CITY OF SANTA CRUZ

INTEGRATED WATER PLAN

Draft Final Report

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June 2003

ACKNOWLEDGEMENTS

The completion of the Integrated Water Plan resulted from an ongoing and continually productive collaboration with the City of Santa Cruz Integrated Water Plan Committee (IWPC). It is a pleasure to acknowledge the support and input of the IWPC members:

- Howard Whitney, Chair
- Karsten Mueller
- Ed Porter
- Mark Primack
- David Reetz
- Keith Sugar
- Andrew Schiffrin, *ex officio*

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EXECUTIVE SUMMARY

The Santa Cruz Water Department (SCWD) provides water to the City of Santa Cruz, as well as a portion of the unincorporated area of Santa Cruz County and a small portion of the City of Capitola. The City has been actively considering possible new water supplies for the past 16 years. The various projects that were studied ranged from groundwater exploration to surface water impoundment, but all had one thing in common - almost all were sized to serve nearly all demand in a drought condition as severe as the 1976-1977 event

After repeated failures to identify a water supply augmentation project on which key stakeholders could agree, the City Council directed that the approach change to one that considers combinations of water conservation, use curtailment in droughts, and development of a more modest additional supply. This 'Integrated Water Planning' (IWP) process began in 1997.

The purpose of the City of Santa Cruz Integrated Water Plan is to respond to the current drought-related crisis and plan for future growth. Specifically, it must help the City : 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.

(Note that a distinction must be made between those supply and infrastructure additions intended to serve demand which is consistent with General Plan growth projections and those additions that serve demand beyond those projections.)

To accomplish this goal, the IWP has relied directly on four critical investigations:

- The *Water Demand Investigation*, completed in 1998 by Maddaus Water Management;
- The *Water Conservation Plan*, completed in 2000 by Gary Fiske & Associates;
- The *Water Curtailment Study*, completed in 2001 by Gary Fiske & Associates; and
- The *Alternative Water Supply Project*, completed in 2002 by Carollo Engineers.

The IWP used the results of these studies to develop and evaluate a set of water resource strategies that meet the needs of the City's water customers over a planning horizon that extends through the year 2030.

Work on the IWP began in March 2001. The IWP process was overseen by the City's Integrated Water Plan Committee (IWPC). The IWPC included three members of the Water Commission, three members of the City Council, and one ex-officio member. The Committee reviewed all documents and public meeting materials, provided key input at every stage of the IWP process, and met regularly with staff and consultant on a bi-weekly basis.

Since the IWPC included members of both the Water Commission and the City Council, both of those bodies were kept informed by their IWPC representatives. SCWD staff also made formal presentations to the Water Commission and City Council at key points during the process.

Successful completion of the IWP required the following steps:

- Define a 'base case' and assess shortages that SCWD customers would experience under base case conditions.
- Identify and characterize the City's conservation, curtailment, and supply options.
- Develop and refine evaluation criteria.
- Develop alternative resource strategies.
- Evaluate strategies against the criteria and recommend preferred strategies.
- Describe key steps to implement preferred strategies.

In addition to these ongoing contacts with City elected and appointed officials, the IWP also sought to inform and solicit direct input from the public. Toward that end, two public workshops were held to educate interested members of the public, answer their questions, and receive their input.

A. CURRENT SOURCES OF SUPPLY

The City currently has four water supply sources:

North Coast Diversions from three North Coast streams (Reggiardo Creek, Laguna Creek, and Majors Creek) and one natural spring (Liddell Spring) located about six to eight miles northwest of the City.

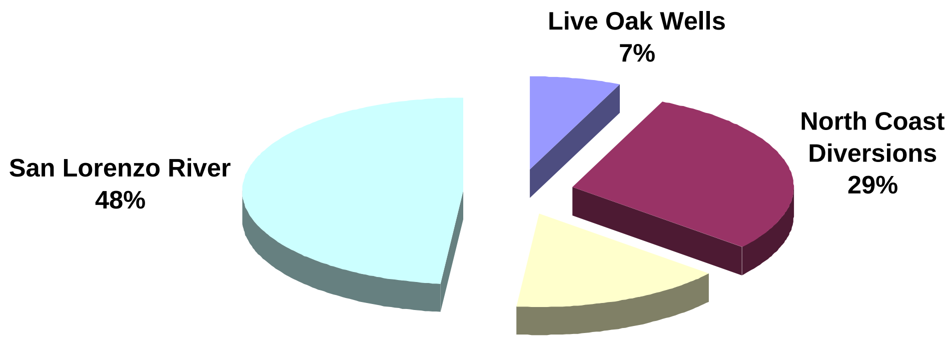
Live Oak (Beltz) Wells. These wells, which currently have the capacity to pump 1 million gallons per day (mgd) from the Purisima aquifer at Live Oak, are expected to be rehabilitated by the City to enable the City to draw up to 2 mgd in drought years beginning in 2006.

San Lorenzo River. Most of the San Lorenzo River supply is diverted at Tait Street. This surface diversion is supplemented by the three shallow wells adjacent to the river. In addition, river water is diverted upstream at Felton and pumped up to the Loch Lomond reservoir to supplement natural flows into Loch Lomond.

Loch Lomond Reservoir. Loch Lomond reservoir is a surface impoundment on Newell Creek with a storage capacity of 2.8 billion gallons. Loch Lomond is used to supplement the City's surface and groundwater supplies.

Figure ES-1 shows the breakdown of average annual volume supplied by these sources.

Figure ES-1
Breakdown of Average Annual Source Production



B. WATER DEMAND FORECAST

The IWP demand forecast is based on the *Water Demand Investigation* that was completed in 1998.[1] Table ES-1 shows the IWP projected annual demand, under average weather conditions.[2]

Table ES-1
IWP ANNUAL DEMAND FORECASTS UNDER AVERAGE WEATHER CONDITIONS
(millions of gallons)

2000	2005	2010	2015	2020	2025	2030
4409	4627	4817	4961	5157	5238	5321

1 Maddaus Water Management, *Final Report: Water Demand Investigation*. March 1998.

2 Note that the demands in the early years of the IWP forecast are adjusted downward from those in the 1998 *Investigation*.

C. WATER CONSERVATION IN THE IWP

The City's Water Conservation Plan was a comprehensive analysis of programmatic conservation alternatives. As a result of that effort, the Santa Cruz City Council directed the SCWD to move forward with implementation of all of the programs recommended in the Water Conservation Plan. Figure ES-2 shows the estimated annual programmatic savings,[3] which ramp up to about 280 million gallons (about 5% of demand). Annual conservation costs, including staffing, range between about $600,000 and $1,000,000 through the planning period.

D. BASE CASE SUPPLY DEFICIENCIES

When water supplies are insufficient to meet customer demand, water customers must be curtailed. Those curtailments typically occur during the May-October "peak season", which is the time of year when rainfall is lowest and demands are highest. The expected peak-season shortage under worst historical hydrologic conditions (i.e. those that occurred in 1977) is a key benchmark that is used to measure system reliability. Currently, this worst-year peak-season curtailment is expected to be about 45%. This measure varies only slightly through the planning period. However, by the end of the planning period, if no action is taken, the nature of the City's problem is substantially different. In addition to the very large worst-year shortages, the City will have difficulty meeting average year demands. In fact, by 2030, there will be a 90% likelihood of some level of curtailment.

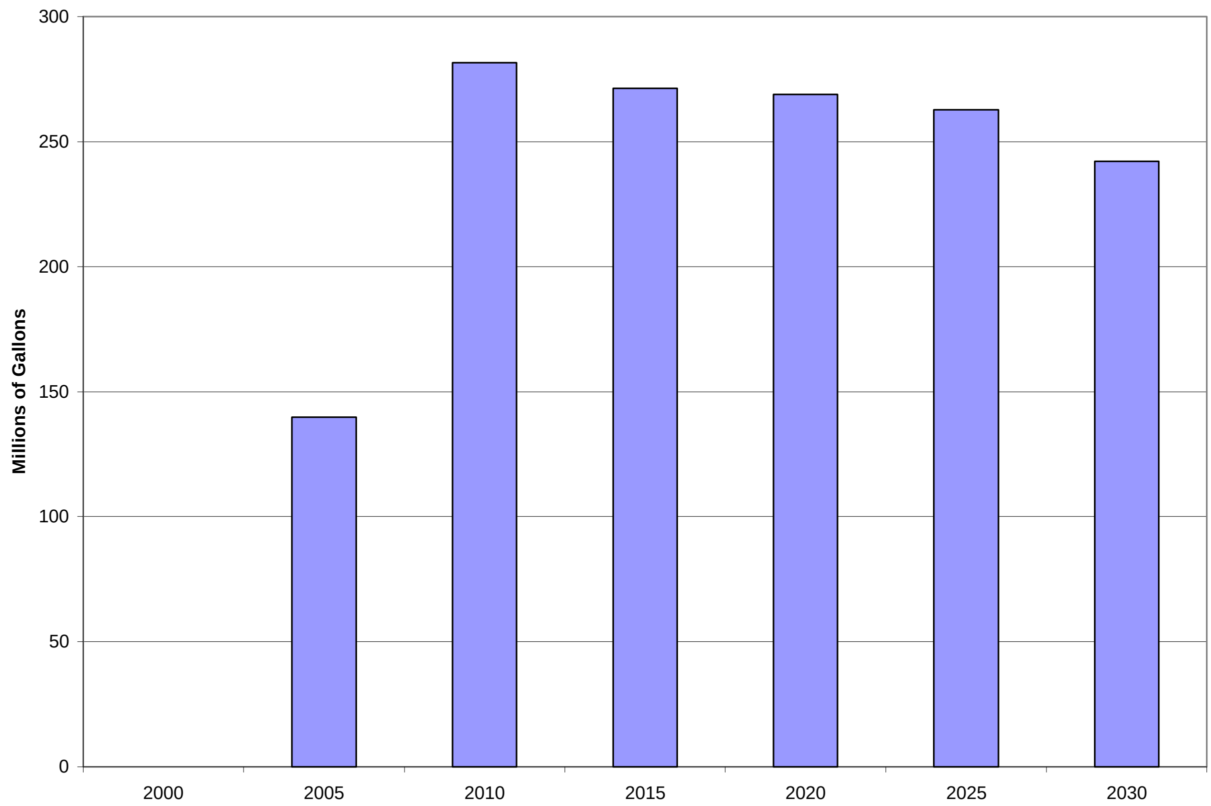
E. OPTIONS FOR BALANCING SUPPLY AND DEMAND

1. Water Conservation

As indicated above, all of the programs recommended in the Water Conservation Plan are included in all strategies. These programs span the range of end uses for residential and non-residential customers. In addition, during the IWP, staff examined potential additional conservation programs beyond those recommended in the Water Conservation Plan. Based on that review, the IWPC decided that no additional conservation programs beyond those included in the Conservation Plan would be included in any strategy.

[3] Programmatic savings are those that are due to the conservation program. Excluded are savings due to natural fixture replacement, which are included in the base demand forecast. It is this "naturally-occurring conservation" that causes the gradual decline in programmatic savings after 2010.

Figure ES-2
Annual Conservation Program Savings



As a signatory to the *Memorandum of Understanding Regarding Urban Water Conservation in California*, the City is committed to implementation of 14 Water Conservation Best Management Practices over the next ten years, many of which are already included in the water conservation plan. In addition, State law requires review and update of the City's Urban Water Management Plan every five years, in which any new initiatives in the field of water conservation are considered. The Department will actively consider new ideas as they arise and will continue to encourage public involvement in this area.

2. Curtailment

A key premise of the integrated water plan is that, overall, it might be better for the City to accept and manage some level of peak-season water shortage from time to time than to try to eliminate the possibility of any future shortage by developing enough supply capacity to overcome the drought of record. Such a choice could minimize the costs of developing new sources and potentially lessen or avoid environmental impacts. It is improbable that the City water system could ever be made totally drought-proof, since local community values, as expressed in the City's General plan, strongly favor environmental protection and preserving the small town character of the City, and because some perceive the need for any water supply improvements as contributing to pressure for unwanted growth in the region. So rather than try to eliminate the possibility of any future shortage, the City's approach is to find a balanced solution that maintains some risk of shortage, but which reduces the burden on the community accompanying such shortages to an acceptable level.

A key issue in the IWP planning process then becomes how much and how often the community is willing and able to tolerate cutbacks in water use in future water shortages, and what degree of hardship corresponding with different size water shortages constitutes an acceptable risk.

The IWP is where the public policy tradeoffs between the economic and environmental costs of providing increased supply capacity are compared with the risk and potential impacts of curtailing customer water use. For example, if it turns out that the costs and environmental impacts are deemed to be unacceptably high to reduce the City's drought shortage from one level to another, the City may choose to accept a greater level of shortfall as its preferred strategy. On the other hand, if it doesn't cost that much more to buy down the shortfall, and the environmental consequences are small, the City might elect to go with a more reliable system to avoid the impacts that larger water shortages impose on residents and businesses.

To provide critical input for this evaluation, the *Water Curtailment Study* was completed in 2001. It was a groundbreaking attempt to achieve a greater understanding of the manner in which different levels of peak-season water supply curtailment affect different groups of customers. The study examined six different levels of shortage severity, ranging from a mild (10%) to an extreme (60%) system-wide peak-season shortage. For each of these, the study looked at likely actions that customers in each customer class would take and the hardships that these actions would impose.

Based on this examination and the results of the *Water Curtailment Study*, the IWPC, and subsequently the Water Commission, determined that *the highest level of worst peak-season shortage that is tolerable for Santa Cruz water customers is 25%*. Larger curtailments were judged to have unacceptable impacts on the community. Thus, the strategies examined in the IWP only focus on curtailment profiles for which the worst peak-season shortage did not exceed this level. The three curtailment profiles that were selected for evaluation are shown in Table ES-2.

As described above, the current worst-year peak-season shortage is 45%. Even with the City's extensive conservation programs, this shortage remains high throughout the planning period. This means that, to reduce the risk of shortage even to the highest acceptable level, the City must develop new supply as soon as possible. Additional increments of supply will be needed in the future to maintain an acceptable shortage risk as future demand grows.

TABLE ES-2
ALTERNATIVE CURTAILMENT PROFILES

CURTAILMENT PROFILE	PROBABILITY OF:			WORST-YEAR PEAK-SEASON SHORTAGE (%)
	<10% Peak-Season Shortage	10-20% Peak-Season Shortage	20-30% Peak-Season Shortage	
1 (Perfect)	0	0	0	0%
2	6-9 in 59[a] (1 in 7-10)	1 in 59	0	15%
3	10-15 in 59 (1 in 4-6)	0-1 in 59	1 in 59	25%

a. The historical hydrologic record includes 59 years of data.

3. New Water Supplies and Infrastructure

Note that the supply and infrastructure alternatives are described in more detail in Section C of Chapter III.

As indicated above, the City has engaged in a series of water supply studies since the mid-1980s. All of those studies provided important information which helped the City focus on those alternatives which show the most technical and institutional promise. Each study had a somewhat different focus and each one removed particular supply options from consideration. As a result of those studies, the following supply options were still under considerations as the IWP began:

- **Seawater Desalination**. This option involves construction of reverse osmosis, pretreatment, and ancillary facilities including buildings, piping, and pumping systems, and modifications to the existing abandoned wastewater outfall. No specific site has been selected for these facilities, but probable locations are in the Industrial area of Santa Cruz or on the University's Long Marine Lab site.

- **Reclamation/Coast Groundwater Exchange**. This option involves construction of a 4-5 mgd tertiary wastewater treatment plant, and associated facilities to deliver that water to North Coast farmers for irrigation purposes. The plant would be located either on the existing wastewater treatment plant site, or in the industrial area of Santa Cruz and would include construction of approximately 45,000 feet of 18-inch pipe. In return, the City would get access to the groundwater supplies currently being used by the farmers. Based on the limited information that is currently available on groundwater hydrology in this area, the IWP assumes an annual yield from this source of 700 million gallons.

- **Santa Margarita Aquifer at Live Oak**. This is a potential small source of supply. The aquifer is below the Purisima aquifer from which the current Beltz wells draw supply. Little information is currently available about this supply. For purposes of the IWP, it is assumed that this source will yield 100 million gallons annually.

For both the desalination and the reclamation/coast groundwater options, discussions with the Soquel Creek Water District resulted in consideration of regional as well as city-only projects. While the latter would serve only customers of the Santa Cruz Water Department, a regional project would serve customers of both agencies. Required facilities for regional projects are nearly identical to city-only facilities with the exception of transmission mains required to pipe water to Soquel Creek Water District.

F. EVALUATION CRITERIA

The IWPC engaged in a process of criteria development to evaluate strategy alternatives. A set of evaluation criteria was adopted by the Water Commission and reviewed by the City Council. Evaluation criteria were developed in the following areas:

1. Cost

Cost criteria focused on total utility revenue requirements, expected water bill increases, and short-term capital investments by the City.

2. Curtailments

Curtailment criteria addressed both the frequency of peak-season shortages of various sizes and the magnitude of the peak-season shortage that would occur under worst-case hydrologic conditions. The IWP examined tradeoffs among different levels of curtailment by explicitly defining three *curtailment profiles*, which are shown in Table ES-2.

3. Vulnerability to External Events

This category includes shortages due to either system failure or regulatory change. System simulations showed that the regulatory changes considered to be realistic possibilities did not distinguish among strategies. Therefore, only vulnerability to system failures was reflected in the strategy evaluations.

4. Environmental Impacts

The IWP included a preliminary analysis of a range of environmental impacts that could be associated with particular strategies. The environmental analysis is summarized in Appendix C. The analysis showed that the only three environmental impacts that had the potential to significantly distinguish among the IWP strategy alternatives were impacts on marine resources, groundwater hydrology, and indirect land use.

5. Energy Consumption

The Water Commission felt it important to compare the energy used by different strategies, since energy production is often associated with emissions into the atmosphere. These emissions, in turn, may contribute to global climate change. Because of limited information on how Soquel Creek Water District would operate supply sources in a regional strategy, or regarding the actions the District would take if the City chose to pursue a city-only strategy, it was decided to focus only on energy usage associated with providing water to City customers.

6. Impacts on Purisima Aquifer

Because of this aquifer's regional importance, it was decided to include a criterion which explicitly estimated each strategy's potential impacts on the aquifer. Generally speaking, strategies that force the Soquel Creek Water District to rely more heavily on the Purisima, in addition to the City's reliance on the aquifer, have more potential of damaging the aquifer.

7. Ease of Implementation

This criterion was based on consideration of required permits, agreements and partnerships, and land acquisition and easements, as well as the estimated duration of the project schedule. Detail on this analysis is included as Appendix D.

G. FORMULATION OF RESOURCE STRATEGIES

The IWP combined conservation, curtailment, and supply options to create resource strategies. *A resource strategy is a combination of conservation and supply options, and the associated operating rules, designed to maintain a particular 'curtailment profile' through the planning period.* The performance of each strategy against the evaluation criteria was assessed to achieve a clear understanding of the tradeoffs that must be made among the criteria.

Considerable effort was devoted to determining the appropriate operating assumptions for potential new water supplies. Those assumptions became key parts of the strategy definition.

Several other key observations and assumptions were made:

- Since the current Santa Cruz system cannot achieve the minimum acceptable curtailment profile (i.e. a worst-year curtailment greater than 25%), *the initial increment of supply for any strategy that will achieve the minimum acceptable level of reliability must be one of the two major supply options*, namely desalination or the reclamation/groundwater exchange.

- *Given the large fixed costs associated with the initial increment of either of these supply options, no strategy may include both of them*. Thus, there are two groups of strategies, one based on desalination, the other based on the reclamation/groundwater exchange.

- The contents of any agreement between the City and the Soquel Creek Water District have not yet been negotiated. For purposes of the IWP, two key assumptions about a regional project are made:
  - Any agreement between the City of Santa Cruz and Soquel Creek Water District would first meet the needs of the City, with only surplus supplies being available to Soquel Creek. Thus, *the capacities of the required supplies in the corresponding city-only and regional strategies are identical*, although those supplies would be utilized much more intensively in a regional strategy than in a city-only strategy.
  - The capital costs and fixed operating costs of any joint project will be divided equally between the parties. Each party will pay the variable operating costs associated with water supplied to its customers.

1. Strategy Descriptions

These observations led to the following strategy descriptions:

a) Desalination Strategies

D-1. **City-Only Desalination**. A sequence of desalination capacity increments sized to maintain the appropriate curtailment level for the City of Santa Cruz.

D-2. **Regional Desalination**. Sequences of desalination capacity increments identical to D-1, with fixed costs divided equally between Santa Cruz and Soquel Creek.

D-3. **City-Only Desalination and Santa Margarita Groundwater**. The Santa Margarita source is developed and the desalination additions are downsized and/or deferred to the extent possible consistent with maintaining the appropriate curtailment level.

D-4. **Regional Desalination and Santa Margarita Groundwater**. Sequences of additions identical to D-3 with fixed costs divided equally.

b) Reclamation/Groundwater Strategies

R-1. **City-Only Reclamation/Coast Groundwater**. A reclamation plant to meet all the irrigation needs of the North Coast growers and a sequence of coast groundwater capacity increments sized to maintain the appropriate curtailment level.

R-2. **Regional Reclamation/Coast Groundwater**. Sequences of capacity additions identical to R-1 with fixed costs divided equally.

R-3. **City-Only Reclamation/Coast Groundwater and Santa Margarita Groundwater**. The Santa Margarita source is developed and the coast groundwater additions are downsized and/or deferred to the extent possible consistent with maintaining the appropriate curtailment level.

R-4. **Regional Reclamation/Coast Groundwater and Santa Margarita Groundwater**. Sequences of capacity additions identical to R-3 with fixed costs divided equally.

For each of these strategies, sequences of supply increments were added as necessary to achieve the desired curtailment profile. The first major supply increment (either desalination or coast groundwater) was added in 2009, which was estimated to be the earliest date that either of these supplies can become operational.[4] Table ES-3 shows the supply additions required for each strategy at each curtailment profile.

H. STRATEGY EVALUATION

The final step of the IWP was to evaluate the strategy alternatives. Including the distinctions among curtailment profiles and between city-only and regional strategies, Table ES-3[5] contains a total of 20 strategies to be rated against the evaluation criteria. The strategies were first evaluated against each individual criterion. Then, four key questions were posed:

1. What are the tradeoffs among different curtailment profiles?
2. How do city-only and regional (i.e. joint with Soquel Creek) strategies compare?
3. What are the comparative advantages of strategies based on desalination vs. those based on the reclamation/coast groundwater exchange?
4. Should the City develop a groundwater supply in the Santa Margarita aquifer at Live Oak in order to downsize the desalination or coast groundwater supply?

1. Curtailment Profile Comparisons

The only criterion that distinguishes significantly among the various curtailment profiles for all strategies is cost. Not surprisingly, strategies with less expected curtailment require larger and earlier supply additions, and therefore cost more. This is illustrated in Charts ES-1, ES-2, and

[4] These initial supply additions are sized to serve demands which are within the 2005 demand estimates of the 1998 *Demand Investigation*, and are therefore accounted for within the 2005 General Plan population projections.

[5] The smallest desalination increment considered in the IWP was 0.5 mgd. Coast groundwater increments are 0.78 mgd, which is the projected capacity of each well.

Table ES-3
RESOURCE STRATEGY SUPPLY ADDITIONS

STRATEGY	2005	2009	2015	2020	2025
DESALINATION (D-1, D-2)					
CURTAILMENT PROFILE 1		Desal 5.0 mgd	Desal 1.0 mgd	Desal 1.0 mgd	Desal 1.0 mgd
CURTAILMENT PROFILE 2		Desal 2.5 mgd	Desal 1.0 mgd		Desal 1.0 mgd
CURTAILMENT PROFILE 3		Desal 2.0 mgd	Desal 1.0 mgd		Desal 1.0 mgd
SHORT-TERM SANTA MARGARITA GW/ DOWNSIZED DESAL (D-3, D-4)					
CURTAILMENT PROFILE 1	Santa Marg. GW 0.55 mgd	Desal 4.5 mgd	Desal 1.0 mgd	Desal 1.0 mgd	
CURTAILMENT PROFILE 2	Santa Marg. GW 0.55 mgd	Desal 2.5 mgd	Desal 1.0 mgd		Desal 1.0 mgd
CURTAILMENT PROFILE 3	Santa Marg. GW 0.55 mgd	Desal 1.5 mgd	Desal 1.5 mgd		
RECLAMATION/GW EXCHANGE (R-1, R-2)					
CURTAILMENT PROFILE 1	CANNOT ACHIEVE				
CURTAILMENT PROFILE 2		Coast GW 3.12 mgd	Coast GW 0.78 mgd		
CURTAILMENT PROFILE 3		Coast GW 2.34 mgd	Coast GW 0.78 mgd		Coast GW 0.78 mgd
SHORT-TERM SANTA MARGARITA GW/ DOWNSIZED RECLAIM COAST GW (R-3, R-4)					
CURTAILMENT PROFILE 1	CANNOT ACHIEVE				
CURTAILMENT PROFILE 2	Santa Marg. GW 0.55 mgd	Coast GW 2.34 mgd	Coast GW 0.78 mgd	Coast GW 0.78 mgd	
CURTAILMENT PROFILE 3	Santa Marg. GW 0.55 mgd	Coast GW 1.56 mgd	Coast GW 0.78 mgd	Coast GW 0.78 mgd	

ES-3. What is striking about all three charts are the very small differences between curtailment profiles 3 and 2, and the substantial differences between profiles 2 and 1. Thus, the City could achieve the smaller and less frequent curtailments of Curtailment Profile 2 at a cost that is scarcely distinguishable from that of CP 3. (Although the costs are very close, the impacts on customers are not. Thus, the 25% worst-year shortage associated with CP 3 would likely require rationing of residential customers, along with significantly more hardship.) Achieving Curtailment Profile 1 (perfect reliability) would require a significantly higher investment on the part of ratepayers and would result in the City having to raise substantially more capital.

Based on these results, Curtailment Profile 2 (maximum 15% drought-year shortage) provides the best cost-reliability tradeoff for Santa Cruz water customers.

2. Comparison of City-Only and Regional Strategies

Charts ES-4 and ES-5 show overall comparisons of city-only and regional strategies. The comparisons are in the form of "contours" which show normalized comparisons of strategy pairs against all criteria against which the two strategies differ significantly. In all cases, the best performance rating (e.g. least cost, smallest energy usage, easiest to implement, etc.) is normalized to 100, with other normalized scores set relative to that.

Although the profiles in the two charts differ somewhat, the relationships between the city-only and regional strategies are basically the same. Not surprisingly, the regional strategies perform substantially better against all three cost criteria, due to the cost-sharing with Soquel Creek.

While both desalination strategies have potential impacts on marine resources, the city-only impacts are estimated as "moderate" while the regional strategy's potential impacts are "high". A more detailed analysis of these impacts and their potential mitigation will be undertaken as part of the EIR.

City-only strategies are estimated to have somewhat more impact on the Live Oak/Purisima aquifer than the regional strategies. Conversely, the city-only reclamation/groundwater strategies have somewhat less impact on the north coast aquifers than their regional counterparts.

Regional strategies are estimated to be somewhat more difficult to implement than city-only strategies. This is due to the higher number of required agreements and partnerships and a need for more land acquisitions and easements in the regional strategies.

Consensus has not been reached on the relative degree to which the various strategies induce growth. One of the key areas of discussion has been whether or not regional strategies are more growth-inducing than city-only strategies. This remains an area of doubt that will be addressed in the EIR.

The substantial cost advantages of the regional strategies provide important savings to current and future ratepayers. This cost difference also leaves significant room for added mitigation expenses to relieve the potential added environmental impacts associated with the regional strategies. The regional strategies also help preserve the Purisima aquifer at Live Oak, which is a critical regional resource. However, the regional strategies are expected to be somewhat more difficult to implement

Superimposed on these considerations is the uncertainty over the growth-inducing impacts of regional vs. city-only strategies.

Due to this uncertainty, no conclusion is drawn on the relative merit of a regional strategy vs. a city-only strategy.

3. Comparison of Desalination and Reclamation/Coast Groundwater Strategies

Chart ES-6 shows the overall comparison of the city-only desalination (D-1) and reclamation/ groundwater (R-1) strategies, while Chart ES-7 shows the comparison between the corresponding regional strategies.

The desalination strategies have the following advantages:

- Much lower near-term capital costs
- Much less vulnerability to short-term system failures
- Lower impact on groundwater basins
- Much easier to implement
- No limitations or uncertainty on annual yield

The reclamation/groundwater strategies have the following advantages:

- Somewhat less expensive to ratepayers over the planning period
- Substantially less impact on marine environment[6]

Recent letters to the City from the California Department of Parks and Recreation and North Coast organic growers have greatly exacerbated the implementation difficulties of the reclamation/groundwater exchange strategies. In particular, the letter from the state expressed the Department's unwillingness to pursue further consideration of the exchange of reclaimed wastewater for groundwater at Wilder Ranch State Park. The exchange was felt to involve "uncharted legal and complex policy issues having serious long-term implications of statewide

[6] At this point, it is unknown how many, if any, of the marine impacts are mitigable. More information on impacts, mitigation approaches and mitigation costs will be developed as part of the EIR.

consequence . . . .” The letter further stated that “it is the Department’s assessment that the use of reclaimed wastewater at Wilder Ranch could result in potential adverse impacts to sensitive natural resources, place possible constraints on recreational usage and adversely impact organic agricultural leasing operations at Wilder Ranch State Park.” The state’s current unwillingness to consider the groundwater exchange represents a major, if not fatal, barrier to moving forward with the reclamation/groundwater exchange strategies.

The full text of the letters is included as Appendix E.

Based on the analytic comparisons and the State of California’s current opposition to the exchange of North Coast groundwater, the desalination strategies are clearly superior.

4. Developing the Santa Margarita Aquifer at Live Oak

Chart ES-8 shows that, for most evaluation criteria, the performance of strategies which include and exclude Santa Margarita/Live Oak development is very close. On the few for which there are noteworthy differences (Graham Hill vulnerability and geo-hydrologic impacts), the strategy which excludes Santa Margarita development is superior.

It is therefore concluded that development of the Santa Margarita aquifer at Live Oak should not be undertaken.

I. CONCLUSION: PREFERRED STRATEGIES

Based on these results, Strategies D-1 and D-2 (City-Only and Regional Desalination) at Curtailment Profile 2 (15% worst-year curtailment) are identified as the preferred alternatives. The final choice between the city-only and regional strategies is deferred to completion of the Environmental Impact Report.

J. IMPLEMENTATION

1. Near Term Actions

Over the next 12-18 months, the City must develop the Environmental Impact Report (EIR) on this IWP, the preliminary design of the desalination plant and associated facilities, and the aggressive implementation of water conservation programs.

2. Key Decisions

This report was sent by the IWPC on February 10, 2003 to the City’s Water Commission. On March 3, 2003, the Water Commission recommended its acceptance by the City Council. Acceptance by the Council will trigger the following actions:

- The formal preparation of the EIR will begin.
- The preliminary design of the desalination facilities will begin.
- Negotiations with the Soquel Creek Water District will be undertaken to develop the parameters of the agreement that would be needed if the City ultimately adopts a regional strategy.

Final adoption of the IWP by the City Council will take place when the EIR is certified.

3. Long-Term Schedule

Development and adoption of the EIR, including preliminary engineering sufficient to adequately define project components for the EIR analysis, is expected to take approximately 12 months.

Subsequent to adoption of the IWP and EIR, additional engineering and final design is expected to take approximately 36 months. The project level EIR and permitting would occur concurrently with the design phase.

Construction of facilities is expected to take approximately 36 months following final project approval. The facility should be on-line in late 2009 or early 2010.

