Chapter 5 – Water Use

5.1 Introduction

This chapter describes the types of customers using water and base projections of future water use. The base projections do not include the impacts from active conservation programs (see Chapter 6) or reductions in potable use from water recycling (see Chapter 7). The balance between water demand and supplies is addressed in Chapter 4. This chapter also presents Redwood City's water shortage contingency plan that outlines the steps the City will take when faced with a water shortage.

5.2 Customer Types

Redwood City's water customers are divided into six categories:

- Single Family Residential: Attached or detached dwelling units that are individually metered.
- Multiple Family Residential: Two or more dwelling units served by a common water meter.
- Commercial: All commercial, industrial, and institutional customers not listed elsewhere.
- Irrigation Commercial: Water meters used exclusively for outdoor uses by commercial customers.
- Irrigation Residential: Water meters used exclusively for outdoor uses associated with residential customers. Almost all of these meters serve Homeowner Associations (HOA).
- Other: Includes fire service meters, schools, churches, and City of Redwood City non-irrigation meters (irrigation meters with Irrigation Commercial).

5.3 Who Uses Redwood City's Water?

The percentage of current water use (FY 2004-05) by customer type is shown in Figure 5-1. The figure shows the following:

- Residential water use makes up 69 percent of total use
    - Single family represents 52 percent
    - Multiple family represents 17 percent
- Commercial users consume 17 percent of total water use.
- Irrigation users, both residential and commercial, represent 13 percent of the total.
- Other water use sums to only one percent.
- Up to 38 percent of total annual water use is related to outdoor use.

For additional information on historic water use in Redwood City, refer to Appendix A-1. Figure 5-2 shows the seasonal pattern of total water use by month. Also plotted on Figure 5-2 is the monthly net irrigation requirement (NIR). As described in Chapter 2, NIR equals evapotranspiration minus effective rainfall; it serves as a measure of the amount of water needed to irrigate turfgrass. It is interesting to note that seasonal patterns of water use and NIR do not coincide exactly. Rather, what appears to be over-watering occurs during the fall months, especially in September and October. This information supports the need for conservation programs that target outdoor water use during this period.

Figure 5-1. Water Use by Customer Type for FY 2004-05

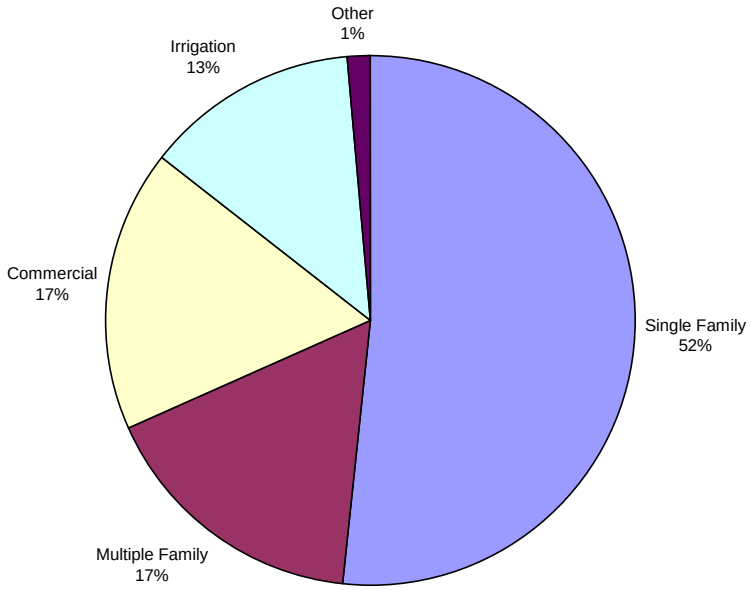
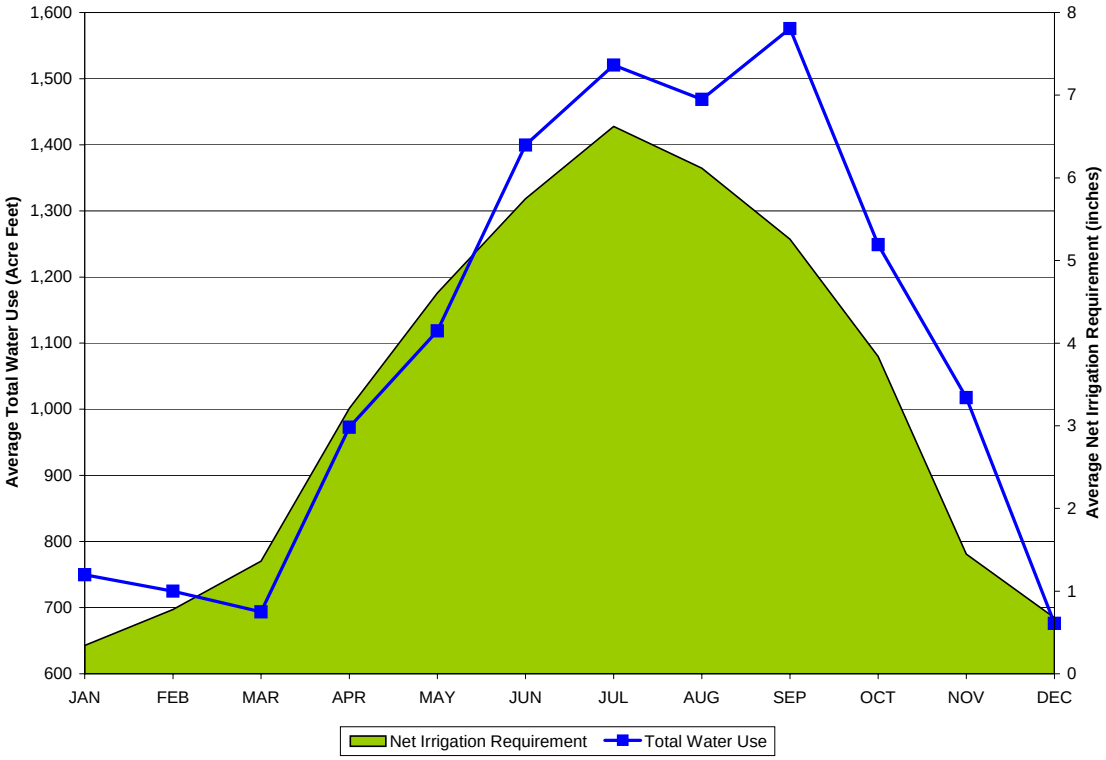


