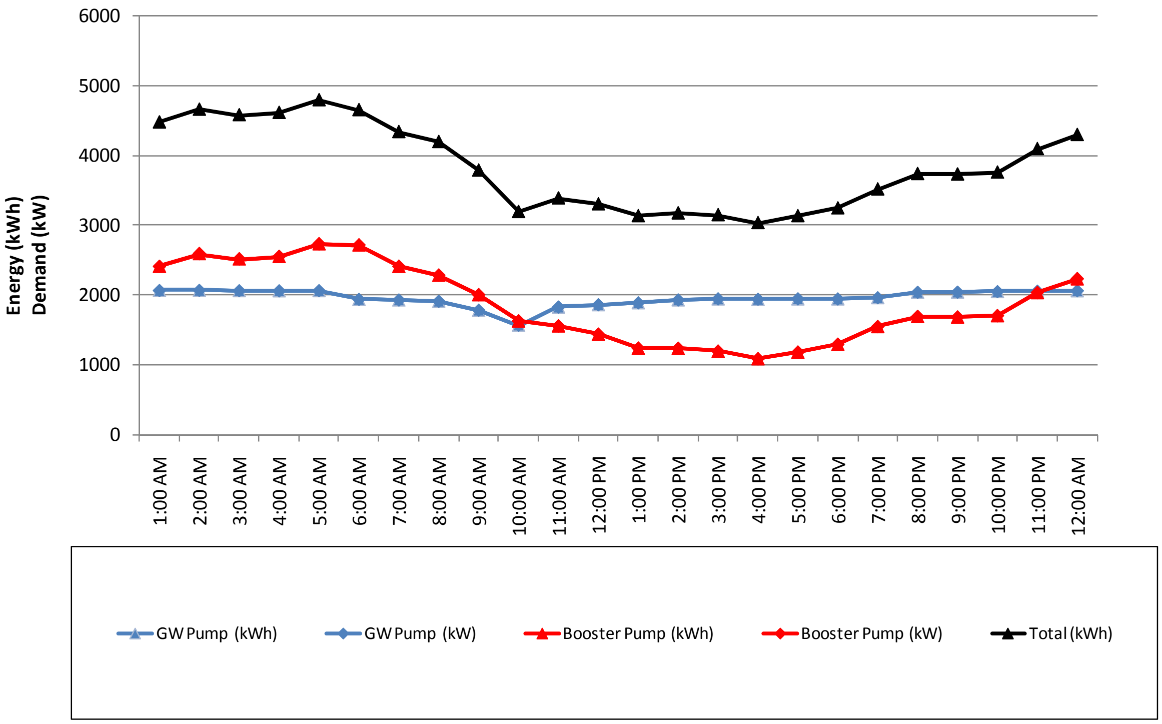

| | |
|---|---|
| **Date** | 6/20/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,955 |
| *Booster Pumps* | 1,653 |
| *Raw Water Pump* | n/a |
| *Water Treatment* | n/a |
| *Pressure System Pumps* | n/a |

**Figure 5: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



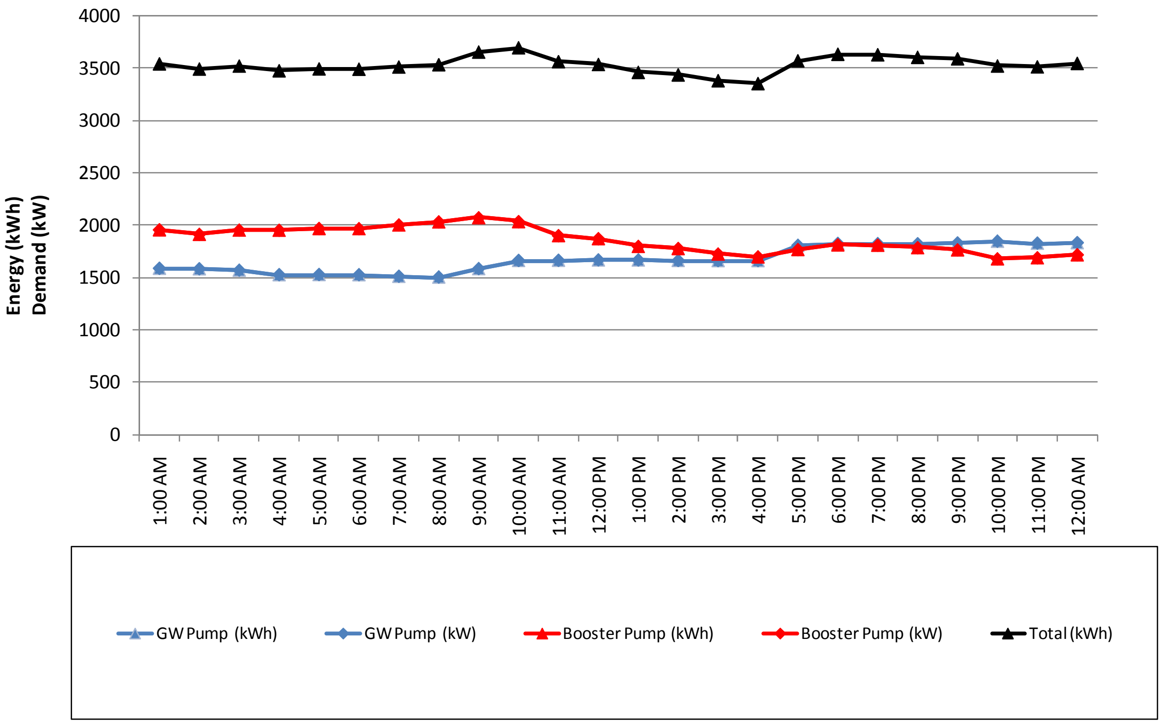

| **Date** | 9/4/2008 |
|---|---|
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Groundwater* | 2,118 |
| *Booster Pumps* | 1,242 |
| *Raw Water Pump* | n/a |
| *Water Treatment* | n/a |
| *Pressure System Pumps* | n/a |

**Figure 6: 24-Hour Energy Profile: Summer High Water Demand Day**



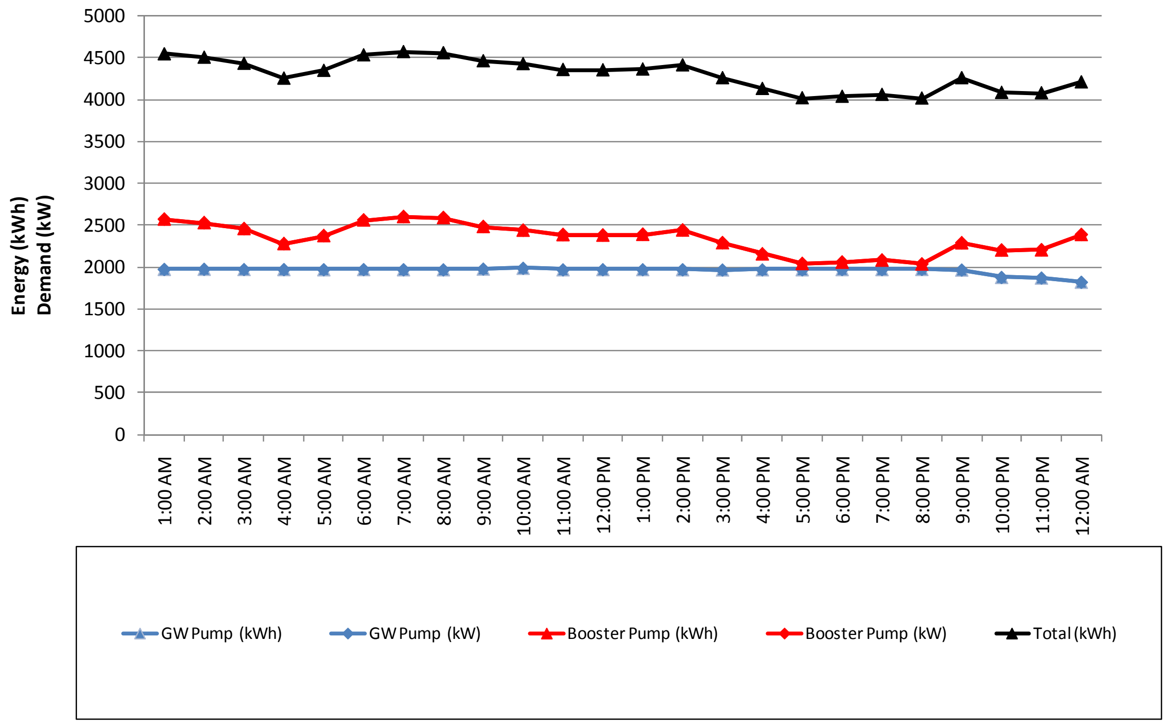

| | |
|---|---|
| **Date** | 8/22/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,945 |
| *Booster Pumps* | 1,157 |
| *Raw Water Pump* | n/a |
| *Water Treatment* | n/a |
| *Pressure System Pumps* | n/a |

**Figure 7: 24-Hour Energy Profile: Summer Average Water Demand Day**



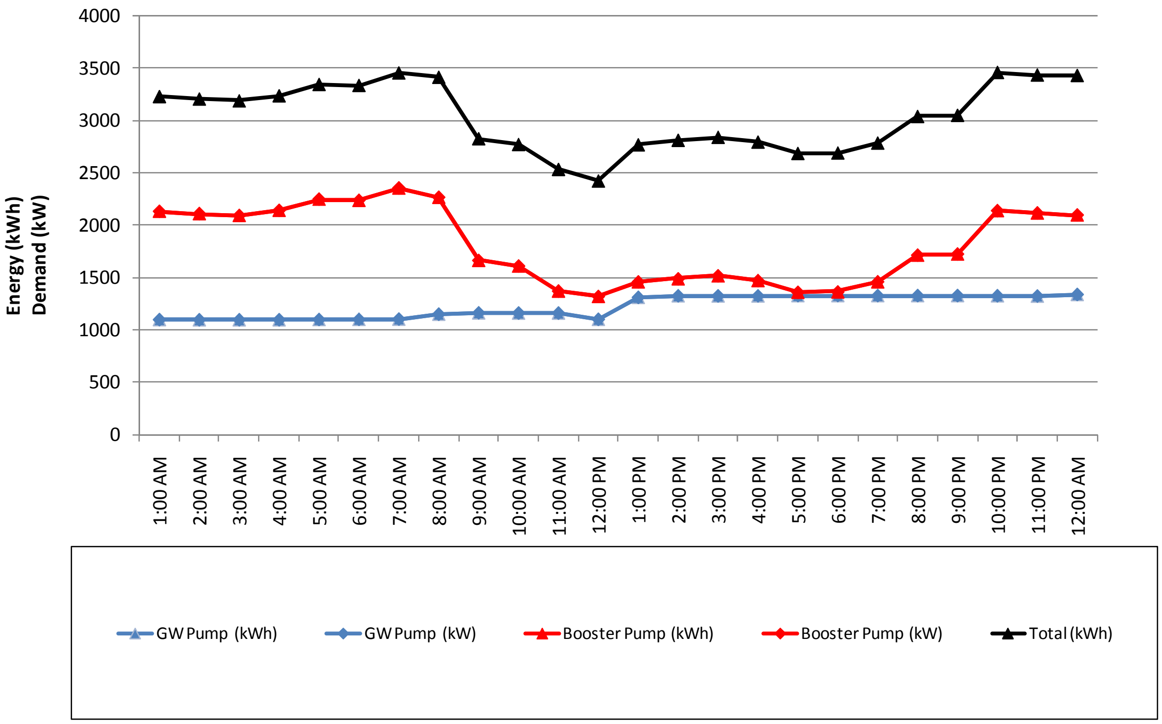

| | |
|---|---|
| **Date** | 6/1/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,706 |
| *Booster Pumps* | 1,732 |
| *Raw Water Pump* | n/a |
| *Water Treatment* | n/a |
| *Pressure System Pumps* | n/a |

**Figure 8: 24-Hour Energy Profile: Summer Low Water Demand Day**



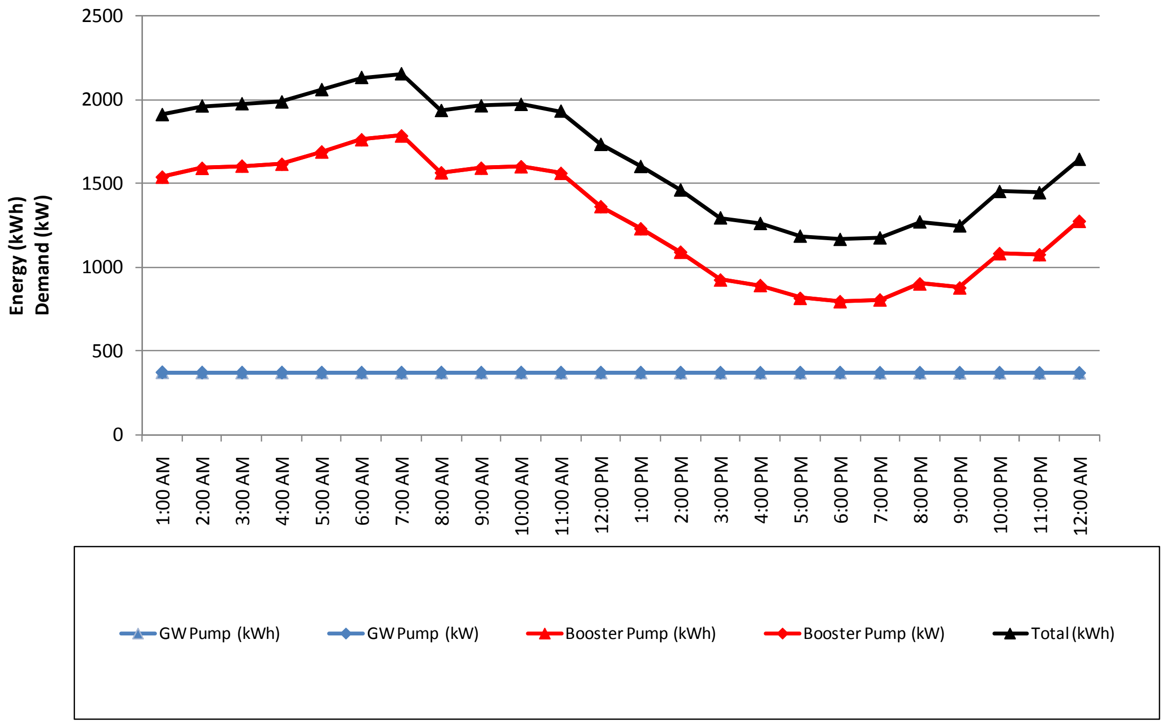

| **Date** | 10/11/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,971 |
| *Booster Pumps* | 2,163 |
| *Raw Water Pump* | n/a |
| *Water Treatment* | n/a |
| *Pressure System Pumps* | n/a |