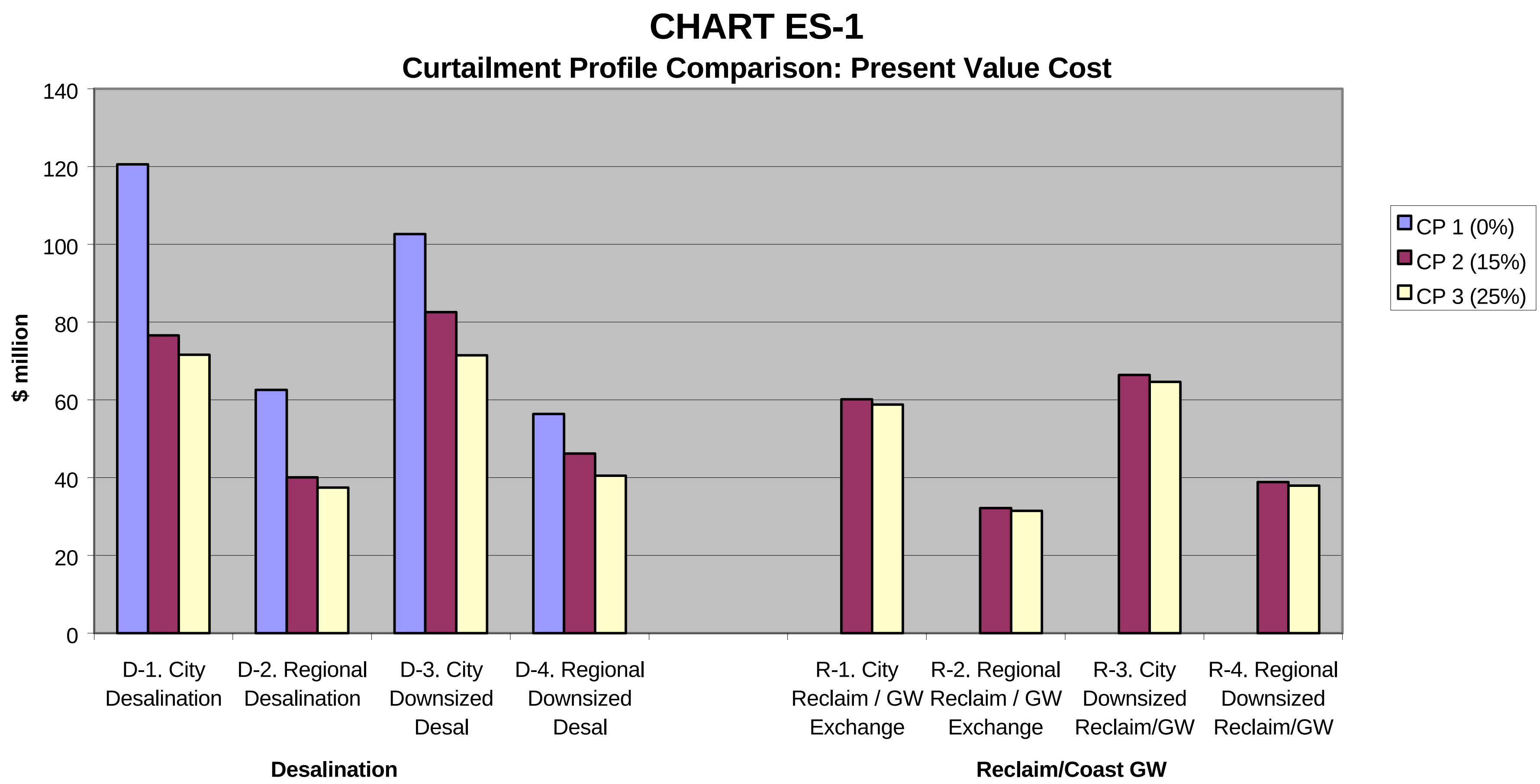


CHART ES-1
Curtailment Profile Comparison: Present Value Cost
$ million
140
120
100
80
60
40
20
0
CP 1 (0%)
CP 2 (15%)
CP 3 (25%)
D-1. City Desalination
D-2. Regional Desalination
D-3. City Downsized Desal
D-4. Regional Downsized Desal
R-1. City Reclaim / GW Exchange
R-2. Regional Reclaim / GW Exchange
R-3. City Downsized Reclaim/GW
R-4. Regional Downsized Reclaim/GW
Desalination
Reclaim/Coast GW

CHART ES-2

Curtailment Profile Comparison: Expected Increase in Monthly Residential Water Costs

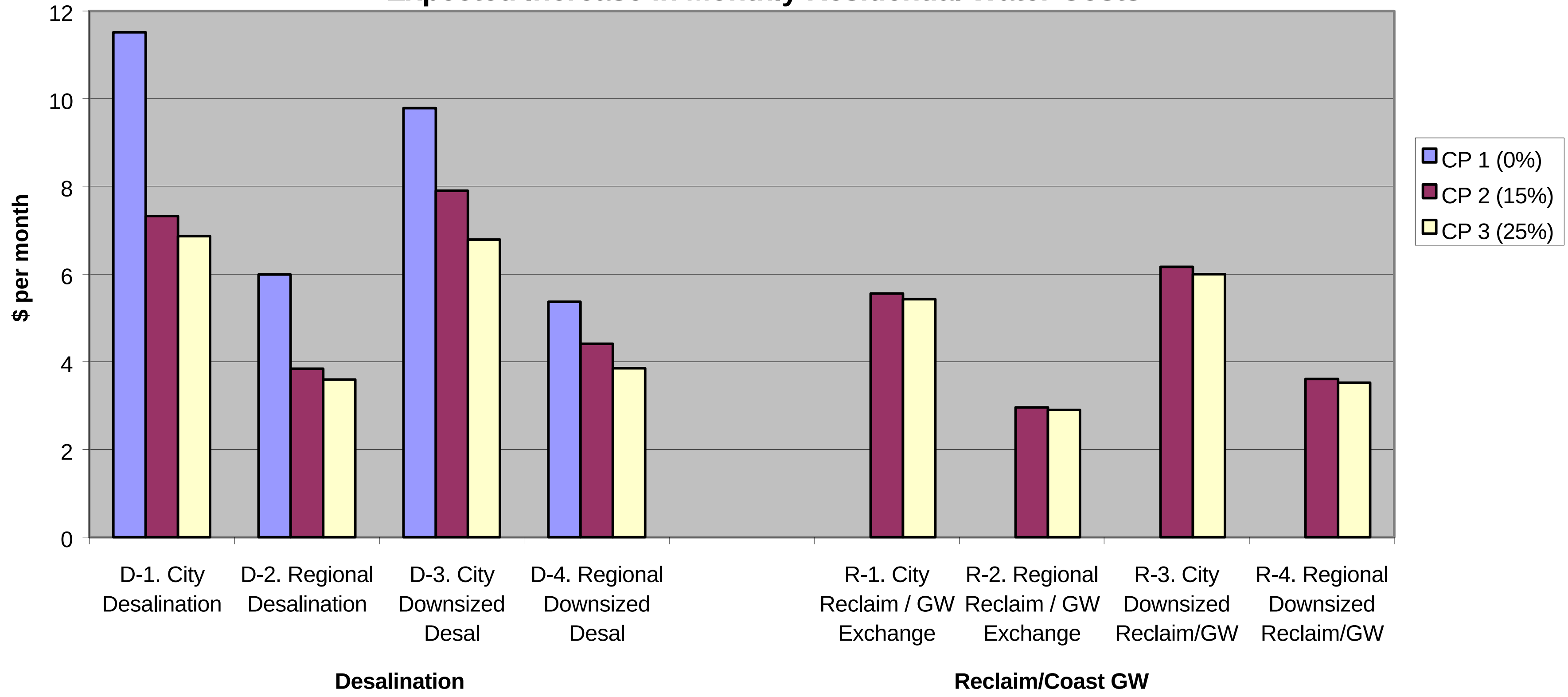


CHART ES-3
Curtailment Profile Comparison: Near-Term Capital Expenditures

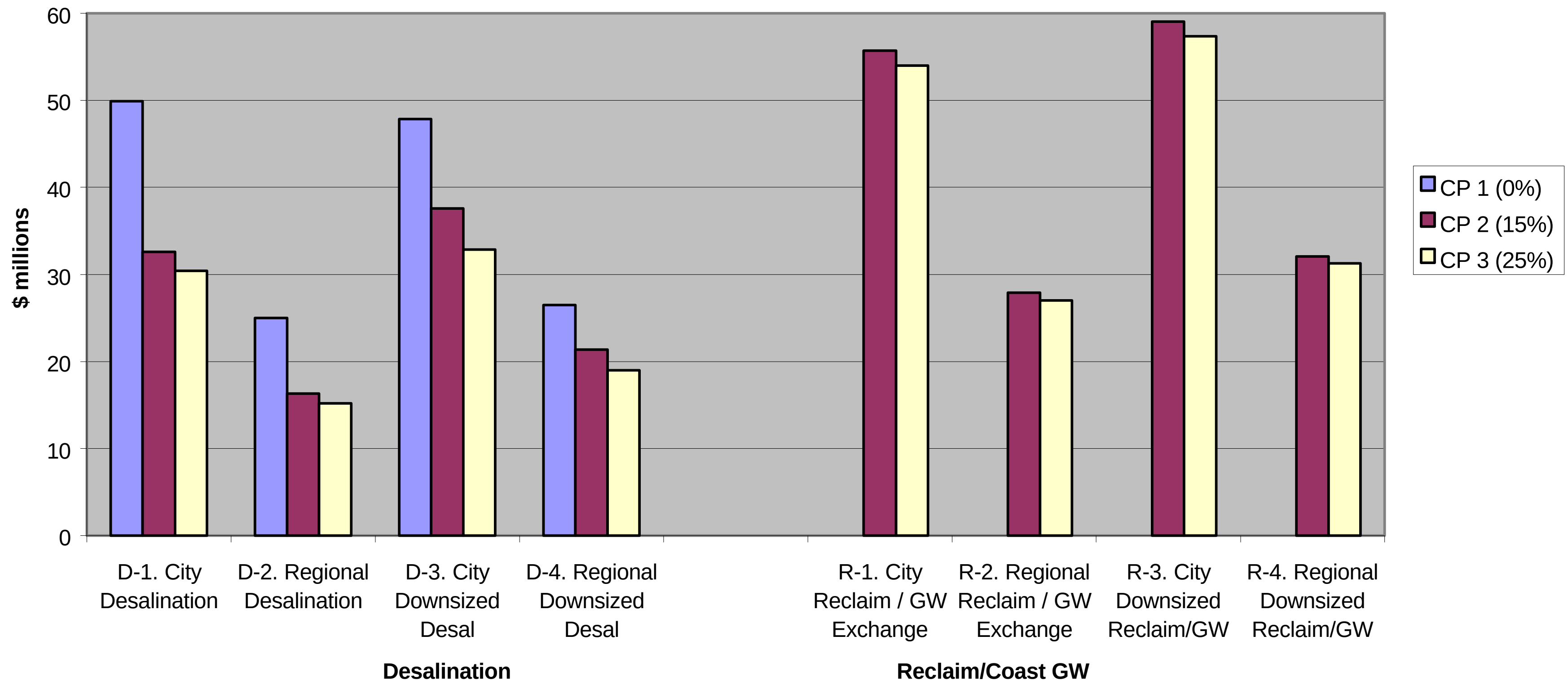


CHART ES-4
City-Only Desal (D-1) vs. Regional Desal (D-2)
(Curtailment Profile 2)

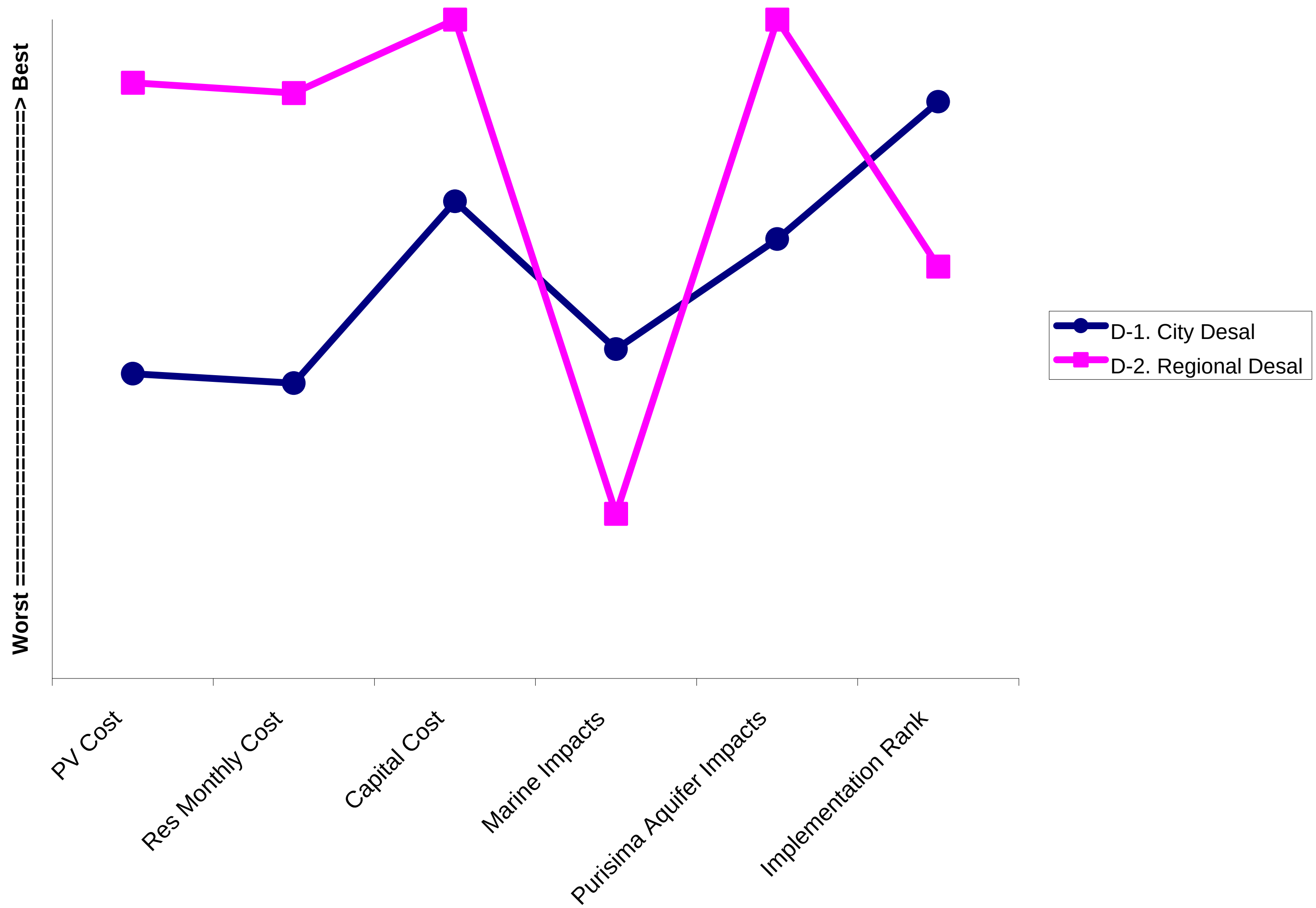


CHART ES-5
City-Only Reclaim/GW (R-1) vs. Regional Reclaim/GW (R-2)
(Curtailment Profile 2)

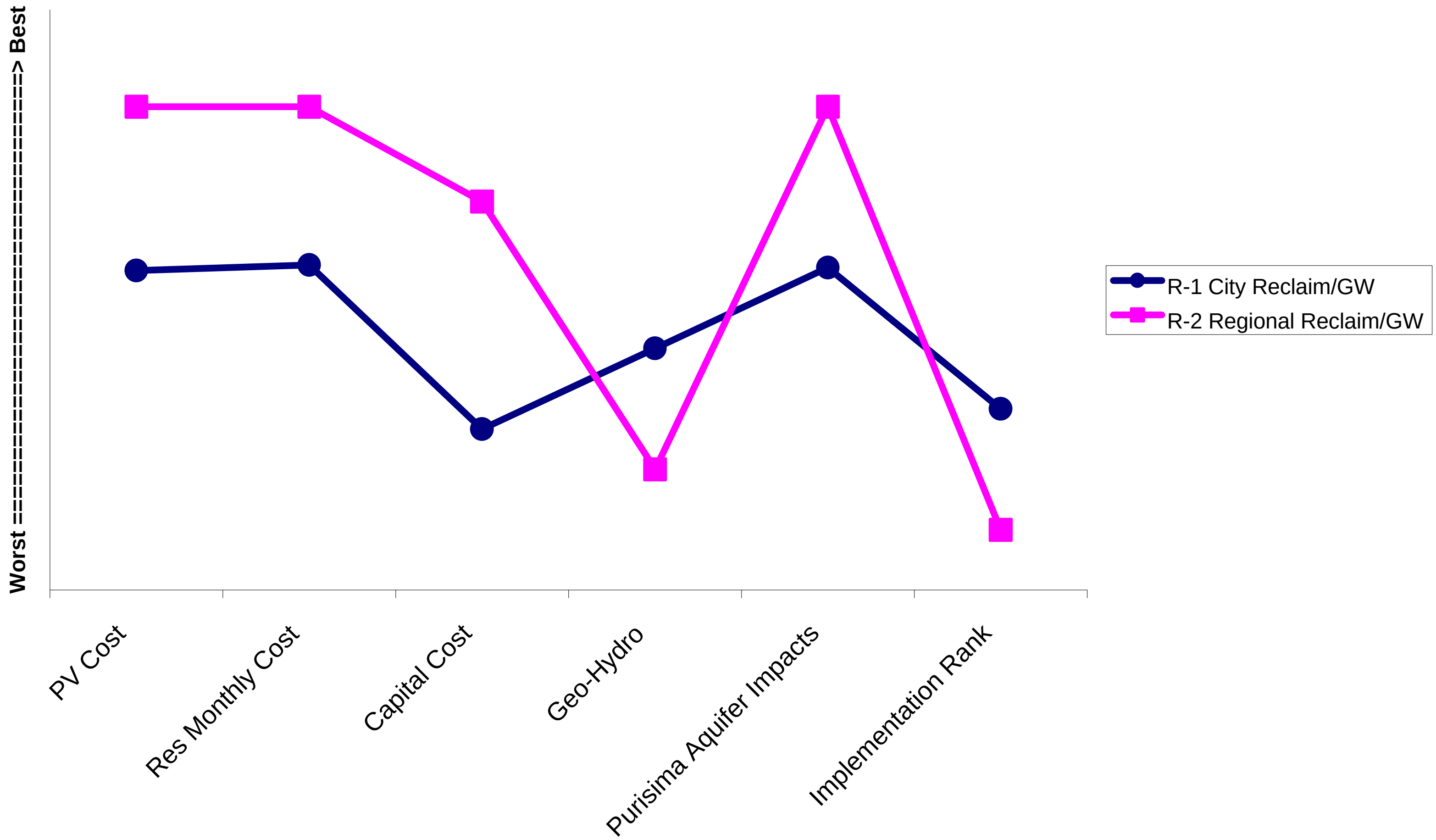


CHART ES-6

City Desal (D-1) vs. City Reclaim/GW (R-1) (Curtailment Profile 2)

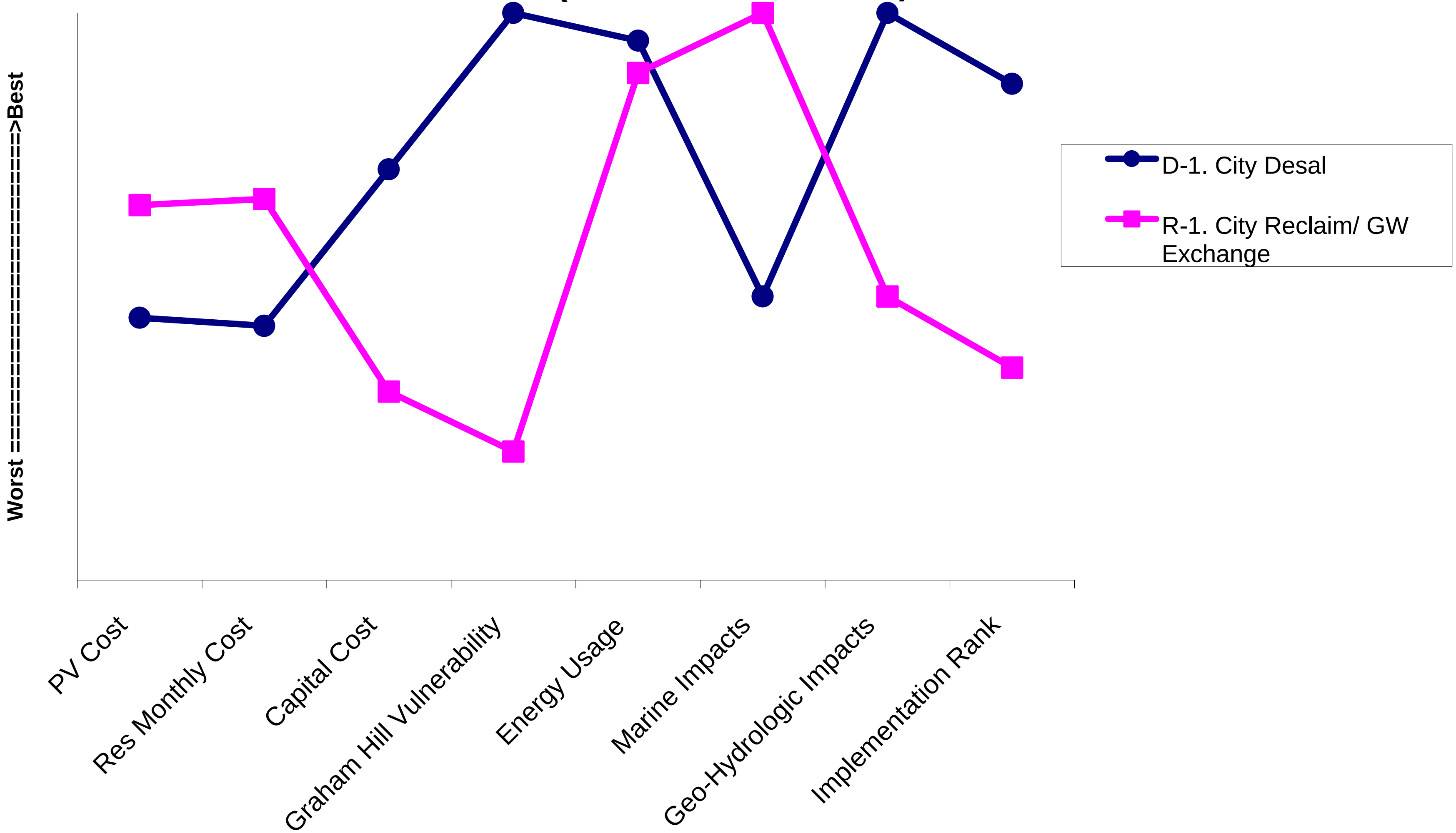


CHART ES-7
Regional Desal (D-2) vs. Regional Reclaim/GW (R-2)
(Curtailment Profile 2)

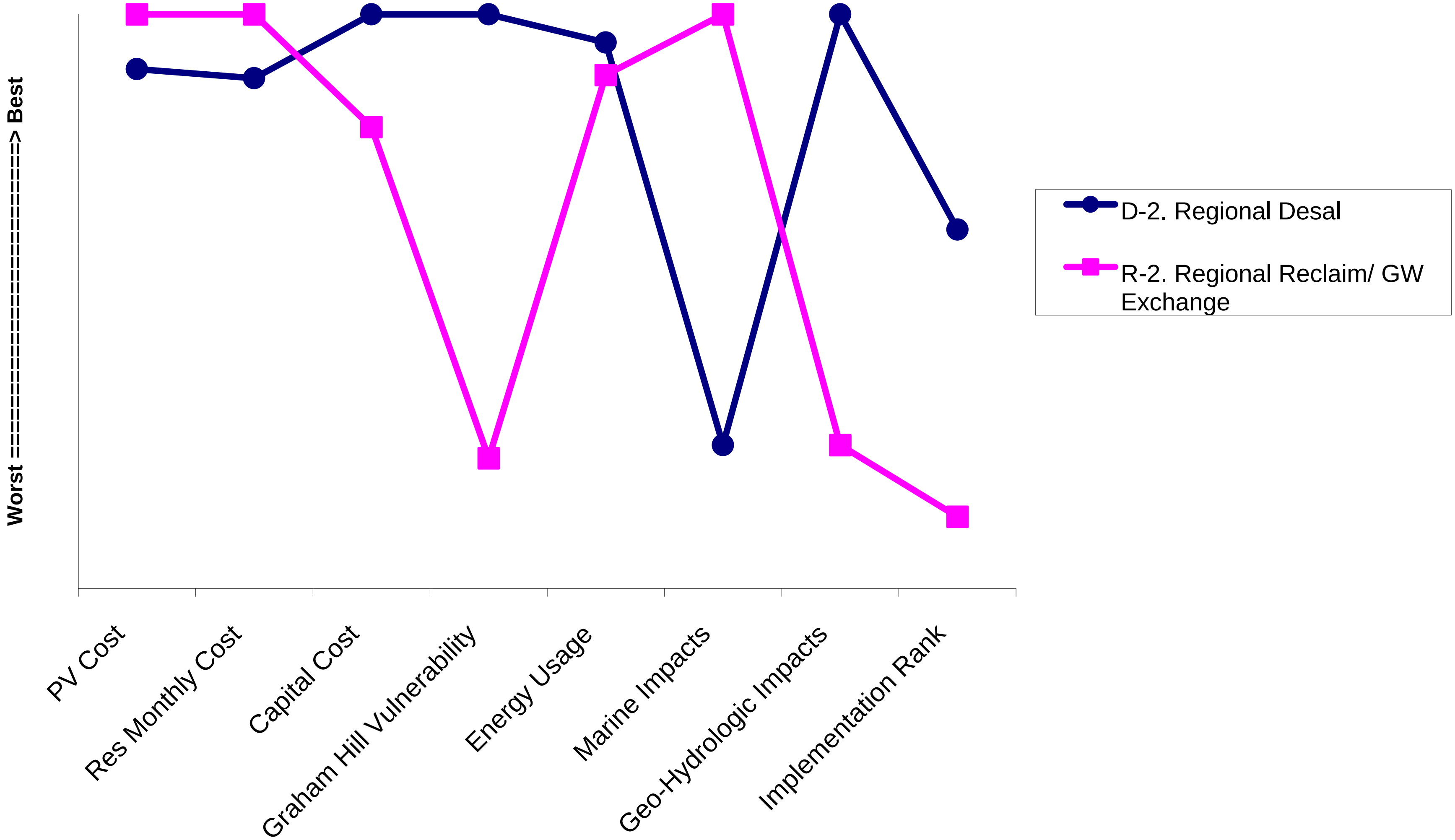
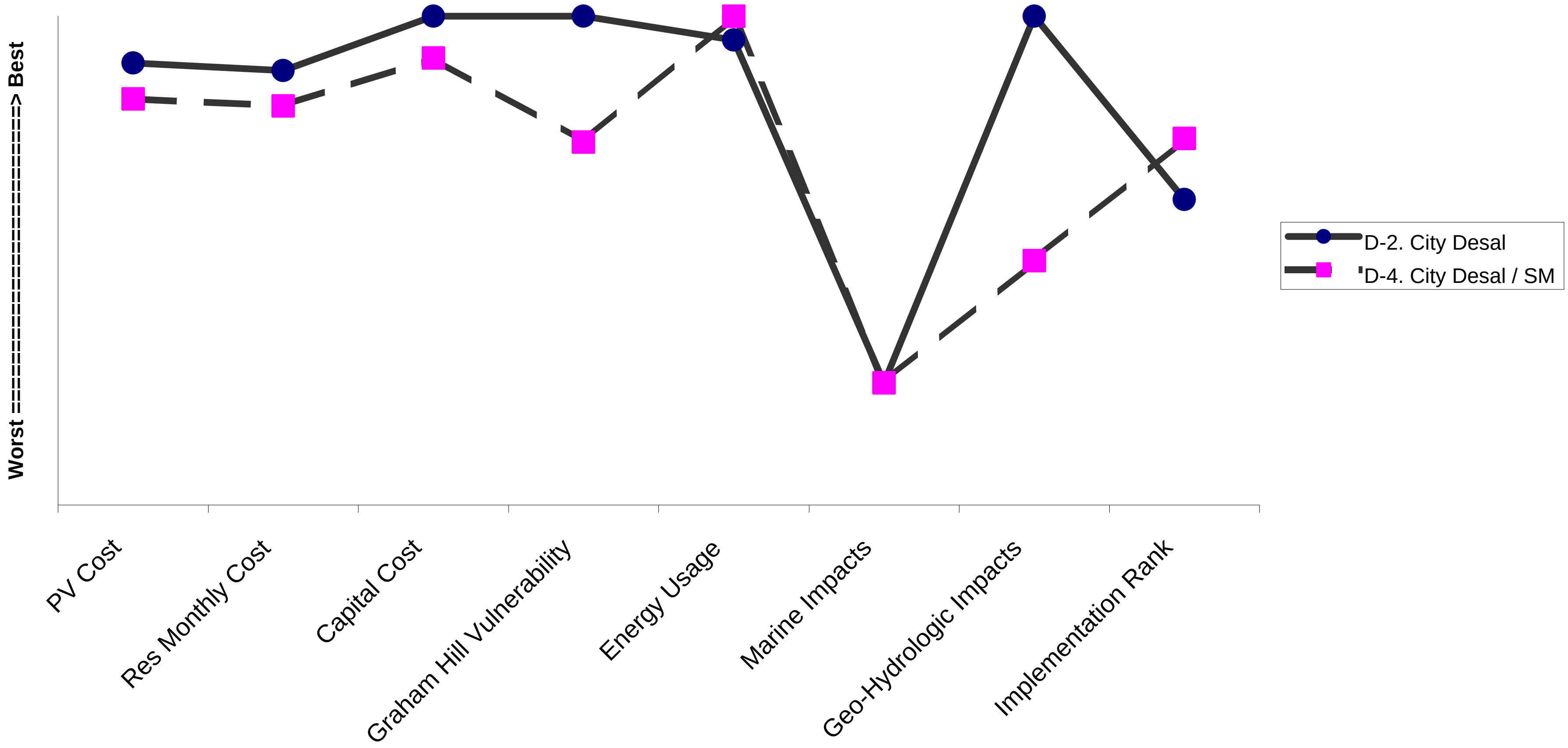


CHART ES-8

Regional Desal (D-2) vs. Regional Downsized Desal with Santa Margarita (D-4)
(Curtailment Profile 2)



I. INTRODUCTION

The City of Santa Cruz is facing a water supply crisis. If the City were to experience a drought similar to the one that occurred in 1976-77, it would be able to serve barely more than half of the summer demand. In an event like the 1987-92 drought, shortages, although not as devastating, would still be large enough to require customer rationing. These system-wide shortages would result in even larger curtailments (shortages) for the City's residential customers. In other drier-than-normal years, the City would also experience shortfalls. Moreover, aside from this current inability to meet demand, the City must also plan for its future growth.

The Santa Cruz Water Department provides water to approximately 90,000 customers in the City of Santa Cruz, a portion of the unincorporated area of Santa Cruz County, and a small portion of the City of Capitola. The drought events of 1976-77 and 1987-92 made it clear that the City's current water supplies were insufficient to serve the then-current water demands under drought conditions. Since those events, as population and the demand for water have grown, that shortfall has been exacerbated.

The City has been actively considering possible new water supplies for the past 17 years. These previous water supply planning efforts were based on the need for new water supply projects to fully serve existing and future ultimate water demands, even during a critical drought such as the event of 1976-77.

In 1997, the City undertook a new water supply planning effort that incorporated a systematic process to investigate alternative approaches to bringing supply and demand into balance. This new approach considers new supply options as one of three ways to achieve this balance. The other two are reducing water demands through water conservation programs and accepting some level of water curtailments during drought conditions. As a result of actively considering these non-structural alternatives, water supply needs are reduced and/or deferred. New supplies are phased in over time as needed.

A. PURPOSE AND SCOPE OF IWP

The purpose of the City of Santa Cruz Integrated Water Plan is to respond to the current drought-related crisis and plan for future growth. Specifically, it must help the City : 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.

To accomplish this goal, the IWP has relied directly on four critical investigations:

- The *Water Demand Investigation*, completed in 1998 by Maddaus Water Management;
- The *Water Conservation Plan*, completed in 2000 by Gary Fiske & Associates;
- The *Water Curtailment Study*, completed in 2001 by Gary Fiske & Associates; and
- The *Alternative Water Supply Project*, completed in 2002 by Carollo Engineers.

The IWP used the results of these studies to develop and evaluate a set of water resource strategies that address the City's existing drought problem and provide a flexible phased approach to serving the growth that is expected over a planning horizon that extends through the year 2030. As will be discussed in detail below, each strategy included different mixes of the three 'building blocks':

- **Water conservation programs**. The City's objective is to maximize the use of its existing water resources before considering new supplies. Consistent with this objective, the City is implementing a broad set of water conservation programs which result in ongoing, dependable, long-term demand reductions. These programs are described in detail in Section A of Chapter III. They include, among others, rebates for water-efficient toilets and clothes washers, water use reviews, apartment sub-metering rebates, and a plumbing-fixture retrofit ordinance.
- **Customer curtailments in times of shortage**. The severity of the City's current imbalance between supply and demand is such that the problem will not nearly be solved through conservation programs alone. But the City recognizes that it must actively consider the possibility of only developing new supplies to redress a portion of the imbalance. This would mean that, during drought periods, customers would be required to curtail their demands as much as is necessary to bring demand and supply into balance. These curtailments are of a short-term nature and would result in some level of customer hardship. These hardships must be balanced against the potential cost and environmental benefits of smaller supply projects.
- **New water supplies and infrastructure**. The City will consider new sources of supply and the associated facilities to address the remaining supply-demand imbalance.

An important part of the IWP was developing a set of evaluation criteria against which each strategy was evaluated and compared. The preferred strategies that are recommended herein result from those assessments.