Figure 5-2. Monthly Total Water Use vs. Weather (2000 to 2004)



5.4 Projected Water Use

5.4.1 Regional Water Supply Modeling

The water demand projections for this UWMP were developed as part of a series of technical studies performed in support of the Capital Improvement Program for the SFPUC Regional Water System in 2004. (URS Corporation, 2004; URS Corporation and Maddaus Water Management, 2004; Raines, Melton & Carella, 2004; URS Corporation, Maddaus Water Management, and Jordan Jones & Goulding, 2004). In addition, Redwood City and the SFPUC have continued to refine their water demand and supply projections through correspondence in 2005. Relevant items from this correspondence are attached to this UWMP as Appendix D.

Water demand projections for the wholesaler were developed using an "End Use" model, which has two main steps: 1) establishing base-year water demand at the end-use level (such as toilets, showers) and calibrating the model to initial conditions; and 2) forecasting future water demand based on future demands of existing water service accounts and future growth in the number of water service accounts. Establishing the base-year water demand at the end-use level is accomplished by breaking down total historical water use for each type of water service account (single family, multifamily, commercial, irrigation, etc.) to specific end uses (such as toilets, faucets, showers, and irrigation).

Forecasting future water demand is accomplished by determining the growth in the number of water service accounts in a wholesale customer service area. Once these rates of change were determined, they were input into the model and applied to those accounts and their end water uses. The model also incorporates the effects of the plumbing and appliance codes on fixtures and appliances including toilets (1.6 gal/flush), showerheads (2.5 gal/minute), and washing machines (lower water use) on existing and future accounts.

5.4.2 Redwood City Water Use Projection Method

Water use projections by customer type have been estimated for the 25-year period of 2005 to 2030. These projections, along with year 2000 water use, are shown in Table 5-1. For each customer type, the projection method multiplies a key demand driver by a water use coefficient to obtain future water use. The demand drivers are number of housing units for the residential sectors and number of employees for the commercial sector. No change in water use is assumed for the "Other" sector. The water use coefficients are based on historical water use.

The water use projections derived from this method have been modified to account for "passive" conservation. Passive conservation is defined as water savings from the adoption of State and Federal plumbing codes and legislation mandating the sale of high-efficiency toilets and clothes washers. These are the two largest end uses of indoor residential water use, making up about half of total indoor use. Passive conservation occurs without any City action or expense; hence it is included in the base projection.

