

Chapter 5

WATER SUPPLY RELIABILITY

This chapter provides an overview of the issues facing the City related to its water supply system reliability. It describes how both supply and demand conditions have changed over time and assesses the ability of the Santa Cruz water supply and delivery system to serve current and future water demands under differing hydrologic conditions in light of these recent changes. The latter portion of this chapter describes the overall approach and the status of programs and projects the City is pursuing to improve its water supply reliability.

5.1 Overview of Water Supply Challenges

The City of Santa Cruz faces two major challenges in meeting its present and future water supply needs. The primary water management problem is the lack of adequate water supply during periods of drought. The second key issue – and one that is not yet fully understood at this time due to pending negotiations with applicable regulatory agencies and to the inherent complexity of the subject – involves ensuring that surface water diversions are operated in a manner that protects the aquatic habitat of threatened and endangered species.

While these two issues present much different water management challenges, they both limit in different ways and times how much water is available to meet the area's water service needs. The following is a brief description of these two fundamental challenges.

5.1.1 Vulnerability to Water Shortage

As explained in Chapter 3, the City water system draws almost exclusively on local surface water sources, whose yield varies from year to year depending on the amount of rainfall received and runoff generated during the winter season.

In normal and wet years, when rainfall and runoff are abundant, the water system is capable of meeting the community's current total annual water requirements. The system is highly vulnerable to shortage, however, in extended dry periods or critically dry years, when the flow in local streams and river sources runs low. Moreover, like other communities on California's central coast, the Santa Cruz water system is physically and geographically isolated. There are no interconnections with other water

suppliers in place to transfer water among adjacent water districts or import emergency supplies from outside the region. Ultimately, the only water available to the City is that which originates from rain that falls on the ocean side of the Santa Cruz Mountains.

Water stored in Loch Lomond Reservoir primarily serves as a backup supply to supplement summer demands. Some amount of storage is used each year, mainly in the summer and fall months when the flows in the coast and river sources decline and additional supply is needed to meet higher daily water demands during the peak season.

In single dry years, the system relies more heavily on water stored in Loch Lomond to satisfy demand, which draws down the reservoir level lower than usual and depletes available storage. In multi-year or critical drought conditions, the combination of very low surface flows in the coast and river sources and depleted storage in Loch Lomond reservoir reduces available supply to a level which cannot support average dry season demands. Compounding the situation is the need to retain a certain amount of water in the reservoir in case another dry year follows.

5.1.2 Endangered Species Act Compliance

All of the streams from which the City diverts water currently support steelhead trout. In addition, the San Lorenzo River may potentially support Coho salmon. Both of these fish species are listed under state and federal Endangered Species Acts (ESA) as either “threatened” or “endangered”.

For the past ten years, the City of Santa Cruz has been in the process of developing a Habitat Conservation Plan (HCP), which is a plan prepared under the ESA by nonfederal parties seeking to obtain permits for incidental taking of threatened and endangered species.

Numerous studies undertaken in support of the HCP have evaluated how much water flow is needed in streams, and during what times of the year, to protect the fisheries habitat during all freshwater life phases (migration, spawning, and rearing) over a range of hydrologic year types. These studies show that there is potential ‘take’, or harm to endangered fish, occurring due to the City’s existing operations, and that more water must remain in the streams to protect the fisheries, primarily on the North Coast streams during the dry season. Additional in-stream flows are also indicated to support anadromous salmonid migration and spawning on North Coast streams during the wet season. Moreover, given renewed focus on the San Lorenzo River for Coho salmon

recovery, the HCP must also address diversions on the San Lorenzo River and on Newell Creek as well.

The City is proposing a phased [conservation 'strategy'](#) that improves in-stream flow for steelhead and salmon by restricting water diversions, while recognizing that the limitations of the existing water supply system does not allow optimal fish flows to be always or consistently achieved. How receptive the regulatory agencies will be to this strategy is unknown at this time.

The process to secure an incidental take permit involves many more steps and is expected to take several more years to complete. While the outcome remains uncertain, it is clear that implementation of endangered species regulation at the state and federal levels will result in less water being available from the City's flowing sources in future years compared to the past. This, in turn, will place greater reliance on water stored in Loch Lomond Reservoir to meet the community's annual water needs and exacerbate the aforementioned problem of water shortage.

5.2 Past Water Supply Deficiencies

The City experienced severe water supply deficiencies in both the 1976-77 and 1987-92 droughts. In 1977, the City imposed severe water rationing in response to a critical shortage of water. During the 1987-92 drought, a water supply emergency was declared and either usage restrictions or rationing was imposed each year for five consecutive years. The 1976-77 event has since been established as the most severe drought of record, and is used by the City as a benchmark for assessing system reliability.

Most recently, the City experienced a moderate water shortage in 2009, as a result of three consecutive years of below normal rainfall and runoff.

5.3 Water Year Classification System

The City uses a water year classification system as an index of water supply conditions for operations studies, to forecast river flows, and to communicate its water supply status to the public. The system is based on total annual runoff in the San Lorenzo River, the City's most important source, measured at the Big Trees gage in Henry Cowell Redwoods State Park.

Annual discharge of the San Lorenzo River was selected as the best individual benchmark of the City's water supply condition for two reasons. First, the river is the

city's single largest source of drinking water, providing about half the normal annual supply. Second, about three quarters of all the water used by city water customers is obtained from a flowing source of supply. In general, the higher the volume discharged from the San Lorenzo River means that:

- the local watersheds in the Santa Cruz mountains are more saturated;
- the stream sources will flow at higher levels later into the dry season; and
- there is more water available from all surface water sources, including the reservoir, to meet system demands over the course of the year.

The converse is also generally true: the lower the volume discharged by the San Lorenzo River means less water is available from all surface water sources to meet system demands.

Under this classification system, the water year (October 1- September 30) is designated as one of four types: wet, normal, dry, or critically dry, depending on the total annual river discharge, as follows:

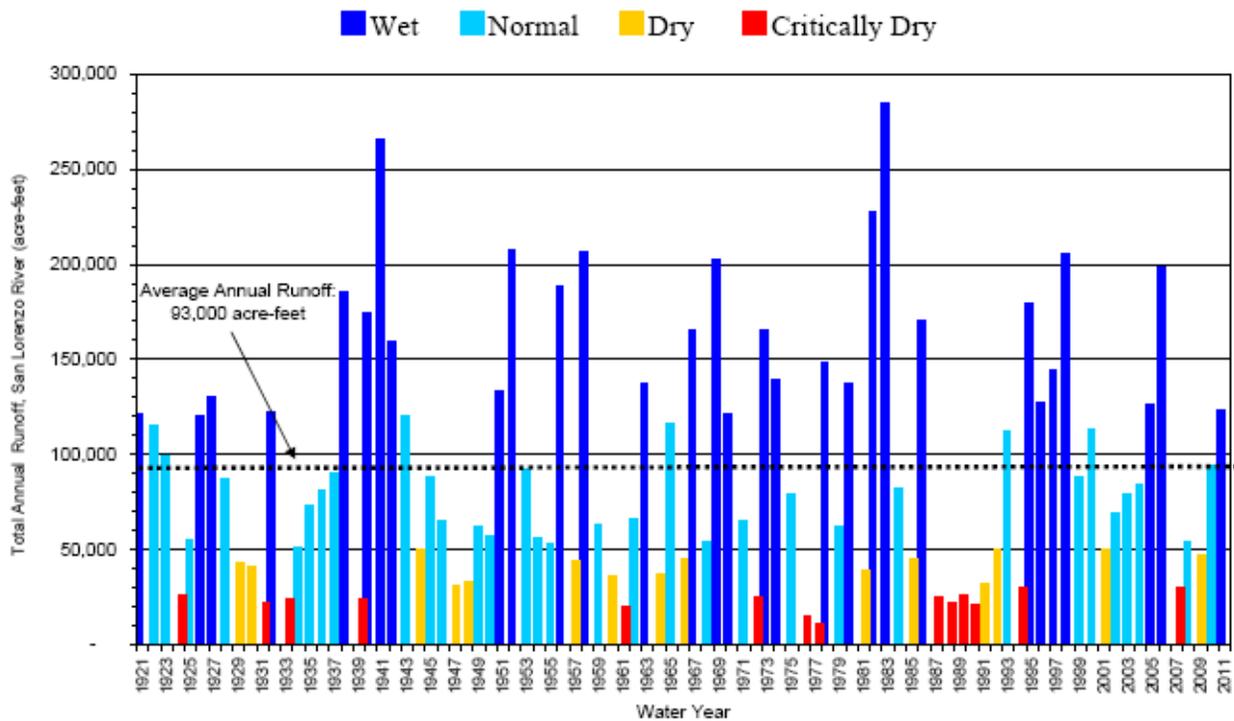
Table 5-1. Water Year Classification System

Classification	Runoff (ac-ft)
Wet	> 119,000
Normal	49,000 - 119,000
Dry	29,000 – 49,000
Critically Dry	<29,000

Figure 5-1 below shows the total annual runoff for the San Lorenzo River over the 90-year period from 1921 to 2011 and the classification for each water year¹. The graph illustrates the dramatic variation in discharge from year to year. Average runoff during this period is about 93,000 acre-feet or 30 billion gallons². The least amount of runoff, 9,500 ac-ft, occurred in the drought of 1977. The maximum recorded discharge was over 280,000 ac-ft in 1983, one of the wettest years on record in California. **This natural variation in the level of runoff available in local streams and rivers, from which the City draws the majority of its supply, is the major factor that results in an inconsistent level of water supply from year to year.**

¹ The actual period of record for the gage on the San Lorenzo River began in 1936, but synthesized flow records generated for earlier modeling studies were used to extend the period of record back to 1921.

² One ac-ft equals 325,851 gallons; 3.07 ac-ft equals one million gallons.

Figure 5-1. Total Annual Stream Discharge from the San Lorenzo River (ac-ft)

Ordinarily, one abnormally dry or critically dry year does not create a water shortage in Santa Cruz. Usually there is sufficient storage in Loch Lomond Reservoir, even after a dry winter, to carry the system through the following summer. Based on past experience, however, a shortage is likely to occur when the central coast region experiences two or more dry or critically dry years in a row.

5.4 Plans to Assure a Reliable Water Supply

The City has been pursuing possible new water supplies for the past 25 years to address the problem of periodic imbalances between available supply and demand, and to plan for future growth. Past efforts to augment supplies have made little progress, however, due to stakeholder disagreement on the appropriate course of action.

In 1997, the City initiated an “integrated water planning” approach to consider all practical options for decreasing demand and increasing supply. The project was overseen by a committee consisting of City Council members and Water Commission members, which held public meetings on regular basis and several public workshops throughout the planning process.

The goals of the City's [Integrated Water Plan](#) (IWP) were to: 1) reduce near term drought year shortages, and 2) provide a reliable supply that meets long-term needs while ensuring protection of public health and safety.

Through the IWP process, the reliability of the Santa Cruz water system was assessed and alternative strategies to ensure that the system achieves and maintains an acceptable level of reliability in the future were evaluated. At the time, operations modeling showed that if an event similar to one in 1976-77 were to recur, the system would barely be able to meet half the community's normal water requirements in the second year of that drought.

In November 2005, the Santa Cruz City Council unanimously adopted the IWP as the City's long-term water resource strategy, which recommended the following three components:

1. Conservation - Reduce water demand and increase water use efficiency in all years through long-term water conservation measures,
2. Use Curtailment – Further reduce water use, by up to 15 percent, through temporary water restrictions in drought years, and
3. Supplemental Supply – Diversify the City's water supply through the construction of a 2.5 mgd seawater desalination facility (with the ability to expand the plant to 4.5 mgd to meet future needs through 2030).

The Integrated Water Plan envisions satisfying 85 percent of normal water needs during a worst-case scenario like the 1976-77 event, thereby reducing the potential shortfall, then estimated to be almost 50 percent, to no more than 15 percent. This reliability goal was considered to be the best overall balance between ensuring public health and safety, cost, and impact on the environment, given the many public policy tradeoffs involved.

The Santa Cruz City Council also certified the IWP Program Environmental Impact Report and selected a cooperative operational scenario that involved partnering with the Soquel Creek Water District as the preferred alternative.

These 3 components are described briefly below.

5.4.1 Water Conservation

A cornerstone of the IWP is to achieve the maximum practical water use efficiency through conservation. Both state water law and the City's General Plan call for a strong emphasis on water conservation and elimination of water waste to stretch existing sources, minimize the need for new water sources, and protect the environment. A full description of the City's water conservation program is included in Chapter 6.

5.4.2 Use Curtailment

In the process of developing the IWP, the City made a fundamental recommendation to not meet full demand in drought years when surface supplies fall short. Instead the IWP calls for supplying 85 percent of normal demand in critical drought years like the 1976-77 event, and for a corresponding reduction in peak season water use of up to 15 percent. This cutback would be achieved through temporary watering restrictions that target primarily landscape irrigation and other outdoor uses. This temporary reduction in water use would be in addition to the long-term water savings achieved through conservation.