**Figure 9: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 3/6/2008 |
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Groundwater* | 1,323 |
| *Booster Pumps* | 1,452 |
| *Raw Water Pump* | n/a |
| *Water Treatment* | n/a |
| *Pressure System Pumps* | n/a |

**Figure 10: 24-Hour Energy Profile: Winter Average Water Demand Day**




| **Date** | 12/13/2008 |
|---|---|
| **Day** | Saturday |
| **Peak Demand (kW)** | |
| *Groundwater* | 368 |
| *Booster Pumps* | 877 |
| *Raw Water Pump* | n/a |
| *Water Treatment* | n/a |
| *Pressure System Pumps* | n/a |

**Figure 11: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Sources


Suburban Water Systems. "Water Production Report." December 2008.

Suburban Water Systems. *2005 Urban Water Management Plan*.

Suburban Water Systems. "*Energy Report*." January through December 2008.

Craig Gott – Suburban Water Systems. Interview by Bill Bennett (GEI) and Lacy Cannon (GEI). September 10, 2009.

# Valley Center Municipal Water District

## Summary

| | | | |
|---|---|---|---|
| **Primary functions** | Agricultural Water, Wastewater | | |
| **Segments of Water Use Cycle** | Distribution, Recycled Water Production | | |
| **Hydrologic Region** | Southland | **DEER Climate Zone** | 10 |
| **Quantity of water (2005)** | Wastewater Treated: 0.41 MGD<br>Water Distributed: 12,416 MGD | Recycled: 0.05 MGD | |
| **Number of Customers** | Water: 8,593<br>Wastewater: 2,750 | **Service Area Size** | 100 Sq miles |
| **Distinguishing Characteristics** | VCMWD retails treated imported water to its service area. The topography is hilly, and energy intensive pumping is required to distribute water to customers. VCMWD does not treat any of its imported supply. | | |
| **Key Energy Drivers** | The majority of energy is consumed by supply and distribution facilities:<br>• Water Distribution - pumping to distribute over hilly topography.<br>• Wastewater Treatment - small wastewater treatment plants contribute to energy consumption, but were not included in this analysis. | | |
| **Water/Wastewater Treatment Technologies** | Water Treatment: VCMWD provides back-up chlorination as needed.<br>Lower Moosa Canyon Water Reclamation Facility: advanced secondary, water reclamation plant<br>Woods Valley Ranch Water Reclamation Facility: tertiary, water reclamation plant | | |
| **Water Resources** | 2008 Supply Distribution: 99% Imported, 1% Reclaimed | | |
| **Marginal Water Supplies** | Short-term: Lake Turner Emergency Water<br>Long-term: increased imports, seawater desalination (Carlsbad). | | |
| **Energy Service Provider** | SGD&E | | |
| **Observed Energy Intensities (kWh/MG)** | **Segment** | **Lower Range** | **Upper Range** |
| | Booster Pumps | 846 | 1,772 |
| | Pressure System Pumps (Water Distribution) | 347 | 432 |

## Background Information

Valley Center Municipal Water District (VCMWD) is a state legislated special district, governed by a five-member board of directors. VCMWD provides treated imported water from the San Diego County Water Authority (SDCWA) directly to its customers. More than 70 percent of the imported supply is delivered to agricultural users. VCMWD is the largest retail purchaser of agricultural water within SDCWA's service area. VCMWD provides sanitary sewer service through two wastewater treatment facilities. Table 1 summarizes VCMWD.

Primary sources of information on Valley Center MWD include: VCMWD's 2006 Urban Water Management Plan, water and energy data for 2008 provided by VCMWD, and VCMWD's public website. A detailed list of references is located at the end of this section.

#### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Agricultural Water, Wastewater |
| **Hydrologic Region** | South Coast |
| **Region Type** | South Land |
| **Energy Service Provider** | SDG&E |
| **DEER Climate Zone** | 10 |
| **Service Area Size** | 100 Sq miles |
| **Service Area Population** | 23,000 (2000) |
| **Number of Customers in 2005** | 8,593 water service accounts<br>2,685 wastewater service accounts |
| ***Residential*** | 6,489 |
| ***Commercial/Industrial/Landscape*** | 285 |
| ***Agricultural*** | 1,696 |
| **Distribution Topology** | Hilly |

### Climate

Valley Center is a semi-arid climate area with dry hot summers and mild winters. Temperatures during the summer months typically range from the low to mid 90's (Fahrenheit). Average precipitation amounts to 14 inches of rain per year.

### Demographics

Population in VCMWD's service area is expected to grow nearly 75 percent in the next 20 years as shown below in Table 2.

#### Table 2: Projected VCMWD Service Area Population

| Year | Population |
|---|---|
| 2000 | 23,000 |
| 2010 | 27,331 |
| 2020 | 33,613 |
| 2030 | 47,853 |

## Water Sources

As seen in Figure 1, VCMWD obtains about 99 percent of its supply from imported surface water sources. The San Diego County Water Authority (SDCWA) supplies VCMWD with water imported from the Metropolitan Water District of Southern California (MWD) through its aqueduct facilities. Reclaimed water from the Lower Moosa Canyon Water Reclamation Facility (Moosa) accounts for about 1 percent of VCMWD's supply and is used to irrigate the Woods Valley Ranch Golf Course.

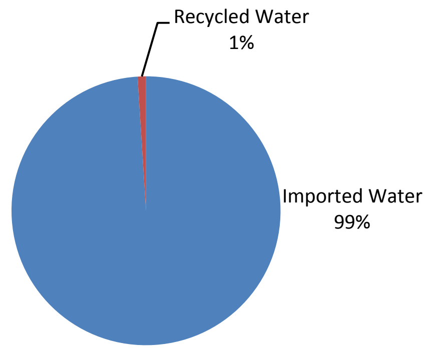



**Figure 1: 2008 Distribution of Sources**

### Local Raw Surface Water

Approximately 400 AF of incidental surface water runoff is collected annually in Lake Turner Reservoir. Due to quality concerns and the lack of surface water treatment capability, Lake Turner water is reserved for emergency supply only.

### Recycled Water

The Woods Valley Ranch Water Reclamation Facility has a 70,000 gallon-per-day capacity and treats wastewater from the Woods Valley Ranch Development. Wastewater is treated to tertiary standards and is used to irrigate the Woods Valley Ranch Golf Course.

### Imported Water

Imported surface water from the SDCWA makes up about 99 percent of VCMWD's water supply. The water is imported as wholesale treated water; it directly enters the distribution system with no additional need for treatment. VCMWD is permitted to make three requests for delivery adjustments per day.

Imports received from VCMWD through SDCWA primarily originate from the Colorado River and the State Water Project. Table 3 below shows the historical percentages of water imported from the Colorado River and the State Water Project.

#### Table 3: Imported Water Supply - SDCWA/VCMWD imported from MWD

| Year | State Water Project | Colorado River Aqueduct |
|---|---|---|
| 2005 | 44% | 56% |
| 2004 | 34% | 66% |
| 2003 | 30% | 70% |
| 2002 | 26% | 74% |
| 2001 | 27% | 73% |

### Marginal Water Supply

The Study Team indentified both short-term and long-term marginal supplies for VCMWD. Short-term marginal supply consists of imports from by SDCWA. Long-term marginal supply is dependent on water transfers made by SDCWA.

VCMWD relies entirely on water purchased from the SDCWA and does not currently participate in any transfer or exchange programs. SDCWA however, does participate in a Conservation and Transfer Agreement with Imperial Irrigation District. The VCMWD 2006 UWMP also identifies potential water transfers available to SDCWA: State Water Bank, CALFED Bay-Delta Program, and non-firm supplies from MWD.

VCMWD has a water purchase agreement with Poseidon Resources, Inc. for 7,500 acre-ft of in-lieu desalinated water from the proposed Carlsbad Seawater Desalination Project. Under this agreement, Poseidon would treat and deliver 7,500 acre-ft of desalinated seawater and deliver it to one or more water agency exchange partners in close proximity to the desalination plant. In turn, VCMWD will take an equivalent amount of imported water as “in-lieu” via SDCWA transfers.

The energy intensity range of VCMWD’s marginal supply is summarized in Table 4. The energy intensity represents the embedded energy for all activities prior to the water reaching VCMWD’s service area. VCMWD’s EI range for distribution including booster pumps and pressure pumps is 1,193 to 2,204 kWh/MG.

#### Table 4: Energy Intensity Range for Marginal Supplies

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term | Imports from SDCWA[a] | 6912 kWh/MG |
| Long-term | Imports from SDCWA[a] | 6912 kWh/MG |
| | Seawater Desalination[b] | 12,276 kWh/MG |

a) Treated water imported from SDCWA; EI from Study 1 results. Reported EI does not include EI range for VCMWD distribution.

b) EI estimated from California Sustainability Alliance for treatment only, 2008.

## Water Demand

VCMWD serves about 8,593 water service customers as of 2005, mostly residential, as summarized in Table 5 below. The corresponding historical and projected water use in each sector is summarized in Table 6; the agricultural sector, while lower in number of customers, has the highest water demand.

According to Valley Center MWD estimates, the number of customers is expected to grow 36.5 percent from 2010 to 2025, but water demand will decrease by 17 percent. This decrease in demand will occur in the agriculture sector corresponding to the decrease in number of agricultural customers.

### Table 5: Historic and Projected Number of Customers by Type

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| Residential | 5,231 | 6,489 | 7,885 | 9,116 | 10,343 | 11,573 |
| Commercial | 290 | 217 | 153 | 176 | 199 | 222 |
| Industrial | 0 | 0 | 0 | 0 | 0 | 0 |
| Institutional/Gov. | 27 | 27 | 33 | 37 | 42 | 47 |
| Landscape | 41 | 135 | 40 | 46 | 52 | 58 |
| Agriculture | 1,696 | 1,725 | 1,555 | 1,469 | 1,382 | 1,296 |
| **Total** | **7,285** | **8,593** | **9,666** | **10,844** | **12,018** | **13,195** |

### Table 6: Historic and Projected Water Demand (AF/Yr)

| Customer Type | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| Residential | 6,423.7 | 5,914 | 8,066 | 8,492 | 9,265 | 9,424 |
| Commercial | 1359.1 | 1,258 | 517 | 583 | 525 | 537 |
| Industrial | 0 | 0 | 0 | 0 | 0 | 0 |
| Institutional/Gov. | 161.5 | 184 | 207 | 230 | 253 | 276 |
| Landscape | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 37,967.5 | 28,020 | 32,758 | 31,434 | 26,496 | 24,235 |
| Other (including unaccounted for system losses) | 104.8 | 2,329 | 2,187 | 2,290 | 1,923 | 1,814 |
| **Total** | **46.016.6** | **38,105** | **43,736** | **43,029** | **38,462** | **36,287** |

## System Infrastructure and Operations

Table 7 below summarizes the infrastructure operated by VCMWD. VCMWD does not treat imported water. VCMWD has significant pumping infrastructure to distribute treated water to customers in 18 pressure zones. VCMWD has three wastewater treatment plants, one of which reclaims wastewater for irrigation.

### Table 7: Infrastructure Summary

| | |
|---|---|
| **Miles of Distribution Piping** | 291 |
| **Number of Pump Stations** | 26 |
| **Number of Plants** | |
| ***Wastewater*** | 3 |
| ***Recycled Water*** | 1 |
| **Number of Storage Facilities** | 42 |
| **System-wide Storage Capacity** | 421 AF |

### Sub-Regions within Agency

VCMWD can be divided into two sub-regions for the purposes of the study, the water system and the wastewater system.

## Sub-Region 1: Water System

### *Distribution*

As a result of steeply varying topography, the District's water distribution system is hydraulically divided into 18 pressure zones, the general boundaries are illustrated in Figure 2. The system includes over 291 miles of pipe ranging in size from 8 inches to 42 inches in diameter. Within these pressure zones, the District currently operates a total of 41 storage facilities (ranging in size from 100,000 gallons to 55.9 million gallons), 26 pump stations, 22 pressure-reducing stations, and one hydropneumatic tank to meet the needs of their customers.