5.4.3 Redwood City Base Water Use Projection Assumptions

Several important assumptions are associated with Redwood City's base water use projections. These assumptions are:

- Passive Conservation. Passive conservation is included in the base projections and is described in the water conservation chapter (Chapter 6).
- Active Water Conservation Programs. The base projections do not include water savings associated with City-run "active" or supported water conservation programs. Water savings from active conservation are described and accounted for in the water conservation chapter (Chapter 6).
- Water Price Impacts. The projections are not adjusted for long-term changes in the real (inflation adjusted) price for water. It is likely that water prices will increase faster than inflation in future years, largely from significant increases in wholesale water prices charged by the San Francisco Public Utilities Commission.
- Wealth Effects. Increasing wealth can drive water use. Re-landscaped single-family and multiple-family housing may intensify water use. This is not accounted for in the model due to the difficulty in quantifying this factor and its effects.
- Water Use Intensification. Increasing residential and commercial space costs can lead to intensification of use at existing sites. Apartments, for example, can see more persons per unit as higher rent costs cause more people to live together to pay the rent. Similarly, business owners are financially motivated to limit the square footage per employee to manage costs. Residential water use intensification is not accounted for in the projections, as they are difficult to estimate. Commercial intensification is factored in by focusing on the number of employees at commercial sites, not just the number of sites.
- Weather. The projections are based on normal water supply and demand conditions. Water use in Redwood City dramatically decreased in 1976-77 and in 1990-91 in response to major droughts. Water use also significantly decreased in FY2004-05 from being a wet year. The total annual precipitation for this year was not high, but precipitation occurred frequently during the key transition months of October, February, March and May. For this reason, the projections on water use coefficients were developed from FY2000-01 data, which is a more typical or normal year.
- Unaccounted for Water. The projected water use factors in a four percent increase to reflect "unaccounted for" water in the distribution system. "Unaccounted for" water is the difference between the water put into the water distribution system and the total billed water use. Water that falls into this category includes water for fire fighting, distribution main flushing, storage tank cleaning, under-reporting meters, and system leaks. In recent years, unaccounted water use has been about four percent of the total water in the system. This rate is considered relatively good, as comparable water systems (based on American Water Works Association national statistics) typically experience rates of five to ten percent for unaccounted for water.

5.4.4 Projected Water Use by Customer Type

Past (year 2000), current (2005) and projected (year 2030) water use by customer type is shown in Table 5-1. Following the table are some observations that can be drawn from the projections.

Table 5-1
Existing and Projected Base Water Use
(af/yr, active conservation not included)

	Actual	Forecast Year					
Customer Type Description	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Single Family	**6,014**	**5,943**	**5,804**	**5,701**	**5,632**	**5,590**	**5,571**
Existing Customers	6,014	6,014	6,014	6,014	6,014	6,014	6,014
Passive Conservation	0	-145	-293	-401	-481	-540	-584
New Customers		73	83	89	99	116	140
Multiple Family	**2,356**	**2,324**	**2,437**	**2,589**	**2,735**	**2,846**	**2,994**
Existing Customers	2,356	2,356	2,356	2,356	2,356	2,356	2,356
Passive Conservation	0	-59	-114	-155	-185	-208	-225
New Customers		26	195	388	564	698	863
Commercial	**2,355**	**2,128**	**2,187**	**2,196**	**2,303**	**2,443**	**2,614**
Existing Customers	2,355	2,355	2,355	2,355	2,355	2,355	2,355
Passive Conservation	0	-66	-117	-156	-187	-210	-229
New Customers		-162	-51	-3	134	298	487
Commercial – Irrigation	**1,110**	**1,110**	**1,110**	**1,110**	**1,176**	**1,253**	**1,342**
Existing Customers	1,110	1,110	1,110	1,110	1,110	1,110	1,110
New Customers		0	0	0	66	143	233
Residential – Irrigation	**626**	**634**	**682**	**738**	**789**	**828**	**876**
Existing Customers	626	626	626	626	626	626	626
New Customers		8	56	112	163	202	250
Other	**135**	**135**	**135**	**135**	**135**	**135**	**135**
Existing Customers	135	135	135	135	135	135	135
New Customers		0	0	0	0	0	0
Summary							
Existing Customers	12,596	12,596	12,596	12,596	12,596	12,596	12,596
Passive Conservation	0	-269	-523	-712	-853	-959	-1,038
New Customers	0	-54	283	586	1,027	1,458	1,974
Total Water Use (Billed)	**12,596**	**12,273**	**12,355**	**12,469**	**12,770**	**13,095**	**13,532**

Single-family residential water use is expected to decline by about 7.4 percent by 2030. Growth in the number of homes will be minimal because only 68 vacant lots designated for single-family residential exist in the City. For unincorporated areas in San Mateo County but within the City's water service area, it is assumed that new homes will expand at the same rate as population projections for the area made in 2005 by the Association of Bay Area Governments. This rate is 25.1 percent, which would result in an additional 425 homes. The decline in water use associated with passive conservation from toilets and clothes washers is projected to be 9.7 percent by 2030.