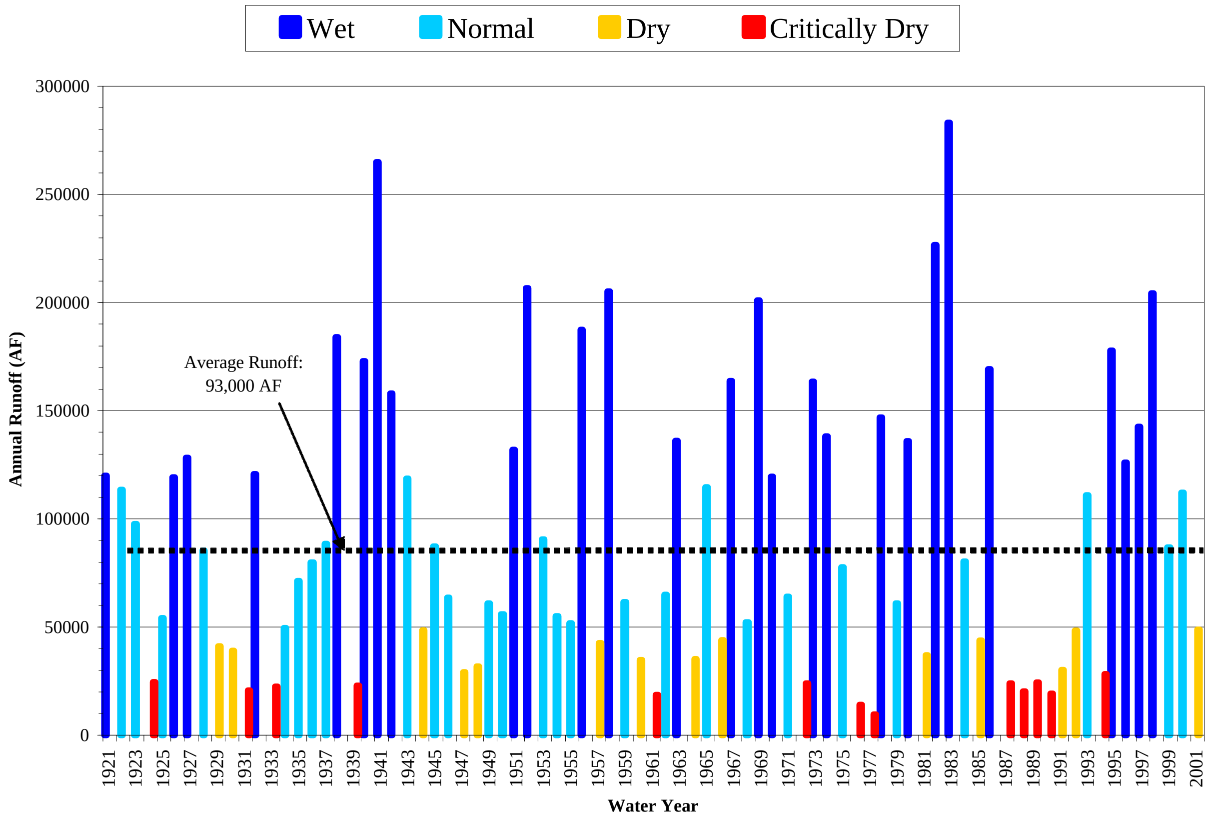
B. OVERVIEW OF WATER SUPPLY PROBLEM

As will be described in detail in Chapter II, the Santa Cruz Water Department relies for the most part on flowing surface water supplies. These flowing supplies are supplemented by stored water in Loch Lomond reservoir and groundwater in the Live Oak wellfield. This dependence on surface supplies makes the City's available supply very vulnerable to hydrologic variability, which is vividly illustrated in Figure I-1.

While the long-term average annual San Lorenzo River runoff is about 93,000 acre-feet (30,300 mg), the driest and wettest year in the 80-year period shown in this chart differ by a factor of 30. In the wet and average years, the City has ample supplies to meet all needs. In the dry and critically dry periods, such as those in the 1976-77 and 1987-92 periods, this is not the case.

FIGURE I-1

Historical Annual San Lorenzo River Runoff



Aside from the extreme variability of supply, this chart illustrates two other important issues.

- Wet and dry periods tend to be cyclical. In other words, wetter periods eventually give way to dry periods and vice versa. Thus, the dry years of the late 1980s and early 1990s were followed by a much wetter than average period in the late 1990s. Year 2001 was the first drier-than-normal year since 1995.

- Dry years often come in clusters. This is critically important to the City's system. Because of stored water in Loch Lomond, the City is usually able to withstand a single dry year. However, as became apparent in the 1976-77 and 1987-92 events, the volume of water that is stored in Loch Lomond is not sufficient to carry the City through severe multi-year events. It is to those events that the City's water supply system is most vulnerable.

Figure I-2 compares the available current supplies in an average water year and in the 1977 drought year to water demands. While there is no shortfall under average conditions, there would be a substantial (1.3 billion gallons) shortfall were a 1977 event to occur today.

C. IWP PROCESS

Work on the IWP began in March 2001. The IWP process was overseen by the City's Integrated Water Plan Committee (IWPC). The IWPC included three members of the Water Commission, three members of the City Council, and one ex-officio member. The Committee reviewed all documents and public meeting materials, provided key input at every stage of the IWP process, and met regularly with staff and consultant on a bi-weekly basis.

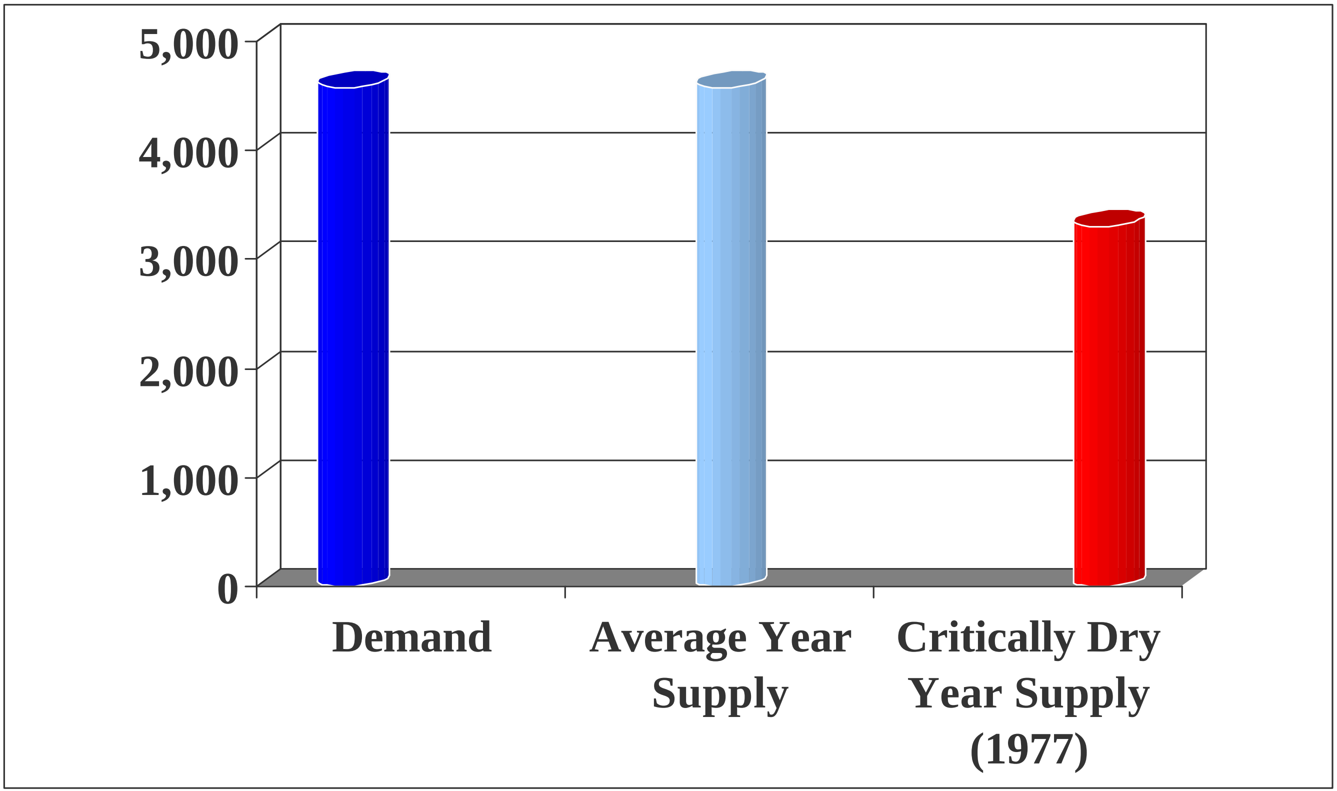
The approach used by the IWP Committee included the following steps:

- Develop a computer modeling tool to analyze and compare alternative strategies.
- Define a 'base case' and assess shortages that SCWD customers would experience under base case conditions. The 'base case' includes current supplies and infrastructure as well as those system enhancements which the Department intends to make independent of the IWP.
- Identify and characterize the City's conservation, curtailment, and supply options.
- Develop and refine evaluation criteria.
- Develop alternative resource strategies.
- Evaluate strategies against the criteria and recommend preferred strategies.
- Describe key steps to implement preferred strategies.

The IWP process is predicated on several critical assumptions:

- **Existing water supplies will continue to be available in the future.** Although implementation of the Endangered Species Act and associated regulations have the potential to decrease the amount of available supply in the future, it is uncertain to what extent the amount of the City's current supplies might be impacted. Therefore, any future loss of existing supplies will require new supplies in addition to those considered in this planning effort.

Figure I-2
Comparison of Annual Water Supply and Demand
(millions of gallons)



- **The City will make substantial investments in maintenance, rehabilitation, or replacement of key facilities to preserve its existing infrastructure.** The past 17 years of unsuccessful attempts to construct a new water supply project has had a tremendous impact on the Water Department's Capital Improvement Program. With the uncertainty of supply planning, rehabilitation or replacement of key facilities was suspended or delayed for fear that major investment in these facilities could be wasted if a new supply project was chosen that required modifications to these same facilities. Many of these facilities including the North Coast diversions and pipelines, the Beltz (Live Oak) Treatment Plant and well field, and the Graham Hill Water Treatment Plant are deteriorating and in need of substantial rehabilitation or replacement. Any loss of production capacity from existing sources due to deterioration of key facilities has the potential to reduce the amount of existing available water supply.

- **Water Conservation programs will be implemented to the fullest extent feasible.** The reductions in future demand for water as a result of these programs will result in a reduction in the amount of required new water supply.

- **The City may choose to not meet full demand for water in periods of drought.** Tolerating water cutbacks during periods of drought can reduce the size of new supply projects required and the associated fiscal and environmental impacts.

D. Relationship Between the IWP, Land Use Plans, and Environmental Review

Land use decisions in the three jurisdictions served by the Santa Cruz Water Department – the City of Santa Cruz, a portion of unincorporated Santa Cruz County and a small part of the City of Capitola – are guided by their respective General Plans, which, in turn, shape demand for water in the service area. All three adopted General Plans were most recently updated in the late 1980s and early 1990s.

Each jurisdiction uses a different planning horizon in its General Plan.

- The City of Santa Cruz, which makes up the majority of land area and accounts for the largest proportion of water use, explicitly uses a 2005 planning horizon in its General Plan. This year was selected because it coincides with the period covered by the University of California Long Range Development Plan. The EIR conducted on the City General Plan similarly covered the period through 2005.
- The County General Plan, which controls land use decisions in the unincorporated area, contains no specific planning horizon, but states: "to remain relevant, the General Plan should be updated at least every ten years". Likewise the EIR on the County General Plan does not refer to a specific planning horizon. In analyzing the rate of growth of housing and population against the County growth management system (Measure J), however, the EIR used 2005 as a comparison period.
- The Capitola General Plan is silent in terms of reference to any specific planning horizon, but refers to AMBAG population projections through the year 2005.

Thus, there is a discrepancy between the time horizons of the General Plans, which appear to go through 2005, and that of the IWP, which extends through 2030. The IWP was based on a demand forecast which covered the planning horizon.[7] This forecast considered vacant land use in the service area, the latest AMBAG population and employment forecast,[8] and university enrollment projections. The discrepancy between forecast periods is not at all atypical. Given the major capital investments considered in a water plan, prudent planning requires a long planning horizon.

The discrepancy did not, in and of itself, hamper the IWP effort. However, the fact that the demand forecast was based on forecasts of growth not included in the currently-adopted General

[7] Maddaus Water Management. *Final Report: Water Demand Investigation*. March 1998

[8] The AMBAG projections do not include the current state fair share housing goals for 2007.

Plans will affect both how the IWP alternatives are analyzed in the environmental review process that will follow IWP completion and the City's IWP approval process. A distinction must be made between those supply and infrastructure additions intended to serve demand which is consistent with General Plan growth projections and those additions that serve demand beyond those projections. This distinction will be made explicit in Section D of Chapter V.

E. COORDINATION AND REVIEW

The IWP was a collaborative process between SCWD staff, consultant, and the IWPC members. Since the IWPC included members of both the Water Commission and the City Council, both of those bodies were kept informed by their IWPC representatives. In addition, SCWD staff made formal presentations to the Water Commission and City Council at key points during the process.

In addition to these ongoing contacts with City elected and appointed officials, the IWP also sought to inform and solicit direct input from the public. Toward that end, two public workshops were held to educate interested members of the public, answer their questions, and receive their input.

The first public meeting was held May 21, 2002, and attracted about 30 attendees. Its purpose was to provide information to the public on the evaluation criteria selected by the committee and accept public input on the evaluation criteria and input on the various supply components to be evaluated. It addressed the following topics:

- The Santa Cruz Water Supply Problem
- Previous Studies
- Elements of the Integrated Water Plan
- Evaluation Criteria
- Strategies Under Consideration
- Relationship Between IWP and Environmental Impact Report

In addition, this meeting included a 'breakout session' in which meeting participants could interact with staff and consultants to discuss specific topics of interest.

The next public meeting, which was attended by about 45 people, was held October 24, 2002. Its purpose was to provide information to the public on the results of the evaluation process and accept public input on the results and on the various supply strategies still under consideration. This meeting addressed the following topics:

- Background and Water Supply Problem
- Integrated Water Planning Process
- Desalination and Reclamation Alternatives

- Key Policy Issues
- Evaluation Process and Results
- Questions and Comments
- Project Schedule and EIR

F. REPORT ORGANIZATION

The remainder of this report is divided into the following chapters:

II. Existing Water Resources and Operations
III. Options for Balancing Supply and Demand
IV. Evaluation Criteria
V. Formulation of Strategies
VI. Evaluation of Strategies
VII. Implementation

II. EXISTING WATER RESOURCES AND OPERATIONS

A. SERVICE AREA CHARACTERISTICS

The Santa Cruz Water Department provides service to the entire City of Santa Cruz, as well as a portion of unincorporated Santa Cruz County and a small portion of the City of Capitola. The service area boundaries are shown in Figure II-1.

Figure II-1

The service area currently includes a population of about 90,000, of which about 60% is within the city limits, 35-40% in the unincorporated areas of the county, and about 1% in Capitola.

The service area has about 34,000 housing units, of which about two-thirds are single-family and one-third multi-family, and an employment base of approximately 45,000 jobs.

Current total annual demand averages about 4.4 billion gallons, of which about 2.5 billion gallons occurs in the six-month May-October peak season. (It is in this peak season that system stress is most likely to occur due to higher demands due to outdoor irrigation and tourism, coupled with potentially lower supplies, particularly in drier-than-normal years.) Average annual per-capita residential demands are very low, currently about 72 gallons per day. This is due to a number of factors, including:

- The City's mild climate and small lot sizes, both leading to a reduced need for outdoor watering;
- A strong conservation ethic in the community; and
- A variety of conservation programs managed by the SCWD.

B. CURRENT SOURCES OF SUPPLY

Figure II-2 is a schematic of the current supply sources for the Santa Cruz Water Department. Figure II-3 shows the breakdown of average annual volume supplied by these sources.

Following are descriptions of the City's four supply sources. Production estimates are based on modeling expected future system operations.

North Coast Diversions. The City diverts water from three North Coast streams (Reggiardo Creek, Laguna Creek, and Majors Creek) and one natural spring (Liddell Spring) located about six to eight miles northwest of the City. Water from these diversions flows by gravity through the Coast Pipeline to the Coast Pump Station, where it is pumped to the Graham Hill Water Treatment Plant (GHWTP) to be treated before being delivered to the distribution system. On average, these diversions currently supply about 1.4 billion gallons annually, about 30% of the total supply.

Live Oak (Beltz) Wells. The City currently has the capacity to pump 1 million gallons per day (mgd) from the Purisima aquifer at Live Oak.[9] The average annual production from this source is just over 300 million gallons, or about 7% of the total.

9 As will be described below, the City intends to restore this source to its historical production level of 2 mgd.

San Lorenzo River. This is by far the City's largest source. Most of the San Lorenzo River supply is diverted at Tait Street. This surface diversion is supplemented by the three shallow wells adjacent to the river. Total annual production of the diversion and wells averages about 2.2 billion gallons, about 48% of the total.

In addition, river water is diverted upstream at Felton and pumped up to the Loch Lomond reservoir to supplement Newell Creek flows into Loch Lomond. Current annual diversions at Felton average just under 200 million gallons. The diversion at Felton became operational in 1974 and was the last supply project added to the City's system.

Loch Lomond Reservoir. Loch Lomond reservoir is a surface impoundment on Newell Creek with a storage capacity of 2.8 billion gallons. Loch Lomond is used to supplement the City's surface and groundwater supplies. Water supplied from Loch Lomond averages about 670 million gallons annually.

Table II-1 shows the estimated annual average, minimum, and maximum production from these sources.[10] This table provides another illustration of the City's dilemma. The minimum annual production from all sources is some 1.2 billion gallons less than the average. This subjects the City to extreme difficulty in drought years.

C. CURRENT KEY FACILITIES

In addition to the supply sources, the Santa Cruz water system also includes a variety of treatment, transmission, and distribution facilities that ensure that treated water is delivered to the taps of all customers. The purpose of the IWP is not to examine in detail the operations of and capital requirements associated with these facilities. However, in order to formulate recommendations on the benefits to be derived from alternative supply configurations, it was critical to capture delivery constraints associated with the following key facilities:

Graham Hill Water Treatment Plant (GHWTP). Water from all sources other than the Live Oak Wells are treated at this plant, which currently has a capacity of about 20 mgd.

Beltz Water Treatment Plant. This plant treats water produced by the Live Oak Wells to remove iron and manganese.

Coast Transmission Main. The Coast main brings water produced by the North Coast Diversions to the Coast Pump Station, where it is pumped to the GHWTP. The IWP assumes a 6 mgd capacity for this line. The City is beginning a rehabilitation project for this key part of the City's infrastructure to reduce transmission losses, which are currently estimated to be 15%.

Coast Pump Station. The Coast Pump Station pumps North Coast and San Lorenzo River supplies up to the GHWTP.

[10] These estimates are produced by the *Confluence* model.

Figure II-2
City Sources of Water Supply

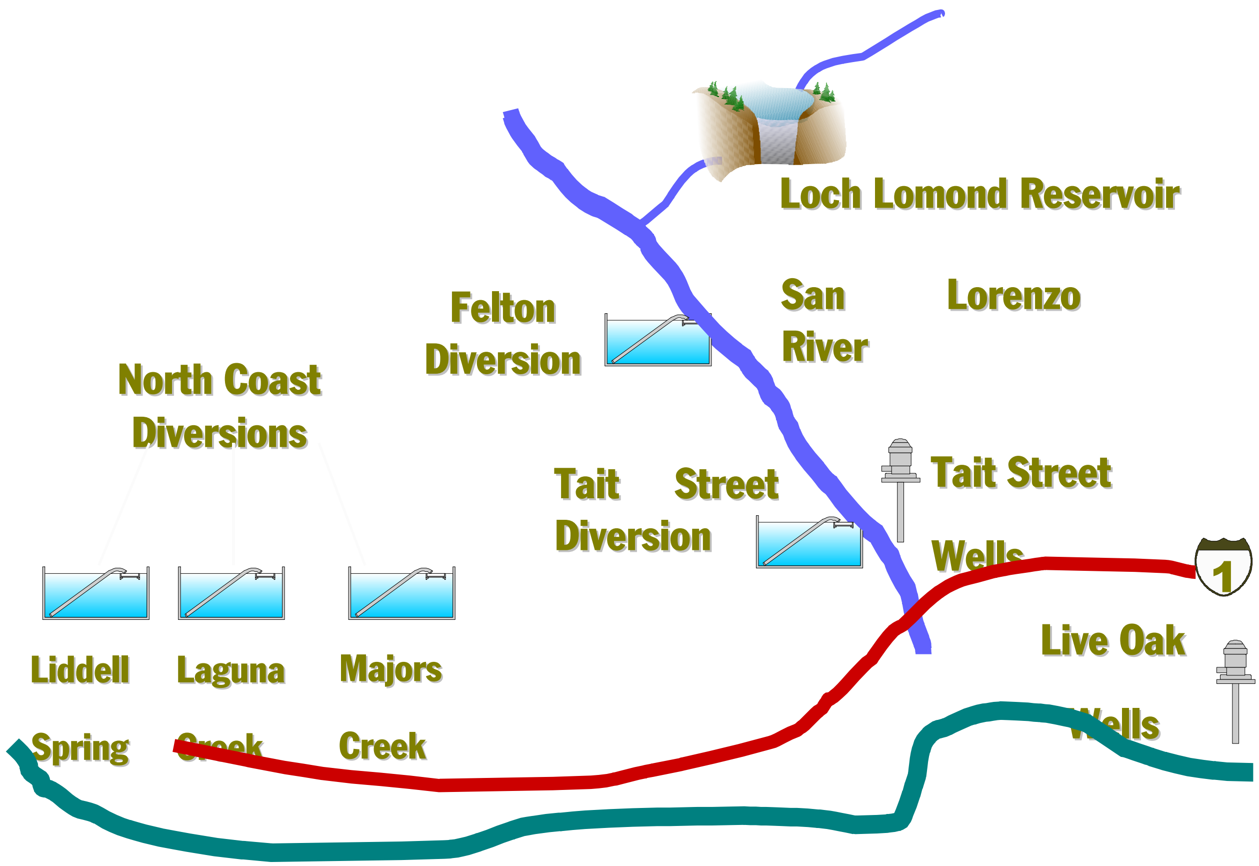


Figure II-3
Breakdown of Average Annual Source Production

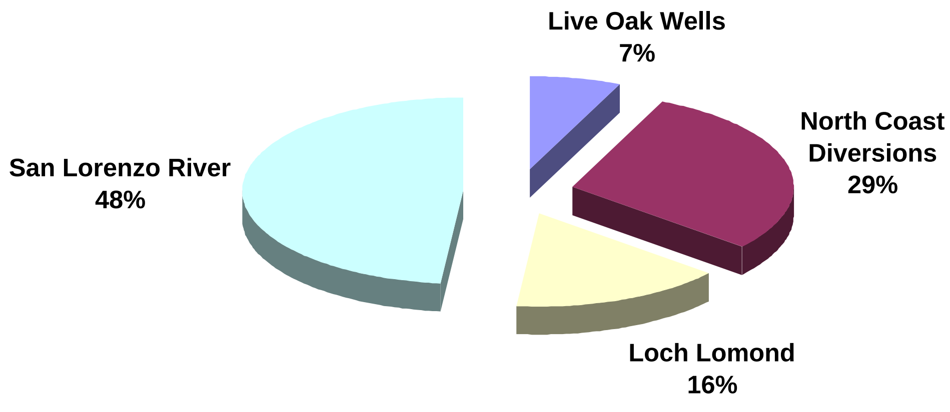


Table II-1
CURRENT ANNUAL SUPPLY PRODUCTION CHARACTERISTICS

SUPPLY	ANNUAL PRODUCTION (MILLIONS OF GALLONS)		
	AVERAGE	MINIMUM	MAXIMUM
North Coast Diversions	1362	421	1900
Live Oak Wells	309	242	365
San Lorenzo River	2242	2004	2495
Loch Lomond	671	264	881
ALL SOURCES[11]	4585	3363	4764

[11] Minimum and maximum production for all sources will not equal sum of individual sources, since minimum and maximum production for individual sources may occur in different hydrologic years.

Felton Booster. This facility pumps water diverted from the San Lorenzo River at Felton up to Loch Lomond reservoir. It is assumed to have a capacity of 8 mgd.

Newell Creek Pipeline. This line moves water from Loch Lomond reservoir to the GHWTP. Its capacity is assumed to be 13.5 mgd.

Treated Water Storage. The City has many treated water storage facilities scattered throughout its service area. The largest such facility is the Bay Street Reservoir. That storage volume is primarily used for two purposes:

- To smooth diurnal (i.e. sub-daily) demand variations.
- As insurance against unexpected short-term system outages that result in one or more raw water supplies being temporarily unavailable.

The IWP assumes a usable treated-water storage volume of 22 million gallons, equivalent to about 2 days of average winter demand and about 1.5 days of average summer demand.

D. MODELING SYSTEM OPERATIONS

In order to investigate the relative merits of different resource strategies, the City must understand how different supply strategies perform against an array of evaluation criteria. To do that, it is necessary to model the operation of the system under a variety of conditions. The City used the *Confluence*® model to do this.

1. Description of the *Confluence*® Model

Confluence was developed to meet the diverse requirements associated with water supply planning. These requirements include the need to assess different types of supply and facility options, as well as "non-structural" options, which could include conservation, re-use, and alternative modes of system operation. All of these alternatives must be evaluated against a range of criteria. Typically, a large number of alternatives must be analyzed and compared quickly, and the results must be presented to and meaningful to a variety of audiences. System performance must be assessed under a range of hydrologic conditions.[12] Confluence is designed to facilitate future testing of changes in supply assumptions

The *Confluence* user interface is written in *Visual Basic*®. Input and output data is stored in *Microsoft Access*®data bases, which allows easy customization of output reports. The computational engine is written in *Digital Visual Fortran 90*® and is extremely fast. Operation

[12] For Santa Cruz, a 59-year hydrologic period of record was used. This record included actual or synthesized daily streamflows for the years 1937-1995 for the North Coast streams, the San Lorenzo River at the Tait Street and Felton diversions, and Newell Creek.

of supply and storage resources is simulated through a multi-area transmission constrained dispatch algorithm.

A detailed description of *Confluence* model operation is included as Appendix A.

E. SYSTEM OPERATING CONSTRAINTS

The *Confluence* model reflects the physical capacities that constrain delivery of water from all supply sources, including the physical delivery capacity of the source as well as the capacities of transmission links and treatment plants through which the water from the source must flow.

In addition to these physical constraints, *Confluence* also permits specification of various rules to govern operation of the water supply system. For the Santa Cruz base case, these rules were developed in close collaboration with SCWD staff. They are based on the manner in which the system has been operated in the past, but also reflect anticipated changes in future operations. Following are brief discussions of key base case operating parameters:

Order of Supply Dispatch. In any time period, the supplies are dispatched to meet demand in the following order:

1. North Coast
   a. Laguna/Reggiardo and Liddell (same dispatch priority)
   b. Majors

2. San Lorenzo River (including Tait St. wells)

3. Live Oak Wells

4. Loch Lomond reservoir (see discussion below of reservoir operation)

In addition, water is diverted at Felton to Loch Lomond between October and May.

Operation of Flowing Supplies. In addition to the physical capacity of the diversion structure, river diversions are also limited by river flows. San Lorenzo River flows are based on 59 years (November 1936 through October 1995) of gaged data. Flows for Newell Creek and the North Coast streams are synthesized data for the same historical period. There are three other constraints to which diversions are subject:

- **Water rights**. The City's North Coast Diversions are currently not subject to any water right limitations. Diversions from these sources are therefore limited only by flows. The San Lorenzo River diversion at Tait Street (including the wells) is subject to a 12.2 cubic-feet-per-second (cfs) (or 7.9 mgd) maximum diversion rate year round.

  The San Lorenzo River diversion at Felton is subject to a 20 cfs (12.9 mgd) year-round diversion rate limit. In addition, this diversion is limited by instream flow requirements ranging from 10 cfs (8.4 mgd) to 25 cfs (16.2 mgd) in different months of the year.

- **Turbidity constraints**. The North Coast and San Lorenzo River diversions are subject to shut-down during and after intense winter rainstorms due to resulting high turbidity levels which cannot be easily treated at the Graham Hill plant. During those periods, demand is met from the Live Oak Wells and Loch Lomond reservoir. While the winter demand levels can easily be met from these supplies, this winter use of Loch Lomond limits its availability in the upcoming summer, due to the lake's annual withdrawal limit (see below).

- **Flush flows**. Diversion of the San Lorenzo River at Felton is subject to one additional constraint. At the beginning of each autumn, diversion at Felton is only permitted after two days of river flows that exceed 100 cfs (64.6 mgd). These flows are necessary to 'flush' the river of debris and other materials that may have been introduced during the low-flow summer months.

Reservoir operations. Water is added to storage through daily Newell Creek inflows, water pumped from Felton, and rainfall on the surface of the reservoir. Water is drawn from storage to meet instream flow requirements, San Lorenzo Valley Water District obligations, and demands, as well as for evaporative losses.

Reservoir operation is constrained by a number of factors:

- Total storage capacity is 2810 mg, of which 100 mg is "dead" (i.e. not useable for any purpose) and an additional billion gallons is not useable to meet demands. This billion gallons is the City's 'insurance policy' against a future drought which is longer and/or more severe than the current 1976-77 'drought of record'. (This volume is, however, used as necessary to meet instream flow requirements and San Lorenzo Valley obligations.)

- Instream flow requirements are 1 cfs (0.65 mgd). As long as there is any water in the reservoir, these requirements are met.

- Newell Creek is deemed to be totally appropriated in the months of June-September. As a result, no inflows during those months are stored; instead, they are passed downstream. If inflows are less than the instream flow requirement of 1 cfs, the remainder must be met from water in storage.

- Water rights limit annual withdrawals to no more than 3200 acre-feet, or 1042.5 mg, of which 102.1 mg goes to the San Lorenzo Valley Water District, leaving a maximum withdrawal to meet Santa Cruz demands of 940.5 mg.

- The San Lorenzo Valley Water District entitlement of 102.1 mg/year is assumed to be met through daily withdrawals of 0.28 mg.

- For each of the two sources of reservoir fill, namely the natural inflows from Newell Creek and the San Lorenzo River water diverted at Felton, there is a 30-day "last-in-first-out" (LIFO) withdrawal constraint. That is, water from either source cannot be withdrawn for 30 days from the most recent day on which water from that source was stored. Daily

Newell Creek inflows are only deemed "stored" if the inflow exceeds the sum of instream flow requirements, demands met, and evaporative losses, net of rain-on-surface.

The key regulator of reservoir operations is a set of *rule curves*. Rule curves recognize the fact that stored water has a value beyond the economic cost of releasing, transmitting, and treating that water. For example, depending on how much water is in storage early in the summer, it may be prudent to slow down release of that water to preserve it to meet late-summer demands. Similarly, under some conditions, it may be necessary to carry over some stored water to guard against a subsequent dry year. For Santa Cruz, the rule curves ensure that *Confluence* will mimic the actual management of Loch Lomond reservoir, which, in a dry year, preserves water in storage as an "insurance policy" against potential additional dry years. The use of reservoir rule curves is discussed in Appendix B.

As will be discussed in Section B.3(a) of Chapter V, the rule curves for Loch Lomond change as new supplies are added to the system to reflect the impact of those new supplies on reservoir operation.

Transmission operations. In order for water produced by a supply source to be available to meet demand, it must traverse a *transmission path*. That path may include one or more transmission links and treatment plants. Each link and treatment plant has a maximum capacity, and the link/treatment plant on the path with the smallest capacity constrains the quantity of water that can traverse that path in any time period.

The capacity of a transmission link can vary to reflect system hydraulic limitations. For Santa Cruz, the capacity of the Felton Booster varies as a function of the level of storage in Loch Lomond.

F. CURRENT SUPPLY DEFICIENCY

Before beginning analysis of alternative supply strategies, the IWP used the *Confluence* model to estimate the current supply deficiency. *The City's water supply system is grossly inadequate to meet current demand under drought conditions. With current supplies and facilities, if a drought comparable to the 1976-77 event occurred today, the City would experience a 45% peak-season shortage in the second year of that event.* This compares to a maximum shortage of approximately 30% that was experienced in the 1976-77 drought.

According to the 2001 *Water Curtailment Study*, a curtailment of this magnitude would result in considerable hardships to residential customers, some of which could affect health and safety. Short showers and unflushed toilets would be a burden for many, if not most, customers, as would the necessity to install new fixtures and appliances. Some would experience the significant inconvenience and/or economic impact of going off-site to consume water for some end uses (e.g. clothes washing). Many customers would have to helplessly watch valued portions of their landscapes die. Some multi-family residents would lose the use of their common pools or laundry rooms.

In general, at this level of shortage, residential customers' lifestyles would be significantly affected.

Although the City's Water Shortage Contingency Plan (Ordinance 92-10) attempts to cushion the impacts of shortages on commercial and industrial customers, a 45% overall shortage would still result in commercial/industrial cutbacks of between 30% and 35%. Cutbacks of this magnitude could lead to substantial revenue losses and business closures, with the resulting impacts on the community's tax base. In addition, businesses describe fully half of the non-economic impacts as 'extreme.'

G. WATER DEMAND FORECAST

The IWP demand forecast is based on the Water Demand Investigation that was completed in 1998.[13] In the short run (i.e. through 2005), the Demand Investigation is based on General Plan growth projections. Table II-2 shows the projection of annual demand, under average weather conditions, that resulted from that study.

Table II – 2
ANNUAL DEMAND FORECAST FROM 1998 WATER DEMAND INVESTIGATION [a]
(millions of gallons)

DEMAND CATEGORY	2000	2005	2010	2015	2020	BUILDOUT [b]
Single-Family Residential	1578	1592	1581	1579	1583	1605
Multi-Family Residential	934	952	960	970	983	1044
Business	838	880	930	970	1001	1174
UC Santa Cruz	204	321	408	408	408	408
Other	619	635	647	657	666	710
SUBTOTAL	**4173**	**4380**	**4526**	**4584**	**4641**	**4941**
Unaccounted-for Water	464	487	503	510	516	549
TOTAL	**4637**	**4867**	**5029**	**5094**	**5157**	**5490**

a. Figures reflect adjustments for naturally-occurring conservation.

b. For IWP purposes, Buildout was assumed to occur in 2040.

The IWP adjusted the near-term figures in Table II-2 downward to reflect actual demand experienced to date. Long-term demands were assumed to remain the same. Table II-3 compares the revised weather-normalized demand forecast that was used in the IWP to the Demand Investigation figures.

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13 Maddaus Water Management, *Final Report: Water Demand Investigation*. March 1998.

Table II – 3
COMPARISON OF FORECASTS GENERATED BY DEMAND INVESTIGATION AND IWP
(millions of gallons)

	2000	2005	2010	2015	2020	2025	2030
Demand Investigation	4637	4867	5029	5094	5157	a	a
IWP	4409	4627	4817	4961	5157	5238	5321

a. The Demand Investigation does not explicitly provide forecasts for these years. Beginning in 2020, the IWP forecasts were based on the growth rates implicit in the Demand Investigation.