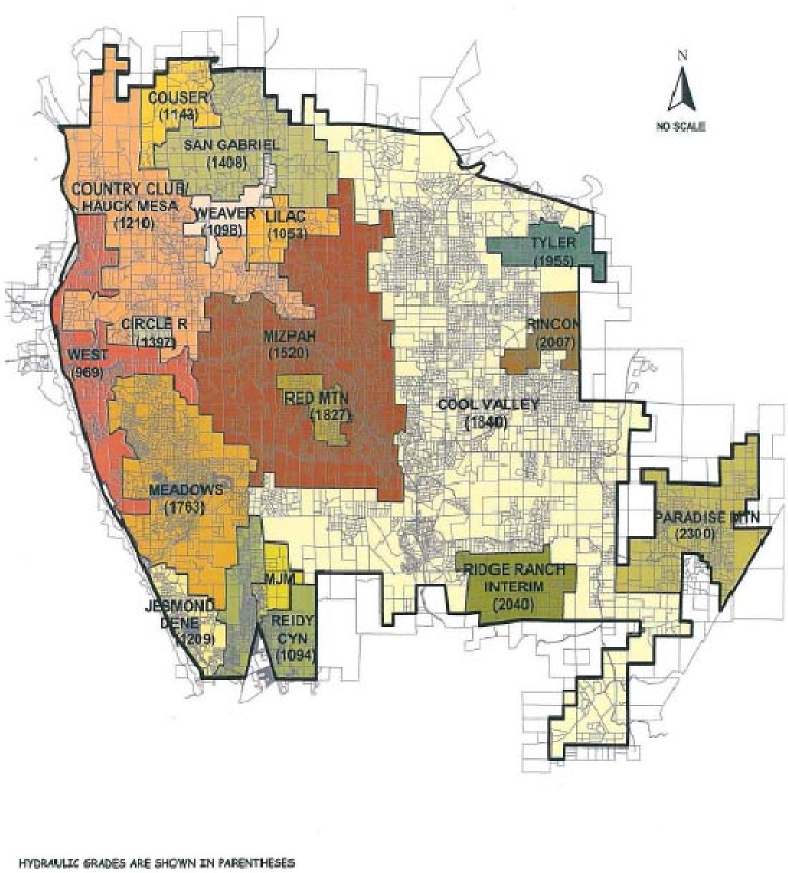



**Figure 2: General Boundaries of 18 Pressure Zones**

A cluster of three of the zones, the Jesmond Dene, Reidy Canyon and MJM, are interconnected with each other, but are connected to the remainder of the system only through a pressure-reducing facility at the Jesmond Dene Bypass Station. This connection provides an alternate source of water under emergency conditions. These zones are generally served from the VC No. 2 aqueduct connection and operate essentially as an independent system.

## Sub-Region 2: Wastewater System

### *Wastewater Collection*

The distribution topology is hilly and multiple booster pumps are required to deliver the wastewater to the treatment plants. The wastewater treatment system is operated to meet demand.

### *Wastewater and Recycled Water Treatment Plants*

**Lower Moosa Wastewater Reclamation Facility**

The Moosa plant provides wastewater treatment services for about 2,264 customers in VCMWD's Interstate 15 corridor area, from the Lawrence Welk development on the south end, east to Hidden Meadows, and north to Circle R Drive. The plant has a current capacity of 0.45 MGD and treats effluent to advanced secondary treatment standards. Estimated recycled water quantities for 2005 are 395 AF/Yr. Disposal of effluent is accomplished by indirect reclamation via discharge to ponds percolating to the San Luis Rey River basin.

**Woods Valley Ranch Wastewater Reclamation Facility**

The Woods Valley Ranch Wastewater Reclamation Facility treats wastewater from the Woods Valley Ranch Development 270 lot and the Woods Valley Ranch golf course facilities. The reclaimed water is returned to the Woods Valley Golf Course for irrigation. This plant has a capacity of 0.70 MGD.

## System Storage

VCMWD has a storage capacity of 421 AF. The system operations are primarily driven by agricultural demand with reservoirs drawn down during the work week and then re-filled on the weekends when energy rates are lower.

## System-wide Operation Strategy

VCMWD purchases treated water from the SDCWA at a rate of about $554/acre-ft as of 2008. As of 2010, SDCWA rates have increased to $1,016/acre-ft (domestic) and $883/acre-ft (ag rate).

Water enters VCMWD's distribution system through seven connections to the SDCWA's first and second aqueducts. The treated water is delivered to VCMWD's customers through a system of pipes, closed storage reservoirs, booster pumps, and pressure reducing stations. The majority of VCMWD's customers are agricultural customers and the overall system is operated according to agricultural demand. The reservoirs are typically filled on weekends, when energy rates are lower, and drawn down during the week.

## Infrastructure Changes

No infrastructure changes in 2008 were identified that would affect the Study Team's data. However, there are current plans to expand the recycled water distribution system.

As approved, the Woods Valley Ranch Residential and Golf Course Development will reclaim 100 percent of the 0.07 mgd tertiary treated effluent originating from the project as well as several surrounding and adjacent properties. The effluent will be used to irrigate the 18-hole golf course which is part of the approved development.

The Live Oak Ranch Development will utilize a tertiary facility to treat 100 percent of the project's maximum effluent flow of 0.038 mgd to irrigate an active citrus grove which is currently part of the project site. The Orchard Run Development will produce 0.075 mgd, which will be tertiary treated and used to irrigate landscaping and open space areas on the development. The Lilac Ranch Development tertiary treatment facility will serve a 330 unit residential development. The treated water will be used on agricultural and landscaped areas on the development site. The North Village Water Reclamation Facility will serve up to 1,000 residential and commercial units located within the planning area designated in the North Village area.

## Energy Profiles

VCMWD provided energy and water flow data to the Study Team for its calculations of energy profiles. VCMWD provided the Study Team with a key to link the energy accounts to the water flow data. Energy data provided included access to SDG&E energy data through a Third Party Authorization Agreement between VCMWD, SDG&E, and the Study Team. Energy data were downloaded as metered, either monthly, TOU, or 15-minute interval. Water flow data was provided on a monthly basis in two formats. Monthly water bills provided monthly quantities delivered to VCMWD from SDCWA's first and second aqueducts. These flows were used at each of the aqueduct facilities. Water data was also provided on a monthly time-step as deliveries per VCMWD customer. A pump zone map and GIS database file were provided to the Study Team. The Study Team sorted the VCMWD delivery locations by pump zone and summed the deliveries to each pump zone. Water flow rates through individual booster pumps were not available. Thus the Study Team applied the total delivery flow per pump zone to each of the pumps in the zone. Energy data per pump was used to distribute the flows to a daily time-step.

Energy is provided to VCMWD from SDG&E. SDG&E energy is used to power 36 booster pumps, 24 reservoirs, 5 pressure stations, and 7 aqueduct connections. A solar energy field is located near the Betsworth pumping station and is used to offset SDG&E energy demand at the pumping station. This energy use is not included in the 24-hour energy profiles.

The energy intensity of each facility type within Valley Center MWD is presented in Figure 3. The energy intensity value of booster pumps in March was removed as an outlier.

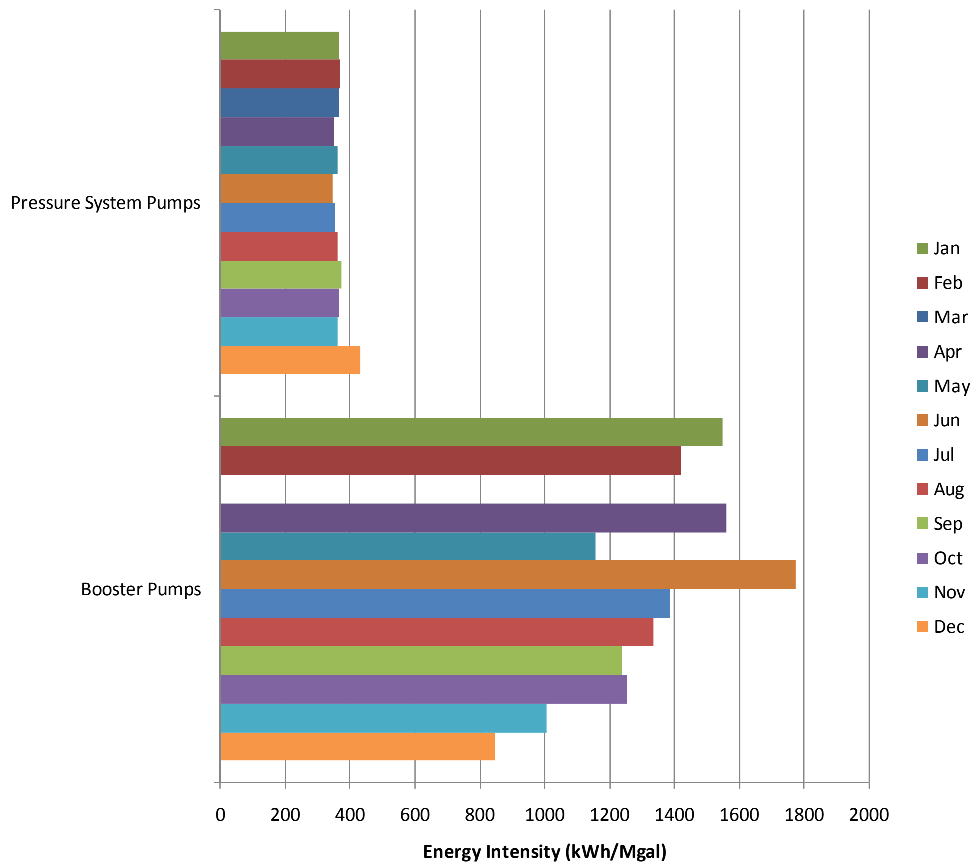
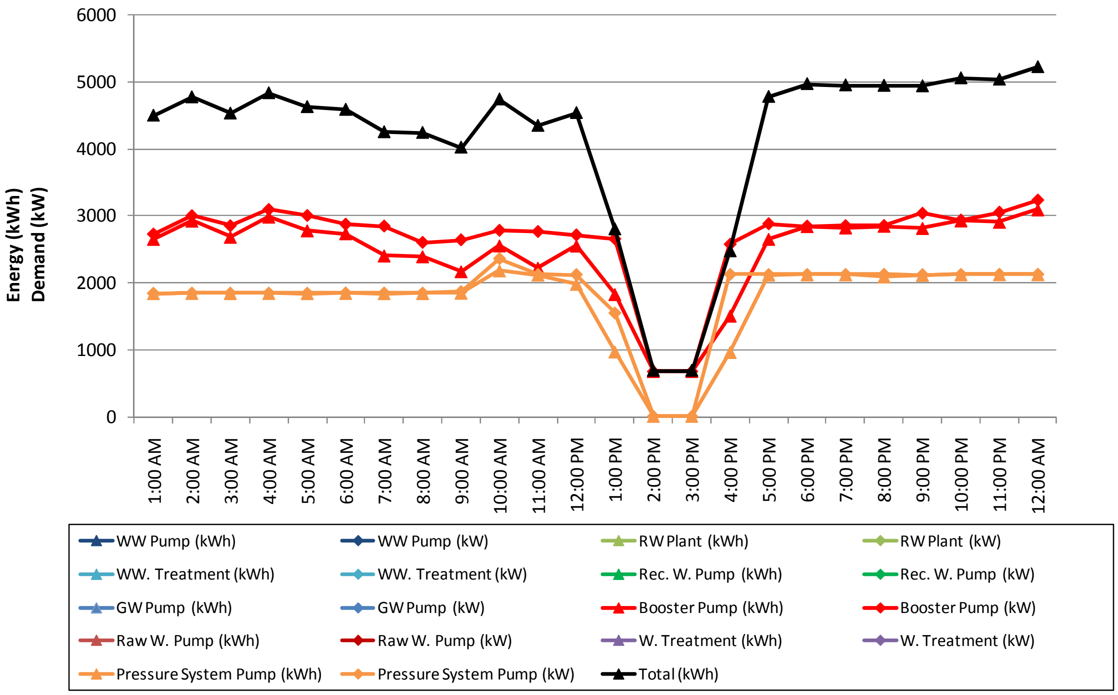


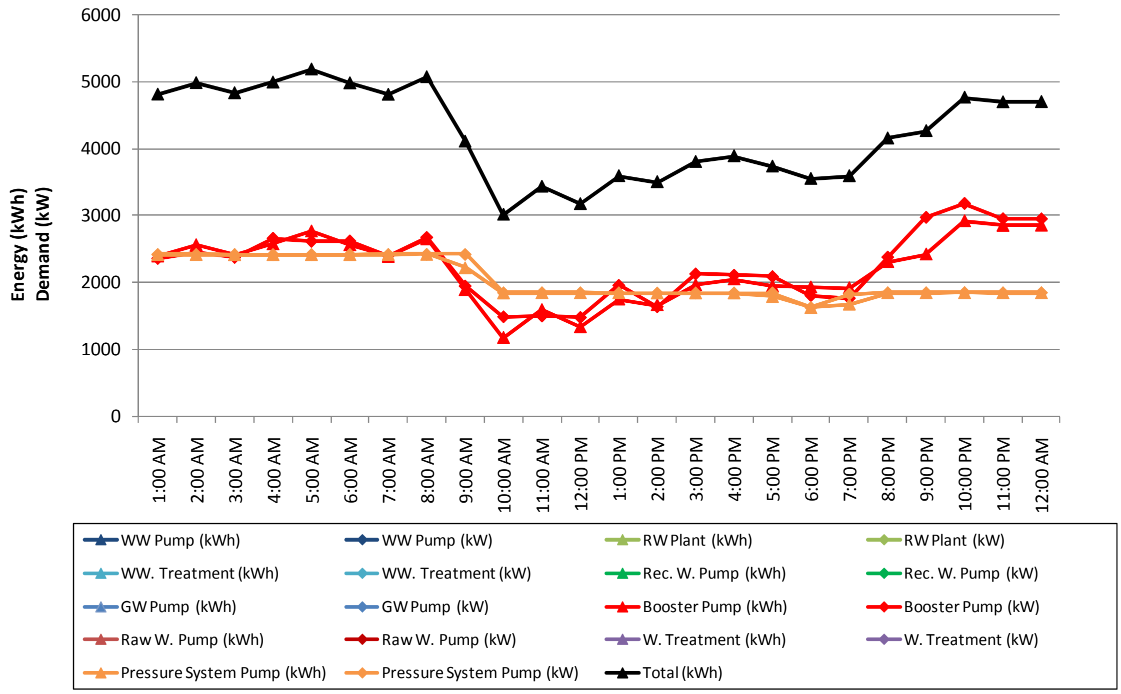

**Figure 3: VCMWD Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 4 through 10. Energy use is split between booster pumps and pressure system pumps.