The conservation and curtailment components of the IWP are closely related in that they both involve reducing customer demand to resolve the City's supply deficiency as opposed to increasing the supply of water. There are important distinctions, however, that set them apart:

1. Curtailment is a short-term reduction in water use that is taken in response to extraordinary circumstances that involves some level of customer sacrifice. The conservation component, in contrast, emphasizes measures that people can take to reduce average daily water use without sacrificing their quality of life.
2. Curtailment involves people making behavioral changes, whereas the conservation component features technological improvements such as low consumption toilets and high efficiency clothes washers that increase water use efficiency without relying on conscious changes in behavior to achieve water savings.
3. Curtailment focuses on reducing outdoor uses of water such as landscape irrigation and exterior washing to preserve available supplies for essential domestic, sanitary and fire protection purposes. The conservation component is aimed primarily at reducing interior uses of water.

The IWP carefully considered other possibilities for use curtailment, ranging from no curtailment up to a 25 percent systemwide reduction in water use under worst case drought conditions. The planning decision to select 15 percent was based mainly on the fact that, while there was only a slight difference in overall cost between the 15 and 25 percent strategies, the difference in terms of the impacts and hardship to residential and business customers, as well as the frequency of cutbacks, between these two curtailment levels was much more substantial. The decision also recognized that water use per-capita is already very conservative, and that the ability of customers to make such cutbacks would become more difficult or costly over time because of the increase in efficiency achieved through additional conservation efforts.

The procedures and actions necessary to achieve the up to 15 percent cutback in systemwide demand established in the IWP are described in Chapter 8.

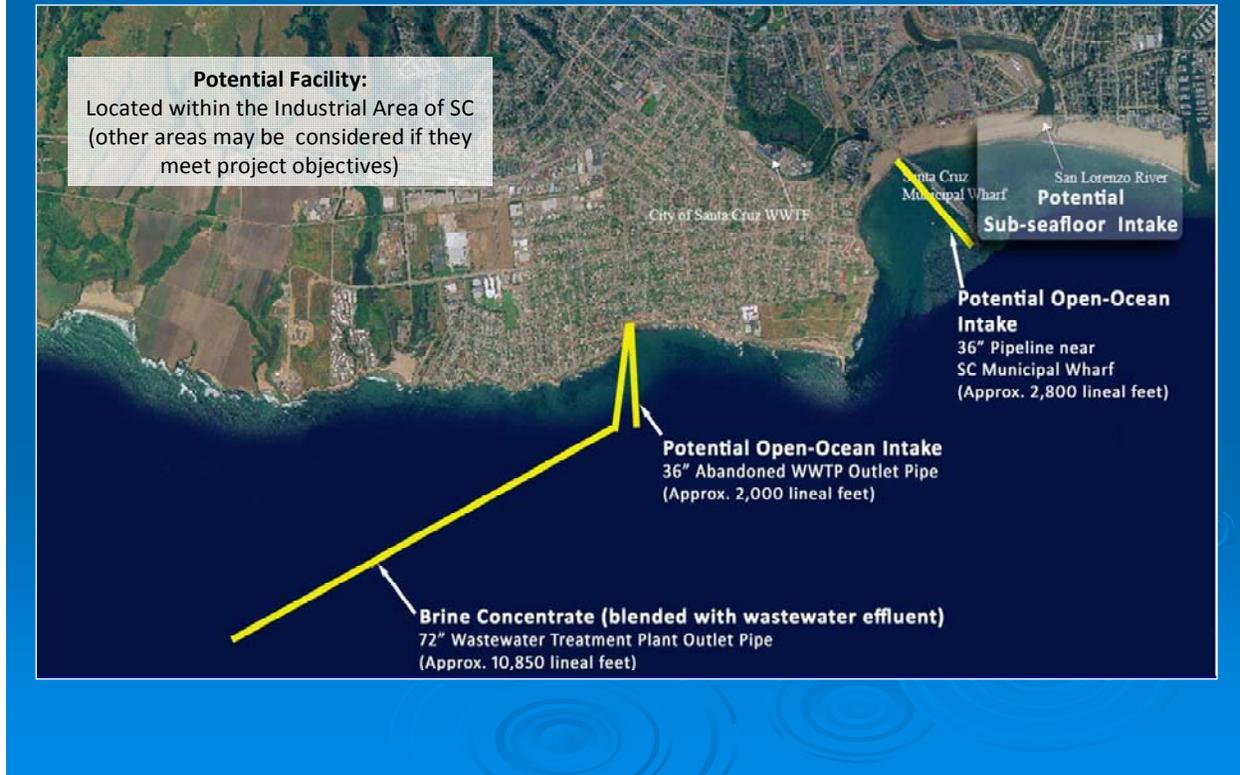
5.4.3 Additional Water Supply

The IWP identified seawater desalination as the preferred alternative for a backup supply of drinking water in times of drought. Several possible options were carefully evaluated, including drilling more wells, upgrades to the north coast system and treatment facilities, and a water transfer involving exchange of groundwater with recycled wastewater for agricultural use on the State park lands north of town. Both the wells and groundwater exchange concept ultimately proved to be infeasible, however, leaving seawater desalination essentially as the only supplemental water supply option available to the City.

The project concept adopted by City Council involves constructing a seawater intake system using an existing, abandoned wastewater outfall, building a new desalination plant with an initial capacity of 2.5 mgd, and installing the associated pipelines and pumping stations for delivering treated water to the distribution system and conveying seawater concentrate to the City's wastewater facilities, where it would be blended with municipal wastewater flows and disposed via a deep ocean outfall (Figure 5-2).

The purpose of this initial increment of desalination capacity is solely for drought protection. Accordingly, the desalination plant would only be used by the City intermittently during the dry seasons of dry and critically dry years when existing supplies fall short.

Figure 5-2. Conceptual 2.5 mgd Desalination Facility



The adopted Integrated Water Plan involves cooperating with the Soquel Creek Water District, which is also looking to secure a long-term supplemental source of water to reduce its reliance on well water and avert the threat of seawater intrusion in local groundwater aquifers. The arrangement calls for the District to use some or all of the future plant's capacity when the City doesn't need it. In return, the District would share in the cost of building and operating the plant. The District's Board in 2006 voted to adopt its own updated Integrated Resource Plan (IRP) that identified this regional desalination plan as its preferred conjunctive use alternative (ESA, 2006).

Since adoption of the IWP in 2005, the City and Soquel Creek Water District have created a joint task force and undertaken numerous technical investigations and projects to explore the possibility of desalination as a new, shared water source to complement the regions' existing surface and groundwater supplies. These activities are described later in this Chapter.

In addition to pursuing desalination, the City remains open to exploring other water supply alternatives that would not be feasible to develop in the short-term, but may be useful to consider over a 20-year or longer time frame. Possibilities include:

- Water recycling
- Regional water transfers
- Groundwater recharge
- Reservoir expansion
- Aquifer storage and recovery
- Off-stream storage

5.5 2011 Integrated Water Plan Model Update

The City continues to evaluate a possible desalination plant and ways to protect anadromous species as it develops an HCP. In the meantime, as explained elsewhere in this report, many of the key assumptions upon which the IWP was based have changed since its adoption in 2005.