Multiple family water use is projected to increase by 27.1 percent by 2030. This increase is driven by a projected 40.0 percent increase in multi-family dwelling units and offset by a 9.6 percent decrease from passive conservation.

Commercial water use is expected to increase by 11 percent. The increase begins only after 2015 as employment recovers from recent lows and high office vacancy rates. Between 2015 and 2030, employment is projected by ABAG to see significant growth. Passive conservation from toilets is estimated to be 9.7 percent over the period.

Irrigation water use is expected to see modest growth. This growth represents total irrigation demand and does not differentiate between irrigation with potable or recycled water. With commercial irrigation, no growth is projected until after 2015 as existing vacant commercial space is sufficient to accommodate commercial growth. After 2015, commercial irrigation is expected to grow with projected employment growth by 21.0 percent. Residential irrigation use is expected to grow by 40.0 percent.

Water use associated with the "Other" class is not projected to change. It is difficult to project how water use for this group would change; however, because it only makes up one percent of total use, its impact is not significant.

In summary, base water use is projected to modestly increase between 2000 and 2030. The increase in water use associated with growth (1,974 af/yr) is somewhat offset by decreases in water use driven by passive conservation with toilets and clothes washers (1,038 AFY). The net increase in water use, therefore, would be 936 af/yr or 7.4 percent.

5.5 Water Shortage Contingency Plan

5.5.1 Introduction

Hydrologic water shortages, such as the 1976-77 and 1987-92 droughts, can span months and years. When City water demands exceed SFPUC water supplies, the City must intervene to moderate its customers' demands or acquire supplemental supplies. Although purchasing supplemental supplies is conceptually possible, neighboring water agencies will likely be in similar water shortage conditions, and finding willing sellers may be impossible. Hence, the water shortage contingency plan focuses on mechanisms necessary to reduce internal water demands to balance the demand/supply situation. The Urban Water Management Planning Act requires that the water shortage contingency plan address the following six steps:

- Step One: Stages of Action
- Step Two: Estimate of Minimum Supply for the Next Three Years
- Step Three: Catastrophic Supply Interruption Plan
- Step Four: Prohibitions, Penalties, and Consumption Reduction Methods
- Step Five: Analysis of Revenue Impacts of Reduced Sales During Shortages
- Step Six: Draft Ordinance and Use Monitoring Procedure.

This section describes the City's water shortage contingency plan, and addresses each of the above steps. The water shortage contingency plan has two guiding principles:

- Water cutbacks are in proportion to outdoor water use. Outdoor water use is an important, but relatively discretionary end use in comparison to indoor water uses related to drinking, cooking, and sanitary activities.

- Water cutbacks are to be based on water needs, not historical water use whenever possible. If customers expect water shortage allocations to be based on historic water use, they may tend to overuse water during non-drought periods to increase their allocation during a shortage. Expressed in a different way, customers who adopt and sustain water conservation practices in their home and businesses

("demand hardened") should not be penalized by receiving the same percentage cutback as non-conserving customers.

5.5.2 Stages of Action

Table 5-2 identifies the stages of action that Redwood City will take in response to a water supply shortage. There are five stages that successively address cutbacks of greater magnitude. The City will largely rely on its Water Allocation Program (described in Chapter 6) to allocate maximum water use for its customers during shortages. Customers exceeding their water allocations will face higher water rates, especially during the higher stages of the plan.

Table 5-2
Water Shortage Stages of Action

Stage	Water Reduction	City Actions
1	0 to 10%	❑ Public education and voluntary cutback request. ❑ Purchase limited amounts of San Francisco water from as needed at perhaps increased prices. ❑ Cutback flushing of water distribution mains for water quality purposes.
2	10 to 20%	❑ Aggressive public conservation education and voluntary cutback request. ❑ Acceleration of conservation BMP implementation. ❑ Water Allocation Program combined with moderate water rate incentives. ❑ Landscapes using potable water cutback up to 60%. ❑ Moratorium on new water connections. ❑ Cutback flushing of water distribution mains for water quality purposes.
3	20 to 30%	❑ Aggressive public conservation education and voluntary cutback request. ❑ Acceleration of BMP implementation. ❑ Water Allocation Program combined with significant water rate incentives. ❑ Landscapes using potable water cutback up to 90%. ❑ Moratorium on new water connections. ❑ Cutback flushing of water distribution mains for water quality purposes.
4	30 to 50%	❑ Aggressive public conservation education and voluntary cutback request. ❑ Acceleration of BMP implementation. ❑ Water Allocation Program combined with severe water rate incentives. ❑ Ban potable water used for irrigation of turf grass or all outdoor uses. ❑ Moratorium on new water connections. ❑ Cutback flushing of water distribution mains for water quality purposes.
5	50% or greater	❑ If system is operational, prohibit all but water used for basic drinking, cooking, and necessary human hygiene. ❑ If system is not operational, establish basic water distribution stations/nodes for essential living conditions. ❑ Moratorium on new water connections.