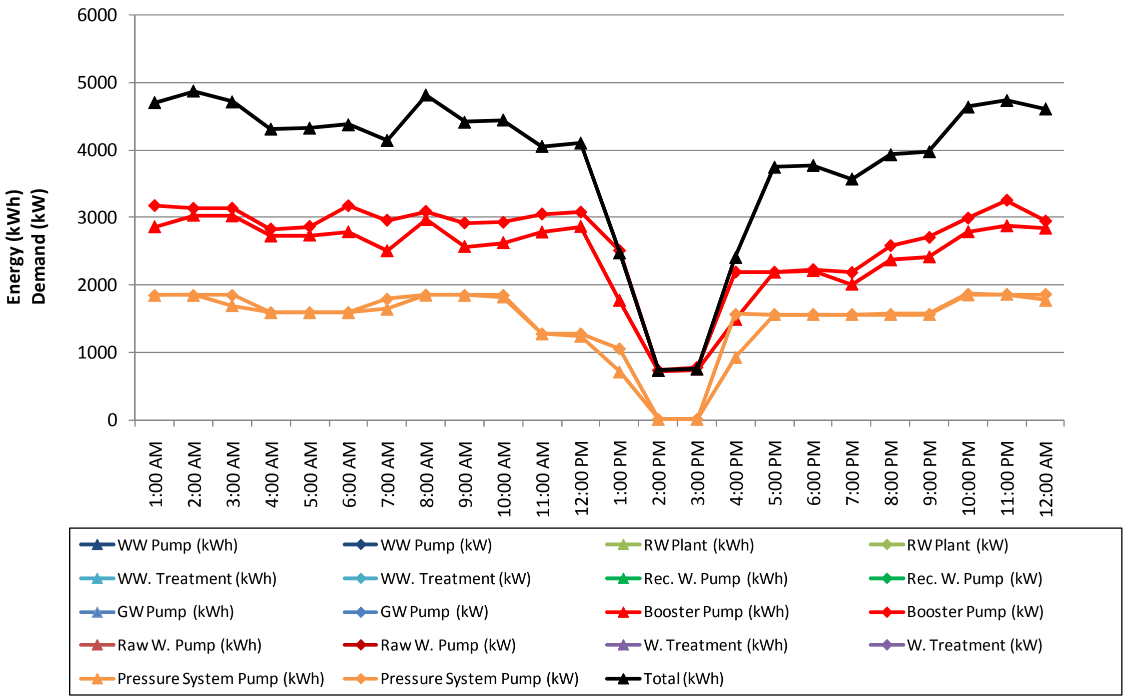

| **Date** | 6/20/2008 |
|---|---|
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,613 |
| *Pressure System Pumps* | 1,031 |

**Figure 4: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



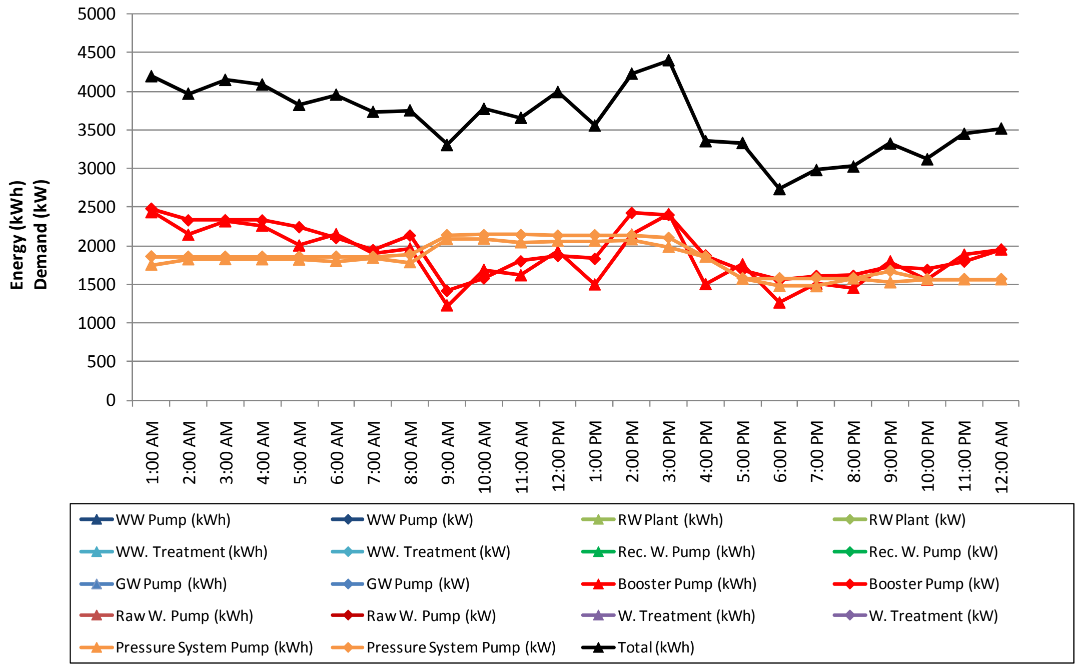

| | |
|---|---|
| **Date** | 9/1/2008 |
| **Day** | Monday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,981 |
| *Pressure System Pumps* | 1,823 |

**Figure 5: 24-Hour Energy Profile: Summer High Water Demand Day**



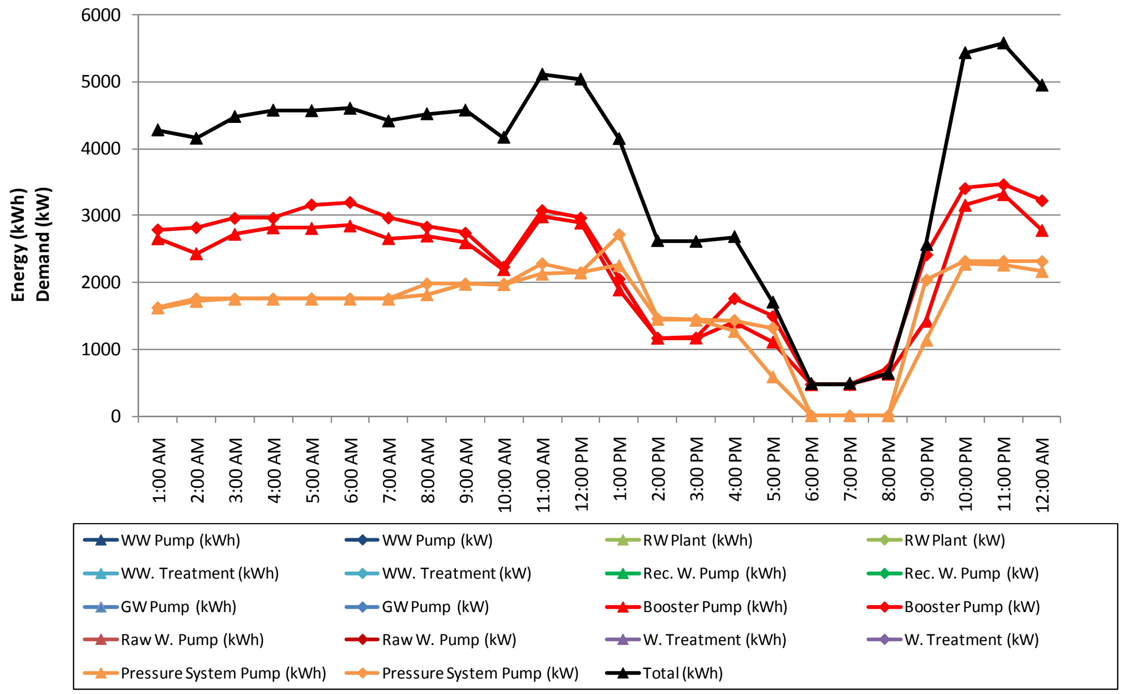

| **Date** | 7/1/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,471 |
| *Pressure System Pumps* | 831 |

**Figure 6: 24-Hour Energy Profile: Summer Average Water Demand Day**



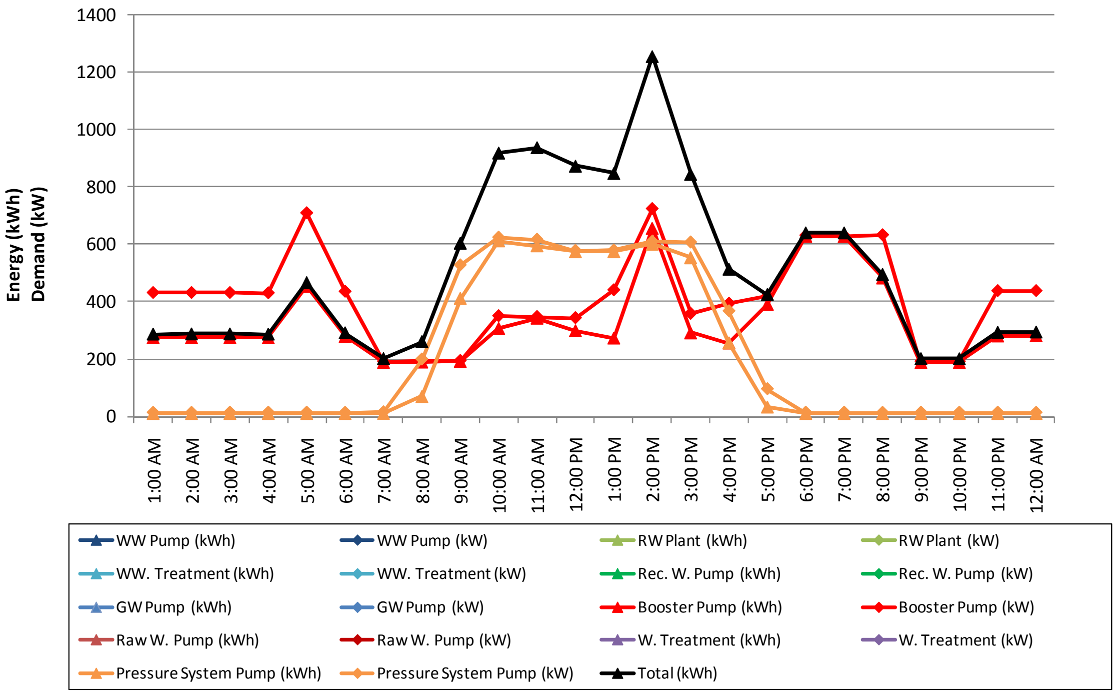

| | |
|---|---|
| **Date** | 6/1/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,892 |
| *Pressure System Pumps* | 1,803 |

**Figure 7: 24-Hour Energy Profile: Summer Low Water Demand Day**



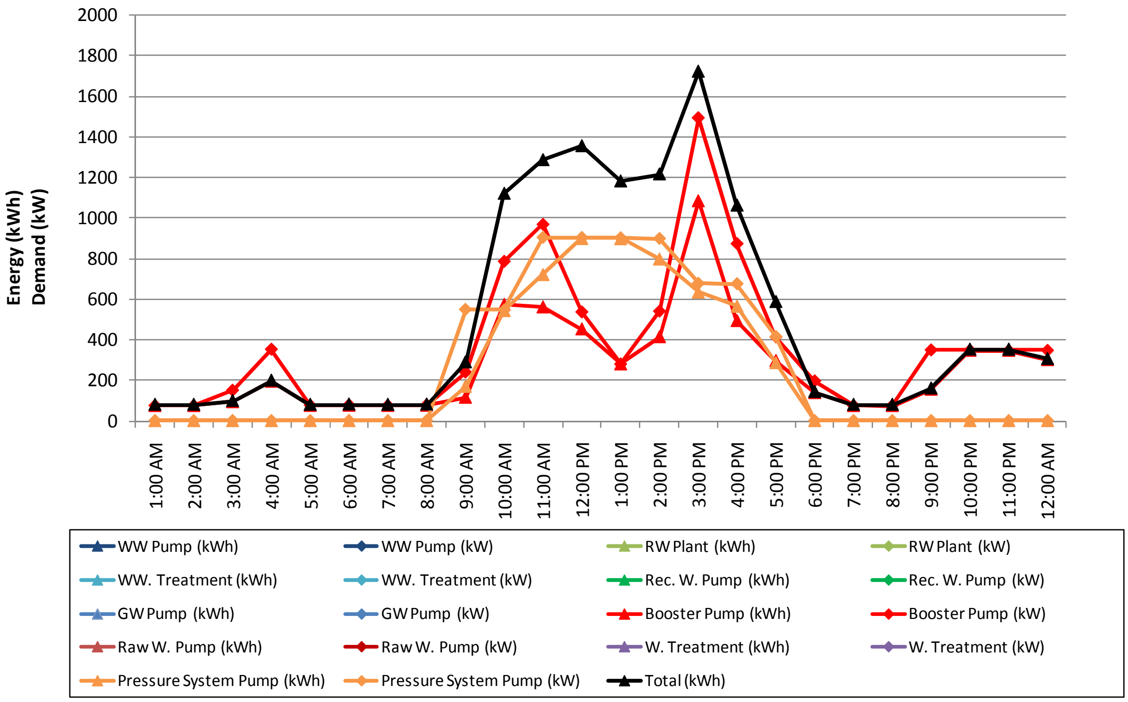

| **Date** | 10/1/2008 |
|---|---|
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 1,231 |
| *Pressure System Pumps* | 1,098 |

**Figure 8: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 12/31/2008 |
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 4,509 |
| *Pressure System Pumps* | 2,812 |

**Figure 9: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 2/1/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Booster Pumps* | 625 |
| *Pressure System Pumps* | 498 |

**Figure 10: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

VCMWD regularly maintains and upgrades pump stations and maintains pipelines, reservoirs and valves to prevent leakage. VCMWD installed a 1MW solar generation facility near the Betsworth pump station, completed in December 2008. This facility helps offset the energy that VCMWD must purchase from SDG&E to pump from the Betsworth facilities.