To test how these changed assumptions affect the need for a new supply source, the Water Department recently updated the City's water supply operations model and analyzed the effect of HCP options on water supply reliability. The planning horizon covered by this model update is 2010 to 2030, corresponding with the timeline for this Urban Water Management Plan. Key changes are summarized in Table 5-2 below. The details of this analysis are included as Appendix K.

The original IWP model was used to examine and compare alternative water strategies using an adopted set of evaluation criteria that included various metrics for cost, magnitude and frequency of shortages, environmental effects, and many other factors. For the updated model, the analysis focuses on two key metrics that were most relevant to the water system status and consistent with the original analysis. These include:

- Worst case peak season deficiency, expressed as percent shortage, and
- Frequency of occurrence of peak season shortages of various magnitudes

The updated model output also calculates what amount of new water supply capacity is needed to limit peak season shortages to 15 percent. Results are summarized in Tables 5-3 through 5-5 below for the following three cases:

Table 5-2. Updates to IWP Operations Model

Component	Description of Update
Water Demand	Actual water demands have been significantly lower than those forecast in the 2005 IWP. The original IWP included a single demand forecast which increased from 4.8 to 5.3 billion gallons per year between 2010 and 2030. The updated model uses two lower demand forecasts corresponding with the scenarios described in Chapter 4, which range from 2010 to 2030 between approximately 4.0 and 4.5 bgy (demand scenario 1), or between 3.5 and 4.0 bgy (demand scenario 2).
Stream Flow	<p>The hydrologic data that formed the basis of the IWP have been revised and extended through 2009. In addition to updating the “unimpaired” flows of the original IWP, the model incorporates alternative flow bypass scenarios developed through the HCP process to enhance fish habitat³. Environmental flow types are categorized as “Tier” 1, 2, and 3, as follows:</p> <ul style="list-style-type: none"> • Tier 1 refers to flows that simply maintain current fish habitat levels, as described in Section 3.5. • Tier 2 refers to the flows that would improve habitat conditions compared to what now exists. • Tier 3 flows would significantly improve stream flows to provide 80% of optimum flows for fish habitat.
Newell Creek - Loch Lomond Reservoir	The model has been adjusted for revised bathymetry data and reservoir rule curves.
Groundwater Supply	In the original IWP it was assumed there would be 2 mgd of well capacity available to the City during time of drought, with 1 mgd available at other times. As described in section 3.6, the City intends to limit its withdrawal to no more than 170 mgd on average (about 0.8 mgd) and 210 mgd (about 1 mgd) in drought years.
Transmission Losses and Efficiency	The updated IWP assumes lower transmission losses in the North Coast system than originally modeled, based on actual leakage rates and assumed rate of repairs. It also assumes permanent repair of the temporary, flexible segment on the Majors Creek pipeline, increasing raw water transmission efficiency.
Desalination	The model reflects the operations agreement regarding how the capacity of a 2.5 mgd plant would be shared between the City and Soquel Creek Water District.

1. No HCP bypass flows. This case is intended mainly to provide an updated baseline of system reliability without consideration of environmental water needs.
2. Water System Reliability under Tier 2 bypass flows
3. Water System Reliability under Tier 3 bypass flows

³ Unimpaired flow refers to North Coast stream flows available to the City for diversion without consideration of habitat needs.

Results of the model update indicate that, without any consideration for environmental water needs, the system reliability has improved considerably relative to conditions portrayed in the original IWP (Table 5-3). This improvement is due mainly to lower water demands. Under the lower of the two demand scenarios, the expected worst-case water shortage has been substantially reduced and the amount of new water supply capacity needed over the next 20 years is less than the 2.5 mgd desalination plant currently being evaluated. However, the system still falls short of the reliability objective set by City Council in the long-term, indicating a need for some additional supply.

Table 5-3. Updated Baseline of Water Supply Reliability: No HCP Flows

Demand Scenario	Probability of Water Shortage of 5 Percent or Greater (%)		Worst-Year Peak Season Shortage (%)		Desalination Capacity Needed to Limit Peak Season Shortage to 15%	
	2010	2030	2010	2030	2010	2030
1	10	30	30	37	1.50	3.25
2	1	12	12	23	0.00	0.75

The Tier 2 flow bypass flow scenario represents an increasing degree of habitat protection and therefore a decreasing volume of stream flows available for diversion to meet water demands. Table 5-4 shows with Tier 2 flow releases under all hydrologic conditions, water supply reliability is degraded, both in the near and the long-term. Even under the lesser of the 2 demand scenarios, achieving the reliability goal of no more than 15% water shortage would require 2.25 mgd of additional water supply capacity in the near term, increasing to 2.75 mgd by the end of the 20 year planning timeline.

Table 5-4. Water System Reliability: Tier 2 Flows

Demand Scenario	Probability of Water Shortage of 5 Percent or Greater (%)		Worst-Year Peak Season Shortage (%)		Desalination Capacity Needed to Limit Peak Season Shortage to 15%	
	2010	2030	2010	2030	2010	2030
1	13	82	43	51	3.25	4.25
2	8	11	37	42	2.25	2.75

Of the various flow scenarios examined in the HCP process, Tier 3 leaves the most water in the streams for fish habitat and results in the least amount of flowing water available for diversion. Modeling of Tier 3 environmental flows indicates that, even assuming desalination capacities needed with Tier 2 flows above, the City would

experience water shortages much more often (statistically every other year) and would require much greater levels of total new water supply capacity to maintain target levels of reliability than presently is being contemplated (Table 5-5).

Tier 3 flows represent a flow scenario that is 80 percent of the optimum condition for the salmonid species present in the streams from which the City withdraws water. Without the addition of new water supply, the City would be incapable of virtually ever meeting Tier 3 flows, even in wet years. In dry years, and consecutive dry years, without additional supply, providing such flow would leave the City with only about 25 percent of average water supply. For that reason, this report does not consider the operation of the water system under that flow scenario unless and until new supply is developed.

What is shown in the following table outlines the impacts of meeting Tier 3 flow with the desalination plant in operation. The far right columns of the table show the needed capacity of a new desalination plant in order to meet Tier 3 flows in multiple dry years in order to limit use curtailment to the designed 15 percent.

Table 5-5. Water System Reliability: Tier 3 Flows

Demand Scenario	Probability of Water Shortage of 5 Percent or Greater (%)		Worst-Year Peak Season Shortage (%)		Desalination Capacity Needed to Limit Peak Season Shortage to 15%	
	2010	2030	2010	2030	2010	2030
1	53	53	57	50	8.75	9.75
2	25	33	48	48	7.50	8.00

5.6 Water Supply and Demand Assessment

The operations modeling results presented above provide one perspective on the City's water supply reliability. Water suppliers also are required to characterize water supply reliability in a manner prescribed by law. Specifically, Section 10635 (a) of the Water Code requires:

“Every urban water supplier shall include, as part of its Urban Water Management Plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the total projected water use

over the next twenty years, in five year increments for a normal water year, a single dry water year, and multiple dry water years.”