The demand forecast will be periodically reassessed. Future changes in forecasted demands will affect the need for additional increments of supply.

H. THE IWP BASE CASE

Prior to developing or analyzing alternative supply strategies, a 'base case' had to be defined.

The base case includes the current water supplies, facilities, conservation programs, and operating constraints, as well as those system modifications which the Department is already planning to develop regardless of which supply strategy is ultimately chosen.

1. Water Supplies and Facilities in the Base Case

In addition to the supply and facility components of the current system described above, the base case also includes:

- **Live Oak Wells**. An additional 1 mgd of Live Oak groundwater capacity beginning in 2006, associated with an ongoing rehabilitation project of the Live Oak wells. Due to competing interests for the groundwater supply, this additional capacity is assumed to be available only in drought years.

- **Coast Main**. The loss rate of the Coast Main decreases in stages from the current 15% to 1% by 2021 due to the City's rehabilitation of the North Coast transmission system.

Figure II-4 shows the *Confluence* base system schematic.

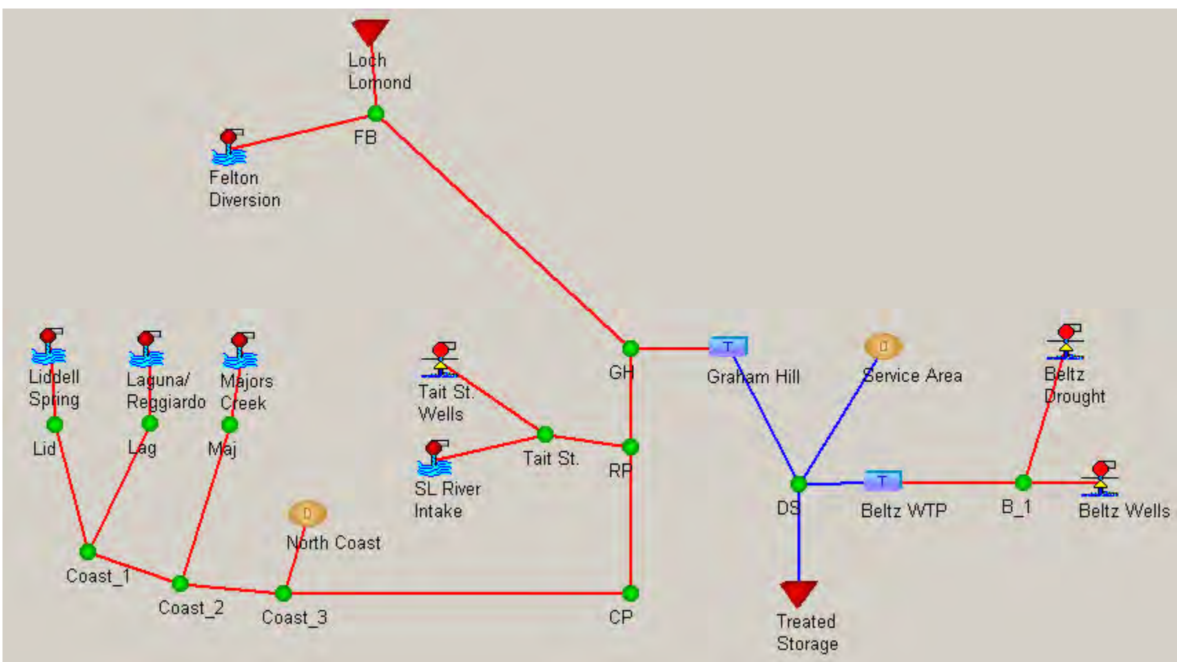
2. Water Conservation in the Base Case

The City's Water Conservation Plan was a comprehensive analysis of programmatic conservation alternatives. As a result of that effort, the Santa Cruz City Council directed the SCWD to move forward with implementation of all of the programs recommended in the Water

Conservation Plan. As a result, all of these programs are included in the base case, as well as in every resource strategy. The base case thus reflects the savings and costs associated with those programs. As illustrated in Figure II-5, the annual programmatic savings[14] ramp up to about 280 million gallons (about 5% of demand). (The slow decline in savings after 2010 is due largely to the fact that increasing natural fixture replacement over time reduces the savings attributable to the City's conservation programs.) Annual conservation costs, including staffing, range between about $600,000 and $1,000,000 through the planning period.

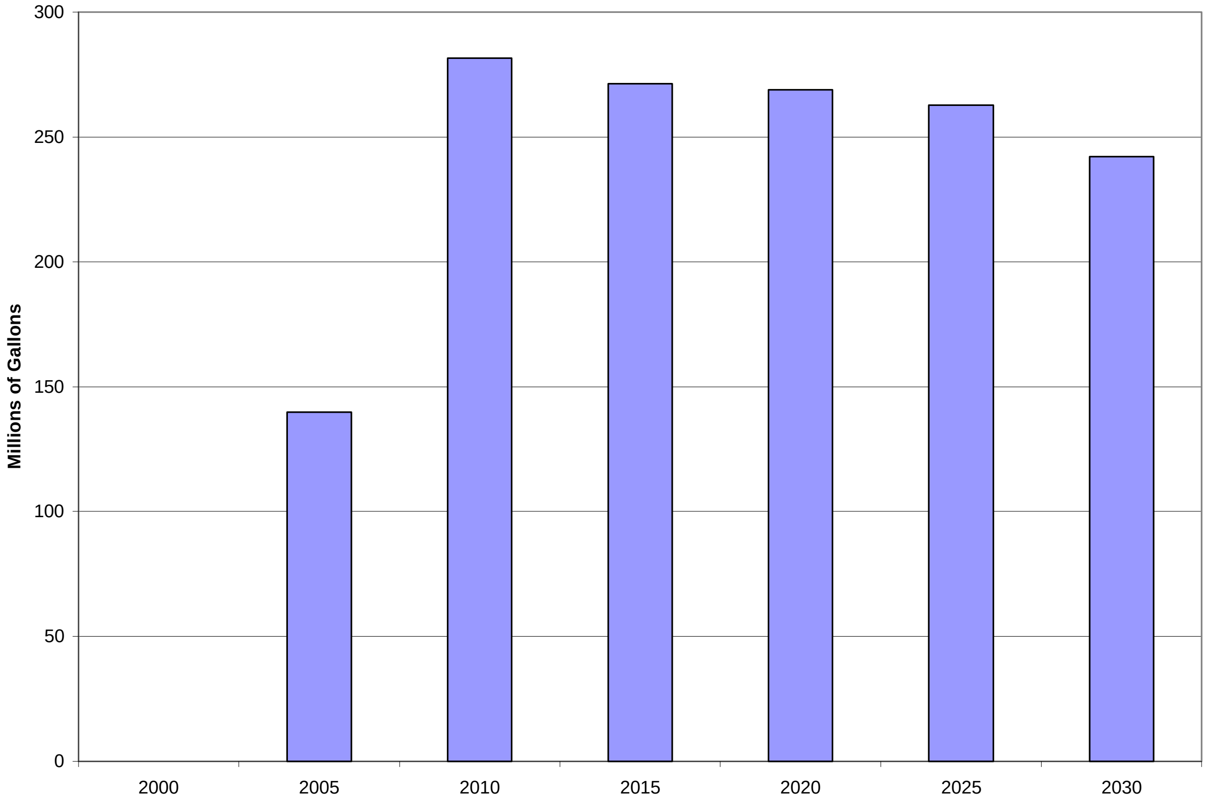
Appendix B includes a more detailed description of the base case assumptions.

Figure II-4
Confluence Base System Schematic



[14] Programmatic savings are those that are due to the conservation program. Excluded are savings due to natural fixture replacement, which are included in the base demand forecast.

Figure II-5
Annual Conservation Program Savings



I. FUTURE SUPPLY DEFICIENCIES

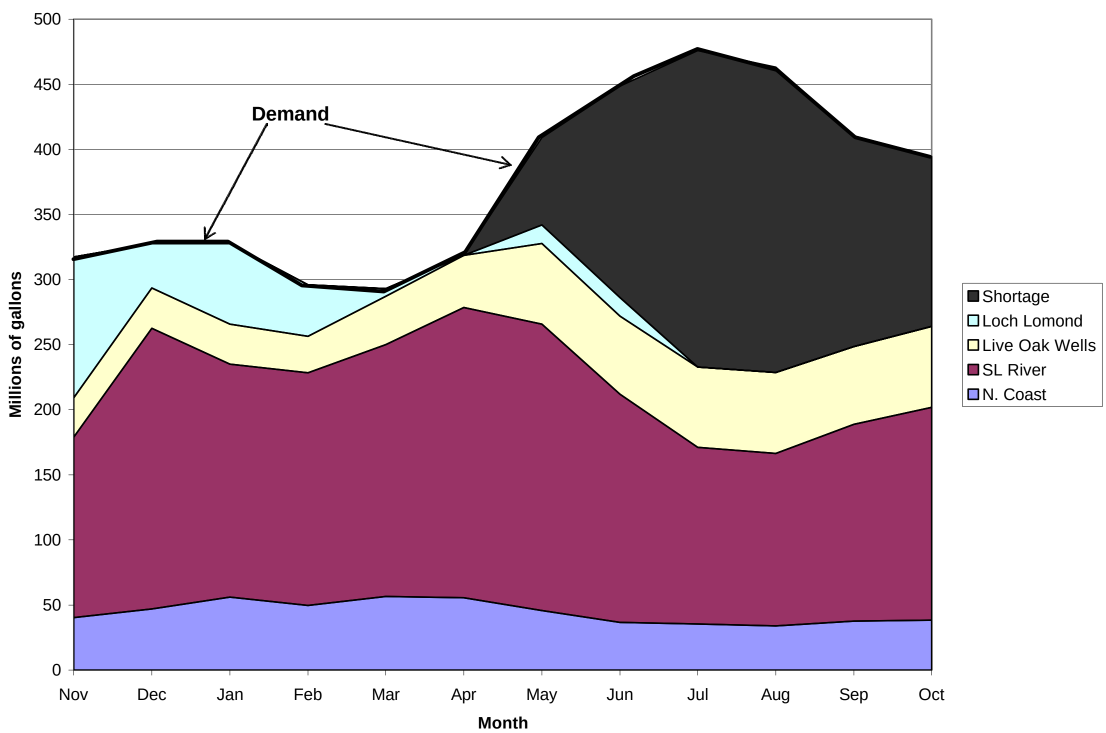
The *Confluence* model was used to examine the performance of the base case under current and future demand conditions. Specifically, the model was used to estimate required water curtailments to 2030 if the City were to take no additional action beyond the base case. Table II-4 shows the expected peak-season curtailment percentage in the worst hydrologic year (1977), along with the expected frequencies of different size curtailments. As indicated above, the current worst-year curtailment is expected to be about 45%; under three other hydrologic conditions, a curtailment in excess of 20% can be anticipated. With the added Live Oak groundwater capacity in 2006 and the continued implementation of water conservation programs, the worst-year shortage shrinks slightly, and then grows steadily back to its current level as demand grows for the rest of the planning period. By the end of the planning period, if no action is taken, the nature of the City's problem is substantially different. In addition to the very large worst-year shortages, the City will have difficulty meeting average year demands. In fact, in 2030, there will be a 90% likelihood of some level of curtailment.

Table II – 4
EXPECTED BASE CASE PEAK-SEASON CURTAILMENTS

	2003	2010	2015	2020	2030
% Worst-Year Peak-Season Curtailment	45%	39%	42%	44%	46%
FREQUENCY OF:					
No Curtailment	41 in 59	42 in 59	35 in 59	19 in 59	4 in 59
<10% Curtailment	11 in 59	10 in 59	16 in 59	31 in 59	44 in 59
10-20% Curtailment	3 in 59	6 in 59	7 in 59	3 in 59	5 in 59
20-30% Curtailment	3 in 59	0 in 59	0 in 59	5 in 59	5 in 59
>30% Curtailment	1 in 59	1 in 59	1 in 59	1 in 59	1 in 59

Figure II-6 illustrates the manner in which shortages occur under 1977 hydrologic conditions. In each month, each of the supply sources produces as much water as possible to meet demand. During the fall, winter, and early spring months, this production is sufficient to meet all demand. Beginning in May, demands grow, available flowing supplies shrink, and water volume stored in Loch Lomond is very low, so that by mid-summer, shortages are very large.

Figure II-6
Typical Worst-Year (1977) Monthly Source Production and Water Shortages



III. OPTIONS FOR BALANCING SUPPLY AND DEMAND

As stated in Chapter I, the purpose of the IWP is to help the City determine *the appropriate mix of water conservation programs, customer curtailments, and water supplies and facilities to respond to the current drought-related crisis and plan for future growth.* This chapter describes each of the three IWP components.

A. WATER CONSERVATION

Achieving the maximum practical water use efficiency through conservation is a cornerstone of the integrated plan. 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 supplies, to minimize the need for new water sources, and to protect the environment.

In 1997, the City undertook a comprehensive study of water conservation. The goals of this study were: 1) to determine which conservation programs were most cost-effective and best-suited to the City's customer base; 2) to identify the potential water savings those programs could achieve and the costs of implementation, and 3) to develop an action plan to guide the Water Department's efforts in the area of water conservation over the next ten years.

Water conservation measures can be employed on a long-term basis to alleviate the need for new water sources and on a short-term basis in response to a temporary water shortage or drought emergency. The focus of the conservation plan is on long-term measures that reduce average daily water consumption. Accordingly, emphasis is placed on water efficient technologies, plumbing fixtures, appliances, and landscaping improvements for which reliable projections of water savings could be made, and measures with lasting water savings.

The water conservation plan was adopted February 2000 by City Council, which recognized the urgency of the City's supply situation and directed staff to begin immediately with implementation of the plan.

The water conservation plan provides an orderly and ambitious framework for increasing the City's efforts over the next several years to reduce customer water demand. The programs cover every major customer category, including residential, commercial, industrial, municipal, and large landscape groups. Four different types of programs are proposed. They include financial incentives, new regulations, water audits for high use customers, and a kit distribution program. These programs address all the predominant end uses of water including toilets, clothes washers, showers, faucets, and landscaping in the residential sector, and the principal indoor and outdoor uses of water in the nonresidential sector.

The conservation plan was developed recognizing that the City will need to impose mandatory water restrictions and/or rationing again when another drought occurs. The interrelationship between long-term use reduction and drought management is a critical planning issue for several reasons. First, the long-term measures, once implemented, will limit to some degree the ability of customers to curtail water use in a future drought, or make such cutbacks more costly for customers to achieve. A good example is with toilets. Once the change is made to a 1.6 gallon flush toilet, the temporary savings to be gained in a drought by reducing toilet flushing is less than with the old fixture. This effect, called “demand hardening”, was considered in program evaluation, but remains difficult to quantify. Second, the most common response that residential customers take to curtail water use in a drought is by reducing or eliminating outdoor lawn and garden watering altogether. For that reason, the long-term plan emphasizes measures that reduce indoor use over outdoor use in the residential sector. Third, any successful conservation program depends on customer cooperation and satisfaction. The long-term plan seeks to balance the need for mandatory measures and enforcement in times of drought by promoting mainly voluntary and incentive-based measures under normal water supply conditions.

The following is a brief description of programs that comprise the water conservation plan. All of these programs are included in each water resource strategy.

1. Residential Programs

Ultra-Low-Flush Toilet (ULFT) Rebates. The City has operated a rebate program to promote the installation of ultra-low-flush (ULF) toilets since 1995. The program features a $75 rebate as a financial incentive for customers to remove their, older, higher-volume toilets and replace them with 1.6 gallon flush ULF toilets.

This is an ongoing program and has consistent annual participation.

High Efficiency Clothes Washer Rebates. This program offers a $100 rebate to residential customers who purchase approved water and energy-efficient machines.

This program began in 2000 and participation has been higher than expected. A review of the first year program indicates that water savings also appear to be greater than the amount projected in the water conservation plan.

In September 2002, the City joined in a statewide program to provide rebates of up to $350 to laundromats, multifamily housing, and institutional common area laundry facilities and businesses with on-premise laundry and/or coin-operated laundry. The “LightWash” program is budgeted through December of 2003.

Conservation Kit Distribution. This program is designed to provide customers with free water conservation devices to retrofit interior plumbing fixtures and reduce indoor water use. These devices include: low-flow showerheads, faucet aerators, leak detection tablets for the toilet and instructions for performing leak detection tests, and informational materials.

This program has been completed. Between April and December of 2001, a total of 17,851 conservation kits were delivered to single-family customers in the City’s water service area. The program was expanded to include requests from multi-family customers in 2002. Approximately 1,500 multifamily households received low flow showerheads and faucet aerators.

Plumbing Fixture Retrofit Ordinance. In this program, which accounts for the largest share of the projected savings, the City adopts an ordinance requiring properties to meet efficiency standards for plumbing fixtures whenever a property changes ownership. The proposed ordinance requires that toilets and showerheads be replaced with water-efficient fixtures. The City works with the County of Santa Cruz and the City of Capitola to request that they adopt similar ordinances, and to obtain authorization to enforce retrofit requirements outside the City's jurisdiction but within the water service area.

The proposed ordinance was presented to City Council and County Board of Supervisors in December 2002 and is scheduled to become effective in March 2003. The scope of the proposed ordinance was expanded to include commercial and industrial properties that change ownership, and to include replacement of old urinals with low consumption fixtures and flush valves.

Residential Water Surveys. This is a voluntary program in which a trained conservation professional performs a site inspection of the customer's plumbing fixtures and irrigation equipment, evaluates household water use practices, and make site-specific recommendations of actions that can be taken to conserve water inside and outside the home. The survey is documented and a written report of recommended water conservation actions will be given to the customer. The landscape review checks and reprograms irrigation equipment as needed, and offers customers a customized lawn irrigation schedule and a rebate toward irrigation equipment retrofits. The program is targeted at the top 20% of the City's residential water accounts.

This program is scheduled to begin in FY 2003-04

Apartment Building Sub-meters. This program provides a rebate to apartment owners to encourage the installation of sub-meters in existing apartment units. Sub-meters measure individual dwelling unit water use where a master meter already exists, allowing the cost of water to be billed to individual apartment dwellers. This raises customers' awareness and provides them with an economic incentive to conserve. It also helps building owners and managers identify units where there may be leaks. The program will target the top 20% of multi-family customers.

This program is scheduled to begin in FY 2005-06

New Construction Ordinance. This program would establish regulations for all future residential dwelling units constructed in the City's water service area to minimize the quantity of water needed to serve new development. Plumbing codes currently in effect provide that new residential construction be equipped with water-saving toilets, showerheads, and faucets, as well as a pressure reducing valve. The new regulations would be in addition to the plumbing code requirements, and would potentially require new residential construction to include a water-efficient clothes washer and water-efficient irrigation equipment and plant materials. Meters for individual dwelling units would be required in new multi-family construction, where feasible.

This program is scheduled to begin in FY 2005-06.

2. Non-Residential Programs

Commercial ULFT Rebates. This rebate program offers an incentive to commercial, institutional, and industrial customers, including UC Santa Cruz, for the early retirement of non-conserving toilets and urinals. Both tank and flush valve toilets are covered. Participants who replace a tank-type toilet receive a $75 rebate; participants who replace a flush valve toilet or urinal receive a $150 rebate.

This program was launched in March 2001.

Commercial, Industrial, and Institutional Water Surveys. Business and industrial customers, as well as the UC Santa Cruz, will be offered voluntary water audits by a trained conservation professional who will perform a complete review of all water fixtures, processes and water use practices at the site. The auditor then will make recommendations on specific actions that will improve efficiency at the facility. The review includes on-site installation of selected items, such as faucet aerators and toilet devices, and offers rebates of up to $2,500 to business customers for installing water-savings fixtures and appliances such as air-cooled ice machines, rinse recycling dishwashers, and horizontal-axis clothes washers. Financial incentives will be made available for the purchase and installation of water saving equipment.

This program is scheduled to begin in FY 2003-04

Large Landscape Water Use Review

Professional landscape auditors will perform site reviews of large landscape customers in the commercial, residential and golf irrigation customer classes. The initial review will identify low-cost improvements such as aligning sprinkler heads, replacing broken heads and trimming plants that disrupt spray patterns. After participants make basic improvements to efficiency, a detailed audit will be conducted to determine precipitation rates of spray heads, distribution uniformity of the irrigation system, turf species, root depth, and soil type. The auditor will provide site-specific watering schedules, recommendations for irrigation equipment retrofits that would further improve efficiency, and information about irrigation equipment rebates.

This program is scheduled to begin in FY 2004-05.

Parks Water Use Review. This water use review is similar to the large landscape review, but is geared to the types of current irrigation systems in city and county parks.

This program is scheduled to begin in FY 2004-05.

Large Landscape Budget-Based Rates. This program implements budget-based rates for large landscape customers. These are defined as customers served by dedicated irrigation meters and are comprised of parks, golf courses, businesses and residences. A water budget will be calculated for each large landscape account.

This program is scheduled to begin in FY 2004-05.

3. Additional Programs Analyzed

During the course of the IWP, staff examined potential additional conservation programs beyond those recommended in the Water Conservation Plan. The staff review included every major end use of water in the residential sector (including both new and existing single and multiple residential accounts), and in the commercial/industrial and large landscape sectors. It sought out viable conservation measures that met two basic tests:

1. Savings must be quantifiable; and
2. Water savings must be lasting.

The following programs were analyzed:

a) Residential Sector

- Expansion of Clothes Washer Program to Include Leased Equipment
- Toilet Distribution
- Pressure Regulation

b) Commercial Sector

- Toilet and Urinal Replacement – program that covers full cost of fixture, parts, and labor for installation.
- Expansion of Clothes Washer Program to Include Leased Equipment

c) Large Landscape Sector

- Weather based irrigation controllers

Based on that review, which revealed that the measures listed above would provide only a small yield, the IWPC decided to examine various regulatory options to limit the amount of water used by existing large commercial and industrial customers. Ultimately, the committee recommended against the idea of including a mandatory water conservation ordinance for large commercial and industrial customers for the following reasons:

1. The net gain to be achieved in terms of water savings was probably very small;

2. The savings above that already accounted for in the demand study and the conservation plan is not necessarily reliable over time; and

3. Such an ordinance could jeopardize the cooperation of commercial water customers, which must be counted on in times of drought.

Thus, the IWPC decided that no additional conservation programs beyond those included in the Plan would be included in any strategy.

As the conservation work plan moves forward, other ideas will be considered and implemented.

4. Urban Water Conservation Best Management Practices

As a signatory to the *Memorandum of Understanding Regarding Urban Water Conservation in California*, the City is committed to implementation of 14 Water Conservation Best Management Practices (BMPs) over the next ten years, many of which are already included in the water conservation plan. These BMPs are listed in Table III-1.

Table III–1
URBAN WATER CONSERVATION BEST MANAGEMENT PRACTICES

1. Residential Water Audit
2. Residential Plumbing Retrofit
3. Distribution System Water Audit
4. Metering with Commodity Rates
5. Large Landscape Programs
6. Clothes Washer Rebate Program
7. Public Information
8. School Education
9. Commercial/Industrial/Institutional Programs
10. Wholesale Assistance
11. Conservation Pricing
12. Conservation Coordinator
13. Water Waste Prohibition
14. Toilet Replacement Program

In addition, State law requires review and update of the City's Urban Water Management Plan every five years, in which any new initiatives in the field of water conservation are considered. A recent change not yet accounted for in the conservation plan was new legislation (AB 1561) that was signed into law this September. Beginning 2007, residential clothes washers sold in California will be required to meet water and energy efficiency standards. This will have the effect of increasing residential water savings once the regulation takes effect, and an adjustment to the plan will be made to account for these savings. The Department will actively consider new ideas as they arise and will continue to encourage public involvement in this area.

Table III-2 summarizes the maximum annual conservation savings reflected in the IWP.

Table III- 2
ESTIMATED ANNUAL CONSERVATION PROGRAM SAVINGS BY 2010

PROGRAM	ANNUAL SAVINGS (MG)
Clotheswasher Rebate Program	21.7
ULFT Rebate – Single Family	34.4
ULFT Rebate – Multifamily	12.8
ULFT Rebate – Business	13.7
Kit Distribution – Single Family	15.8
Retrofit on Resale – Single & Multifamily	100.6
Indoor Water Use Review – Business	29.9
UCSC Indoor Review	2.3
Water Use Review – Multifamily	21.3
Water Use Review – Single Family	12.4
Landscape Review – Golf	5.4
Landscape Review – Bus.	1.8
Landscape Review – Res.	1.4
Parks Review – City and County	6.5
Multifamily Submetering	1.8
TOTAL ANNUAL SAVINGS	281.7

B. CURTAILMENT

A key premise of the integrated water plan is that, overall, it might be better for the City to accept and manage some level of water shortage from time to time than to try to eliminate the possibility of any future shortage by developing enough supply capacity to overcome the drought of record. Such a choice could minimize the costs of developing new sources and potentially lessen or avoid environmental impacts. It is improbable that the City water system could ever be made totally drought-proof, since local community values, as expressed in the City's General plan, strongly favor environmental protection and preserving the small town character of the City, and because some perceive the need for any water supply improvements as contributing to pressure for unwanted growth in the region. So rather than try to eliminate the possibility of any future shortage, the City's approach is to find a balanced solution that maintains some risk of shortage, but which reduces the burden on the community accompanying such shortages to an acceptable level.

A key issue in the IWP planning process then becomes how much and how often the community is willing and able to tolerate cutbacks in water use in future water shortages, and what degree of hardship corresponding with different size water shortages constitutes an acceptable risk.

The IWP is where the public policy tradeoffs between the economic and environmental costs of providing increased supply capacity are compared with the risk and potential impacts of curtailing customer water use. For example, if it turns out that the costs and environmental impacts are deemed to be unacceptably high to reduce the City's drought shortage from one level to another, the City may choose to accept a greater level of shortfall as its preferred strategy. On the other hand, if it doesn't cost that much more to buy down the shortfall, and the environmental consequences are small, the City might elect to go with a more reliable system to avoid the impacts that larger water shortages impose on residents and businesses.

To provide critical input for this evaluation, the *Water Curtailment Study* was completed in 2001. It was a groundbreaking attempt to achieve a greater understanding of the manner in which different levels of peak-season water supply curtailment affect different groups of customers. The study examined six different levels of shortage severity, ranging from a mild (10%) to an extreme (60%) system-wide peak-season shortage. For each of these, the study looked at likely actions that customers in each customer class would take and the hardships that these actions would impose.

The study assumed that shortages will be allocated to classes of service based on the classification of end uses into three priorities, which are consistent with those in the City's current water shortage contingency plan, codified in Ordinance 92-10:

1. **Health and safety**. This is the highest priority use. All residential interior and non-residential sanitary uses are assumed to fall under this priority, as is all usage at the wastewater treatment plant.

2. **Business**. This second priority use includes all usage that is related to commercial activity in the city. All non-sanitary uses in the business class are assigned this

priority, as are all usage by the agriculture, industrial, golf, municipal, and miscellaneous classes of service.

3. **Outdoor irrigation**. This lowest priority use includes all outdoor usage in the single family, multi-family, UCSC, and large landscape classes.

As shown in Table III-3, end uses related to health and safety are assumed to be cut back the least in a water shortage, while irrigation will be cut back the most. The prioritization recognizes the critical importance to the city's economic well-being and the well-being of its citizens of business activities. While these uses are of a lower priority than health and safety uses, the ranking attempts to shield them from the full brunt of a water shortage. It should also be noted that such outdoor uses as golf course irrigation, agricultural irrigation, and commercial irrigation are all considered to have a business priority.

Table III-3
ESTIMATED PEAK-SEASON USAGE-PRIORITY SHORTAGES

SHORTAGE CONDITION	PEAK-SEASON SYSTEM SHORTAGE	SHORTAGES BY USAGE PRIORITY		
		HEALTH AND SAFETY	BUSINESS	IRRIGATION
Mild	**10%**	0%	5%	30%
Moderate	**20%**	6%	15%	50%
Serious	**30%**	14%	25%	60%
Severe	**40%**	21%	30%	75%
Critical	**50%**	28%	35%	100%
Extreme	**60%**	42%	50%	100%

Based on these priorities, Table III-4 summarizes the impacts on different customer classes of different levels of peak-season system shortages. The table indicates that both the magnitudes and customer impacts of a given system-wide shortage vary by customer class.

The study then used a variety of data sources to gain an understanding of the actions customers would take to achieve various usage reductions and the hardships that would be imposed on customers as a result of these actions. Data sources included:

- Evidence from past California droughts
- Focus groups with Santa Cruz residential customers
- A study of shortage impacts on Santa Cruz residential landscapes
- Mail survey and interviews with key representatives of each business sector.

Table III-4
ESTIMATED RELATIVE CUSTOMER CLASS PEAK-SEASON SHORTAGE IMPACTS [a]

SHORTAGE CONDITION	PEAK-SEASON SYSTEM SHORTAGE	SINGLE-FAMILY		MULTI-FAMILY		BUSINESS		INDUSTRIAL	
		SHORTAGE	IMPACT	SHORTAGE	IMPACT	SHORTAGE	IMPACT	SHORTAGE	IMPACT
Mild	**10%**	11%	1	9%	1	4%	1	5%	2
Moderate	**20%**	22%	1	19%	1	13%	2	15%	3
Serious	**30%**	31%	3	27%	3	22%	4	25%	5
Severe	**40%**	41%	4	37%	4	27%	4-5	30%	5
Critical	**50%**	54%	5-6	48%	5-6	33%	6	35%	6
Extreme	**60%**	63%	6	56%	6	48%	6	50%	6

a. Key to Shortage Impacts:

1. Little or none

2. Some

3. Intermediate

4. Considerable

5. Major

6. Catastrophic

Key findings for residences and businesses included:

Residential Customers. In general, it is likely that Santa Cruz residential customers could deal with system shortages in the 10%-20% range with little difficulty. At about the 30% level, as rationing becomes necessary, impacts become more significant. Chief among these is the anxiety accompanying rationing and its associated administrative and economic impacts. Effects on households of a 40% system shortage would be serious, with important lifestyle changes.

Catastrophic shortages in the 50%-60% range would raise customer concern about everyday water use to an unparalleled level. They would also impose major and burdensome lifestyle changes, some of which could well affect basic health and safety. There would be a greatly-increased level of conflict between customers and the City government to resolve issues and complaints. There may also be increased levels of conflict among neighbors and even within families, as water becomes a very scarce resource.

Business and Industrial Customers. Anticipated impacts of water curtailments vary considerably across business sectors. In general, economic impacts due to a 15% cutback of business and industrial supplies (corresponding to a 20-25% system-wide shortage) will vary, with many businesses expecting these impacts to be manageable. Most businesses could get by with few if any production or employment cutbacks. Revenue losses for most sectors are anticipated to be fairly small.

An exception is the “green industry”, which would be significantly affected due to residential curtailments associated with this level of system shortage. Restaurants also report more significant impacts at this level due largely to their prior conservation actions.

Non-economic hardships at this level of curtailment are generally small, with the possible exception of hospitals and medical offices, hotels and motels, and retail establishments. A 25% cutback to business and industrial customers (30-40% system-wide shortage) would result in a larger production cutbacks and revenue losses, averaging about 20% across all sectors. Particularly hard-hit sectors include restaurants and retailers. Residential cutbacks at this level of shortage will be very damaging to retail nurseries and landscape contractors. Smaller hotels and motels may feel severe economic stress. Employee layoffs will become more common. City, county, and state tax revenues will be affected.

Non-economic hardships are much more significant, with 60% being described as “considerable” or “extreme.” The level of care of medical patients will be affected. Some smaller businesses will curtail their operations or close entirely, perhaps permanently. There will be some loss of employment. The use of community facilities, such as school athletic fields, will be curtailed. Some customers may have difficulty complying with state regulations that depend on water use. The appearance of landscaping around business establishments will be seriously affected.

A 35% business and industrial shortage (50% system-wide shortage) would result in average revenue losses across all businesses that are expected to exceed 30%. For restaurants and retailers, these revenue losses approach catastrophic levels. Business closures will be more common. Landscape contractors, particularly new and/or small businesses, will be hit very hard.

More hotels and motels will shut down permanently. Losses to the community's tax base are likely to be more significant.

Fully 50% of non-economic hardships are characterized as "extreme." Business closures and layoffs will affect more members of the community, with young entry-level employees more likely to be affected. Hospitals will limit activity to emergency cases only. Outpatient care will be reduced or eliminated with serious impacts on community health and safety. School athletic fields will likely be closed to community users. The general appearance of the City's business districts will suffer as all outdoor watering around businesses ceases.

Information on impacts to other customer classes are described in detail in the *Water Curtailment Study*. The information in the Study was used by the IWPC to define the alternative Curtailment Profiles described in Section B.2 of Chapter V.

C. WATER SUPPLIES

The third leg of the IWP 'three-legged stool' is additional water supplies. New supplies become necessary if conservation and an acceptable level of curtailment are insufficient to bridge the gap between existing supplies and current and future demands. The supply component of the IWP is the culmination of a long series of studies of water supply alternatives in which the City has engaged since 1985. Following is a brief summary of that history.

1. Prior Studies

The last water supply augmentation project completed for the City's water system was the construction of the Felton Diversion Dam and Pumping Station in 1975 whose original purpose was to assist in filling Loch Lomond Reservoir and a future Zayante Reservoir.

While the Department continued to study the Zayante Dam project after the completion of Felton Diversion, concern over the environmental impacts of the Zayante project grew and the City worked to form a Joint Powers Authority to study additional solutions to the region's water supply deficiencies.

a) 1985-1989

In June 1985, a Joint Powers Authority representing the water agencies and land use agencies in North Santa Cruz County prepared the North Santa Cruz County Water Master Plan (NSCCWMP). The report focused on regional opportunities to augment supply, but also proposed some City-only alternatives. The report made no specific recommendation but referred all alternatives for additional study.