## Sources


Valley Center Municipal Water District. “Urban Water Management Plan.” February 2006.

Valley Center Municipal Water District. http://www.vcmwd.org/. Accessed 1/12/2010.

Valley Center Municipal Water District. Water Invoices Jan-Dec 2008.

Valley Center Municipal Water District. Monthly Energy.

Wally Grabbe, District Engineer - Valley Center MWD. Interviewed: 10/21/09. Interviewed by: Lacy Canon (GEI)

# Westlands Water District (WWD)

## Summary

| | |
|---|---|
| **Primary function** | Agricultural Water |
| **Segment of Water Use Cycle** | Supply |
| **Hydrologic Region** | Tulare Lake<br>**DEER Climate Zone:** 13 |
| **Quantity of water (2008)** | Contracted: 296 MGD<br>Pumped: 410 MGD |
| **Number of Customers** | Total: 600 family owned farms<br>**Service Area Size:** 937.5 Sq miles |
| **Distinguishing Characteristics** | Westlands Water District (WWD) provides water to agricultural customers, and drainage service to those lands that need it. Most of the land east of the San Luis Canal (SLC) slopes from elevation 320 to 160 feet and has gravity service from the SLC. Small recirculating pumping plants at the headworks of each of the gravity laterals pressurize the laterals serving lands adjacent to the SLC which are too high in elevation to be served through the gravity laterals. The land lying west of the SLC is at higher elevations than the SLC and is served by pumping from the SLC and gravity from the Coalinga Canal. |
| **Key Energy Drivers** | • Water Supply- significant energy is used to pump groundwater<br>• Water Conveyance- Pumps divert water from the San Luis Canal<br>• Water Distribution – Energy is used to pump water to Priority Area II which is at higher elevations than the San Luis Canal |
| **Water/Wastewater Treatment Technology** | N/A – no treatment required |
| **Water Resources (2008)** | CVP Allocations: 33.9%, Groundwater: 46.9%, Water User Acquired: 8.7%, Water Transfers: 10.5% |
| **Marginal Water Supplies** | Short-term: Increased CVP allocations, water transfers, conjunctive use, San Joaquin and King River flood flows.<br>Long-term: Increased surface water and/or imported water supplies |
| **Energy Service Provider** | PG&E, PWRPA, CVP (temporary diversions) |

**Observed Energy Intensities (kWh/MG)**

| Segment | Lower Range | Upper Range |
|---|---|---|
| Groundwater | 1,571 | 2,530 |
| Raw Water Pumps | 1,044 | 1,341 |

## Background Information

It is the mission of Westlands Water District (WWD) to provide a timely, reliable, and affordable water supply to its customers, and to provide drainage service to those lands that need it. To this end, Westlands is committed to the preservation of its federal contract, which includes water and drainage service, and to the acquisition of additional water necessary to meet the needs of its landowners and water users. Table 1 provides a summary of WWD.

Westlands farmers produce more than 60 high quality commercial food and fiber crops sold for the fresh, dry, canned and frozen food markets, both domestic and export. More than 50,000 people live and work in the communities dependent on the District's agricultural economy. The communities in and near the District's boundaries include Mendota, Huron, Tranquillity, Firebaugh, Three Rocks, Cantua Creek, Helm, San Joaquin, Kerman, Lemoore and Coalinga (Figure 1).

Primary sources of information on Westlands Water Storage District include: WWSD's public website, WWSD's 1999 Water Management Plan, and WWSD's 1996 Groundwater Management Plan. A detail list of references in located at end of this section.

### Table 1: Agency Profile

| | |
|---|---|
| **Agency Type** | Agricultural Water |
| **Hydrologic Region** | Tulare Lake |
| **Region Type** | Central Valley |
| **Energy Service Provider** | PG&E, PWRPA, CVP |
| **DEER Climate Zone** | 13 |
| **Service Area Size** | 937.5 Sq miles |
| **Number of Customers in 2008** | 600 |
| **Distribution Topology** | Flat to Moderate |


**Figure 1: Westlands Water District Map**

## Climate

Annual precipitation in Westlands averages about seven inches, the majority of which falls during the months of December through March. Summer maximum temperatures frequently exceed 100E F and winter temperatures occasionally fall below freezing. With a mean annual temperature of 62E F, the area has an average frost-free growing season of 280 days.

## Demographics

The District primarily serves agricultural needs, but some communities are served as well. Table 2 presents the cropping patterns for the area. Table 3 presents the past and future populations of the major communities in the area.

### Table 2: Present and Future Cropping Patterns

| Year | Crops[a] (Acres) | | |
|---|---|---|---|
| | Total Planted | Multi-cropping | Total Land Area Use |
| **2000** | 577,466 | -13,255 | 564,191 |
| **2001** | 577,057 | -12,783 | 564,274 |
| **2002** | 564,154 | -15,491 | 579,645 |
| **2003** | 579,380 | -15,747 | 563,633 |
| **2004** | 578,743 | -18,073 | 560,670 |
| **2005** | 578,982 | -18,435 | 560,547 |
| **2006** | 580,056 | -20,312 | 559,744 |
| **2007** | 577,755 | -9,208 | 568,547 |
| **2008** | 575,038 | -6,411 | 568,627 |
| **2010** | 605,000 | -67,000 | 538,000 |

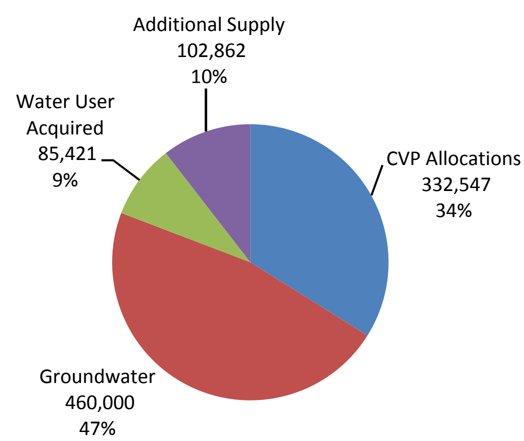
a) Including: alfalfa, hay, cotton, field crops, grain, trees, vegetables, vines, fallow, out of production)

### Table 3: Community Population Projections

| Community | 1995 | 2000 | 2010 | 2020 |
|---|---|---|---|---|
| Firebaugh | 5,095 | 5,490 | 5,885 | 6,280 |
| Huron | 4,200 | 5,425 | 5,950 | n/a |
| Mendota | 10,000 | 14,000 | 22,000 | 30,000 |

## Water Sources

The District has experienced a decrease in its water supply since the drought that began in 1987. Drought conditions as well as environmental regulations have led the U.S. Bureau of Reclamation to dramatically reduce the amount of water it delivers to Westlands, to the point where today, the District can expect to receive only about 50 percent of its contractual water supply in an average water year. Figure 2 shows the current sources of water used by the District.




### Figure 2: 2008 Distribution of Sources (AF)

## Groundwater and Water User Acquired Water

The majority of groundwater supplied in the area comes from wells enrolled in the Groundwater Management Program, through which the wells are integrated into the WWD's comprehensive water supply system. This supply is indicated as "Groundwater" in Figure 2. The pumps supplying this water have been transferred to WWD; WWD operates and maintains these facilities. Customers pump water according to WWD schedules and are charged a cost-based fee for groundwater pumped.

Additional groundwater is pumped from private wells within the WWD service area. This supply is indicated as "Water User Acquired" in Figure 2. Water User Acquired water is pumped by individual users through private wells that are not regulated by WWD. WWD does survey the static water levels in the wells and the water quality and quantity of the pumped groundwater, as part of the Groundwater Management Plan completed under provisions of AB3030 in 1996.

The groundwater basin underlying Westlands is essentially comprised of two water-bearing zones: (1) an upper zone above a nearly impervious Corcoran Clay layer containing the Coastal and Sierra aquifers and (2) a lower zone below the Corcoran Clay containing the Sub-Corcoran aquifer. These water-bearing zones are recharged by subsurface inflow from the east and northeast, the compaction of water-bearing sediments, percolation of pumped groundwater, and percolation from imported and natural surface water.

Through the Groundwater Management Program, Westlands installs or acquires title to groundwater pumps and integrates them into its comprehensive water supply system. The program provides groundwater pumping from these District-owned facilities by program participants. Participants must agree to transfer groundwater pumping facilities to the District and to operate and maintain those facilities. Participants pump groundwater according to District schedules and are charged a cost-based fee for groundwater pumped.

Groundwater quality, measured as electrical conductivity, in the lower water-bearing zone varies throughout the District in Figure 3. Typically, water quality varies with depth with poorer quality existing at the upper and lower limits of the aquifer and with the optimum quality somewhere between. The upper limit of the aquifer is the base of the Corcoran Clay with the USGS identifying the lower limit as the base of the fresh groundwater. The quality of the groundwater below the base of fresh water exceeds 2,000 parts per million total dissolved solids (TDS) which is too high for irrigating crops.

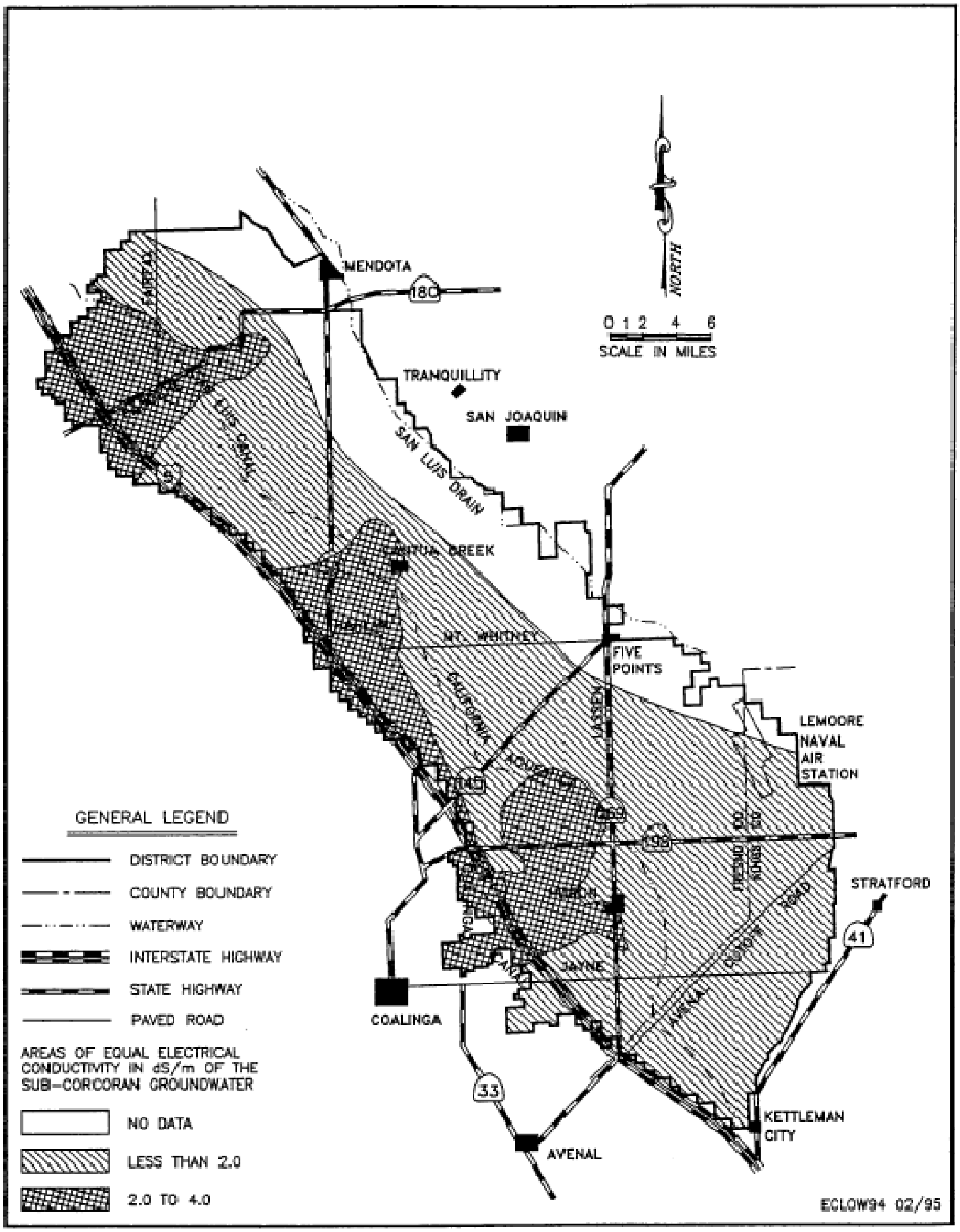



**Figure 3: Electrical Conductivity of Sub-Corcoran Groundwater, December 1994**

## Imported Water

Westlands annual Contract entitlement from the U.S. Bureau of Reclamation's Central Valley Project (CVP) is 1,150,000 AF. The surface water supply is allocated to more than 535,000 acres eligible to receive Project water. An additional 33,000 acres farmed in the District ineligible to receive Project water must rely solely on pumped groundwater. The District has three separate priority areas of water allocation. During periods of drought, deficiencies are applied as an equal percentage of the Contract entitlement of each priority area.