In the analysis that follows, estimates of supply are given by both individual source and for the total available supply, based on data obtained from the City’s updated operations model. The analysis assumes that future diversions, beginning sometime within the next five years (corresponding with year 2015), will be limited according to the Tier 2 flow scenario discussed above. It also assumes groundwater availability will be limited in future years as described in Chapter 3. Estimates for projected demand all assume the lower of the two future demand scenarios described in Chapter 4.

5.6.1 Normal Water Years

This assessment reflects average water supply available to the City modeled over the 73-year period of record (1936-2009), as presented in Table 3-4. Note that beginning 2015, production from the coastal sources is seen to decline reflecting greater environmental in stream bypass flows. This reduction is partly compensated for in normal water years by increased diversion from the San Lorenzo River and partly by greater withdrawals from Loch Lomond Reservoir.

Table 5-6. Supply and Demand Comparison, Normal Water Year (mgd)

	2010	2015	2020	2025	2030
North Coast	1,150	860	860	860	860
San Lorenzo River	1,770	1,940	1,990	2,040	2,090
Live Oak Wells	170	170	170	170	170
Loch Lomond Reservoir	1,040	1,040	1,040	1,040	1,040
Supply Total	4,130	4,010	4,060	4,110	4,160
Demand Total	3,522	3,684	3,847	3,946	4,046
Difference	608	326	213	164	114
Average Annual Deficit (% of demand)	--	--	--	--	--

Under normal water years, there is a slight surplus of supply and the City is able to fully meet projected water demand through 2030, even accounting for habitat needs.

5.6.2 Single Dry Water Years

This assessment presents water supply available to the City as reflecting conditions experienced during water year 2007, which was a recent critically dry year. As shown in Table 5-7, water supply during a single dry year is barely sufficient to meet system demand in the near term, and is not sufficient to meet projected demand from 2020 to 2030. The City may experience slight shortages of water under this hydrologic condition, which increases as demand increases over time.

Table 5-7. Supply and Demand Comparison, Single Dry Water Year (mgy)

	2010	2015	2020	2025	2030
North Coast	1,000	690	690	690	690
San Lorenzo River	1,900	2,140	2,187	2,234	2,280
Live Oak Wells	170	170	170	170	170
Loch Lomond Reservoir	500	740	757	774	790
Supply Total	3,570	3,740	3,804	3,868	3,930
Demand Total	3,522	3,684	3,847	3,946	4,046
Difference	48	56	(43)	(78)	(116)
Average Annual Deficit (% of demand)	--	--	-1%	-2%	-3%

5.6.3 Multiple Dry Water Years

This assessment presents the estimated water supply available during the second year of a two-year drought sequence similar to 1976-977, which is the most critical drought on record and one used by the City as a worst-case drought sequence for supply planning purposes.

In an extreme two-year drought similar to the 1976-77 event, the estimated water supply available to the City in the second year of that event, according to the updated operations model, ranges from 3,200 mgy under current conditions to between 2,640 and 2,830 mgy when Tier 2 flows are included. This reduction equates to about 23 to 35 percent less water on an annual basis than is available in normal water years. Table 5-8 below shows that there would be a modest (<10%) annual water supply deficit under current demand conditions, which will worsen to between 28 and 30 percent in future years, mostly because less water will be available for diversion from surface sources in the future. Growth in water demand also is a contributing factor.

Table 5-8. Supply and Demand Comparison, Multiple Dry Water Years (mgy)

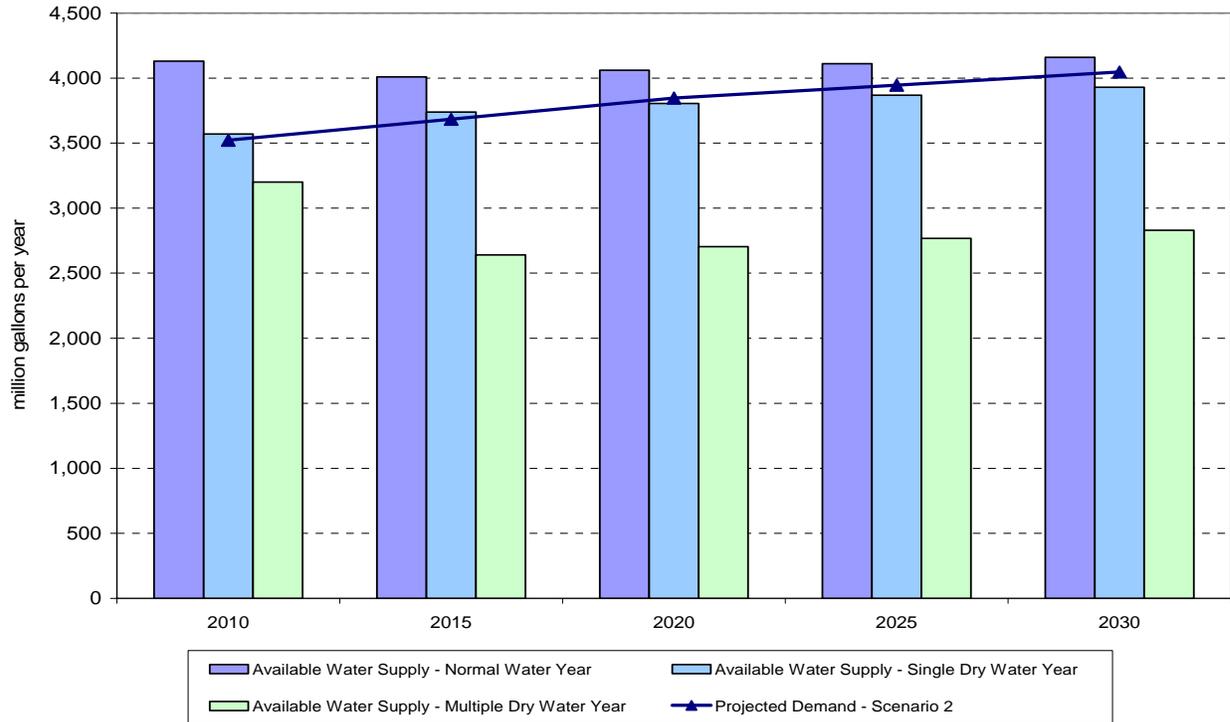
	2010	2015	2020	2025	2030
North Coast	710	500	500	500	500
San Lorenzo River	1,930	1,760	1,807	1854	1,900
Live Oak Wells	170	170	170	170	170
Loch Lomond Reservoir	390	210	227	244	260
Supply Total	3,200	2,640	2,704	2,768	2,830
Demand Total	3,522	3,684	3,847	3,946	4,046
Difference	(322)	(1,044)	(1,143)	(1,178)	(1,216)
Average Annual Deficit (% of demand)	-9%	-28%	-30%	-30%	-30%
Peak Season Deficit (% of demand)	-12%	-37%	-39%	-41%	-43%

The deficit expressed in Tables 5-7 and 5-8 are expressed as annual average deficits. However, because supplies available to meet demand are reduced mainly during the peak season period between April and October, the actual shortfall that would be experienced is higher. The peak season shortages associated with the extreme two year drought is also presented in Table 5-8, which ranges, once Tier 2 flows are factored in, between 37 percent in 2015 and 43 percent in 2030. A shortage of this magnitude is roughly equivalent in scale to the entire amount of water normally used by the City's single family residential category over a year's time.