Based on the first guiding principle described above, Table 5-3 shows the anticipated water cutbacks by customer type associated with 10, 15, and 20 percent cutback scenarios. The irrigation customers would be burdened with the largest percentage reductions. Single-family residential customers would have cutbacks roughly equaling the total percentage reduction. Commercial customers would have smaller cutbacks. Multiple-family residential customers would experience the smallest percentage cutbacks because their water uses are largely related to indoor purposes.

Table 5-3
Water Cutbacks by Customer Type (1)

Customer Type	10% Total Cutback	15% Total Cutback	20% Total Cutback
Single Family	10-12%	15-18%	19-24%
Multiple Family	3-4%	4-6%	6-8%
Commercial	7-9%	10-13%	14-17%
Irrigation	26-34%	40-51%	53-68%
Other	12-15%	17-23%	23-30%

(1) The percentage cutbacks shown are averages for customer types. Individual customer cutbacks will vary depending on the proportion of their water use associated with outdoor water use.

5.5.3 Estimate of Minimum Supply for Next Three Years

The minimum water supply for the next three years is shown in Table 4-2 in Section 4.4 of this UWMP.

5.5.4 Catastrophic Supply Interruption Plan

The Potable Water Emergency Plan was developed to prepare cities and towns and the San Mateo County/Operational Area for a planned response to emergency situations that affect water utilities, i.e., natural disasters, technological incidents, and national security/terrorism emergencies. The plan is not designed for responding to every conceivable contingency, but it addresses the major known hazards and general response/recovery considerations. Catastrophic interruption to the regional water system from earthquakes is one scenario that could occur. The City is also vulnerable to local failures in its water distribution system from such occurrences.

The plan serves to guide the City's emergency management and Water Coordinator in an organized response to water treatment and distribution emergencies, which affect the Redwood City (Office of Emergency Services, 2004). Detailed information is provided on personnel roles, responsibilities, emergency services, communication, recovery, and reporting procedures. Specifically, the plan describes the following:

- San Mateo County/Operational Area emergency management organization to assist in mitigating any significant emergency or disaster.

- Authorities, policies, responsibilities, and procedures required, protecting the health and safety of San Mateo County.

- Operational concepts and procedures associated with field response to emergencies, Emergency Operations Center (EOC) activity, and the recovery process.

- Standardized Emergency Management System (SEMS) for use within the City of Redwood City, San Mateo County/Operational Area, State Office of Emergency Services (OES) Coastal Region and state systems.

- Multi-agency and multi-jurisdictional coordination, particularly between local government (Redwood City) and San Mateo County; San Francisco Water Department and local, state, and federal agencies during emergency operations.

- Pre-event emergency planning as well as emergency operations procedures. This plan has been designed for conformance with SEMS (Government Code Section 8607) and should be used in conjunction with the State Emergency Plan and local emergency plans.

The procedures are designed to facilitate the acquisition and distribution of alternative potable water to Redwood City in the event of a local, Operational Area and/or Regional water emergency. These procedures require the support of public, private, and volunteer agencies.

5.5.5 Water Shortage Ordinance and Use Monitoring Procedure

Redwood City's use monitoring procedure and water shortage contingency ordinance are illustrated in the City's Water Shortage Contingency Ordinance adopted in 1990, and attached to this UWMP as Appendix E.

5.5.6 Mandatory Prohibitions and Penalties for Excessive Use

Redwood City's mandatory prohibitions and penalties for excessive water use are illustrated in the City's Water Shortage Contingency Ordinance adopted in 1990, and attached to this UWMP as Appendix E.

5.5.7 Revenue and Expenditure Impacts

The City Council adjusts water rates and charges each fiscal year as necessary to sustain balanced Water Enterprise Fund revenues and expenditures. The City's *Water Financing Plan* is substantially driven by the policies described in this UWMP.