The original Westlands entered into a 40-year water supply Contract with the Bureau in 1963, providing for the delivery of 900,000 AF annually. In 1965 the Bureau committed an additional 250,000 AF annually to the District, although the Bureau and Westlands recognized that amount was insufficient for the additional irrigable acreage.

The Merger Agreement between the original Westlands and Westplains Water Storage District was codified by California Water Law in 1965. It specifies that the original Westlands area has a priority right to the 1963 Contract water. The 900,000 AF delivered under the 1963 Contract, therefore, is allocated first to about 337,000 eligible acres in Priority Area I (the original Westlands area), providing about 2.6 AF/AC.

The 250,000 AF allocation for Priority Area II (former Westplains area) provides only about 1.3 AF for each of the 187,000 acres eligible to receive Project water. An additional 18,000 eligible acres annexed to the District after the merger (Priority Area III) does not receive any allocation until and unless Priority Areas I and II have been allocated about 2.6 AF/AC.

The 1963 Contract allows Westlands to purchase additional (interim) water from the Bureau when it is available, which is usually allocated to Priority Area II. Between 1975 and 1988, the District purchased a total of more than 1 million acre-feet of additional water to boost average annual deliveries from 1.15 to 1.23 million AF. Since 1988, interim water has not been available. In addition to the Project water supply, since 1989 the District has been actively engaged in water marketing and conjunctive use with other agencies and purchases from the State Water Bank. While providing neither firm, abundant, nor economical water, these sources have provided insurance against well failures and higher than anticipated crop water needs.

### Additional Supplies

WWD receives additional water supply on a year by year basis from flood flow from the San Joaquin and Kings Rivers, which feed the Mendota Pool.

### Marginal Water Supply

WWD identified both short-term and long-term marginal supply sources. In the short-term, additional demand can be met by imported water from the Central Valley Project (CVP), transfers, conjunctive uses, and use of flood water flows. Long-term marginal supply sources identified in the 1996 Groundwater Management Plan also consist of increased surface supplies, imported CVP water, and conservation.

#### *Imported Water*

Estimates of water demand for the next 12, 24, and 36 months should be similar to the nonagricultural water use in an average water year, about 5,000 AF. The “worst case” water supply estimates for the next 12, 24, and 36 months is nil. Currently all non-agricultural water is part of the CVP contract supply. Since the extent of the additional regulatory restrictions is unknown at this time, this possibility cannot be ruled out. However, it has been the policy of the USBR to deliver a minimum of 75 percent of historical M&I use, even when agricultural allocations are considerably less than that.

The CVP allocation to Westlands is shared between agricultural, incidental agricultural and incidental non-agricultural water users. The District’s Regulations for the Allocation of Agricultural Water Within the Westlands Water District state "The District's General Manager is authorized to set aside from the total entitlement whether they be from the District's basic contract supply or some other general source of water, for each area of the District the amount of water needed for M&I purposes…." Historically, when the overall water supply has been reduced, the non-agricultural water allocation may not be reduced a similar percentage. In certain cases of severe reduction, it is likely that the District would receive CVP hardship water for health and safety purposes based on the statement of need.

### *Water Marketing and Conjunctive Use*

In addition to the Project water supply, since 1989 the District has been actively engaged in water marketing and conjunctive use with other agencies and purchases from the State Water Bank. While providing neither firm, abundant, nor economical water, these sources have provided insurance against well failures and higher than anticipated crop water needs.

### *Water Transfers*

Water transfers have become an important component in Westlands water supply. Transfers from other districts are pursued each year to supplement reduced contract deliveries when the price is reasonable. Transfers within the District are used to supplement a water user's allocation from supplies currently available. Other supplies from internal groundwater transfers are possible but because of uncertainty that groundwater can meet Title 22 standards and the lack of proximity to District distribution facilities, these supplies cannot be guaranteed. Due to the shortage of supply, no water is transferred out of Westlands.

### *Water Conservation*

Westlands believes that although there have been no mandatory reductions imposed on the District's non-agricultural customers, water conservation has occurred during periods of reduced supply. This is apparent when comparing non-agricultural water use in full and reduced water supply years (in 1991 and 1992 water use was less than above average in each year). In the unlikely event that the CVP allocates no water to Delta export water service contractors and the allocation for M&I use is less than 75 percent of historical use, the District will purchase water from other sources including an Emergency Drought Water Bank. Mandatory rationing will be imposed to the extent that sufficient water cannot be purchased.

### *San Joaquin and Kings River Flood Flows*

On a year by year basis flood flows from the San Joaquin and Kings Rivers are available to Westlands. These water supplies flow into the Mendota Pool on a seasonal basis and are available to the District through the 7-1 Pumping Plant. No water was taken from this source in the 1996-97 water year. The upper limit, due to pumping plant limitations, of water delivered from this source would be approximately 20,000 AF.

The energy intensity range of Westlands' marginal supply is summarized in Table 4. The energy intensity represents the embedded energy for all activities prior to the water reaching WWD's distribution system. The distribution system would add an addition 1,044-1,341 kWh/MG to the energy intensity.

**Table 4: Energy Intensity Range for Marginal Supplies**

| Marginal Supply | Description | Energy Intensity Range |
|---|---|---|
| Short-term and Long-term | Imports from CVP (Tracy, O'Neil, Dos Amigos)[a] | 1,313 kWh/MG |
| | Imports from CVP (from San Luis, above Dos Amigos)[a] | 1,934 kWh/MG |
| | Imports from CVP (from San Luis, after Dos Amigos) | 2,350 kWh/MG |
| | Groundwater[c] | 1,571-2,530 kWh/MG |

a) CVP average EI Cumulative from Study 1 results.

b) Surface water distribution EI range from Study 2 results for WWD.

c) Groundwater EI range from Study 2 results for WWD.

## Water Demand

Westlands must allocate (ration) water to its farmers, even in the wettest years. Its annual Contract entitlement from the Bureau's Central Valley Project (CVP) is 1,150,000 AF. The annual safe yield of the confined underground aquifer adds about another 135,000 AF to 200,000 AF. The total water available is about 15 percent (215,000 AF) short of the 1.5 million AF required to water the entire irrigable area in the District (Figure 4).

In addition to meeting crop water requirements for normal growth, significant amounts of water are used on plants for cultural practices such as weed control, climate control, holding tomatoes for harvest, and ensuring a tight head of lettuce or swelled garlic bulbs. Because of the continuing changes in water management due to cultural practices, Westlands' farmers now require more water on acreage where low water use crops, such as wheat and barley, were previously grown.

Future projections of water demand were not available.

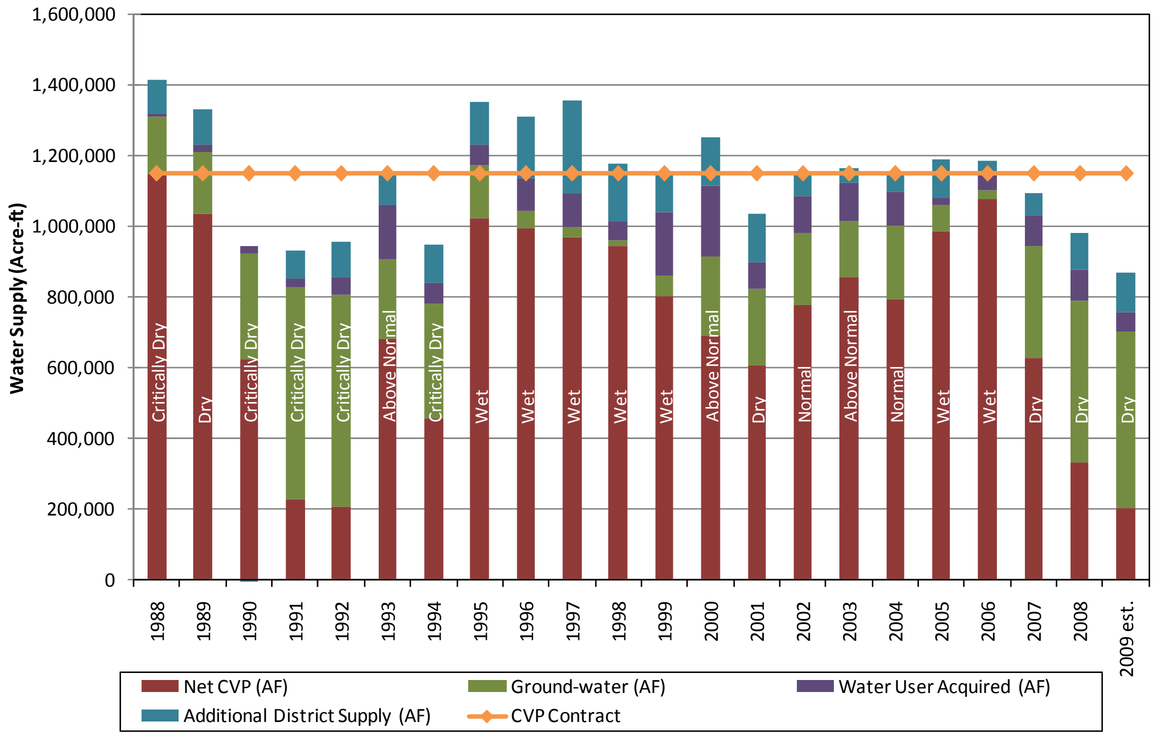



**Figure 4: Westlands Water District Supply**

## System Infrastructure and Operations

Table 5 summarizes the key pieces of physical infrastructure of the District's system.

**Table 5: Infrastructure Summary**

| | |
|---|---|
| **Miles of Distribution Piping** | 1,034 |
| **Miles of Canal** | 7.4 |
| **Number of Meters** | 3,300 |

### *Distribution*

The water that is delivered to Westlands is pumped from the Sacramento-San Joaquin Delta during the winter months when there is an abundance of water in the system. It is delivered 70 miles through the Delta-Mendota Canal to San Luis Reservoir. During the spring and summer, the water is released from San Luis Reservoir and delivered to Westlands farmers through the San Luis Canal and the Coalinga Canal. Once it leaves the federal project canals, water is delivered to farmers through 1,034 miles of underground pipe and over 3,300 metered delivery outlets.

Westlands' permanent distribution system consists of a closed, buried pipeline network designed to convey irrigation water to 160- or 320-acre land units from the SLC, the CC, and a 7.4-mile unlined canal from the Mendota Pool. The distribution system was built between 1965 and 1979. The area served by the completed system serves approximately 88 percent of the irrigable land in the District, including all land lying east of the SLC.

Water is distributed through 1,034 miles of buried pipe, varying in diameter from 10 to 96 inches. Gravity and pumps feed 38 lateral pipelines from the east bank of the SLC, while water is pumped into 27 laterals on the west bank. Six partially completed laterals are served from the CC. The basic design flow rate of each on-farm delivery system is one cubic-foot per second per 80 acres. The water is delivered with a minimum head pressure of five feet above the high point of the parcel. Farmers control individual deliveries at each of the more than 3,000 metered outlet valves.

Most of the land in the original Westlands is east of the SLC and slopes gently from an elevation of about 320 feet to about 160 to 200 feet at the eastern boundary. Most of this land has gravity service from the SLC. Small recirculating pumping plants at the headworks of each of the gravity laterals pressurize the laterals serving lands adjacent to the SLC which are too high in elevation to be served through the gravity laterals.

The land lying west of the SLC, most of which is in Priority Area II, is at higher elevations than the SLC. It is served by pumping from the SLC and also by gravity from the CC. Most of the remaining District lands are served by farmer-constructed temporary diversions. The farmers maintain these facilities for Westlands. Some of the pumping costs are offset by the availability of less expensive CVP power.

Approximately one-third of the land between the SLC and the CC is served by pumping from the SLC. The other two-thirds are served by laterals from the CC.