5.6.4 Water Supply Reliability Summary

The supply and demand comparisons discussed above are presented graphically in Figure 5-3 below.

Overall, the findings are mixed. The City has sufficient water supply available in normal years to meet its present and future needs. In single dry years, supplies are barely sufficient in the near term but slightly inadequate to meet expected demands by 2020 and beyond. In multiple dry years, available supplies fall substantially short of system demands. The one variable that represents the biggest unknown at this time is the amount of water that will be required from in-stream flow purposes. Should regulatory agencies mandate the City release more water than is represented under Tier 2 flows, these conclusions could change and shortages could be even greater than presented above.

Figure 5-3. Water Supply and Demand Comparison

5.7 Desalinated Water Opportunities

Section 10631 (j) requires water suppliers to:

“Describe the opportunities for development of desalinated water, including but not limited to, ocean water brackish water, and groundwater, as a long-term supply.”

5.7.1 Need for the Proposed Seawater Desalination Project

Over the past several years the City has been working closely with the Soquel Creek Water District (District) to investigate the possibility of a shared new water source to complement the region’s existing surface and groundwater supplies. Having evaluated many water supply alternatives, both agencies concluded that desalinated seawater, in conjunction with conservation and water-use restrictions during drought, would provide a reliable and flexible water supply to meet long-term needs while providing for public health and safety.

In recent years, the need for a supplemental water supply has been reinforced by new understanding about future availability of existing water supplies for both water agencies. As described above, the amount of surface water that the City will be able to

divert from its already limited existing sources is going to be further diminished in order to improve habitat conditions for endangered species. For the District, (and to a lesser extent, the City as well) recent studies have concluded that the estimated sustainable yield of the groundwater basins on which it relies have been too high and either have been, or are in the process of being, revised downward.

5.7.2 Establishment of a Regional Seawater Desalination Cooperative

In response to the City Council's direction to pursue the IWP recommendation, a cooperative was established by the City and the District to evaluate a potential regional desalination plant in Santa Cruz. The cooperative, known as **scwd²**, is responsible for carrying out desalination efforts identified in the IWP and District's IRP.

The **scwd²** Task Force is comprised of two Santa Cruz city council members and two Soquel Creek Water District board members. The **scwd²** Task Force oversees all aspects of the **scwd²** seawater desalination program in monthly public meetings. These meetings provide a forum for public input on the project. The **scwd²** Task Force will determine a governance structure should the decision be made to proceed with a cooperative desalination project.

In April 2010, the Santa Cruz City Council and Soquel Creek Board approved an *"Agreement Endorsing Recommendations of Joint Task Force on Seawater Desalination Facility"* (Appendix L). Key elements of this agreement are a priority system defining when each agency has first right to water produced at the plant, cost sharing for capital and operating costs, how to handle emergency requests for water, and arbitration for disputes over water allocations in emergencies. The City would use up to 2.5 million gallons per day during drought conditions (Priority users: May through October). Soquel Creek Water District would use up to 2.5 million gallons per day (estimated average use approximately 1.5 mgd) during non-drought conditions (Priority users: December through March).

5.7.3 Progress Made by scwd²

Several studies have been completed, are now underway, or are planned that will provide data and recommendations for the regional desalination plant. These include:

- Pilot Plant Program (completed April 2010);
- Watershed Sanitary Survey (completed March 2010);
- Intake Studies:
 - Open Ocean Intake Effects Study (completed December 2010);

- Offshore Geophysical Survey (completed August 2010);
- Intake Technical Feasibility Study (ongoing, completion expected Sept. 2011);
- Energy Minimization and Greenhouse Gas Reduction Study (ongoing);
- Environment Impact Report (ongoing);
- Seawater Reverse Osmosis (“SWRO”) Desalination Facility Design (ongoing);
- SWRO Intake Facility Design (completion of preliminary design expected spring 2013); and
- SWRO Infrastructure Design (RFP tentatively planned for spring 2013).

The pilot plant program was implemented using funds provided by the City, the District, and DWR Proposition 50 grant money. Grant funding received for these studies totals over \$2.5 million, with approximately \$2 million awarded by DWR for the pilot plant program and \$611,000 awarded by the State Water Resources Control Board for the intake studies.

Pilot Desalination Plant Test Program



From March 2008 through April 2009, **scwd**² conducted a comprehensive pilot plant test program to evaluate alternative treatment systems for a seawater reverse osmosis (SWRO) desalination plant. The goals of the test program were to: 1) to demonstrate to the California Department of Public Health that seawater from the northern Monterey Bay area can be successfully desalinated to produce potable water, 2) test any special treatment needs, and 3) to provide water quality data for regulatory approval and permitting for a potential full-scale plant.

The pilot plant treated 50 gallons per minute of seawater supplied from the UC Santa Cruz Long Marine Laboratory's existing open ocean intakes and focused on four primary areas of study: pretreatment, reverse osmosis, post-treatment, and solids handling. The study evaluated the ability of various treatment technologies to meet existing and anticipated drinking water quality regulations and then further evaluated the technologies in terms of energy, cost, chemical use, and footprint requirements. The desalination pilot plant demonstrated that seawater desalination will be a safe and reliable source of water supply for residents served by the City and the Soquel creek Water District. Results of the program will be used in designing a full-scale facility that meets Department of Public Health regulations and reduces costs.

5.7.4 Public Outreach Activities

The City and District have collaboratively undertaken extensive public outreach and education activities in connection with the desalination project. Such activities have included:

- Dedicated regional seawater desalination program website: www.scwd2desal.org
- Monthly project email updates
- Newsletters, handouts, fact sheets, and white papers
- Scores of community and public meetings
- Educational display boards
- Open house and monthly tours during the pilot plant operation
- Taste test event
- Individual listening sessions
- Telephone polls
- Group presentations

5.7.5 Anticipated Permits and Environmental Review

The proposed project will require a number of potential permits, authorizations, and consultations from federal, state, and local agencies. A list of the anticipated permits required for the desalination plant is provided in Appendix M.