Following the completion of the NSCCWMP, City Council expressed its preference for groundwater alternatives and directed staff to investigate the feasibility of developing 815 million gallons of groundwater suggested in the NSCCWMP. At the same time, the City relinquished its water rights to 5,000 million gallons of water from Zayante Creek with the request that the State Water Resources Control Board reserve this amount in the name of North Santa Cruz County. The Consulting firm of Luhdorff & Scalmanini was hired in 1987 to investigate three areas for possible ground water development potential.

The conclusion of this groundwater investigation was that there were not 815 million gallons of groundwater available to the City. There was only the potential for a 100 gpm well in Harvey West Park and a 250 gpm well on Thurber Lane in Santa Cruz Garden that would require considerable treatment. At best, these two wells could only yield about 180 million gallons annually.

The results of the studies during the 1985-1989 period are summarized in Figure III-1

b) 1989-1997

At the conclusion of the Luhdorff & Scalmanini groundwater work that demonstrated the lack of adequate groundwater supply, two surface water storage projects, water conservation, and interties were all that remained as potential projects. The City then contracted with Leedshill-Herkenhoff to prepare a Water Master Plan for the City of Santa Cruz to identify other possible water supply projects.

As a continuation of the Leedshill-Herkenhoff work, the City then hired Camp Dresser & McKee to prepare a Water Supply Alternatives Study for the City of Santa Cruz that reviewed the 1989 Water Master Plan Alternatives, and added several new alternatives.

This study then grouped projects and created a system by which a Technical Advisory Committee would rate projects on a number of weighted criteria to arrive at the single project (or group of projects) that was most feasible. The project that was rated most feasible was the Brackish Groundwater Wells project.

The City then hired Carollo Engineers in 1995 to perform all necessary work to design the Brackish Wells Project. Prior to any actual field work being performed, i.e. test well construction and pumping, this project encountered considerable resistance from area residents concerned that the test pumping could lead to a project that might harm their water wells. Because of this resistance, the Water Commission and City Council elected to abandon this effort. The technical feasibility of this project was never actually proven, as the test pumping data needed was not collected.

Figure III-2 illustrates the supply studies during the 1989-1997 period.

Figure III-1
1985-1989 SUPPLY STUDY

<u>NSCCWMP</u>

Regional Alternatives:
- Water Conservation and Leak Control
- Interties between Santa Cruz and other agencies
- Zyante Creek Dam
- Additional Groundwater for Scotts Valley and San Lorenzo Valley

City-only Alternatives:
- Baldwin Creek Off Stream Storage
- Groundwater for North Coast domestic customers
- Groundwater from Purisima (Live Oak)
- Groundwater from North Coast
- Groundwater from San Lorenzo

<u>Luhdorff & Scalmanini</u>

Groundwater in eastern City and Live Oak
Groundwater in North Coast
Groundwater in San Lorenzo River alluvium

<u>Conclusion</u>

Insufficient Groundwater Supplies

In June 1985, a Joint Powers Authority representing the water agencies and land use agencies in North Santa Cruz County prepared the North Santa Cruz County Water Master Plan (NSCCWMP). The report focused on regional opportunities to augment supplies, but also proposed some City-only alternatives.

Following the completion of the NSCCWMP, City Council expressed its preference for groundwater alternatives and directed staff to investigate the feasibility of developing 2500 acre-feet of groundwater.

At the same time, the City Council relinquished its water rights to 15,000 acre-feet of water from Zyante Creek with the request that the State Water Resources Control Board reserve this amount in the name of North Santa Cruz County.

The conclusion of this groundwater investigation was that there were not 2500 acre-feet of groundwater available to the City. There was only potential for a 100 gpm well in Harvey West Park and a 250 gpm well on Thurber Lane that would require considerable treatment. At best, these two wells could yield only 550 acre-feet annually.

Figure III-2
1989-1997 SUPPLY STUDY

Leedshill-Herkenhoff

Upgrade Existing Supply System - **Implemented**
Majors Creek Pump Station
Parallel Pipe from Coast Pump Station to GHWTP
Groundwater from Purisima (Thurber Ln)
Groundwater from San Lorenzo River alluvium (Harvey West Park)
Wastewater Reclamation from Scotts Valley
Enlarge Loch Lomond
Interties between Santa Cruz and other agencies
Waterman Gap Reservoir

Increase capacity at Felton Diversion
Zyante Dam
Bald Mountain School Dam
Baldwin Creek Dam
Glenwood Dam
Jamison Dam
Bear Creek Dam

Alternative	Reason Not Carried Forward
Increase Felton Div	Insufficient supply
Zyante Dam	Council unwilling
Bald Mtn School Dam	Geologically poor site
Baldwin Cr Dam	Insufficient supply
Glenwood Dam	
Jamison Cr Dam	Move to Waterman Gap site
Bear Cr Dam	Move to Waterman Gap site

CDM

Enlarge Loch Lomond
Waterman Gap Reservoir
Kings Creek Reservoir
Yellow Bank Creek Off Stream Storage
Brackish Groundwater from North Coast

Groundwater from San Lorenzo River alluvium (Harvey West Park)
Groundwater from Purisima (Thurber Ln)
Wastewater Reclamation from Scotts Valley
Intertie between Santa Cruz and Scotts Valley

Alternative	Reason Not Carried Forward
Groundwater from San Lorenzo River alluvium (Harvey West Park)	Insufficient supply
Groundwater from Purisima (Thurber Ln)	Extensive treatment required
Wastewater Reclamation from Scotts Valley	Limited due to extraordinary cost of distribution system
Intertie between Santa Cruz and Scotts Valley	Scotts Valley opposed

Conclusion

Brackish Groundwater from North Coast

The CDM study left four surface storage projects as potentially viable, including:

- Waterman Gap Reservoir
- Kings Creek Reservoir
- Yellow Bank Creek Reservoir
- Loch Lomond enlargement

All of these surface storage options will face major regulatory and environmental review. Thus, even if these projects prove technically feasible, the lead-time for their development would be very lengthy. The City's critical immediate need for new supply led to the conclusion that these surface storage projects should not be considered at this point. This does not preclude possible future consideration of these alternatives.

c) 1997-present

Following the abandonment of the Brackish Wells project, the City amended the Carollo Engineer's contract to investigate other supply options. Among the original list of projects studied were several groundwater options, conjunctive use with Soquel Creek Water District, and an off-stream storage project at the Olympia Quarry.

As the work of the IWP Committee began, the following supply augmentation projects were still considered viable:

- **Seawater Desalination**. This option involves construction of reverse osmosis, pretreatment, and ancillary facilities including buildings, piping, and pumping systems, and modifications to the existing abandoned wastewater outfall. No specific site has been selected for these facilities, but probable locations are in the Industrial area of Santa Cruz or on the University's Long Marine Lab site.

- **Reclamation/Coast Groundwater Exchange**. This option includes two separate construction projects. The first is a 4-5 mgd tertiary wastewater treatment plant, and associated facilities to deliver that water to North Coast farmers for irrigation purposes. The plant would be located either on the existing wastewater treatment plant site, or in the industrial area of Santa Cruz and would include construction of approximately 45,000 feet of 18-inch pipe. In all years, the farmers would use reclaimed water rather than groundwater to irrigate their fields. This will insure preservation and availability of the groundwater when needed by the City. Moreover, all of the reclaimed water would be delivered to the farmers; no reclaimed water would be delivered to current SCWD customers.

  In return, the City would get access to the groundwater supplies currently being used by the farmers. The second City construction project would therefore involve the wells and associated facilities necessary to extract this groundwater. Based on limited geo-hydrologic information, the IWP assumes an annual yield from this source of 700 million gallons.

- **Santa Margarita Aquifer at Live Oak**. This is a small potential source of supply. The aquifer is below the Purisima aquifer from which the current Beltz wells draw supply. Little information is currently available about this supply. For purposes of the IWP, it is assumed that this source will yield 100 million gallons annually.

- **North Coast Upgrades**. This concept would include upsizing pipelines, adding pumping facilities at Majors Creek, and increased capacity of North Coast intakes.[15]

- **Coast Pump Station Upgrades.** This concept included upgrades to pumping facilities and adding a parallel pipeline between Coast Pump Station and GHWTP.

- **Treatment Upgrades.** This concept considered pretreatment of North Coast and/or San Lorenzo River supplies to reduce loss of available flowing supplies during winter storm induced turbidity events.

For both the desalination and the reclamation/coast groundwater options, discussions with the Soquel Creek Water District resulted in consideration of regional as well as city-only projects. While the latter would serve only customers of the Santa Cruz Water Department, a regional project would serve customers of both agencies. Required facilities for regional projects are nearly identical to city-only facilities with the exception of transmission mains required to pipe water to Soquel Creek Water District.

The *Confluence* model was used to assess the effectiveness of the North Coast Upgrades, the Coast Pump Station Upgrades, and Treatment Upgrades. None of these potential investments had a significant impact on the size of drought curtailments. They are therefore not included in the strategies described in Chapter V. Thus, the IWP considered the following supply options:

- Seawater desalination (city-only and regional)
- Reclamation/Coast groundwater exchange (city and regional)
- Santa Margarita Aquifer at Live Oak

Figure III-3 shows the progress of the City's supply studies from 1997 to the present.

[15] Recall that the base case does include rehabilitation of the North Coast transmission system to reduce water losses. This rehabilitation does not increase the flow capacity of this system.

Figure III-3
1997-Present SUPPLY STUDIES

<u>Carollo</u>

Groundwater from Santa Margarita (Live Oak)
Wastewater Reclamation/Coast Groundwater Exchange
Seawater Desalination
Maximize existing sources:
Pretreat North Coast
Parallel pipe from Coast Pump Station to GHWTP
Increase capacities of North Coast diversions and pipelines

Brackish groundwater from San Lorenzo River alluvium
Groundwater from San Lorenzo River alluvium
Groundwater from North Coast w/recharge
Conjunctive Use with Soquel Creek Water District
Groundwater from Purisima (Live Oak)
Olympia Quarry

Alternative	Reason Not Carried Forward
Brackish groundwater from SLR alluvium	Water rights conflict
Groundwater from SLR alluvium	Water rights conflict
Groundwater from North Coast w/recharge	Water rights conflict
Conjunctive Use with Soquel Creek	Water rights conflict
Groundwater from Purisima (Live Oak)	Competing interests limits supply
Olympia Quarry	Numerous technical and institutional issues

<u>IWP Process</u>

Groundwater from Santa Margarita (Live Oak)
Wastewater Reclamation/Coast Groundwater Exchange
Seawater Desalination

Maximize existing sources:
Pretreat North Coast
Parallel pipe from Coast Pump Station to GHWTP
Increase capacities of North Coast diversions and pipelines

Alternative	Reason Not Carried Forward
Pretreat North Coast	Insufficient supply
Parallel pipe from Coast Pump Station to GHWTP	Insufficient supply
Increase capacities of North Coast diversions and pipelines	Insufficient supply

<u>IWP EIR Analysis</u>

Seawater Desalination
Groundwater from Santa Margarita (Live Oak)
Wastewater Reclamation/Coast Groundwater Exchange

IV. EVALUATION CRITERIA

As discussed in detail below, alternative water resource strategies include different combinations and sequences of the options described in Chapter III. In order to choose the strategy which best meets the IWP objectives, each strategy must be evaluated against a set of criteria. A critical part of the IWP process was developing those criteria. This chapter begins with a discussion of the criteria development process and then describes the evaluation criteria that emerged from that process.

A. EVALUATION CRITERIA DEVELOPMENT

The criteria development process began with a series of discussions by the IWPC. Based on those discussions, the IWPC recommended a set of evaluation criteria to the Water Commission. At its June 4, 2001 meeting, the Commission accepted a modified version of the IWPC recommendations.

The process recognized that the purpose of the IWP is to respond to the current drought-related crisis and plan for future growth. Since the form and content of the evaluation criteria provide information on how well strategies meet that goal, the criteria should have the following properties:

1. Discriminate Among Strategies

A criterion must be able to discriminate among different strategies. If all strategies look alike against a particular criterion, it is of no use.

2. Understandable and Meaningful to Decision Makers

It was recognized that the IWP will generate a large amount of detailed and complex information, much of which will be very valuable to staff and consultant. However, since the decision-makers generally do not have the time or the expertise to deal with all of that complexity, the criteria must extract the information most important to decision makers and be expressed in ways that will be meaningful to them.

3. Reasonable Number

The number of criteria must be sufficient to cover the issues that are truly important, and no more than that. Overlap among the criteria (i.e. having two criteria which basically measure the same thing) must be minimized. While there is no “right” number of criteria, it is important to recognize that more criteria introduce more complexity into the analysis and the decision-making process.

4. Measurable

All criteria must be measurable. That is, there must exist some scale for each criterion against which the performance of a strategy can be assessed. Some of those scales will likely be based on qualitative assessments, while others will be quantified in dollars, volumes, percentages, etc. It is not necessary to attempt to force all criteria to be measured in the same units. In fact, doing so could obscure important information about the individual criteria.

5. Reflect Community Concerns

The criteria must accurately reflect the issues that are important to Santa Cruz citizens and policymakers. If the criteria miss the mark in this regard, the IWP recommendations will not necessarily result in "better decisions."

6. Precise Language

The words used to describe each criterion are important. A lack of precision can lead to ambiguity and later misunderstandings.

B. IWP EVALUATION CRITERIA

Based on the foregoing considerations, the Water Commission recommended and the City Council adopted a set of criteria to guide the evaluation of resource strategies. The following discussion of these criteria is divided into several categories. Within each category, there are one or more specific criteria.

1. Cost[16]

Cost is a major concern in any utility planning effort. Major supply investments are being considered. The debt service on the City's portion of these investments, as well as any changes in operating and maintenance costs, become revenue requirements that are passed through to SCWD ratepayers, as do the Water Department's costs of implementing conservation programs. In addition, customers who participate in conservation programs may have out-of-pocket costs that are not reimbursed by the Department.

There may also be financial concerns regarding the City's ability to raise capital that cause the City to prefer limiting its near-term capital investment.

[16] Cost estimates for supply and facility additions are based only on conceptual-level engineering and are therefore very preliminary. Based on industry standards, actual costs could vary from these estimates by as much as 75%.

The following three evaluation criteria were adopted:

C-1. *Present value of incremental SCWD revenue requirements over the planning period, expressed in constant (i.e. pre-inflation) dollars.* These revenue requirements reflect the annual debt service on capital investments as well as all fixed and variable operating costs. Note that only costs to the City are reflected here. The present value concept explicitly considers the time value of money, and therefore places a greater value on near-term costs than on future costs.

C-2. *The average of the real-dollar (net of inflation) monthly water bill increases experienced by a "typical" residential customer over the planning period.*[17] These bill increases are over and above those that would have taken place under 'base case' conditions. The monthly usage of a "typical" residential customer was assumed to be 8,000 gallons per month.[18]

C-3. *Total required City capital investment through 2010.*

2. Curtailments

As discussed above, an underlying premise of the IWP is the consideration of alternative levels of use curtailment (water shortage). The Curtailment Study was completed to help the City better understand the impacts on its citizens of different curtailment levels. Generally speaking, the curtailments that are of concern here are shortfalls that occur because the combination of available supplies, delivery capacities, and system operating rules results in an inability to fully meet demand. These curtailments may be estimated statistically, based on assumptions about future weather and hydrology.

This is in contrast to a use restriction due to an 'external' event, such as a regulatory change or system failure, which results in an inability to fully meet demand. These events are generally much less predictable. The vulnerability to such 'external' events is a separate category of criteria (see below).

For any strategy, there are two critical issues to be considered:

- The frequency of occurrence of particular curtailment magnitudes.
- The shortage that will occur under worst-year (1977 hydrology) conditions.

17 Actual bill increases over the planning period vary depending on the projected variation in capital and operating costs.

18 Note that Santa Cruz water customers are billed on a bi-monthly basis. Thus, the expected increase in a customer's bi-monthly bill will therefore be double the numbers reflected in this criterion. Also note that the actual bill also includes wastewater, stormwater, and garbage, in addition to water.

Moreover, we are concerned with two types of shortage, one which is primarily due to a lack of sufficient supply and results in an inability to meet seasonal demands. The other is due to insufficient delivery (e.g. treatment or transmission) capacity and results in an inability to meet demand on particularly hot summer days.

The following four criteria were adopted:

CURT-1. Frequency of total peak-season shortages of selected sizes, measured as a percent of demand.

CURT-2. Size of worst total peak-season shortage.

CURT-3. Frequency of multi-day shortages of selected sizes.

CURT-4. Size of worst multi-day shortage.

As will be described in detail in Chapter V, tradeoffs among different levels of curtailment are analyzed by explicitly defining three *curtailment profiles*.

3. Vulnerability to External Events

These criteria address the ability of a strategy to meet demands in the event of unexpected:

- Catastrophic events, caused either by natural disasters (e.g. earthquakes, fires, slides,), human error (e.g. spills), or mechanical failure; or
- Regulatory changes, due for instance to endangered species protection.

Shortages due these types of events are much less predictable than those due to supply or capacity insufficiencies, the probabilities of which can be estimated based on historical records and growth forecasts. Typically, a catastrophic shortage is of large magnitude, but of short duration. A regulatory shortage may result in an ongoing deficiency.

The adopted criteria include:

V-1. Expected average daily shortage resulting from a two-day loss of either the Graham Hill Water Treatment Plant or the Newell Creek Pipeline.

V-2. Expected added seasonal shortage resulting from one of four regulatory changes, including:

- *Scenario A.* This scenario is based on minimum bypass flows required by Fish and Game Code Section 1601. While the requirements are intended for new construction, any modifications to the existing diversions that require a 1601 permit could trigger this requirement.

- *Scenario B.* This scenario is based on potential bypass flows as requested by the Department of Fish and Game in recent correspondence concerning the permit application for the Laguna Creek Pipeline Access Road repair project.

- *Scenario C.* This scenario is based on minimum degradation of water quality at Liddell Spring due to continued mining at the RMC/Lonestar Quarry.

- *Scenario D.* This scenario is based on maximum degradation of water quality at Liddell Spring due to continued mining at the RMC/Lonestar Quarry.

The strategy evaluation process, described in Section A.2 of Chapter VI, found that Criterion V-2 did not distinguish among alternative strategies.

4. Environmental Impacts

There are many environmental impacts that could be associated with particular strategies. The IWP included a preliminary analysis, which allows the identification of *potential* impacts. More detailed environmental analysis will be included in the Environmental Impact Report (EIR). The following areas of potential environmental impact were assessed:[19]

- Marine resources
- Direct land use
- Indirect land use
- Traffic
- Recreation
- Visual resources
- Hydrology (surface water and groundwater)
- Public health and safety
- Fisheries
- Wetlands, wildlife, and plants
- Cultural resources
- Air quality
- Noise

A summary of the results of the environmental analysis is included as Appendix C. The analysis showed that the only three environmental criteria that distinguished among the IWP strategy alternatives (see below) were:

- *ENV-1. Marine resources*

[19] These categories were developed in accordance with CEQA Sections 15060 (Preliminary Review) and 15063 (Initial Study).

- *ENV-2. Groundwater hydrology*[20]

- *ENV-3. Indirect land use (growth inducement)*

For each of these, a four-point scale was applied, with the following values:

1. *No potential impact*
2. *Low potential impact*
3. *Moderate potential impact*
4. *High potential impact*

5. Energy Consumption

Different supply sources use different amounts of energy. The Water Commission felt it important to compare the energy used by different strategies, since energy production is often associated with emissions into the atmosphere. These emissions, in turn, may contribute to global climate change. Since information was not available regarding the manner in which the Soquel Creek Water District would operate supply sources in a regional strategy, or regarding the actions the District would take if the City chose to pursue a city-only strategy, it was decided to focus only on energy usage associated with provision of water to City customers. If a regional strategy is accepted by the City Council, the energy use to serve both jurisdictions will be analyzed in the EIR.

The adopted criterion is:

EC-1. Expected total strategy energy usage in kwh over the planning period to provide water to City of Santa Cruz customers.

6. Impacts on Purisima Aquifer

The City of Santa Cruz, the Soquel Creek Water District, a few smaller water districts, and many private properties rely on the Purisima formation for groundwater resources. According to the Soquel Creek Water District's 1999 Integrated Resources Plan (IRP), total pumpage from the Purisima was estimated to be approximately 2,230 mg/year of which 12% (257 MG in 1992) was pumped by the City of Santa Cruz and 55% (1232 MG, 1997 well meter readings) was pumped by Soquel Creek Water District. In addition, there are well over 1,000 private wells that draw from this source. The report also states "recent analysis suggests that combined (Soquel Creek Water) District and non-District pumping is near the perennial yield of the Purisima Formation."

[20] This scale measures impacts on North Coast groundwater and groundwater in the Santa Margarita aquifer at Live Oak. Impacts on the Purisima aquifer are measured separately (see below).

The City has planned rehabilitation projects that will bring the City's Live Oak well and treatment plant capacity to 1 mgd (365 MG/year) in normal years and 2 mgd (730 MG/year) in droughts. Although these figures are higher than those used in the Soquel Creek IRP, they are lower than historic pumping that occurred prior to the loss of production due to the 1989 Loma Prieta Earthquake. These figures (1 mgd average and 2 mgd drought) are used in the *Confluence* model base case.

Clearly, the Purisima is of vital importance to many users. Because of the base case assumptions, all supply strategies currently under consideration have the potential to impact this resource. However, strategies that provide less than 650 MG/year to Soquel Creek Water District may force that district to rely more heavily on the Purisima in addition to the City's reliance based on planned rehabilitation projects. Strategies that provide at least 2200 MG/year to Soquel Creek Water District have the potential to improve conditions and allow for water level recovery after the City and the District rely heavily on the Purisima in dry years.

At this point, the manner in which a regional supply will operate to serve Soquel Creek demands is uncertain. These uncertainties will be resolved in future negotiations between the parties.

The evaluation criterion is:

P-1. A three-point scale on potential impacts in year 2020 to the Purisima aquifer, as follows:

1. *Improvement in condition of aquifer*
2. *No change in condition of aquifer*
3. *Degradation in condition of aquifer*

7. Ease of Implementation

Four factors were considered in assessing the ease of implementation of different strategies:

- Permits required
- Agreements/ partnerships required
- Land acquisition/easements
- Project schedule

Based on analysis of all of these, the strategies were ranked in order of increasing anticipated implementation difficulty. The criterion is stated as follows:

EI-1. An ordinal ranking of strategies in terms of overall expected implementation difficulty.

C. TRADEOFFS

In comparing strategy alternatives (see below), the foregoing criteria often conflicted with one another, which sometimes resulted in the need to make difficult tradeoffs. Such tradeoffs are the essence of integrated water planning. Each decision maker may make those tradeoffs differently. In Chapter VI, these tradeoffs are illustrated and discussed in detail.

V. FORMULATION OF STRATEGIES

A. OVERALL APPROACH

Chapter III described the options available to the City for dealing with the current and future imbalances between supply and demand. There are three types of options:

Conservation programs. These are programs that result in long-term reductions in customer demand.

Curtailment. The City can also plan to only eradicate a portion of the supply/demand imbalance with conservation and new supplies, and thereby continue to tolerate some expected level of curtailment in dryer-than-normal years.

Supplies. These are new supply or facility options that will increase the quantity of water available to the City and its water customers. Some strategies (so-called 'regional' strategies) also provide water to the Soquel Creek Water District.

The IWP combined these options to create *resource strategies*. The performance of each strategy against the evaluation criteria was then assessed to achieve a clear understanding of the tradeoffs that must be made among the criteria. This chapter discusses the strategy development process. Chapter VI describes the evaluation of these strategies, and the resulting recommendations.

1. Resource Strategy Definition

A resource strategy is a combination of conservation and supply options, and the associated operating rules, designed to maintain a particular 'curtailment profile' through the planning period.

B. STRATEGY COMPONENTS

Following are discussions of the conservation, curtailment, and supply components of the IWP resource strategies.

1. Conservation

As discussed in Section A of Chapter III, all strategies include a common set of conservation programs, which correspond to those programs recommended in the *Water Conservation Plan* and adopted by the City Council.

2. Curtailment Profiles

As discussed in Section B.2 of Chapter IV, a key set of evaluation criteria relates to curtailments. Those criteria are restated here:

CURT-1. Frequency of total peak-season shortages of selected sizes, measured as a percent of demand.

CURT-2. Size of worst total peak-season shortage.

CURT-3. Frequency of multi-day shortages of selected sizes.

CURT-4. Size of worst multi-day shortage.

Two of the four curtailment criteria (CURT-1 and CURT-2) relate to seasonal shortages, and two to short-duration shortages that result from temperature-driven demand peaks. Over the course of the IWP effort, it became apparent that the latter two criteria were inappropriate given the Water Department's annual curtailment management process. An appreciation of that process is critical to understanding the manner in which the IWP deals with water supply reliability.

In the spring of each year, the Department must determine the level of curtailment, if any, that is required for the upcoming summer. That decision will be based on:

- The current water stored in Loch Lomond.
- The streamflows for the remaining spring and all summer months.
- The summer temperature patterns.

Of these, only the first is known with certainty at the time the decision is made. For the other two, prudent forecasts must be made. Based on discussions with SCWD staff, the *Confluence* model makes the following assumptions:

- Peak-season streamflows are assumed to be 10% below the actual streamflows in the hydrological year being simulated.

- The peak-season temperature pattern will be fixed at that experienced in a prior warmer-than-average summer. (Based on an examination of the historical temperature data, 1976 temperatures were chosen.)

The conservative nature of both of these assumptions reflect the potentially severe consequences to Santa Cruz water customers of overly-optimistic assumptions.

Depending on the expected severity of the summer situation based on those conservative assumptions, customers may be asked or required to curtail their demands by a particular amount *for the entire summer*.[21] Sound drought management must be seasonal, rather than sporadic. It is unrealistic to expect customers to achieve short-duration curtailments during the summer, and the Department does not attempt to do that.

Because the daily temperature patterns are assumed identical in every summer, it became impossible to estimate the frequency of various sizes of multi-day shortages. Based on this and the real-world difficulties of short-term curtailments, the decision was made to eliminate the multi-day curtailment criteria (CURT-3 and CURT-4) from consideration.

Based on the two seasonal reliability criteria (CURT-1 and CURT-2), the IWPC examined a range of *curtailment profiles*. A curtailment profile (CP) is a description of a level of supply reliability that might be achieved. The profile is described in terms of expected frequencies and magnitudes of seasonal curtailments. Each profile was described by the following parameters:

- Probability of a peak-season shortage smaller than 10%.
- Probability of a peak-season shortage between 10% and 20%.
- Probability of a peak-season shortage between 20% and 30%.
- Probability of a peak-season shortage exceeding 30%.
- Percent magnitude of the worst peak-season shortage.

Based on this examination and the results of the *Water Curtailment Study*, the IWPC, and subsequently the Water Commission, determined that *the highest level of worst peak-season shortage that is tolerable for Santa Cruz water customers is 25%*. Larger curtailments were judged to have unacceptable impacts on the community. Thus, the strategies examined in the IWP only focus on curtailment profiles for which the worst peak-season shortage did not exceed this level. The three curtailment profiles that were selected for evaluation are shown in Table V-1.

As described above, the current worst-year peak-season shortage is 45%. Even with the City's extensive conservation programs, this shortage remains high throughout the planning period. This means that, to reduce the risk of shortage even to the highest acceptable level, the City must develop new supply as soon as possible. Additional increments of supply will be needed in the future to keep pace with expected demand growth.

[21] For more detail on the City's approach to different levels of customer curtailment, see the *Curtailment Study*.

TABLE V-1
ALTERNATIVE CURTAILMENT PROFILES

CURTAILMENT PROFILE	PROBABILITY OF: <10% Peak-Season Shortage	PROBABILITY OF: 10-20% Peak-Season Shortage	PROBABILITY OF: 20-30% Peak-Season Shortage	WORST-YEAR PEAK-SEASON SHORTAGE (%)
1 (Perfect)	0	0	0	0%
2	6-9 in 59 (1 in 7-10)	1 in 59	0	15%
3	10-15 in 59 (1 in 4-6)	0-1 in 59	1 in 59	25%

There are important differences in customer impacts among these three profiles. While CP 1 would impose no hardship on customers, CP 2 would require periodic restrictions on outdoor usage, and CP 3 would require more such restrictions and, under worst conditions, summer rationing. It must be recalled that all such cutbacks could well be more difficult in the future due to the "hardening" of demands that occur as a result of conservation programs.

As described below, all supply strategies were configured to achieve each of these three curtailment profiles, and the tradeoffs among these profiles were considered.

3. New Supplies

As described above in Section C of Chapter III, the City has studied many water supply alternatives during the past two decades. Most recently, as part of the current IWP effort, the City contracted for the Alternative Water Supply Project. As a result of these many prior studies and the need to take action as quickly as possible to meet the City's current shortfall, the supply alternatives considered for inclusion in the IWP strategies are as follows:

- City desalination
- Regional (i.e. joint with Soquel Creek Water District) desalination
- City reclamation/coast groundwater exchange
- Regional reclamation/coast groundwater exchange
- Santa Margarita aquifer at Live Oak

The conservation programs common to all strategies and these supply alternative are the 'building blocks' to construct strategies to achieve one or another curtailment profile.

a) Operational Assumptions for New Supplies

The operating assumptions for the existing system components are described in detail in Section E of Chapter II above. As new supplies are added, the system operating assumptions for the new supplies as well as the remainder of the system must be re-examined. These operating assumptions are critical; the manner in which a desalination plant or a coast groundwater supply is assumed to be operated will have a major impact on the size and timing of capacity that must be added. Thus, these operating assumptions must be in line with the manner in which the SCWD would actually operate these supplies in the future.

(1) Desalination Operating Assumptions

As discussed earlier, the current system, including the water stored in Loch Lomond, is sufficient to meet demands under most hydrologic conditions. It is only in dry years that existing sources are strained. Moreover, the energy requirements of the desalination process are very high, making this supply very expensive to operate. Thus, the primary use of desalination must be to relieve pressure on existing sources during dry periods.[22] The trigger for use of this expensive source is the level of storage in Loch Lomond, as depicted in the Loch Lomond rule curves.

The addition of a desalination plant has several distinct impacts on the lake:

- Under drought conditions, the new plant will be able to supplement stored water in Loch Lomond to meet demands.

- In addition, the presence of the new supply will allow the City to comfortably draw the reservoir down to lower levels. Recall that current lake operation treats 1 billion gallons of the 2.8 billion lake capacity as unusable. This volume provides insurance against a possible third drought year. As desalination capacity is added, the peak-season volume that could be produced by that plant provides the same kind of ‘insurance policy’. Thus, reservoir ‘dead storage’ is decreased on a gallon-for-gallon basis as new capacity is added, thereby multiplying the value to the SCWD of the new supply.

- While the base case rule curves, reflecting current system operations, ensured that, under 1976 hydrologic conditions, curtailments would occur in order to preserve stored water for use in a possible second extreme drought year, that is no longer necessary with a new source such as desalination. The new source moderates reservoir drawdown and provides ‘insurance’ supply for the second drought year. Thus, it is only in the second drought year that shortages occur.

There is a direct relationship between the storage levels that trigger operation of the desalination plant (i.e. the ‘height’ of the rule curve) and the resulting overall system capital and operating costs:

- Lower trigger levels would allow more use of the lake before turning to desalination, which would in turn result in a greater chance of running out of usable storage before the

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[22] Recall that, in the infrequent cases when flowing supplies are unusable due to turbidity or ‘first flush’ constraints and Loch Lomond water rights limit the use of that source, the desalination plant will be used to serve demand.

end of the 1977 operating year. This would bring about the need for even more desalination capacity, and resulting higher capital costs, in order to maintain the desired 1977 curtailment level.

- Higher trigger levels would give rise to a greater chance of not using all the usable lake water over the 2-year drought period. This would leave water in the lake while making more use of the expensive desalination plant, thereby increasing operating costs.

Monthly trigger levels were chosen to steer a middle ground between these undesirable outcomes. For example, as of April 30, desalination use is triggered only if storage in Loch Lomond is less than 56% of the total usable storage capacity of about 1.7 billion gallons. By the end of August, this trigger decreases to 40%.

(2) Reclamation/Groundwater Operating Assumptions

As discussed in Section III.C.1(c), the reclamation/groundwater exchange supply option assumes that the reclamation plant will operate every year to provide irrigation water to North Coast farmers. All North Coast irrigation would be done with reclaimed water rather than with groundwater. Thus the only operating decisions that must be made are in regard to the coast groundwater supply. This supply is substantially less expensive to operate than desalination. In current dollars, the variable operating cost for the coast groundwater supply could be as much as $400 per million gallons. The comparable power cost for desalination exceeds $1800.

The operating cost difference between the two supplies could argue for differences in operations. However, the groundwater operating costs are still substantially greater than the costs to transmit and treat water from Loch Lomond (about $170). Thus, it was determined that the operating rules described above for the desalination would also be assumed for the coast groundwater supply.

C. STRATEGY DEVELOPMENT

Over the course of the strategy development process, several key observations and assumptions were made:

- As described in Section F of Chapter II, the current Santa Cruz system results in a level of reliability far below the minimum acceptable curtailment profile. This means that *the initial increment of supply for any strategy that will achieve even that minimum acceptable level of reliability must be one of the two major supply options*, namely desalination or the reclamation/groundwater exchange.

- *Given the large fixed costs associated with the initial increment of either of these supply options, no strategy may include both of them*. Thus, there are two groups of strategies, one based on desalination, the other based on the reclamation/groundwater exchange.