### System Storage

Westlands has 16 small regulating reservoirs designed to act as a controlling mechanism at the upper reach of each pumping plant.

### System-wide Operation Strategy

In general, farmers apply for an allocation from the USBR contract entitlement that WWD administers. A water user can take delivery of their allocation as needed, throughout the season, which extends from March through September. The March water year beginning allows the water user to better manage and utilize their allocation by adjusting their management decisions for the rainy season, rather than having to make the same decisions at the end of December, as was necessary previously.

Westlands operates an arranged rate-demand water ordering system. Farmers must notify the District 24 hours prior to beginning the irrigation. Flows are usually ordered in multiples of 24-hour periods, but can be adjusted for shorter periods with WWD approval.

WWD delivers Project water to its customers based on priority classifications. Priority Area I, the original Westlands area, has a priority right to 1963 Contract water in the amount of 900,000 AF. 337,000 acres are Priority I and eligible to receive the 1963 Contract allocation, providing about 2.6 acre-ft/acre.

Priority Area II has a 250,000 acre-ft Project water allocation for 187,000 acres, providing for about 1.3 acre-ft/acre. Priority Area III has 18,000 eligible acre, but does not receive any allocation until and unless Priority Area I and II have received their allocations.

### Infrastructure Changes

No infrastructure changes to WWD's system have been identified in calendar year 2008.

## Energy Profiles

WWD provided energy and water flow data to the Study Team for its calculation of energy profiles. WWD also provided the Study Team with permission to use energy and water flow data collected for a previous study conducted by GEI/NCI in 2008 (PWRPA Load Forecasting) for Study 2 calculations. Energy data provided by WWD included: monthly PWRPA power in units of kWh for deep wells and temporary facilities. Temporary facilities are privately owned distribution systems in area where no WWD or USBR facilities exist. Monthly USBR power was provided for temporary facilities and permanent facilities in units of kWh. Permanent facilities deliver surface water from the San Luis Canal and were constructed by WWD and USBR. Water flows provided by WWD included monthly flows in units of acre-ft for PWRPA powered deep wells and temporary facilities and USBR powered permanent and temporary facilities. Flow data values were converted from acre-ft to MG.

Interval energy data from the PWRPA study was used for the groundwater wells and temporary facilities supplied by PWRPA power. The monthly flows from WWD were combined and distributed to the energy data to determine daily flows proportional to the energy consumed. The USBR power and flows provided by WWD were used for the USBR power supplied permanent and temporary facilities. Monthly flows were evenly distributed to each day of the month since no detailed energy data was available to distribute them.

The energy intensity of each facility type within Westlands Water District is presented in Figure 5.

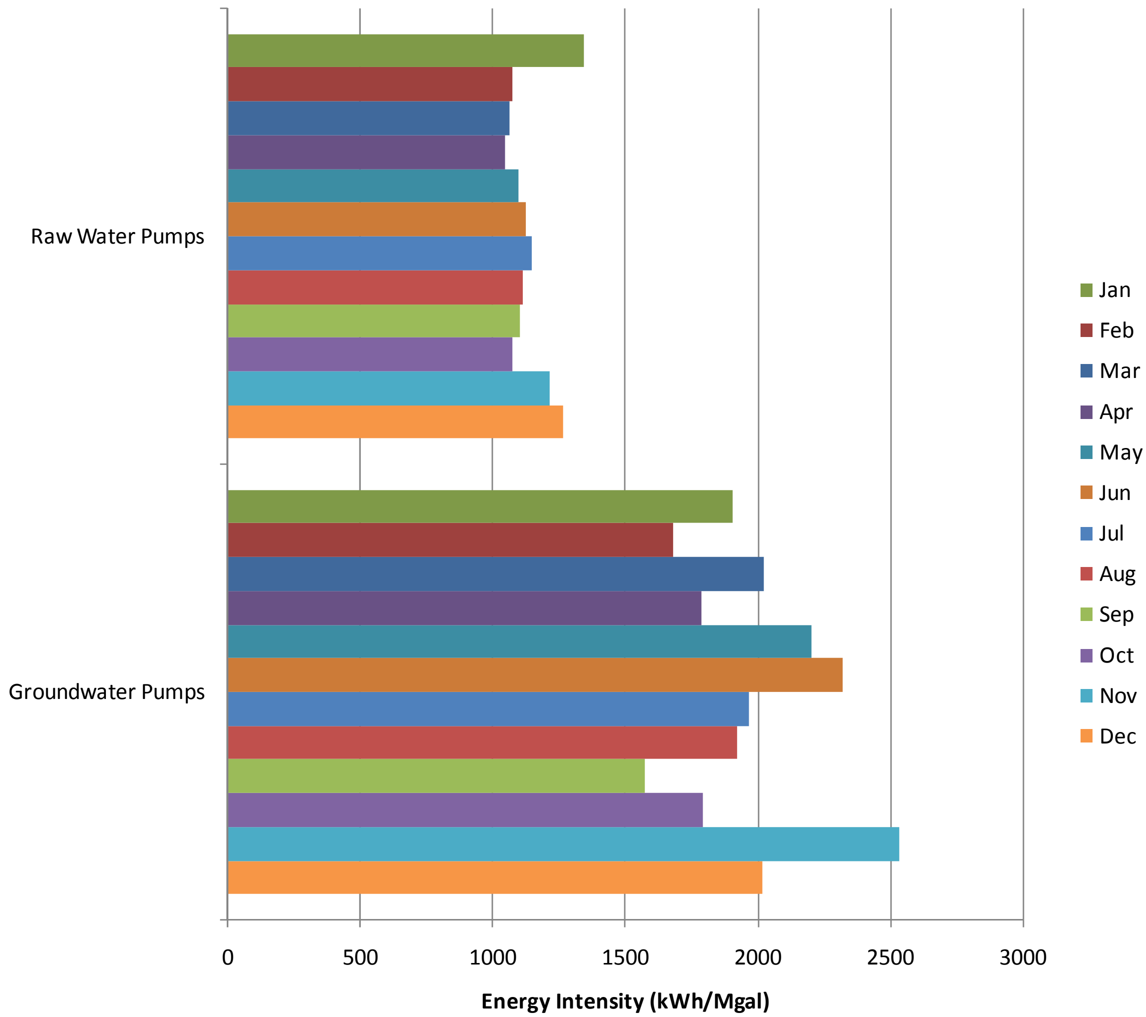
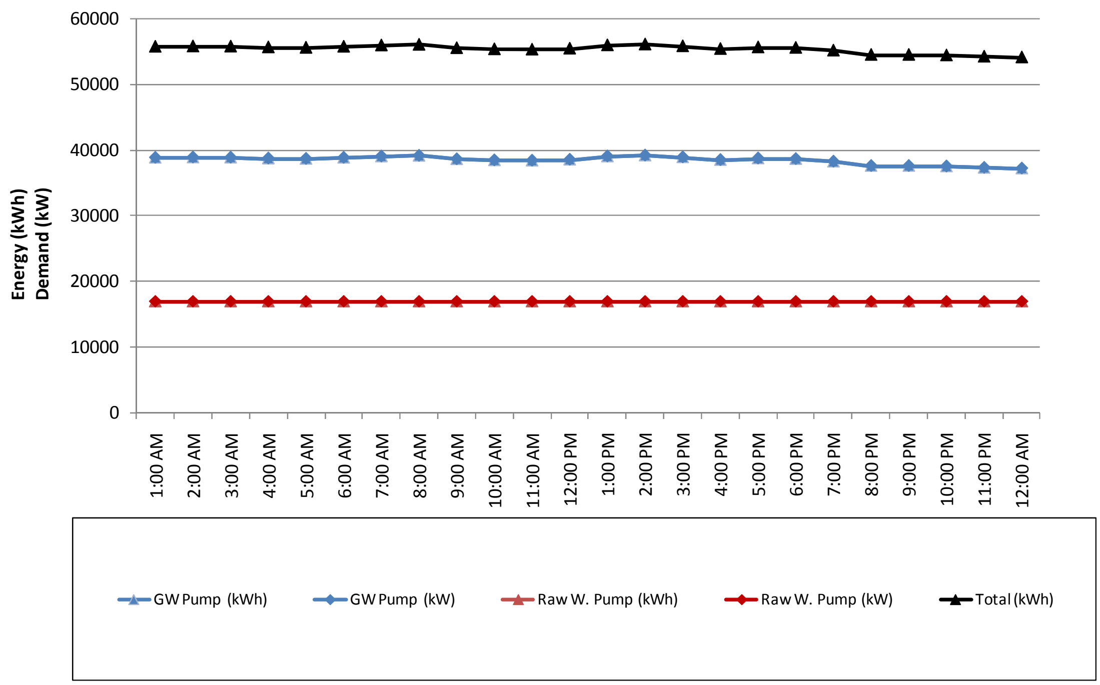


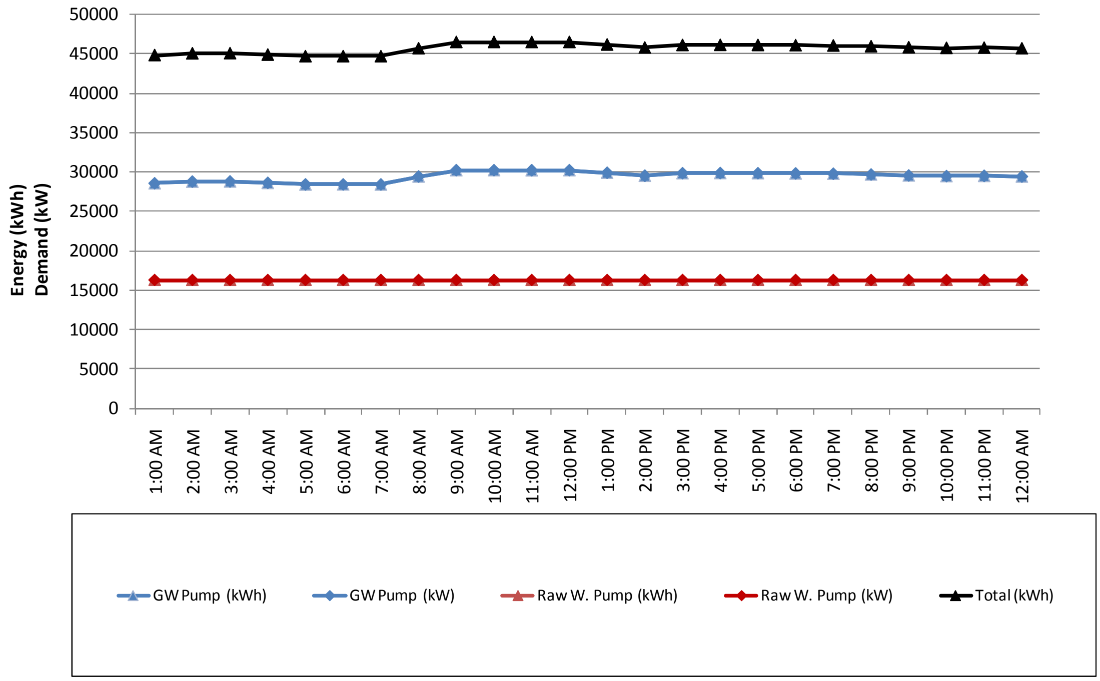

**Figure 5: Westlands Monthly Energy Intensity by Facility Type**

Hourly Energy profiles and peak energy demand is documented in Figures 6 through 12. The majority of energy used by Westland Water District is for groundwater pumping.