Before any final decisions are made, the City of Santa Cruz and Soquel Creek Water District (scwd2) Regional Seawater Desalination Project will undergo a thorough environmental review in compliance with the California Environmental Quality Act (CEQA). The environmental review process underway is summarized in Figure 5-4.

No decision has yet been made on the actual construction of the proposed project. The environmental review process, currently underway, will include detailed information about the effects that the proposed desalination plant is likely to have on the environment, and ways in which these environmental effects might be minimized. This will ensure that the governing bodies and permitting agencies consider any potential environmental impacts when deciding whether to approve the project. The environmental review process provides ample opportunities for the public to provide input on the project.

Figure 5-4. Key Steps in Environmental Review Process



5.7.6 Anticipated Schedule

The City is currently under contract for the design of a regional desalination plant. Scoping sessions were held in December 2010 to discuss environmental issues related to the plant and the scope of the EIR to be prepared. Environmental review for the full-scale plant is expected to extend through 2012 and plant construction could begin thereafter. Major design and construction tasks, with the anticipated preparation dates shown in parentheses, are listed below:

- Intake Design (2011-2013)
- Intake Construction (2013-2015)
- Plant Design (2010-2012)
- Plant Construction (2012-2015)
- Infrastructure Design (2011-2012)
- Infrastructure Construction (2013-2014)

The City acknowledges some uncertainty related to the approval and timing of the permanent desalination plant construction and operation. The likelihood of construction of a permanent plant is currently uncertain as design plans have not been completed, and it cannot be predicted at this time whether the Coastal Commission and other agencies would issue the necessary approvals. Nonetheless, the City has identified a

desalination plant as its best option to alleviate supply shortages in drought conditions, and therefore has committed to pursuing this option with the intent of working diligently with the other agencies with regulatory and/or permitting authority over the plant to obtain all necessary approvals. Thus, the future desalination facility, which is planned and being pursued, is considered to be the most likely future water source, although it nonetheless remains somewhat uncertain until design, environmental review, and regulatory approvals are completed, and the project is given the go-ahead by the City and the District.

The desalination project is the subject of some community debate and discussion with some community members appealing to the City to seek alternatives to this project. Objections include:

- Its energy requirements
- Potential impacts on marine life
- Its cost
- The fact that there has been an overall decline in system water demand

Those seeking alternatives are urging the City to focus more on aggressive water conservation, mandating such things as drip irrigation, composting toilets, and rainwater catchment, in addition to a Water Demand Offset Program and water exchanges with neighboring water districts. The controversy over this project could end up on a ballot, which, along with regulatory hurdles that must be cleared, adds some uncertainty to this project.

5.7.7 Estimated Cost and Funding for a Regional Desalination Plant

The current estimated cost for design, permitting, property acquisition, and construction of the regional desalination plant between 2010 and 2018 is approximately \$116 million. The City anticipates that these costs will be shared with the District. City funds are expected to come from the sale of bonds, rates, or a combination of these sources. The City also will evaluate the potential for future grants from the state for part of the construction of the regional plant; however, at present, no grant funding has been obtained for the plant.

5.8 Opportunities for Exchanges or Transfers of Water

Section 10631(d) of the Water Code requires water suppliers to:

“Describe the opportunities for exchanges or transfers of water on a long-term or short-term basis”.

The City presently has no means to exchange or transfer water from neighboring water systems or from the State or federal water projects. Emergency interties exist between the City system and the Scotts Valley and Soquel Creek Water District that serve the urbanized areas north and east of the City water system. These connections, however, were set up to feed water from the City system to the adjacent Districts for short-term emergency purposes. The interties are not intended for, nor are the adjacent systems currently capable of, transferring or exchanging water with the City.

5.8.1 Conceptual Conjunctive Use and Water Transfer Concept

Many years ago, in its 1989 Water Master Plan, the City considered a conjunctive use arrangement between the City and the Soquel Creek Water District (City of Santa Cruz, 1989). The arrangement, intended to stretch the north County region’s surface and groundwater supplies, called for the City delivering water from its surface water sources to the District during the winter months to allow the District to rest its wells and add to basin storage. The District, in turn, would deliver stored groundwater back to the City in drought conditions. The concept eventually was shelved after the master plan concluded based on further investigation that there was little potential for such a two-way, conjunctive use arrangement between the City and the District.

Renewed interest in this idea came about in recent years through a Proposition 50 Integrated Regional Water Management Program grant being led by the County of Santa Cruz. With assistance from Kennedy/Jenks Consultants, the County has been exploring various sources and methods for increasing groundwater storage in Scotts Valley area. Over time, the project scope was expanded to evaluate using surplus winter stream flow from the San Lorenzo River to reduce groundwater pumping and increase storage in both the Scotts Valley and Soquel areas.

The operational approach being considered by the County involves diverting excess winter flows from the San Lorenzo River, treating it at the City’s Graham Hill Water Treatment Plant, and delivering it to Scotts Valley and Soquel for direct use. Intertie pipelines would need to be constructed or enlarged. The plan would primarily benefit the neighboring water districts and does not represent a substitute for or alternative to desalination. It may be possible, though not certain, that sometime in the future if and when the basin is restored, the Soquel Creek Water District might be able to send some amount of water back to the City in drought conditions.

The potential benefits, considerations, and challenges were outlined in a 2011 status report to the County Board of Supervisors. The County intends to seek additional grant funds to develop operational details, address legal and regulatory requirements, and complete engineering designs and cost estimates.

The Santa Cruz City Council recently expressed its interest in pursuing this water transfer project with the County and neighboring water districts, with the understanding that there is little upside potential that the City water system would be supplemented by such a project, and the caveat that Water Department staff carefully examine whether the project could negatively impact the City's water system by relinquishing any of the City's water rights, diminishing the system flexibility, or complicating the City's pursuit of an incidental take permit.

5.8.2 Other Opportunities for Exchanges or Transfers of Water

The regional desalination project described above essentially is a form of transfer project in that, once the plant becomes operational, water would be delivered from the City system to the District system in most years.

The other opportunity the City is exploring includes a recycled water and potable water exchange that involves Pasatiempo Golf Club and the Scotts Valley Water District, described in section 7.5.4.

5.9 Minimizing the Need to Import Water

Section 10620(f) of the Water Code requires water suppliers to

“describe the water management tools and options that maximize resources and minimize the need to import water from other regions”.

In adding this requirement, the Legislature declared that California will best be served by meeting the municipal and other water needs of each hydrologic region to the maximum extent practical without interbasin transfers that diminish the resources of other regions.

The City of Santa Cruz does not now, nor does it plan to, import water, either from outside the Central Coast hydrologic region, or outside the Santa Cruz County boundaries. All of its water resources are obtained entirely from local sources.