- The contents of any agreement between the City and the Soquel Creek Water District have not yet been negotiated. For purposes of the IWP, two key assumptions about a regional project are made:
    - Any agreement between the City of Santa Cruz and Soquel Creek Water District would first meet the needs of the City, with only surplus supplies being available to Soquel Creek. Thus, *the capacities of the required supplies in the corresponding city-only and regional strategies are identical*, although those supplies would be utilized much more intensively in a regional strategy than in a city-only strategy.
    - The capital costs and fixed operating costs of any joint project will be divided equally between the parties. Each party will pay the variable operating costs associated with water supplied to its customers.

1. Strategy Descriptions

These observations led to the following strategy descriptions:

a) Desalination Strategies

D-1. **City-Only Desalination**. A sequence of desalination capacity increments sized to maintain the appropriate curtailment level for the City of Santa Cruz.

D-2. **Regional Desalination**. Sequences of desalination capacity increments identical to D-1, with fixed costs split as described above.

D-3. **City-Only Desalination and Santa Margarita Groundwater**. The Santa Margarita source is developed and the desalination additions are downsized and/or deferred to the extent possible consistent with maintaining the appropriate curtailment level.

D-4. **Regional Desalination and Santa Margarita Groundwater**. Sequences of additions identical to D-3 with fixed costs split as described above.

b) Reclamation/Groundwater Strategies

R-1. **City-Only Reclamation/Coast Groundwater**. A reclamation plant to meet all the irrigation needs of the North Coast growers and a sequence of coast groundwater capacity increments sized to maintain the appropriate curtailment level.

R-2. **Regional Reclamation/Coast Groundwater**. Sequences of capacity additions identical to R-1 with fixed costs split as described above.

R-3. **City-Only Reclamation/Coast Groundwater and Santa Margarita Groundwater**. The Santa Margarita source is developed and the coast groundwater additions are downsized and/or deferred to the extent possible consistent with maintaining the appropriate curtailment level.

R-4. **Regional Reclamation/Coast Groundwater and Santa Margarita Groundwater**. Sequences of capacity additions identical to R-3 with fixed costs split as described above.

2. Strategy Construction

As discussed above, the base case supplies and facilities result in a worst-year (1977 hydrology) shortage of about 38% with current demands, increasing to about 46% with forecasted 2030 demands. For each of these strategies, the process of determining the magnitude and timing of supply additions for each curtailment profile was as follows:

Where relevant (Strategies D-3, D-4, R-3, and R-4), add the Santa Margarita groundwater supply in 2005. This is estimated to be the earliest date that this supply can come on line. The small magnitude of this supply does not permit water supply reliability to approach even Curtailment Profile 3.

Add first major supply increment (either desalination or coast groundwater) in 2009. This is estimated to be the earliest date that either of these supplies can come on line. The magnitude of the increment is that necessary to achieve the desired level of worst-year curtailment (either 0%, 15%, or 25%). The smallest desalination increment considered in the IWP was 0.5 mgd. Coast groundwater increments are 0.78 mgd, which is the projected capacity of each well. As described above, Loch Lomond dead storage is decreased as new supplies are added.

If necessary, add the next supply increment in 2015. Supply is added at this point only if the worst-year curtailment exceeds the desired level. If this is the case, sufficient capacity is added to bring the worst-year curtailment below the desired level.

This procedure is repeated at five-year increments through the end of the planning period in 2030.

Table V-2 shows the results of this process. For example, to achieve Curtailment Profile 1, Strategy D-1 would require 5 mgd of desalination capacity in 2009. As demand grows, additional capacity would be needed to maintain that curtailment profile. Specifically, 1 mgd increments would be required in 2015, 2020, and 2025, for a total of 8 mgd of capacity by the end of the planning period.

The table yields several important observations:

- **Higher levels of reliability require larger and earlier capacity increments**. For example, Strategies D-1 and D-2 require 5 mgd of desalination capacity in 2009 to achieve Curtailment Profile 1, compared to 2.5 mgd and 2.0 mgd to achieve Curtailment Profiles 2 and 3 respectively. Over the planning period, the total required capacities are 8, 4.5, and 4 mgd respectively for profiles 1, 2, and 3.

- **The Santa Margarita groundwater supply permits reductions in required capacity from either of the major sources**. Due to this supply's limited annual yield, the reductions are small.

- **None of the strategies based on the reclamation/groundwater exchange is able to achieve Curtailment Profile 1**. This is due to the assumed 700 million gallon annual volume limitation from this source.

3. Strategy Operating Characteristics

Table V-3 compares the average and maximum annual production of the major supplies (desalination or coast groundwater) in the various strategies.

The results are not surprising. In general, regional strategies require the new supplies to operate at higher levels and more frequently than their city-only counterparts. The differences in average annual production are particularly striking, reflecting the sporadic nature of city-only operation when compared to regional operation.

This does not mean, for example, that a city-only desalination plant would produce 93 million gallons in 2010 under all hydrologic conditions. The average includes many hydrologic conditions for which the annual production is small. For instance, in 2010, the *median* desalination production level for Strategy D-1 is about 40 mg. This means that, for half the hydrologic conditions, annual production is less than 40 mg.

D. RELATIONSHIP TO GENERAL PLANS

As indicated in Chapter I, it is important to understand the relationship between the anticipated schedule of supply additions and the forecast periods in the General Plans of the three jurisdictions served by the Santa Cruz Water Department.

As described in Section G of Chapter II, the IWP demand forecast is based on a modification of the 1998 Water Demand Investigation. The modifications reduced demands in the short term to reflect slower growth experienced to date. Due to these reductions, the 2005 Demand Investigation forecast, which is consistent with General Plan projections, is forecast in the IWP to be delayed until between 2010 and 2015. (See Table II-3.)

As a result, the initial major IWP supply additions, which occur in 2009, are sized to serve demands which are within the 2005 demand estimates of the Demand Investigation, and are therefore accounted for within the 2005 General Plan population projections.

The capacity increments beyond 2009 are not accounted for within the existing General Plan projections. The environmental review for these would therefore likely be completed in future Supplemental EIRs.

TABLE V-2
RESOURCE STRATEGY SUPPLY ADDITIONS [a]

STRATEGY	2005	2009	2015	2020	2025
DESALINATION (D-1, D-2)					
CURTAILMENT PROFILE 1		Desal 5.0 mgd	Desal 1.0 mgd	Desal 1.0 mgd	Desal 1.0 mgd
CURTAILMENT PROFILE 2		Desal 2.5 mgd [b]	Desal 1.0 mgd		Desal 1.0 mgd
CURTAILMENT PROFILE 3		Desal 2.0 mgd	Desal 1.0 mgd		Desal 1.0 mgd
SHORT-TERM SANTA MARGARITA GW/ DOWNSIZED DESAL (D-3, D-4)					
CURTAILMENT PROFILE 1	Santa Marg. GW 0.55 mgd	Desal 4.5 mgd	Desal 1.0 mgd	Desal 1.0 mgd	
CURTAILMENT PROFILE 2	Santa Marg. GW 0.55 mgd	Desal 2.5 mgd [b]	Desal 1.0 mgd		Desal 1.0 mgd
CURTAILMENT PROFILE 3	Santa Marg. GW 0.55 mgd	Desal 1.5 mgd	Desal 1.5 mgd		
RECLAMATION/GW EXCHANGE (R-1, R-2)					
CURTAILMENT PROFILE 1	CANNOT ACHIEVE				
CURTAILMENT PROFILE 2		Coast GW 3.12 mgd	Coast GW 0.78 mgd		
CURTAILMENT PROFILE 3		Coast GW 2.34 mgd	Coast GW 0.78 mgd		Coast GW 0.78 mgd
SHORT-TERM SANTA MARGARITA GW/ DOWNSIZED RECLAIM COAST GW (R-3, R-4)					
CURTAILMENT PROFILE 1	CANNOT ACHIEVE				
CURTAILMENT PROFILE 2	Santa Marg. GW 0.55 mgd	Coast GW 2.34 mgd	Coast GW 0.78 mgd	Coast GW 0.78 mgd	
CURTAILMENT PROFILE 3	Santa Marg. GW 0.55 mgd	Coast GW 1.56 mgd	Coast GW 0.78 mgd	Coast GW 0.78 mgd	

a. The smallest desalination increment considered was 0.5 mgd. Coast groundwater increments are 0.78 mgd, the projected delivery capacity of each well.

b. See Chapter VI discussion of why the size of this increment does not change.

TABLE V-3

MAJOR SOURCE OPERATING CHARACTERISTICS
(Curtailment Profile 2)

STRATEGY	AVERAGE ANNUAL PRODUCTION (MG)		MAXIMUM ANNUAL PRODUCTION (MG)	
	2010	2020	2010	2020
D-1: City-Only Desalination	93	217	509	722
D-2: Regional Desalination	656	755	818	1144
D-3: City-Only Desalination & Santa Margarita GW	74	146	476	709
D-4: Regional Desalination & Santa Margarita GW	647	710	796	1104
R-1: City-Only Reclamation/GW	124	224	711	812
R-2: Regional Reclamation/GW	653	696	900	983
R-3: City-Only Reclamation/GW & Santa Margarita GW	76	142	485	747
R-4: Regional Reclamation/GW & Santa Margarita GW	641	680	793	972

Notes:

Production figures for strategies D-1 through D-4 are for the desalination plant; for strategies R-1 through R-4, they are for the coast groundwater supply. All figures are for the 12 months ending October.

Soquel Creek Water District demand on either supply assumed to be constant 1.7 mgd.

VI. EVALUATION OF STRATEGIES

The final step of the IWP was to evaluate the strategy alternatives. Including the distinctions among curtailment profiles and between city-only and regional strategies, Table V-2 contains a total of 20 strategies to be evaluated against the evaluation criteria.

As discussed in Chapter IV, the evaluation approaches for the various criteria differed, as did the evaluation scales.

The complete evaluation results are contained in Tables VI-1, VI-2, and VI-3. The reader can refer to these tables throughout the following discussion of strategy evaluation. The discussion will rely on a set of charts that isolate key parts of the evaluation. The evaluation begins by comparing the strategies against each of the individual evaluation criteria. It will then address overall strategy comparisons. Based on those comparisons, the chapter will end by identifying a pair of preferred strategies.

A. Criteria Comparisons

The following discussion focuses on the performance of the eight strategies (D-1 through D-4 and R-1 through R-4) against each of the evaluation criteria. The results, along with some 'key messages', are displayed in Charts VI-1 through VI-10. The comparisons are made at a fixed level of reliability, namely Curtailment Profile 2. At this point, this choice is arbitrary, but the relative evaluations of the strategies at any of the three curtailment profiles would look about the same. The question of which curtailment profile is most appropriate is addressed below.

1. Cost Criteria

Table VI-4 shows the performance of the 8 strategies against the three cost criteria. Charts VI-1, VI-2, and VI-3 compare the costs graphically. Desalination strategies are somewhat more expensive than reclamation/groundwater strategies over the planning period. Present value desalination strategy costs range from $40 to $83 million. For reclamation/groundwater strategies, the corresponding range is between $32 and $66 million. Translated into typical residential monthly bill impacts, the range for desalination strategies is from $3.84 to $7.90. The range for reclamation/groundwater strategies is between $2.96 and $6.17.

Conversely, the substantial front-end fixed capital cost of the reclamation plant itself makes the near-term capital requirements of the reclamation strategies substantially higher than the desalination strategies. The range of near-term capital costs for the desalination strategies is from $16 million to $38 million, compared to a range of $28 to $59 million for reclamation/ groundwater strategies.

Table VI-1

STRATEGY EVALUATION COMPARISONS: CURTAILMENT PROFILE 1

CURTAILMENT	PROBABILITY OF:	
PROFILE 1	< 10% Peak-Season Shortage	0
	10-20% Peak-Season Shortage	0
	20-30% Peak-Season Shortage	0
	WORST-YEAR SHORTAGE	0%

	STRATEGY	COST [1]			VULNERABILITY TO EXTERNAL EVENTS [2]		ENERGY CONSUMPTION (million kwh) [3]	ENVIRONMENTAL (Indices)			EASE OF IMPLEMENTATION (Rank)
		Present Value Cost ($ millions)	30-Year Average Monthly Res. Bill Increase ($ per month)	Capital Outlay Through 2010 ($ millions)	Short-Term (mgd)	Long-Term (mg)		Marine	Hydrology	Land-Use	
D-1	City Desalination	$121	$11.51	$50	1.10	356.75	277	3	1	2	2
D-2	Regional Desalination	$63	$5.99	$25	1.10	356.75	277	4	1	4	4
D-3	City Near-Term Santa Margarita GW/ Downsized Desal	$103	$9.78	$48	2.35	350.00	253	3	3	2	1
D-4	Regional Near-Term Santa Margarita GW/ Downsized Desal	$56	$5.37	$26	2.35	350.00	253	4	3	4	3
R-1	City Reclamation/ Coast GW Exchange	CANNOT BE ATTAINED									
R-2	Regional Reclamation/ Coast GW Exchange	CANNOT BE ATTAINED									
R-3	City Near-Term Santa Margarita GW/ Downsized Reclaim Coast GW	CANNOT BE ATTAINED									
R-4	Regional Near-Term Santa Margarita GW/ Downsized Reclaim Coast GW	CANNOT BE ATTAINED									

1. Expected costs over planning period, expressed in Year 2002 dollars. Costs are relative to base case.
2. Vulnerability indices based on Curtailment Profile 3.
3. Expected total energy usage over planning period by City of Santa Cruz.

Table VI-2

STRATEGY EVALUATION COMPARISONS: CURTAILMENT PROFILE 2

CURTAILMENT PROFILE 1	PROBABILITY OF:	
	< 10% Peak-Season Shortage	6-9 in 59
	10-20% Peak-Season Shortage	1 in 59
	20-30% Peak-Season Shortage	0
	WORST-YEAR SHORTAGE	15%

	STRATEGY	COST [1]			VULNERABILITY TO EXTERNAL EVENTS [2]		ENERGY CONSUMPTION (million kwh) [3]	ENVIRONMENTAL (Indices)			EASE OF IMPLEMENTATION (Rank)
		Present Value Cost ($ millions)	30-Year Average Monthly Res. Bill Increase ($ per month)	Capital Outlay Through 2010 ($ millions)	Short-Term (mgd)	Long-Term (mg)		Marine	Hydrology	Land-Use	
D-1	City Desalination	$77	$7.32	$33	1.10	356.75	260	3	1	2	2
D-2	Regional Desalination	$40	$3.84	$16	1.10	356.75	260	4	1	4	4
D-3	City Near-Term Santa Margarita GW/ Downsized Desal	$83	$7.90	$38	2.35	350.00	246	3	3	2	1
D-4	Regional Near-Term Santa Margarita GW/ Downsized Desal	$46	$4.41	$21	2.35	350.00	246	4	3	4	3
R-1	City Reclamation/ Coast GW Exchange	$60	$5.55	$56	4.85	353.25	276	1	3	2	6
R-2	Regional Reclamation/ Coast GW Exchange	$32	$2.96	$28	4.85	353.25	276	1	4	4	8
R-3	City Near-Term Santa Margarita GW/ Downsized Reclaim Coast GW	$66	$6.17	$59	4.05	374.25	286	1	3	2	5
R-4	Regional Near-Term Santa Margarita GW/ Downsized Reclaim Coast GW	$39	$3.61	$32	4.05	374.25	286	1	4	4	7

1. Expected costs over planning period, expressed in Year 2002 dollars. Costs are relative to base case.
2. Vulnerability indices based on Curtailment Profile 3.
3. Expected total energy usage over planning period by City of Santa Cruz.

Table VI-3
STRATEGY EVALUATION COMPARISONS: CURTAILMENT PROFILE 3

CURTAILMENT	PROBABILITY OF:	
PROFILE 1	< 10% Peak-Season Shortage	10-15 in 59
	10-20% Peak-Season Shortage	0-1 in 59
	20-30% Peak-Season Shortage	1 in 59
	WORST-YEAR SHORTAGE	25%

STRATEGY		COST [1]			VULNERABILITY TO EXTERNAL EVENTS [2]		ENERGY CONSUMPTION (million kwh) [3]	ENVIRONMENTAL (Indices)			EASE OF IMPLEMENTATION (Rank)
		Present Value Cost ($ millions)	30-Year Average Monthly Res. Bill Increase ($ per month)	Capital Outlay Through 2010 ($ millions)	Short-Term (mgd)	Long-Term (mg)		Marine	Hydrology	Land-Use	
D-1	City Desalination	$72	$6.86	$30	1.10	356.75	256	3	1	2	2
D-2	Regional Desalination	$38	$3.59	$15	1.10	356.75	256	4	1	4	4
D-3	City Near-Term Santa Margarita GW/ Downsized Desal	$72	$6.79	$33	2.35	350.00	243	3	3	2	1
D-4	Regional Near-Term Santa Margarita GW/ Downsized Desal	$41	$3.85	$19	2.35	350.00	243	4	3	4	3
R-1	City Reclamation/ Coast GW Exchange	$59	$5.43	$54	4.85	353.25	276	1	3	2	6
R-2	Regional Reclamation/ Coast GW Exchange	$32	$2.90	$27	4.85	353.25	276	1	4	4	8
R-3	City Near-Term Santa Margarita GW/ Downsized Reclaim Coast GW	$65	$6.00	$57	4.05	374.25	285	1	3	2	5
R-4	Regional Near-Term Santa Margarita GW/ Downsized Reclaim Coast GW	$38	$3.52	$31	4.05	374.25	285	1	4	4	7

1. Expected costs over planning period, expressed in Year 2002 dollars. Costs are relative to base case.
2. Vulnerability indices based on Curtailment Profile 3.
3. Expected total energy usage over planning period by City of Santa Cruz.

Not surprisingly, the cost-sharing with Soquel Creek makes the regional strategies substantially less expensive to the City than the city-only strategies.

TABLE VI-4
PERFORMANCE OF STRATEGIES AGAINST COST CRITERIA

STRATEGY	PRESENT VALUE COST ($ millions)	COST TO TYPICAL RESIDENTIAL CUSTOMER ($/month)	CITY OF SC CAPITAL COST THROUGH 2010 ($ millions)
Desalination:			
D-1. City-Only	$77	$7.32	$33
D-2. Regional	$40	$3.84	$16
D-3. City-Only w/ Santa Margarita	$83	$7.90	$38
D-4. Regional w/ Santa Margarita	$46	$4.41	$21
Reclamation/Groundwater Exchange:			
R-1. City-Only	$60	$5.55	$56
R-2. Regional	$32	$2.96	$28
R-3. City-Only w/ Santa Margarita	$66	$6.17	$59
R-4. Regional w/ Santa Margarita	$39	$3.61	$32

2. Vulnerability Criteria

As described in Chapter IV, these criteria address the ability of a strategy to meet demands in the event of unexpected catastrophic events or regulatory changes. Table VI-5 shows the performance of the strategies against these two vulnerability criteria.

TABLE VI-5
PERFORMANCE OF STRATEGIES AGAINST VULNERABILITY CRITERIA

STRATEGY	EXPECTED ADDED SHORTAGE IN 2030 DUE TO 2-DAY LOSS OF GHWTP (mgd)	EXPECTED ADDED PEAK-SEASON SHORTAGE DUE TO REGULATORY CHANGES (mg)
Desalination:		
D-1. City-Only	1.10	357
D-2. Regional	1.10	357
D-3. City-Only w/ Santa Margarita	2.35	350
D-4. Regional w/ Santa Margarita	2.35	350
Reclamation/Groundwater Exchange:		
R-1. City-Only	4.85	353
R-2. Regional	4.85	353
R-3. City-Only w/ Santa Margarita	4.05	374
R-4. Regional w/ Santa Margarita	4.05	374

a) Catastrophic Events

The catastrophic events on which the IWP focused were two-day losses of the Graham Hill treatment plant and the Newell Creek Pipeline. Chart VI-4 shows the comparison of strategy performance in the event of a two-day loss of the Graham Hill treatment plant. The desalination strategies are much less vulnerable to such an event than the reclamation/groundwater strategies. This is because the desalinated water can be delivered directly to either the Santa Cruz or Soquel Creek system without additional treatment at Graham Hill. The coast groundwater supply must be treated at Graham Hill.

A two-day loss of the Newell Creek Pipeline will render the Loch Lomond supply inaccessible. Due largely to the volume of treated water storage in the Santa Cruz system (most at the Bay Street reservoir), all of the strategies could equally withstand such an event with no customer curtailment. Thus, this event does not distinguish among the strategies.

b) Regulatory Events

Chart VI-5 shows the mean, over the four regulatory events, of the added peak-season shortage. There is little distinction in how the strategies respond to these events.

3. Environmental Impacts

As discussed above, and described in detail in Appendix C, a preliminary analysis was done to assess a variety of potential environmental impacts of the strategies. That analysis concluded that the strategies can be distinguished against three environmental criteria:

- Marine resources
- Groundwater hydrology
- Indirect land use (growth inducement)

Table VI-6 summarizes the impacts of the strategies on marine resources and groundwater hydrology. Charts VI-6 and VI-7 compare these impacts. Not surprisingly, only the desalination strategies have a potential effect on marine resources. As described in Appendix C, these impacts relate primarily to the entrainment and impingement of marine organisms. Moreover, because of the ongoing nature of desalination plant operation in a regional strategy, the regional desalination strategies are estimated to have more potential impacts than the city-only strategies.

Desalination strategies that do not include development of the Santa Margarita aquifer at Live Oak have no geo-hydrologic impacts. Those that do include the Santa Margarita are estimated to have moderate impacts. Because of their potential impacts on the North Coast aquifers, the reclamation/coast groundwater strategies have greater impacts overall than do the desalination strategies.

The third environmental criterion is indirect land use, specifically growth inducement impacts. Growth inducement was discussed at great length by the IWPC, and the committee members were unable to reach agreement on any distinctions among the strategies. One of the key areas of disagreement was over the distinction, if any, between the degree to which regional and city-only strategies induce growth. On the one hand, it was argued that the city-only strategy would not induce growth because the facility would only be operated significantly in drought years since the City has ample water in other years. This limits the potential for direct growth inducement.

Moreover, the initial capacity increment provided for in the IWP was to meet current drought-year shortages. Any potentially available additional supply (as provided, for example, by desalination facilities that have a larger physical capacity than is needed initially) would be restricted by permit conditions of the facility that would limit its use and a policy statement by the City that reinforced the purpose and need of the facility.

TABLE VI-6
SUMMARY OF IMPACTS ON MARINE AND GROUNDWATER RESOURCES

STRATEGY	MARINE RESOURCE IMPACTS	GROUNDWATER HYDROLOGY IMPACTS
Desalination:		
D-1. City-Only	Potential to entrain and/or impinge organisms. Potential to damage kelp and reef habitat by in-water construction. No anticipated impacts of brine disposal due to mixing and dilution before outfall.	No impacts.
D-2. Regional	Potentially greater entrainment and impingement impacts than Strategy D-1 because of greater plant operating frequency. No impacts from brine disposal.	No impacts.
D-3. City-Only w/ Santa Margarita	Same impacts as D-1.	Potential impacts to Santa Margarita aquifer include depletion, and seawater intrusion.
D-4. Regional w/ Santa Margarita	Same impacts as D-2.	Higher potential for depletion and seawater intrusion of Santa Margarita aquifer.
Reclamation/Groundwater Exchange:		
R-1. City-Only	No impact.	Potential depletion of North Coast aquifer and subsequent seawater intrusion if there is not adequate recharge. Potential water quality and contamination issues from an upslope landfill. Potential benefit if the volume of water withdrawn for this strategy is less than the volume that is presently withdrawn.
R-2. Regional	No impact.	Higher potential for depletion of groundwater aquifer and seawater intrusion since water would be withdrawn more frequently and at a higher volume. Potential water quality and contamination issues from an upslope landfill.
R-3. City-Only w/ Santa Margarita	No impact.	North Coast aquifer: Impacts similar to R-1. Santa Margarita aquifer: Impacts similar to D-3.
R-4. Regional w/ Santa Margarita	No impacts.	North Coast aquifer: Impacts similar to R-2. Santa Margarita aquifer: Impacts similar to D-4.

In contrast, the regional alternative would provide water supply that is specifically intended for growth and thus was seen as having potentially greater environmental impacts related to growth than the City-only alternative. However, a point was raised that the later increments of water supply planned in the City-only alternative are also for future growth needs, and thus, following the same reasoning, may also have environmental impacts related to growth-inducement.

In the end, the Committee could not agree whether there was a clear distinction between the city-only and regional alternatives in terms of growth-inducement impacts.

This issue will be examined in more detail in the upcoming EIR. The CEQA guidelines require that EIRs discuss whether a proposed project will foster direct or indirect growth of population, economic development, or housing construction. Growth inducement can be broadly defined as any action or circumstance that encourages growth or removes a barrier to growth, regardless of whether the resulting growth is in excess of projections made by local jurisdictions or regional associations of governments or not. Section 15126.2 (d) of the guidelines also states that growth in any area should not be assumed as necessarily beneficial, detrimental, or of little significance to the environment. However, if there are indirect environmental effects of growth induced by a project, they need to be addressed when preparing an EIR. If induced growth is within the projections of an adopted general plan, as is the case for the first increment of supply provided by the IWP, it is often feasible to refer to the general plan EIR for the impact assessment, so additional analysis is not needed.

This discussion will rely upon a clearly described project description that includes a statement of the IWP objectives and presentation of the data that motivates these objectives (e.g., present and projected drought-year supply deficits, population growth as anticipated in the current General Plans, and the anticipated water demand estimates). The evaluation will include discussion of potential impacts due to growth-inducement on traffic, air quality, noise, and public health and safety.

4. Energy Consumption

Recall that this criterion refers only to the energy used to serve the City's water customers. It explicitly excludes energy used to serve Soquel Creek customers. Therefore, as shown in Table VI-7 and Chart VI-8, the energy consumption of the corresponding city-only and regional strategies are identical. The EIR will examine the energy consumption associated with Soquel Creek use of a regional supply.

The table and chart also show that there is only a small difference among all the strategies in terms of their mean energy usage. The reclamation/coast groundwater strategies generally use slightly more energy (276–286 million gallons) through 2030 than do their desalination counterparts (246-260 million gallons). The energy intensiveness of the desalination plant makes this result appear counter-intuitive. It is due to two factors:

TABLE VI-7
PERFORMANCE OF STRATEGIES AGAINST ENERGY USE CRITERION

STRATEGY	EXPECTED TOTAL ENERGY USE OVER PLANNING PERIOD TO SERVE SCWD CUSTOMERS (million kwh)
Desalination:	
D-1. City-Only	260
D-2. Regional	260
D-3. City-Only w/ Santa Margarita	246
D-4. Regional w/ Santa Margarita	246
Reclamation/Groundwater Exchange:	
R-1. City-Only	276
R-2. Regional	276
R-3. City-Only w/ Santa Margarita	286
R-4. Regional w/ Santa Margarita	286

- The desalination plant runs very infrequently. Therefore, on average, the energy usage associated with that plant is low.
- The reclamation plant operates every year to provide irrigation water to the coast farmers. This year-in, year-out operation adds considerable energy usage to the reclamation/coast groundwater strategies.

5. Impacts on Purisima Aquifer

As shown in Table VI-8 and Chart VI-9, it is estimated that city-only strategies have somewhat higher potential impacts on the Purisima than regional strategies. This is because, without access to a regional resource, the Soquel Creek Water District will be forced to rely more heavily on the Purisima, which would result in a higher likelihood of basin degradation.

TABLE VI-8
IMPACT OF STRATEGIES ON PURISIMA AQUIFER

STRATEGY	EXPECTED IMPACT ON PURISIMA AQUIFER IN 2020
Desalination:	
D-1. City-Only	Degradation
D-2. Regional	No Change
D-3. City-Only w/ Santa Margarita	Degradation
D-4. Regional w/ Santa Margarita	No Change
Reclamation/Groundwater Exchange:	
R-1. City-Only	Degradation
R-2. Regional	No Change
R-3. City-Only w/ Santa Margarita	Degradation
R-4. Regional w/ Santa Margarita	No Change

6. Ease of Implementation

Table VI-9 shows the ratings of each of the eight strategies against each of the following potential implementation constraints:

- Permits required
- Agreements/ partnerships required
- Land acquisition/easements
- Project schedule

Based on these ratings, Chart VI-10 shows the overall implementation rankings of the eight strategies. The strategy judged easiest to implement is ranked first, and the one judged most difficult is ranked eighth. The remainder of the implementation analysis is thoroughly described in Appendix D. One of its key results is that desalination strategies are estimated to be much easier to implement than reclamation/coast groundwater strategies. This is based in large measure on the sizeable number and expected difficulty of the required agreements and partnerships that would be required for the reclamation/groundwater strategies.

TABLE VI-9

RATING OF WATER SUPPLY STRATEGIES: CONSTRAINTS ON IMPLEMENTATION

	Desalination				Reclamation/Groundwater Exchange			
	D-1	D-2	D-3	D-4	R-1	R-2	R-3	R-4
Implementation Factor:	City Desalination	Regional Desalination	City Downsized Desalination/ Groundwater Well	Regional Downsized Desalination/ Groundwater Well	City Reclamation/ North Coast Groundwater	Regional Reclamation/ North Coast Groundwater	City Downsized Reclamation/ North Coast Groundwater	Regional Downsized Reclamation/ North Coast Groundwater
Permits Required	Major	Major	Major	Major	Considerable	Considerable	Considerable	Considerable
Agreements and partnerships	Few	Considerable	Few	Considerable	Major	Major	Major	Major
Land acquisition and easements	Considerable	Considerable	Considerable	Considerable	Few	Some	Few	Some
Schedule	Considerable	Considerable	Some	Some	Considerable	Considerable	Some	Some

The other key result is that regional strategies are expected to be somewhat more difficult to implement than their city-only counterparts. Once again, this is due in part to the higher number of agreements and partnerships. It is also due to an expectation of a need for more land acquisitions and easements in the regional strategies.

B. Overall Strategy Comparisons

The overall evaluation of alternatives can conveniently be broken into four key questions:

1. What are the tradeoffs among different curtailment profiles?
2. How do city-only and regional (i.e. joint with Soquel Creek) strategies compare?
3. What are the comparative advantages of strategies based on desalination vs. those based on the reclamation/coast groundwater exchange?
4. Should the City develop a groundwater supply in the Santa Margarita aquifer at Live Oak in order to downsize the desalination or coast groundwater supply?

Each of these questions will be discussed in turn.

1. Curtailment Profile Comparisons

The only criterion that distinguishes significantly among the various curtailment profiles for all strategies is cost. Not surprisingly, strategies with less expected curtailment require larger and earlier supply additions, and therefore cost more. This is illustrated in Charts VI-11, VI-12, and VI-13. What is striking about all three charts are the very small differences between curtailment profiles 3 and 2, and the substantial differences between profiles 2 and 1. Thus, the City could achieve the smaller and less frequent curtailments of Curtailment Profile 2 at a cost that is scarcely distinguishable from that of CP 3. (Although the costs are very close, the impacts on customers are not. Thus, the 25% worst-year shortage associated with CP 3 would likely require rationing of residential customers, along with significantly more hardship.) Achieving Curtailment Profile 1 (perfect reliability) would require a significantly higher investment on the part of ratepayers and would result in the City having to raise substantially more capital.

a) Conclusion

Based on these results, Curtailment Profile 2 (maximum 15% drought-year shortage) provides the best cost-reliability tradeoff for Santa Cruz water customers.

2. Comparison of City-Only and Regional Strategies

Charts VI-14 and VI-15 contain overall comparisons of city-only vs. regional desalination and reclamation/groundwater strategies. Each chart shows two strategy “contours”. The contours permit a comparison of the performance of two strategies against all evaluation criteria for which the two strategies differ significantly. In order for such a comparison to be meaningful, the scales for all of the criteria must be normalized in a way that discriminates between small and large differences. In all cases, the best performance rating (e.g. least cost, smallest energy usage, easiest to implement, etc.) is normalized to 100, with all other normalized scores set relative to that.

Although the profiles in the two charts differ somewhat, the relationships between the city-only and regional strategies are basically the same.

a) Cost

Not surprisingly, the regional strategies are substantially less costly to the City , due to the cost-sharing with Soquel Creek.

b) Environmental

(1) Geo-hydrologic Impacts

The city-only reclamation/groundwater strategies have somewhat less potential impacts on the North Coast aquifer than their regional counterparts.

(2) Marine Environment

Both city-only and regional desalination strategies are estimated to have potential marine impacts. The city-only potential impacts are estimated as “moderate” while the regional strategy’s potential impacts are “high”. These potential impacts are, at this point, based on limited information and are intentionally conservative. As discussed in detail in Appendix C, these potential impacts involved entrainment or impingement of marine organisms. A more detailed analysis of these impacts and their potential mitigation will be undertaken as part of the EIR.

(3) Growth Inducement

As described above, consensus has not been reached on the relative degree to which the various strategies induce growth. One of the key areas of discussion has been whether or not regional strategies are more growth-inducing than city-only strategies. This remains an area of doubt that will be addressed in the EIR.

c) Ease of Implementation

Regional strategies are estimated to be somewhat more difficult to implement than city-only strategies. This is due to the higher number of required agreements and partnerships and a need for more land acquisitions and easements in the regional strategies.

d) Purisima Aquifer

The city-only strategies have somewhat more impacts to the Live Oak/ Purisima aquifer than the regional strategies. This is an important consideration, since ensuring the health of this resource that is shared with Soquel Creek Water District is fundamental to this water planning effort. If this resource is degraded, the yield of the City's base case Live Oak supply would need to be revised downward and facility sizes would need to be increased to compensate.

e) Conclusion

The substantial cost advantages of the regional strategies provide important savings to current and future ratepayers. The regional strategies also help preserve the Purisima aquifer at Live Oak, which is a critical regional resource. Finally, the regional strategies are expected to be somewhat more difficult to implement

Superimposed on these considerations is the uncertainty over the growth-inducing impacts of regional vs. city-only strategies.