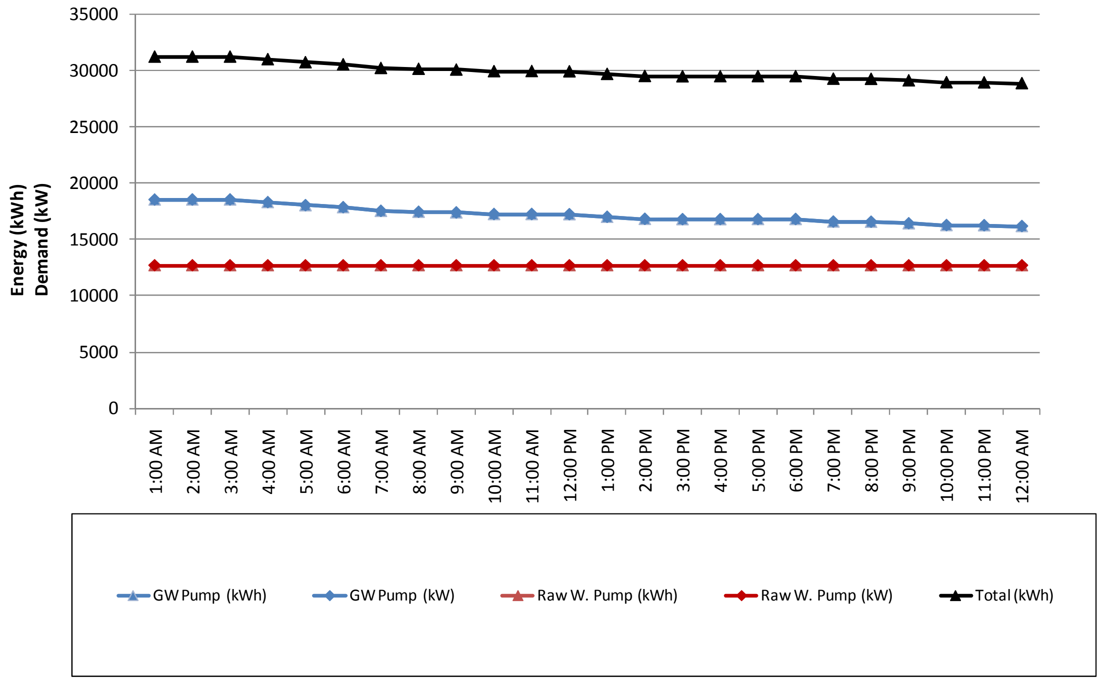

| **Date** | 7/8/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 38,673 |
| *Raw Water Pump* | 16,929 |

**Figure 6: 24-Hour Energy Profile: Summer Peak Energy Demand Day**



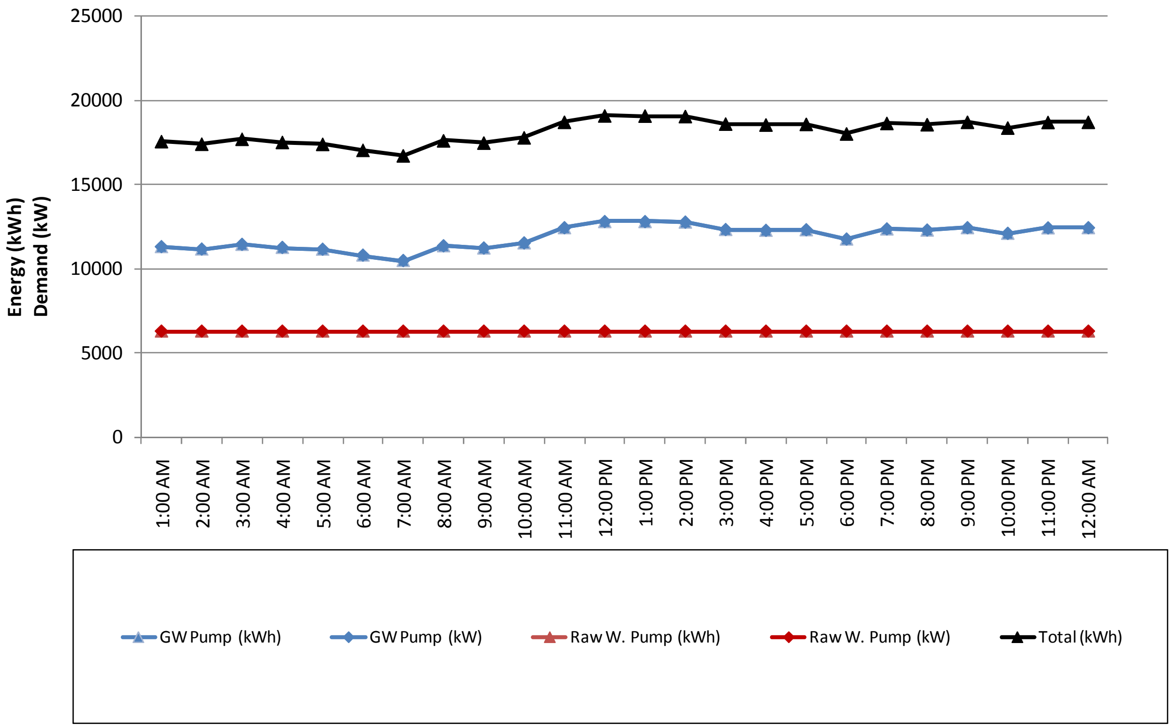

| | |
|---|---|
| **Date** | 5/1/2008 |
| **Day** | Thursday |
| **Peak Demand (kW)** | |
| *Groundwater* | 29,858 |
| *Raw Water Pump* | 16,244 |

**Figure 7: 24-Hour Energy Profile: Summer High Water Demand Day**



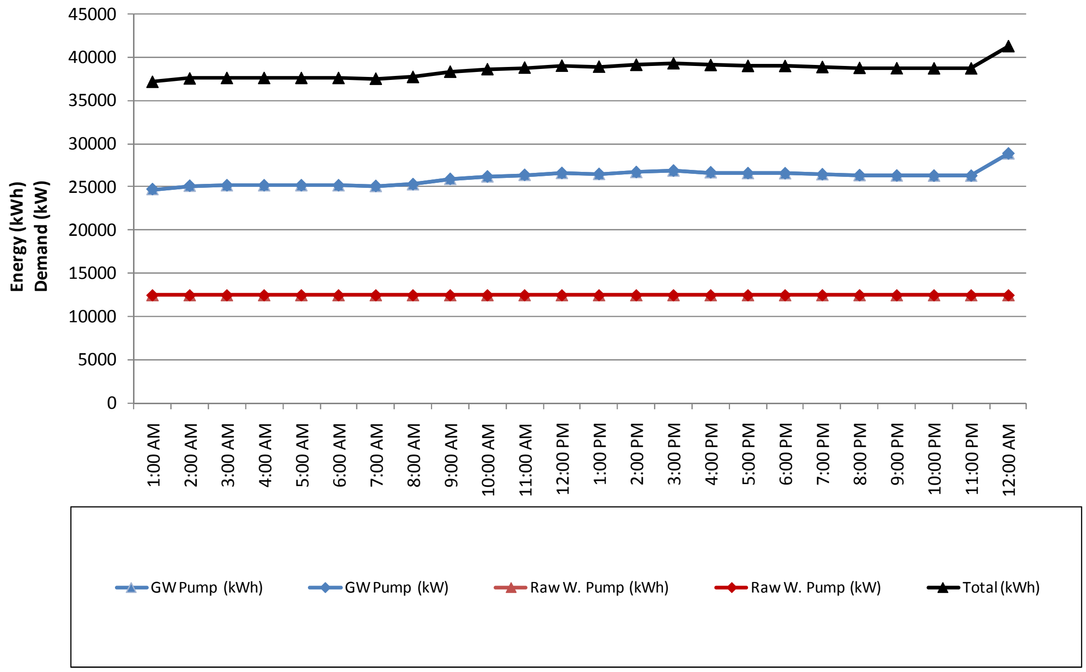

| | |
|---|---|
| **Date** | 8/31/2008 |
| **Day** | Sunday |
| **Peak Demand (kW)** | |
| *Groundwater* | 16,776 |
| *Raw Water Pump* | 12,691 |

**Figure 8: 24-Hour Energy Profile: Summer Average Water Demand Day**



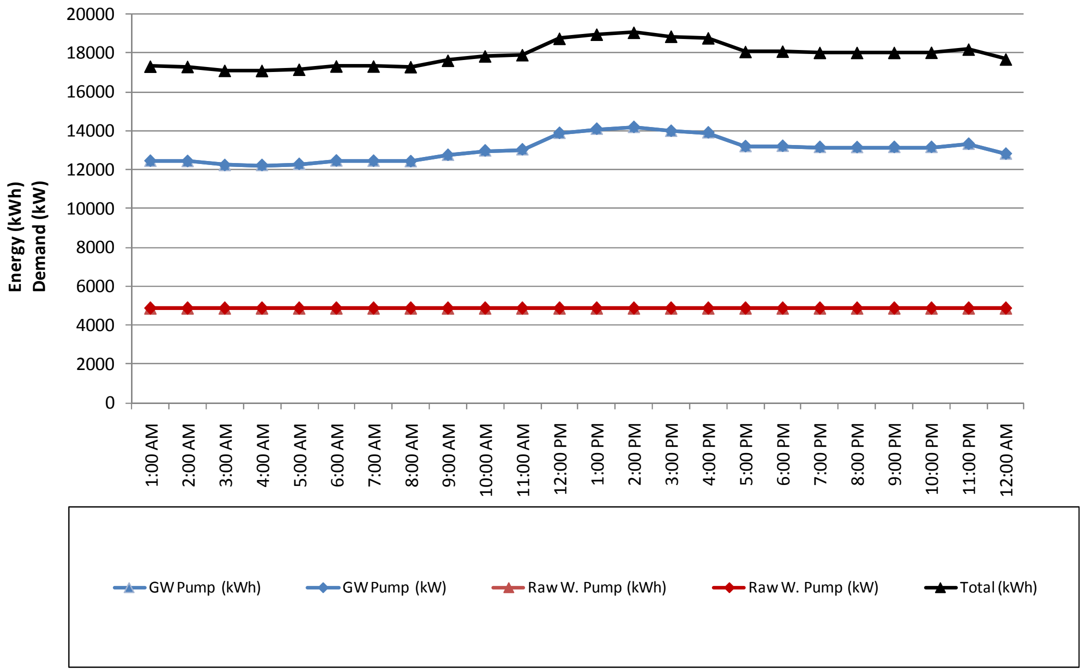

| | |
|---|---|
| **Date** | 10/1/2008 |
| **Day** | Wednesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 12,305 |
| *Raw Water Pump* | 6,268 |

**Figure 9: 24-Hour Energy Profile: Summer Low Water Demand Day**



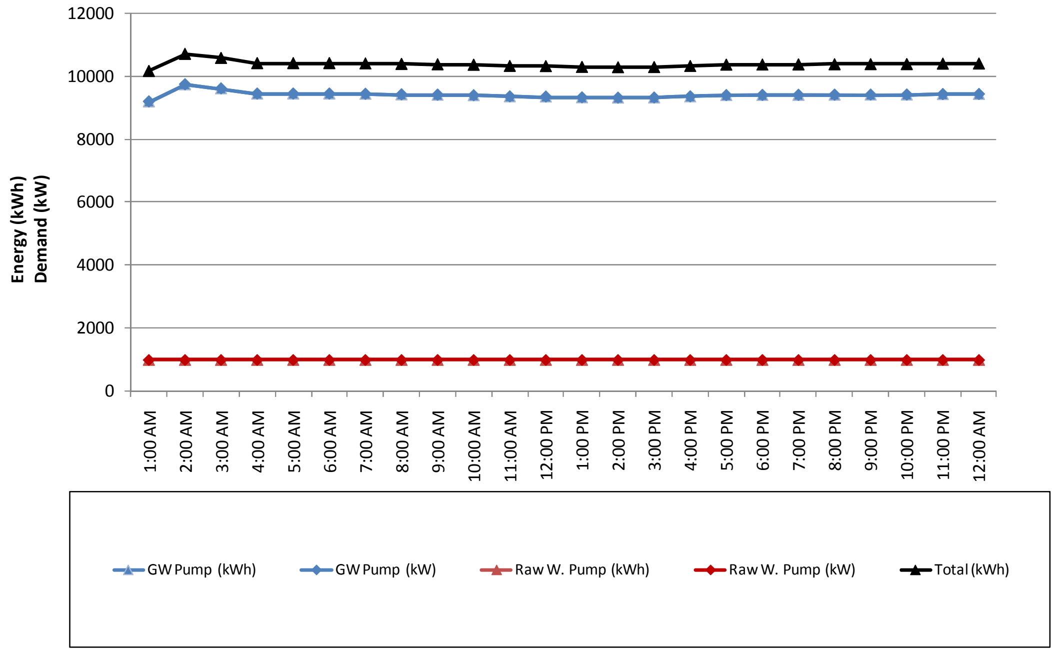

| **Date** | 4/1/2008 |
|---|---|
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 26,764 |
| *Raw Water Pump* | 12,449 |

**Figure 10: 24-Hour Energy Profile: Winter High Water Demand Day**




| | |
|---|---|
| **Date** | 2/29/2008 |
| **Day** | Friday |
| **Peak Demand (kW)** | |
| *Groundwater* | 13,684 |
| *Raw Water Pump* | 4,876 |

**Figure 11: 24-Hour Energy Profile: Winter Average Water Demand Day**




| | |
|---|---|
| **Date** | 1/1/2008 |
| **Day** | Tuesday |
| **Peak Demand (kW)** | |
| *Groundwater* | 9,348 |
| *Raw Water Pump* | 983 |

**Figure 12: 24-Hour Energy Profile: Winter Low Water Demand Day**

## Current Infrastructure Related Energy Efficiency Projects

WWD has a limited surface supply and therefore water conservation is an ongoing effort. WWD promotes conservation through conservation programs, efficiency, water meters, groundwater management, and irrigation techniques. Examples of each are described below:

- As a USBR customer, WWD is required to develop and maintain a water conservation plan. WWD promotes conservation to its customers by providing an Irrigation Guide, a weekly publication on crop water use. WWD also maintains an Irrigation Management Handbook, which provides specific information about the district. WWD's Irrigation System Management Program provides financial assistance to farmers for water conservation.
- WWD has maintained an average of 83 percent efficiency for seasonal application for 20 years.
- WWD requires water meters at each delivery point including private wells (participating in conjunctive use programs). Meters are placed on a preventive maintenance cycle so that they are regularly calibrated and tested. Metering allows farmers to manage and account for all water delivered.
- WWD prepares an annual Deep Groundwater Conditions Report to monitor quantity and quality of groundwater resources. Farmers use this information to manage supplies, facilitate more accurate irrigation scheduling, monitor pump efficiency, and participate in conjunctive use programs.
- Efficient irrigation techniques and systems are implemented to maximize limited supplies.

## Sources

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Westlands Water District. WWD Public Website. http://www.westlandswater.org/wwd/aboutwwd/aboutwwd.asp?title=Who%20We%20Are&cwide=1680, Accessed 11/17/2009.

Westlands Water District. *Water Management Plan*, September 30, 1999, Revised with Supplemental Urban Plan May 2002.

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