Refer to Chapter 6 for a description of the water conservation activities the City is pursuing that are intended to maximize the beneficial use of existing resources.

5.10 Influence of Water Quality on Water Supply Reliability

Section 10634 of the Water Code requires water suppliers to:

“include information on the manner in which water quality affects water management strategies and supply reliability”.

In adopting this requirement, the Legislature recognized that water quality regulations are becoming an increasingly important factor in water agencies' selection of raw water sources, treatment alternatives, and modifications to existing treatment facilities. It further acknowledged that changes in drinking water quality standards may also impact the usefulness of water supplies and may ultimately impact supply reliability.

The City's Graham Hill Water Treatment Plant (GHWTP) currently complies with all drinking water standards set by the US Environmental Protection Agency (EPA) and the California Department of Public Health (DPH). These regulations require monitoring of water sources, watershed protection, treatment techniques, and extensive monitoring of treated water quality throughout the distribution system.

As a predominantly surface water supplier, the City has a strong interest in watershed protection of the lands upstream of its diversions and outside its corporate boundaries. The Water Resources section of the Water Department has responsibility for monitoring timber harvests, land development, road maintenance and other human activities to avoid contamination and pollution from occurring in the City's water supply watersheds. Water Resources staff works with state, county, and local agencies, and private property owners to ensure land use and development in the City's watersheds are compatible with the goals to maintain water quality in local streams for municipal drinking water purposes. The Water Resources section also has responsibility for updating the City's Watershed Sanitary Survey and Source Water Assessments required by the State Department of Public Health. An update of Watershed Sanitary Survey is planned for late 2011-12.

The primary issues with respect to water quality are the reliability of the treatment plant itself and treatment challenges posed by future changes in our source water mix due to habitat conservation. The GHWTP is a conventional surface water treatment plant that was commissioned in 1960 as a 12 mgd plant and has undergone an expansion and a

number of improvements over the last 40 years. Except for groundwater from the Live Oak wells, all water delivered through the City system is treated at this plant. In other words, it must operate properly 100 percent of the time to maintain water service throughout the entire system. This is even more crucial since 2008 when the Bay Street Reservoir was taken out of service. The system presently has very limited treated water storage.

Figure 5-5. Graham Hill Water Treatment Plant



Since the early 2000s, the City has been evaluating additional process improvements to accommodate a variety of changing conditions such as potential higher daily plant output, changing water quality regulations, and future changes in our source water mix. As additional information has become available from various studies such as the Initial Distribution System Evaluation, water quality testing, and work on the HCP has progressed, the focus on treatment plant improvements has narrowed to:

- Enhance reliability. The plant can be made more reliable by adding redundancy and constructing upgrades to the both the filters and filtered water tank.
- Reduce the formation of Disinfection Byproducts. One of the added challenges the City faces with respect to drinking water quality involves the interrelationship between source water quality and future in-stream flow requirements, which will reduce the volume of flow available from the North Coast and San Lorenzo River. The North Coast streams and springs are the City's purest source of water supply. In addition to the loss of supply, one consequence of a reduced North Coast flow is a

greater reliance on water from Loch Lomond Reservoir. Lake water has a higher total organic carbon concentration, and hence a higher disinfection byproduct formation potential. The full implications of greater in-stream flow requirements on the City's drinking water quality are yet to be determined.

The City just completed a major electrical project, including the installation of a larger electrical service, new power control equipment, and a new backup generator to provide for future plant process changes. Over the next decade, the City plans to invest upwards of \$15 million in upgrades to the plant to enhance water quality and increase overall system reliability.

5.11 Reliability Issues Associated with Water Rights and Entitlements

Other uncertainties exist with regards to a water rights conformance proposal to the State Water Resources Control Board (SWRCB) related to Newell Creek diversions, and an application to extend water rights diversions from the Felton Diversion along the San Lorenzo River. These uncertainties also have the potential to reduce the City's water supply, as discussed below.

5.11.1 Water Rights Conformance Proposal

City is in the process of developing and submitting filings to the SWRCB to rectify a historical deficiency in the City's water rights on Newell Creek. For example, SWRCB does not allow the City to divert water from Newell Creek directly to the Graham Hill Water Treatment Plant. Instead, a 30-day "last-in-first-out" restriction prohibits the withdrawal of water from Loch Lomond Reservoir until 30 days following the most recent diversion into the reservoir from the same source (Gary Fiske & Associates, 2003). Based upon the original filings, which were thought to be adequate due to the anticipated use of Loch Lomond Reservoir, these water rights allow only for diversion to storage and not for direct diversion, (i.e., into the City's water supply distribution system). This circumstance makes the water supply technically unavailable as a source for City use during times when, for example, the reservoir is receiving more inflow from Newell Creek than is released downstream. The water rights filings by the City are intended to correct this historical deficiency and bring the water rights and current operations into conformance. The proposed direct diversion rights are limited to the same volume of water, purposes and places of use as the existing rights such that they match the existing rights to the extent possible while allowing direct diversion, consistent with historic practice.

5.11.2 Felton Diversion Water Rights Time Extension Project

Pursuant to the City's permits to divert water at Felton for storage in Loch Lomond Reservoir, the City must put all of its approximately 980 mgy entitlement to full beneficial use by December 2006, in order to maintain its appropriative rights to the water. While the City has been diligently putting water from the Felton Diversion to beneficial use over the years, to date the City has used just over half the permitted amount on an annual basis. In the future, however, the City expects to need the full 980 mgy and, therefore, has filed timely petitions with the SWRCB to extend the time allowed for putting the full 980 mgy to beneficial use. The water supplied from the Felton Diversion is considered critical to meeting the City's projected future demand, in particular during operational outages, changes in operations in response to environmental concerns, and during dry years. The City has been granted two other such extensions of time – in the mid-1980s and again in the mid-1990s after negotiations with California DFG and execution of a Memorandum of Agreement that modified the manner in which the City operated the facility. This petition is currently pending while the City works with the California Department of Fish and Game and NOAA Fisheries on completion of the HCP and a Section 10 permit.

Either of these water rights challenges could lead to some loss of existing water supply capacity and system flexibility that would, in turn, affect system reliability and influence the need for additional water supply.

As indicated in the foregoing sections, there are many complex challenges and uncertainties that the City faces in its effort to maintain a safe, adequate, and reliable water supply. These include hydrologic, environmental, water quality, and legal factors. The City is pursuing a balanced approach to meet these challenges that includes both demand reduction and a phased, flexible addition to diversify the City's and the regions' existing water supply sources. One additional challenge not mentioned above, and one that underscores the need for a phased and flexible response, is the concern about global climate change. This topic, and the steps being taken by the City to plan for climate change, are discussed in Chapter 9.