Due to this uncertainty, no conclusion is drawn on the relative merit of a regional strategy vs. a city-only strategy.

3. Comparison of Desalination and Reclamation/Coast Groundwater Strategies

Chart VI-16 shows the overall comparison of the city-only desalination (D-1) and reclamation/ groundwater (R-1) strategies, while Chart VI-17 shows the comparison between the corresponding regional strategies. Following are discussions of the key tradeoffs.

a) Cost

The cost impacts on ratepayers are slightly higher for the desalination strategies than for the reclamation/groundwater strategies, as shown by the 'present value cost' and 'residential monthly cost' criteria. However, the reclamation/groundwater strategy requires somewhat more short-term capital investment.

b) Vulnerability to Catastrophic Events

The desalination strategy offers significantly more relief from an unexpected outage at the Graham Hill water treatment plant. This is because the desalination plant produces treated water which does not require further treatment at Graham Hill. This additional system redundancy is an especially important issue. Future failures of the Graham Hill treatment plant are very possible as the plant is old and is often called on to operated near its maximum capability.

c) Energy Usage

The difference in energy consumption between the two strategies is insignificant.

d) Environmental

(1) Marine Impacts

The desalination strategy is estimated to have potential impacts on the marine environment due to entrainment and impingement of marine organisms at the intake. Of course, the reclamation/groundwater strategy has no marine impacts. As stated earlier, these potential impacts will be studied in more detail in the EIR, at which time potential mitigation actions will also be investigated.

(2) Geo-Hydrologic Impacts

While the desalination strategy (particularly a regional strategy) has much higher potential marine impacts, it has much lower potential impacts to area groundwater basins. A regional reclamation/groundwater strategy has the potential to seriously impact the North Coast groundwater basins. The desalination strategy has no such impact.

e) Ease of Implementation

As described earlier, the desalination strategy is estimated to be considerably easier to implement than the reclamation/groundwater strategy, due primarily to the larger number of partnerships and agreements that are required. This anticipated difficulty was validated by recent letters from the California Department of Parks and Recreation and from North Coast organic growers. The letter from the state expressed the Department's unwillingness to pursue further consideration of the exchange of reclaimed wastewater for groundwater at Wilder Ranch State Park. The exchange was felt to involve "uncharted legal and complex policy issues having serious long-term implications of statewide consequence . . . ." The letter further stated that "it is the Department's assessment that the use of reclaimed wastewater at Wilder Ranch could result in potential adverse impacts to sensitive natural resources, place possible constraints on recreational usage and adversely impact organic agricultural leasing operations at Wilder Ranch State Park."

The state's current unwillingness to consider the groundwater exchange represents a major, if not fatal, barrier to moving forward with the reclamation/groundwater exchange strategies.

The full text of the letters is included as Appendix E.

f) Other Considerations

The yield of the north coast groundwater basin is subject to considerable uncertainty. Based on limited information, the IWP assumes an annual safe yield of 700 million gallons. A recent staff study estimates annual withdrawals by North Coast farmers at no more than 400 million gallons.[23] If the yield were in fact that low, this strategy could not achieve curtailment profile 2. Moreover, the yield would be insufficient for a regional strategy. Thus, if the reclamation/groundwater strategy is selected, it would have to be contingent on considerable geo-hydrologic study to confirm the basin yield before moving forward with the project. There is, of course, no such uncertainty of yield associated with desalination.

g) Conclusion

The foregoing analysis has shown that desalination strategies have the following advantages:

- Much lower near-term capital costs
- Much less vulnerability to short-term system failures
- Lower impact on groundwater basins
- Much easier to implement
- No limitations or uncertainty on annual yield

The reclamation/groundwater strategies have the following advantages:

- Somewhat less expensive to ratepayers over the planning period
- Substantially less impact on marine environment[24]

When these comparisons are coupled with the State of California's current opposition to the exchange of North Coast groundwater, the desalination strategies are clearly superior.

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[23] City of Santa Cruz Water Department. *Investigation of Agricultural Water Sources, Northern Santa Cruz County, California*. June 2002

[24] At this point, it is unknown how many, if any, of the marine impacts are mitigable. More information on impacts, mitigation approaches and mitigation costs will be developed as part of the EIR.

4. Developing the Santa Margarita Aquifer at Live Oak

The final question that must be addressed is whether to develop the Santa Margarita aquifer at Live Oak as a source to supplement the desalination plant. This groundwater supply is estimated to have a small yield (assumed to be 100 million gallons annually), and even that figure is very uncertain.

As shown in Table V-3, due to the small size of the Santa Margarita supply, the downsizing and/or deferral of desalination is minor at best. For Curtailment Profile 2, it turns out that no deferral or downsizing of the desalination facility results.[25] In any event, the cost differences due to such deferral/downsizing will be very slight. and the discrete (0.5 mgd) increments of desalination

Chart VI-18 shows that, for most evaluation criteria, the performance of the two strategies is very close.[26] On the few for which there are noteworthy differences (Graham Hill vulnerability and geo-hydrologic impacts), the strategy which excludes Santa Margarita development (D-2) is superior.

In addition, the uncertainty of the magnitude of this supply results in the need for additional exploratory studies, analogous to those described above for the North Coast wells.

It is therefore concluded that development of the Santa Margarita aquifer at Live Oak should not be undertaken.

5. Preferred Strategies

There is no strategy that is unequivocally superior to all others. Such a strategy would have to out-perform all others on all evaluation criteria. In real-world planning efforts, this is rarely the case. Tradeoffs must always be made.

Reviewing the four questions that needed to be resolved:

1. Because of the relative costs to ratepayers of the three curtailment profiles, Curtailment Profile 2 (15% worst-year curtailment) was chosen.

2. In spite of the substantial cost and other advantages of a regional strategy, the remaining uncertainty in the degree to which a regional strategy induces growth resulted in no clear advantage for either the city-only or the regional strategy. Additional information is needed and will be developed during the EIR.

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[25] There are two reasons for this. First, it is due to the discrete (0.5 mgd) increments of desalination capacity. In addition, because of the extreme uncertainty of the Santa Margarita supply, it was decided not to increase useable storage in Loch Lomond when this supply is present.

[26] This chart compares regional strategies. The comparison between city-only strategies is very similar.

3. While estimated to be slightly more costly overall, the desalination strategies significantly out-perform the reclamation/groundwater strategies against all other criteria, with the important exception of impacts on marine resources. The marine impacts will be better specified in the EIR, along with potential mitigation approaches. In particular, the recent letter from the State Parks Department places the ability to implement the reclamation/groundwater strategies in serious doubt. Moreover, as stated above, the state's current unwillingness to consider the groundwater exchange may be an insurmountable barrier to moving forward with the reclamation/groundwater exchange strategies.

4. Supplemental development of the Santa Margarita aquifer at Live Oak does not significantly improve performance against any criterion. It increases vulnerability to a Graham Hill plant outage and increases geo-hydrologic impacts.

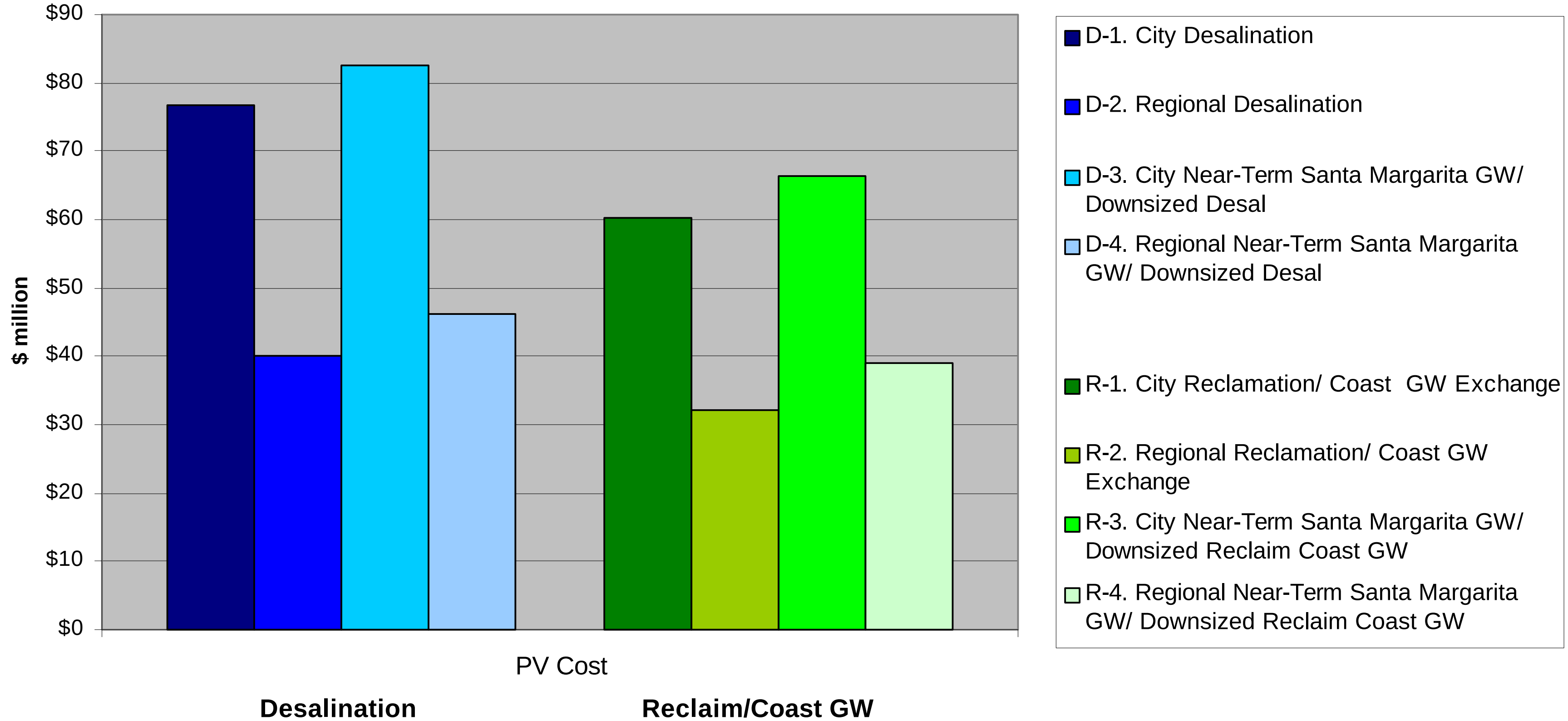
Based on these results, Strategies D-1 and D-2 (City-Only and Regional Desalination) at Curtailment Profile 2 (15% worst-year curtailment) are identified as the preferred alternatives. The final choice between the city-only and regional strategies is deferred to completion of the Environmental Impact Report.

Table VI-10 compares the cost components for the two preferred strategies. In all cases, the net cost is the cost in excess of the operations and maintenance costs that would be incurred in the base case.

Table VI-10
PRESENT VALUE COST COMPONENTS OF PREFERRED STRATEGIES
($ millions)

COST COMPONENT	STRATEGY D-1 CITY-ONLY DESALINATION	STRATEGY D-2 REGIONAL DESALINATION
Debt Service on Capital Investment	$31	$15
Operations & Maintenance	$74	$53
Conservation	$12	$12
SUBTOTAL	$117	$80
LESS: Base Case O&M	($40)	($40)
NET COST	**$77**	**$40**

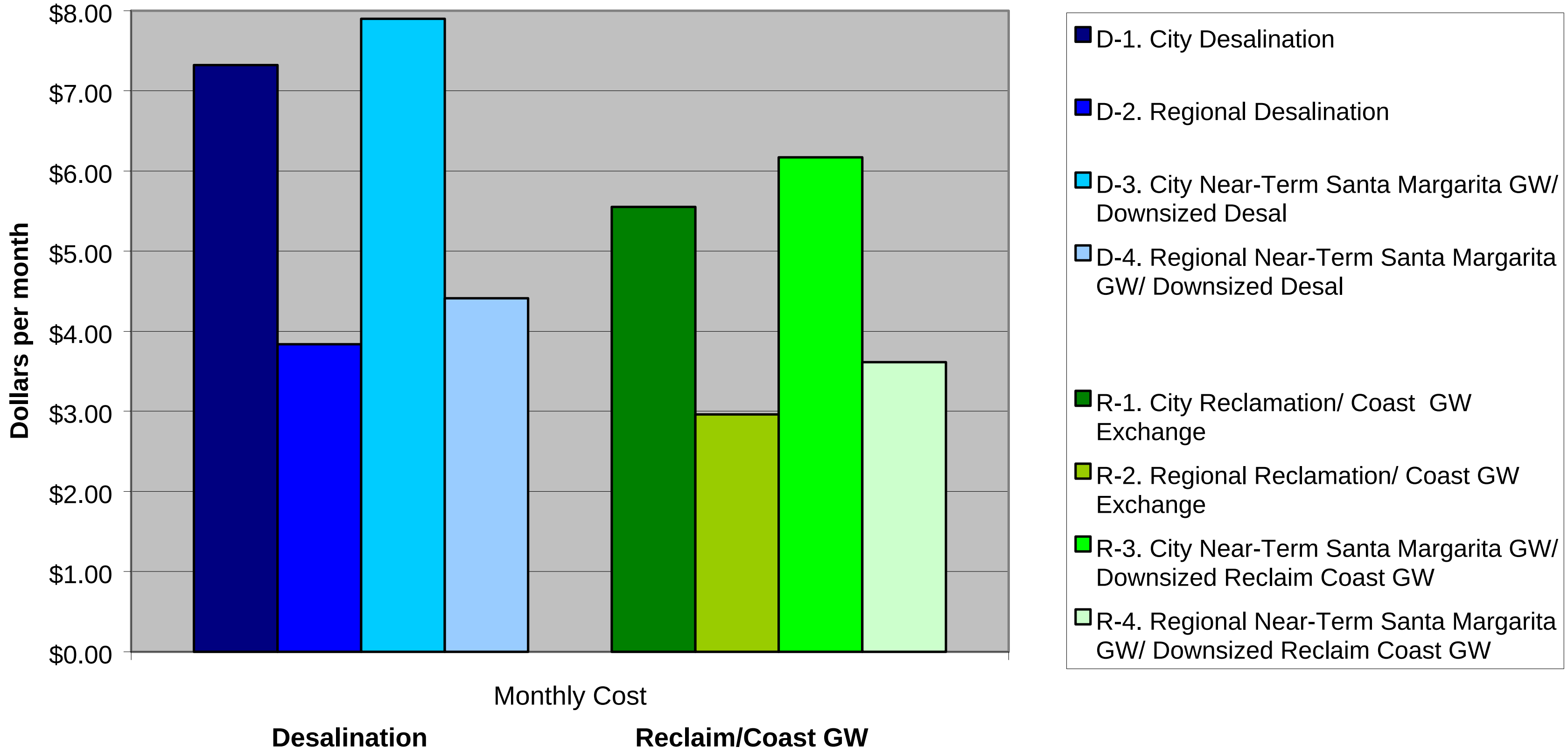
CHART VI-1
Strategy Comparison: Present Value Cost to City
(Curtailment Profile 2)



Key Messages:

Desalination strategies *somewhat more expensive* than Reclamation strategies.
City-only strategies *substantially more expensive* than Regional strategies.

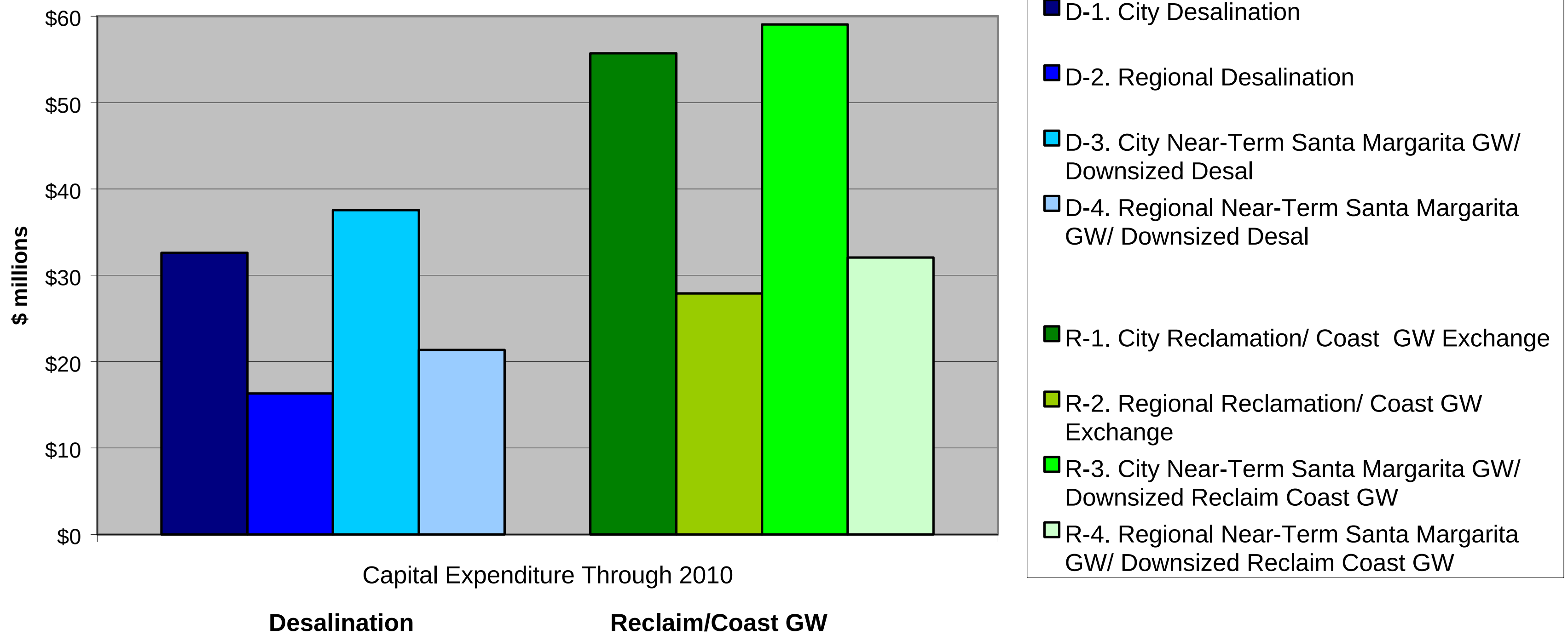
CHART VI-2
Strategy Comparison:
Expected Monthly Cost to Santa Cruz Residential Customers
(Curtailment Profile 2)



Key Messages:

Desalination strategies affect customer costs *somewhat more* than Reclamation strategies.
City-only strategies affect customer costs *substantially more* than Regional strategies.

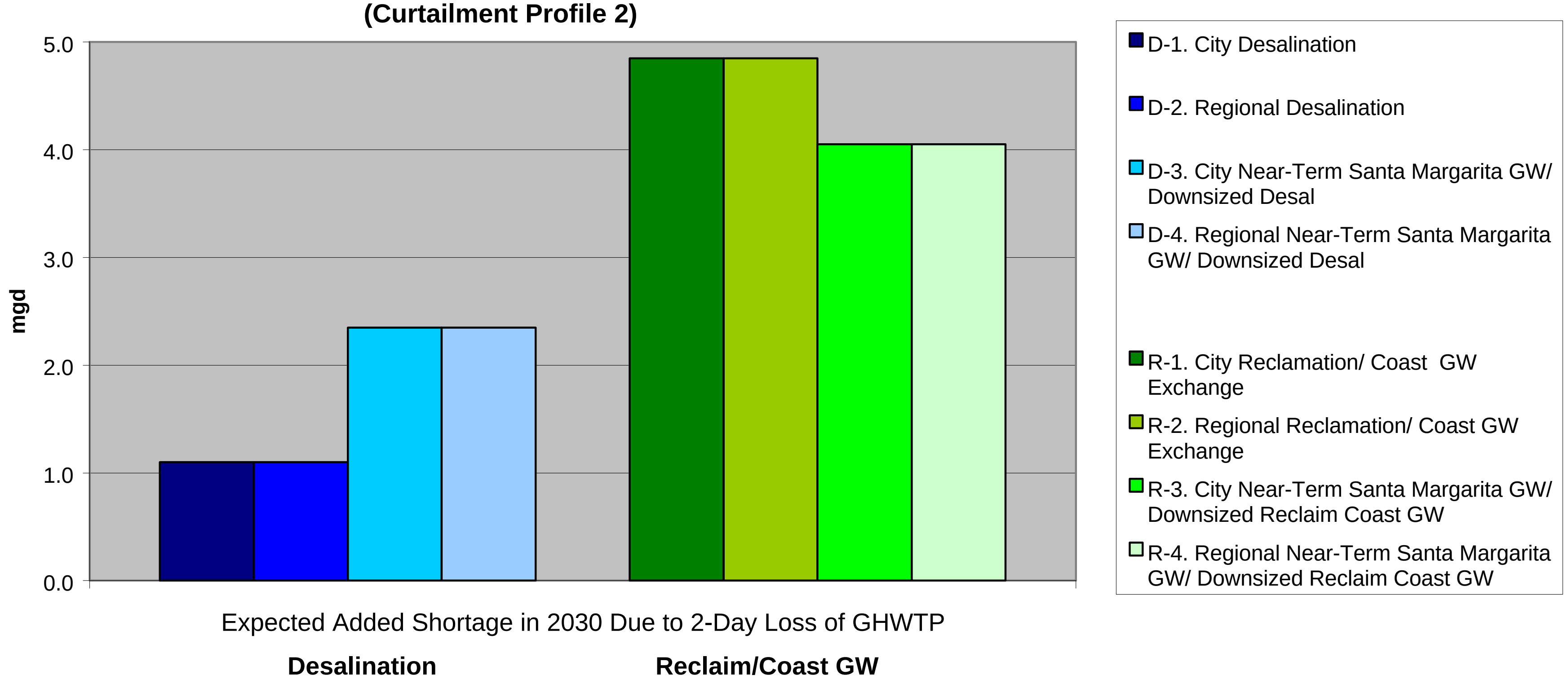
CHART VI-3
Strategy Comparison:
Near-Term City Capital Expenditure
(Curtailment Profile 2)



Key Messages:

Desalination strategies *much less capital intensive* than Reclamation strategies.
City-only strategies *substantially more capital intensive* than Regional strategies.

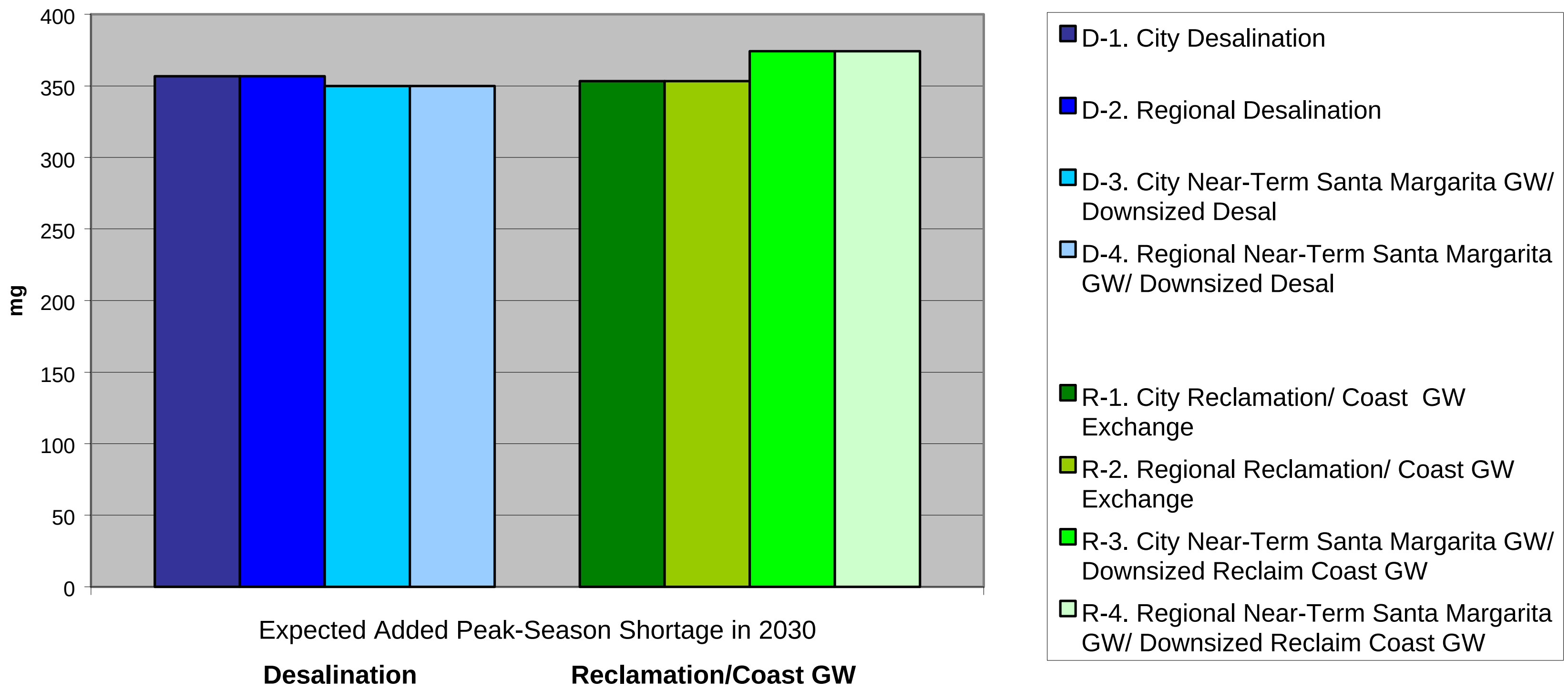
CHART VI-4
Strategy Comparison:
Vulnerability to Loss of Graham Hill Treatment Plant
(Curtailment Profile 2)



Key Message:

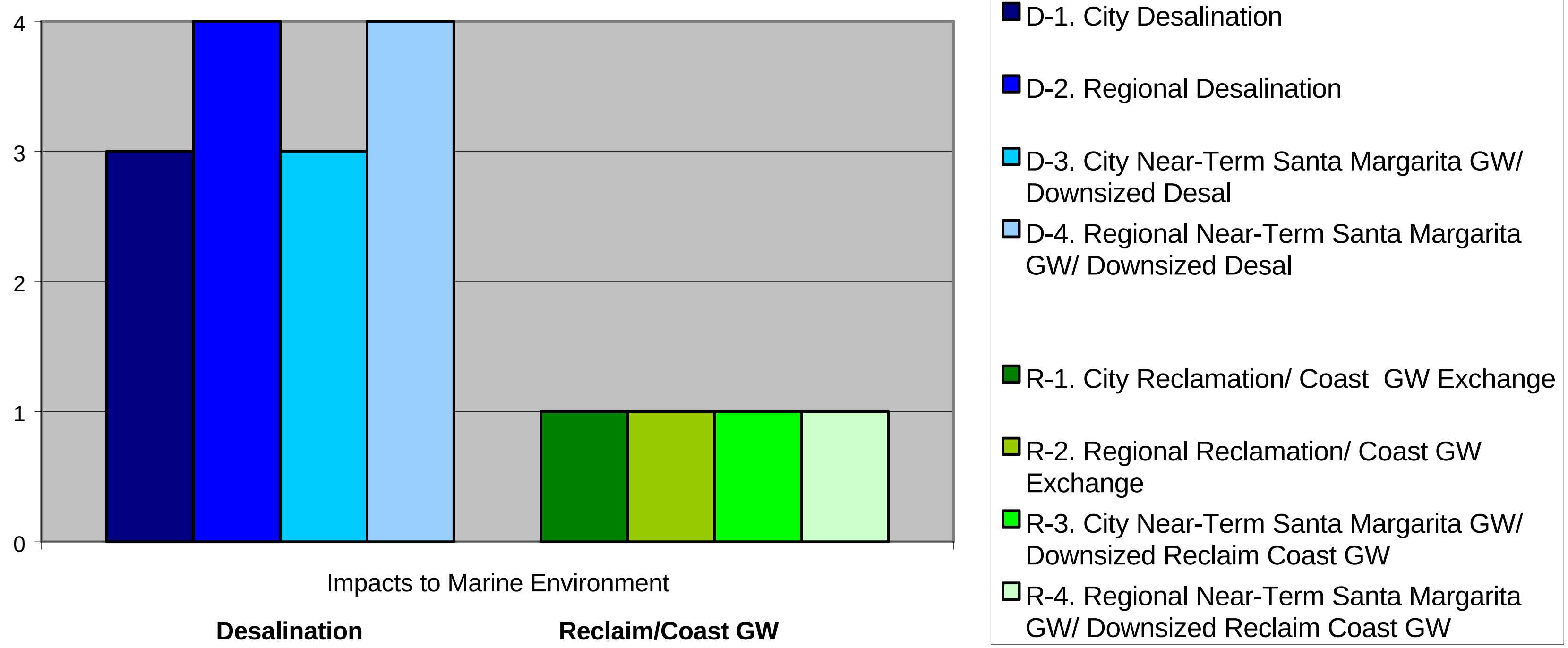
Desalination strategies *much less vulnerable* than Reclamation strategies.

CHART VI-5
Strategy Comparison: Vulnerability to Regulatory Events
(Curtailment Profile 2)



Key Message:
Little distinction in vulnerability of strategies.

CHART VI-6
Strategy Comparison:
Potential Marine Environment Impacts
(Curtailment Profile 2)



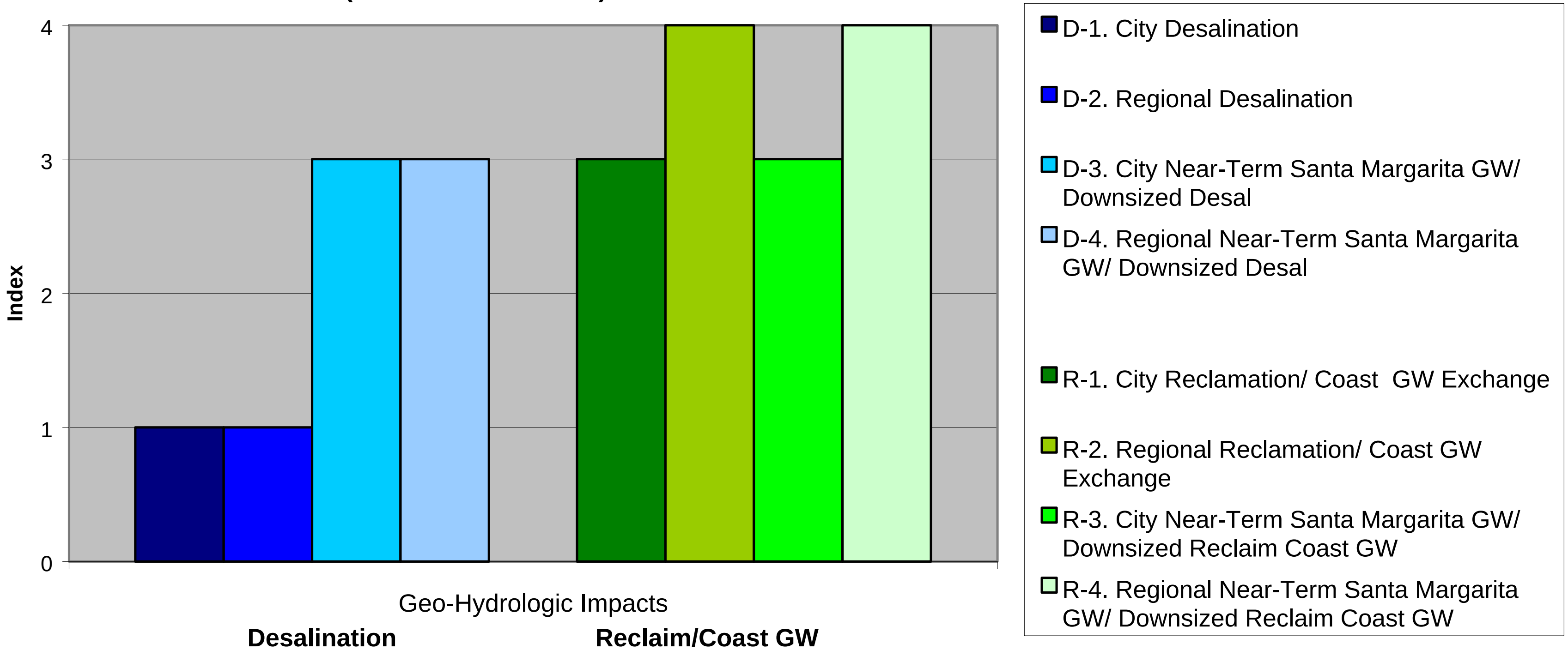
Impact Key:
1=None 3=Moderate
2=Low 4=High

Key Messages:

Desalination strategies have *substantially more potential marine impact* than Reclamation strategies.

City-only desalination strategies have *less potential marine impact* than Regional strategies.

CHART VI-7
Strategy Comparison:
Potential Geo-Hydrologic Impacts
(Curtailment Profile 2)



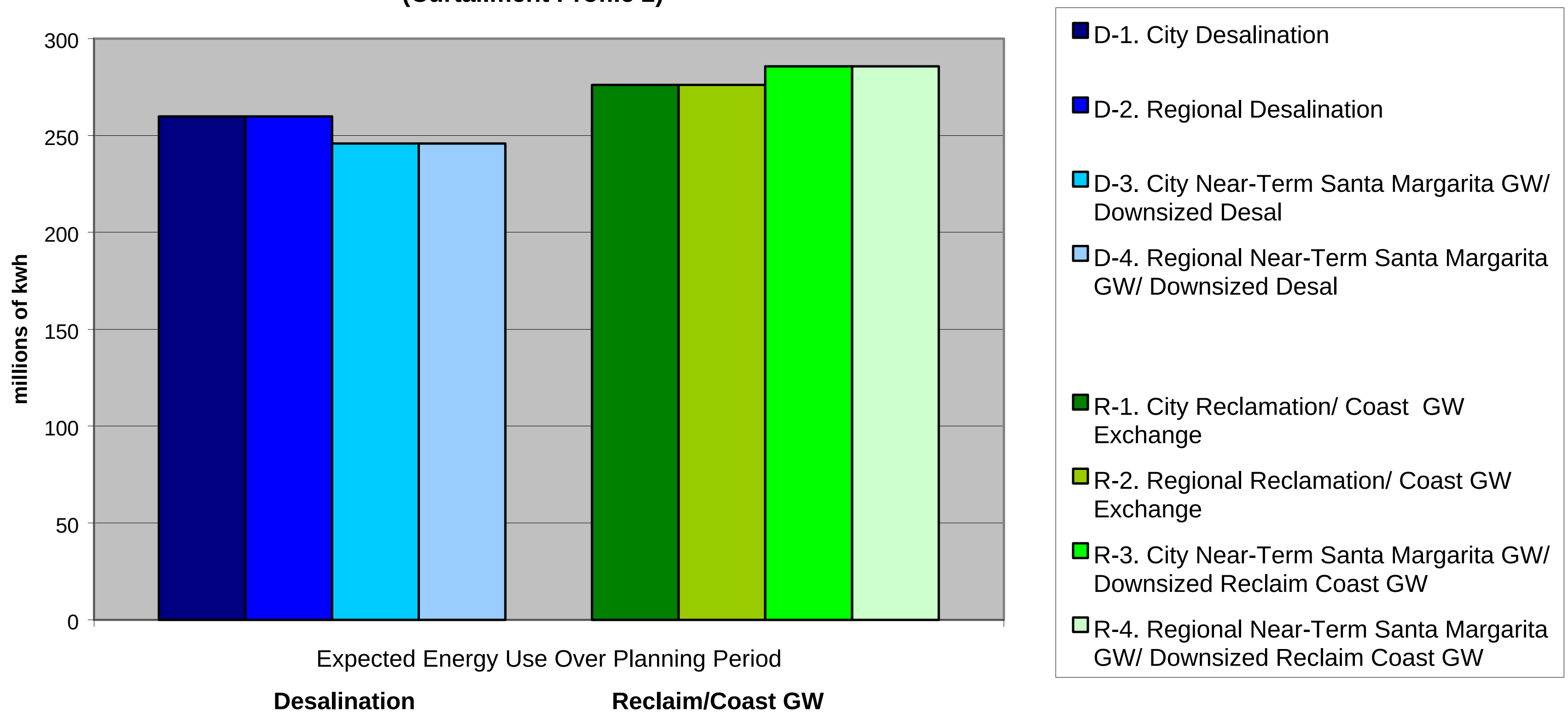
Impact Key:
1=None 3=Moderate
2=Low 4=High

Key Messages:

Desalination strategies have *less potential impact on groundwater basins* than Reclamation strategies.

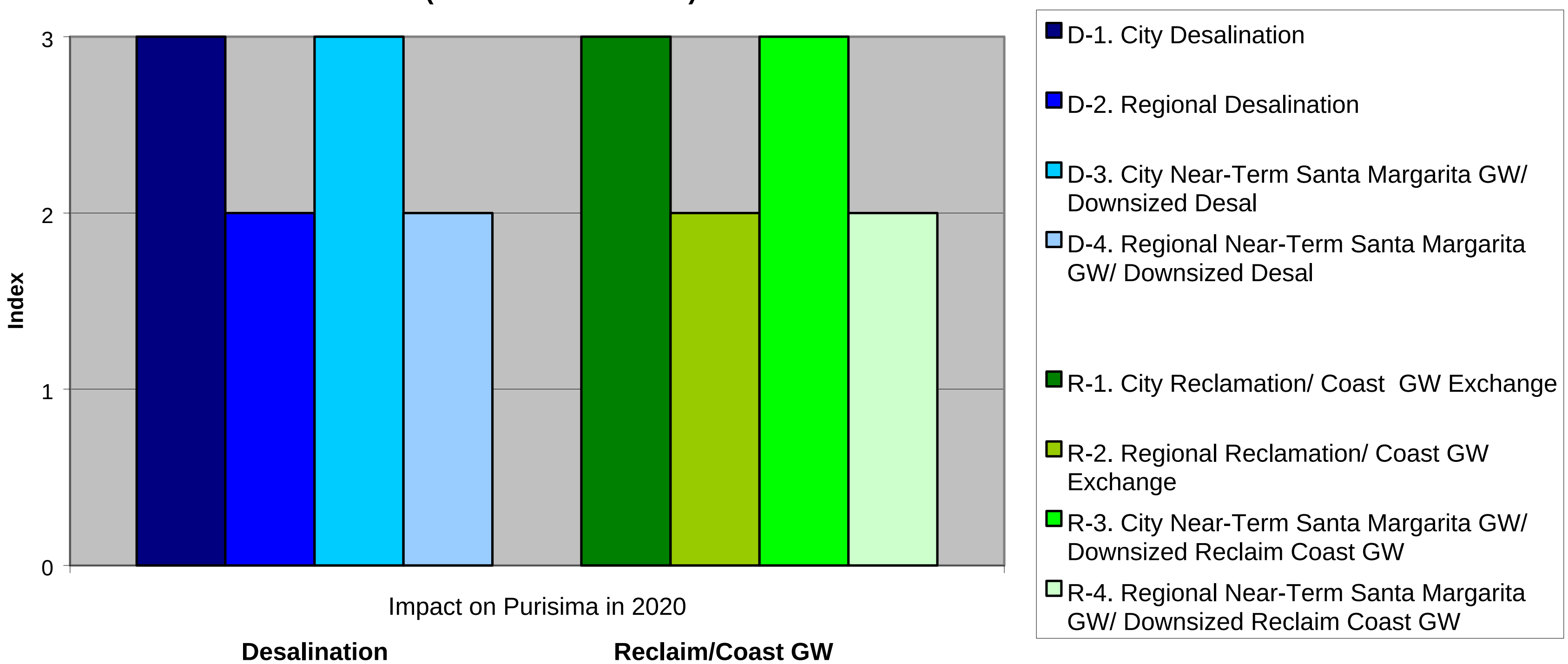
Desalination strategies without development of the Santa Margarita at Live Oak have *much less potential impact on groundwater basins* than Desalination strategies with SM/Live Oak.

CHART VI-8
Strategy Comparison: Energy Usage by City of Santa Cruz
(Curtailment Profile 2)



Key Message:
Desalination strategies *somewhat less energy intensive* than Reclamation strategies.

CHART VI-9
Strategy Comparison:
Impacts on Purisima Aquifer
(Curtailment Profile 2)

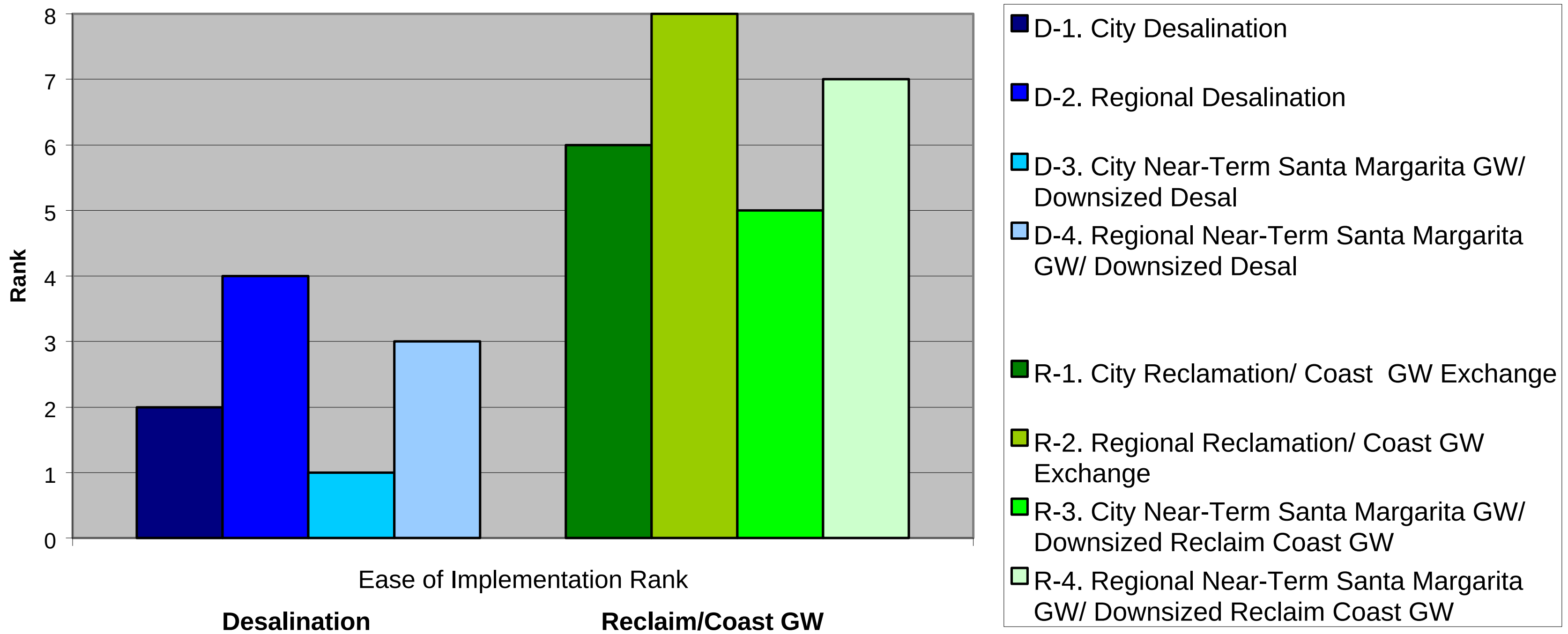


Impact Key:
1=Improvement
2=No change
3=Degradation

Key Message:

City-only strategies have the potential of *somewhat more damage* to Purisima aquifer than Regional strategies.

CHART VI-10
Strategy Comparison:
Ease of Implementation
(Curtailment Profile 2)



Key Messages:

Desalination strategies *much easier to implement* than Reclamation strategies.
City-only strategies *somewhat easier to implement* than Regional strategies.

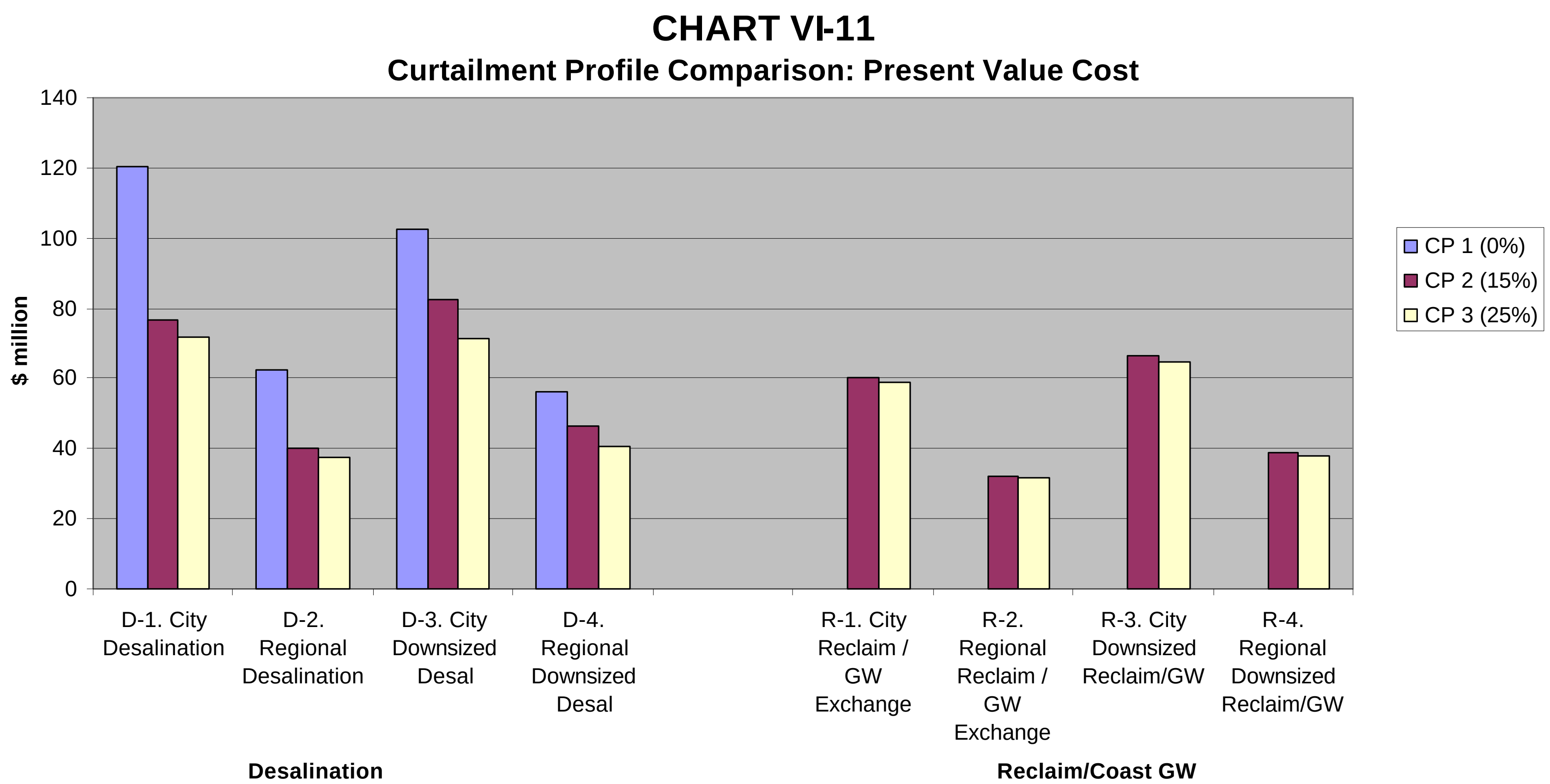


CHART VI-11
Curtailment Profile Comparison: Present Value Cost
$ million
140
120
100
80
60
40
20
0
CP 1 (0%)
CP 2 (15%)
CP 3 (25%)
D-1. City Desalination
D-2. Regional Desalination
D-3. City Downsized Desal
D-4. Regional Downsized Desal
R-1. City Reclaim / GW Exchange
R-2. Regional Reclaim / GW Exchange
R-3. City Downsized Reclaim/GW
R-4. Regional Downsized Reclaim/GW
Desalination
Reclaim/Coast GW

CHART VI-12
Curtailment Profile Comparison:
Expected Increase in Monthly Residential Water Costs

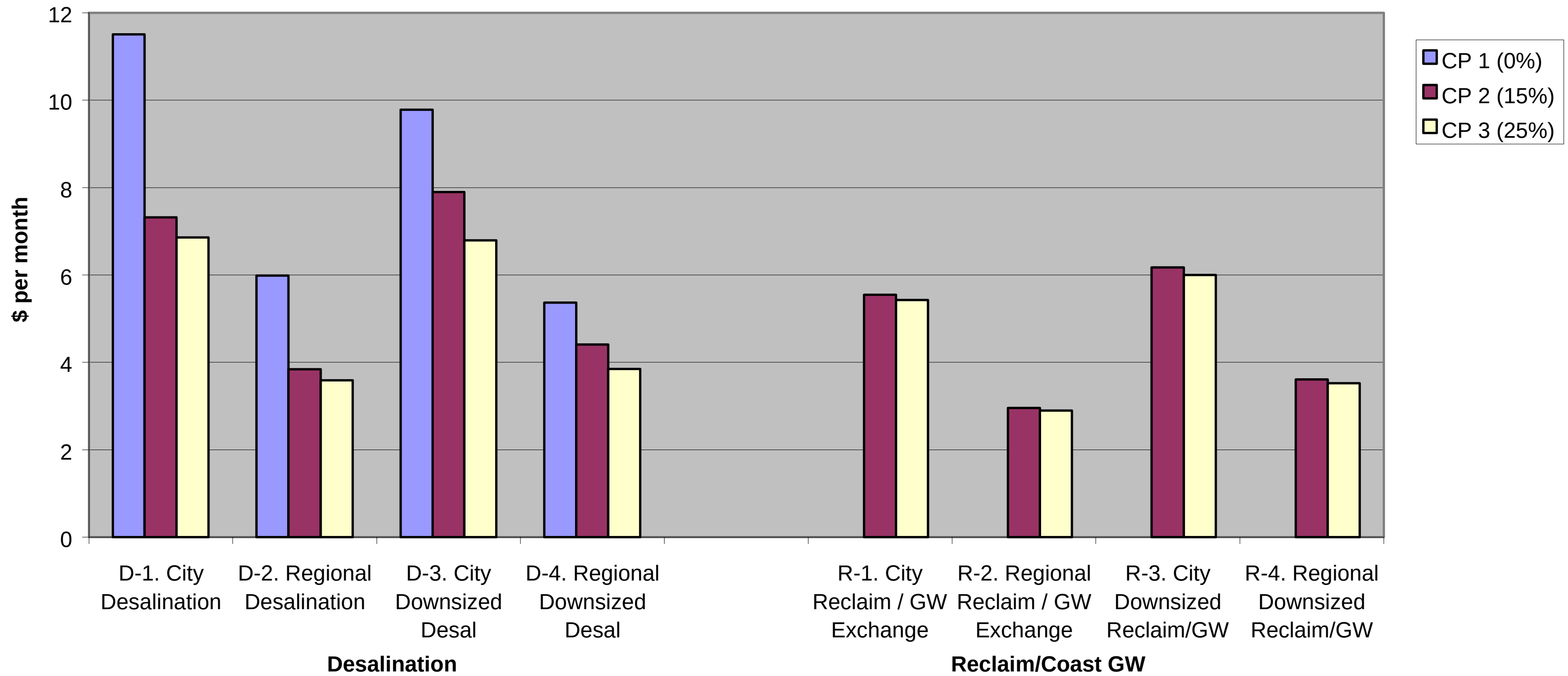


CHART VI-13
Curtailment Profile Comparison: Near-Term Capital Expenditures

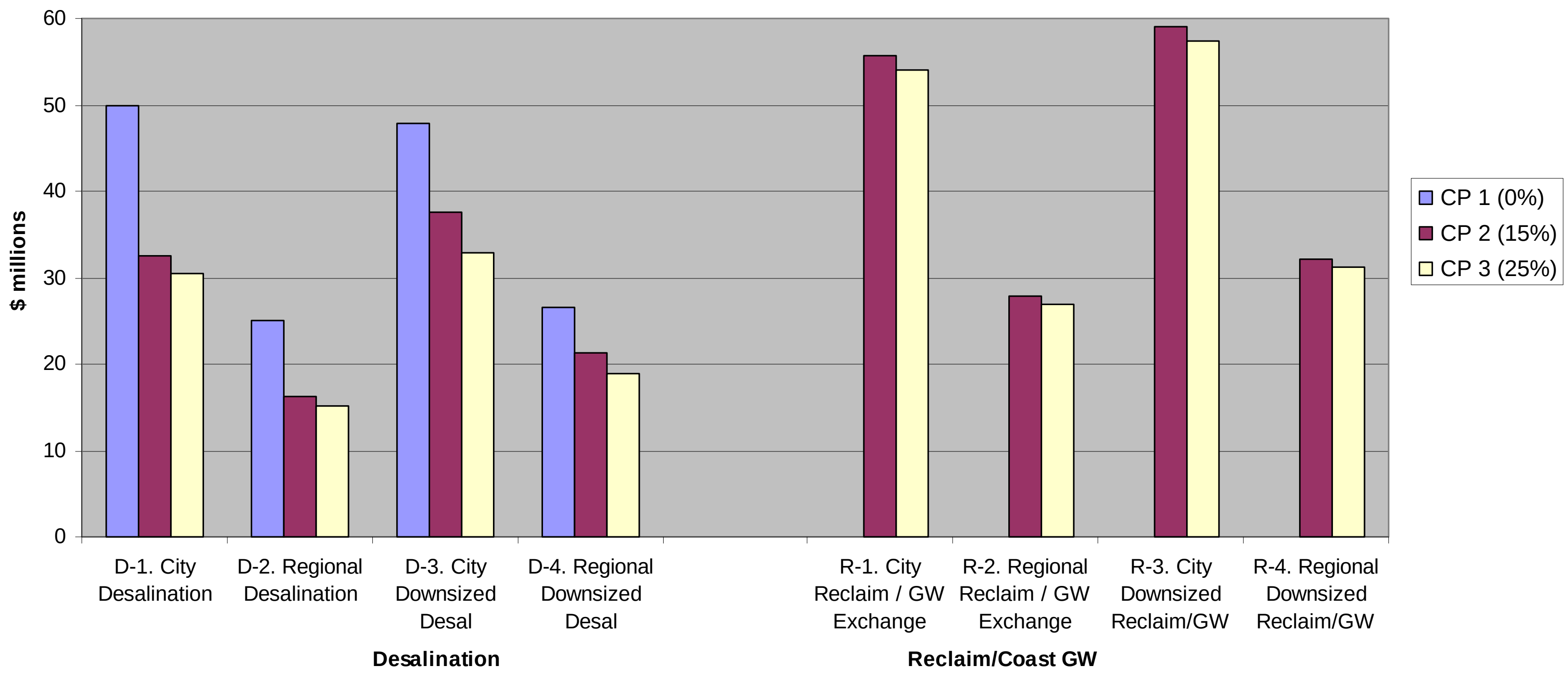


CHART VI-14
City-Only Desal (D-1) vs. Regional Desal (D-2)
(Curtailment Profile 2)

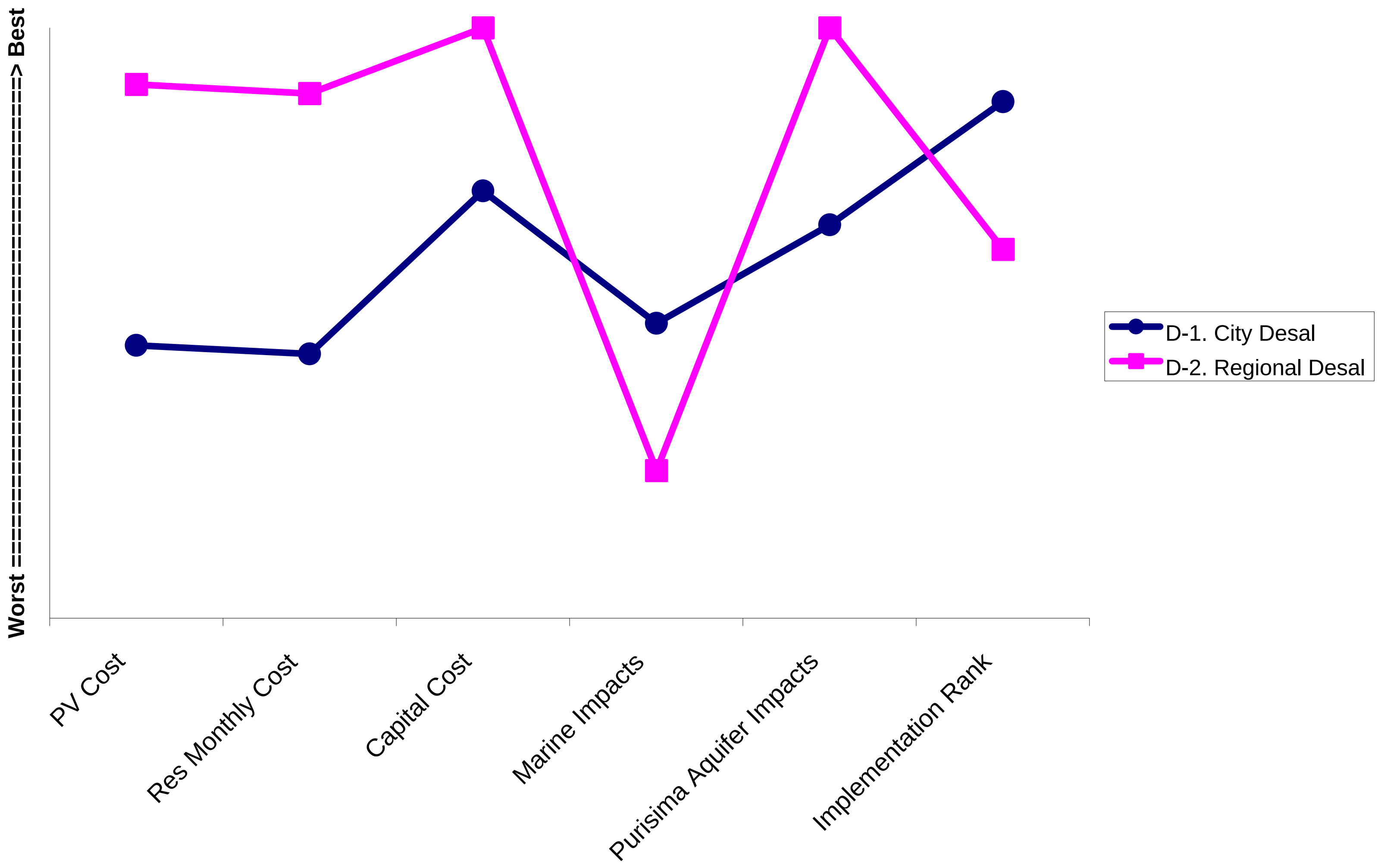


CHART VI-15
City-Only Reclaim/GW (R-1) vs. Regional Reclaim/GW (R-2)
(Curtailment Profile 2)

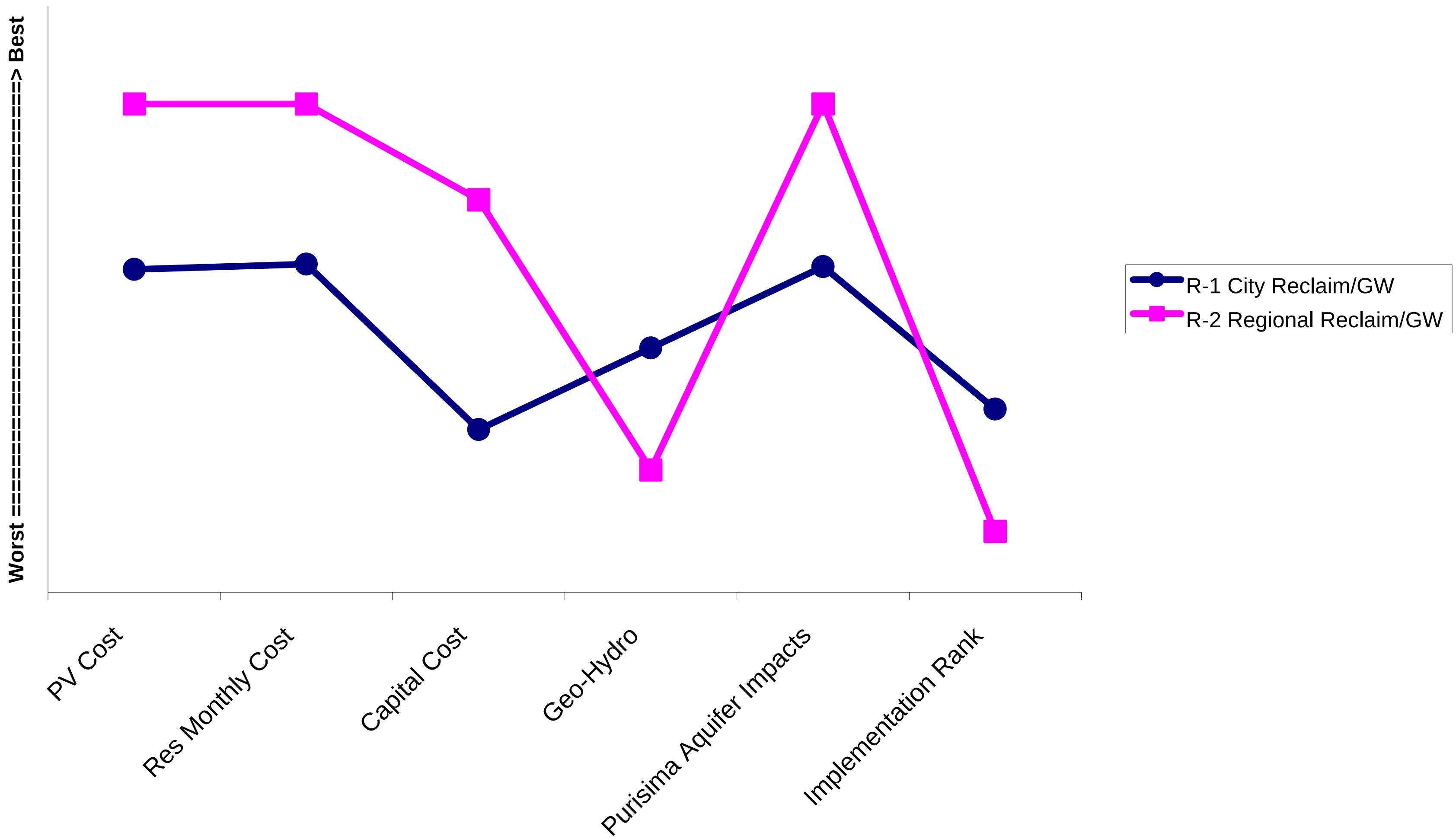


CHART VI-16
City Desal (D-1) vs. City Reclaim/GW (R-1)
(Curtailment Profile 2)

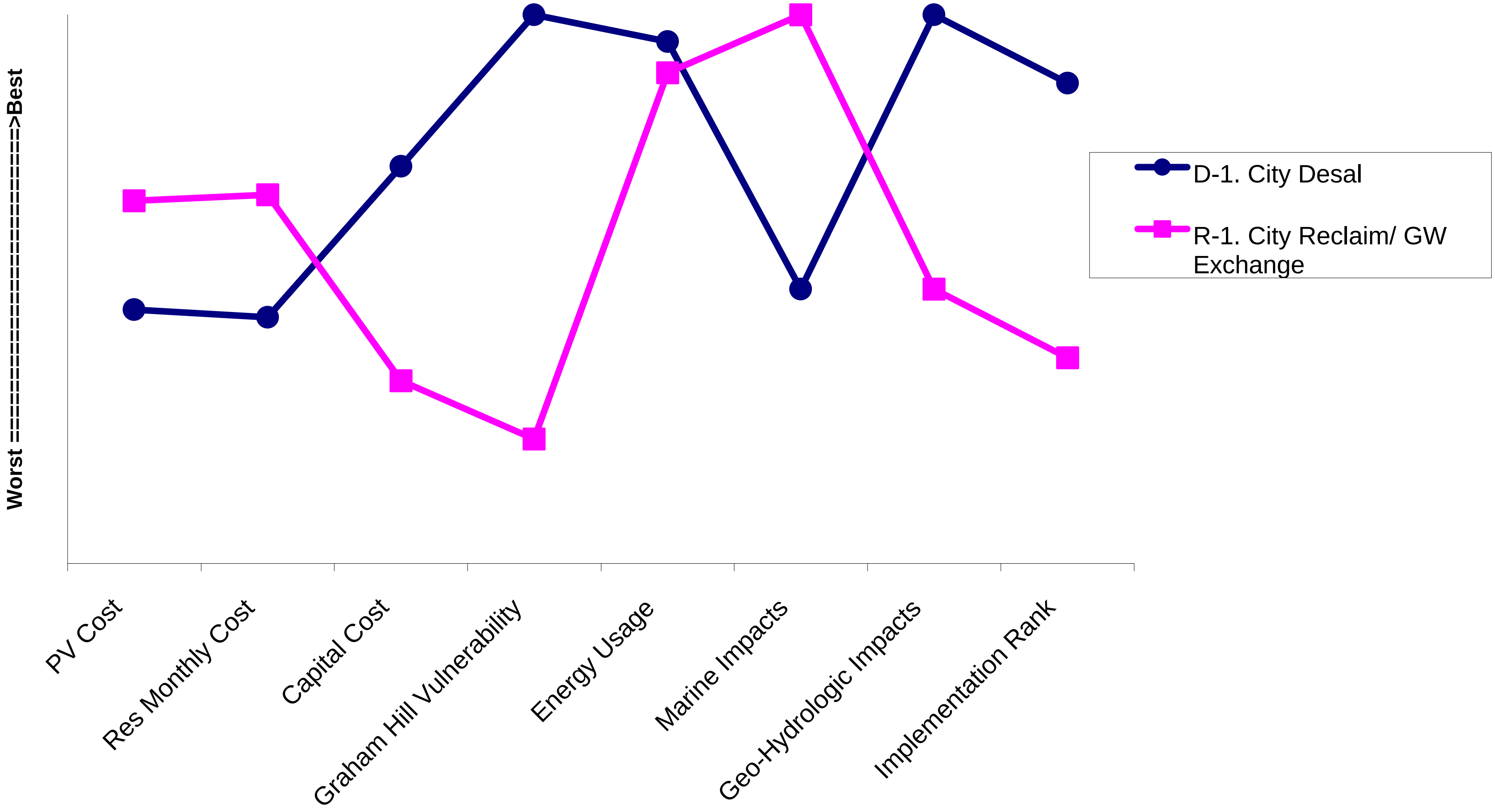


CHART VI-17
Regional Desal (D-2) vs. Regional Reclaim/GW (R-2) (Curtailment Profile 2)

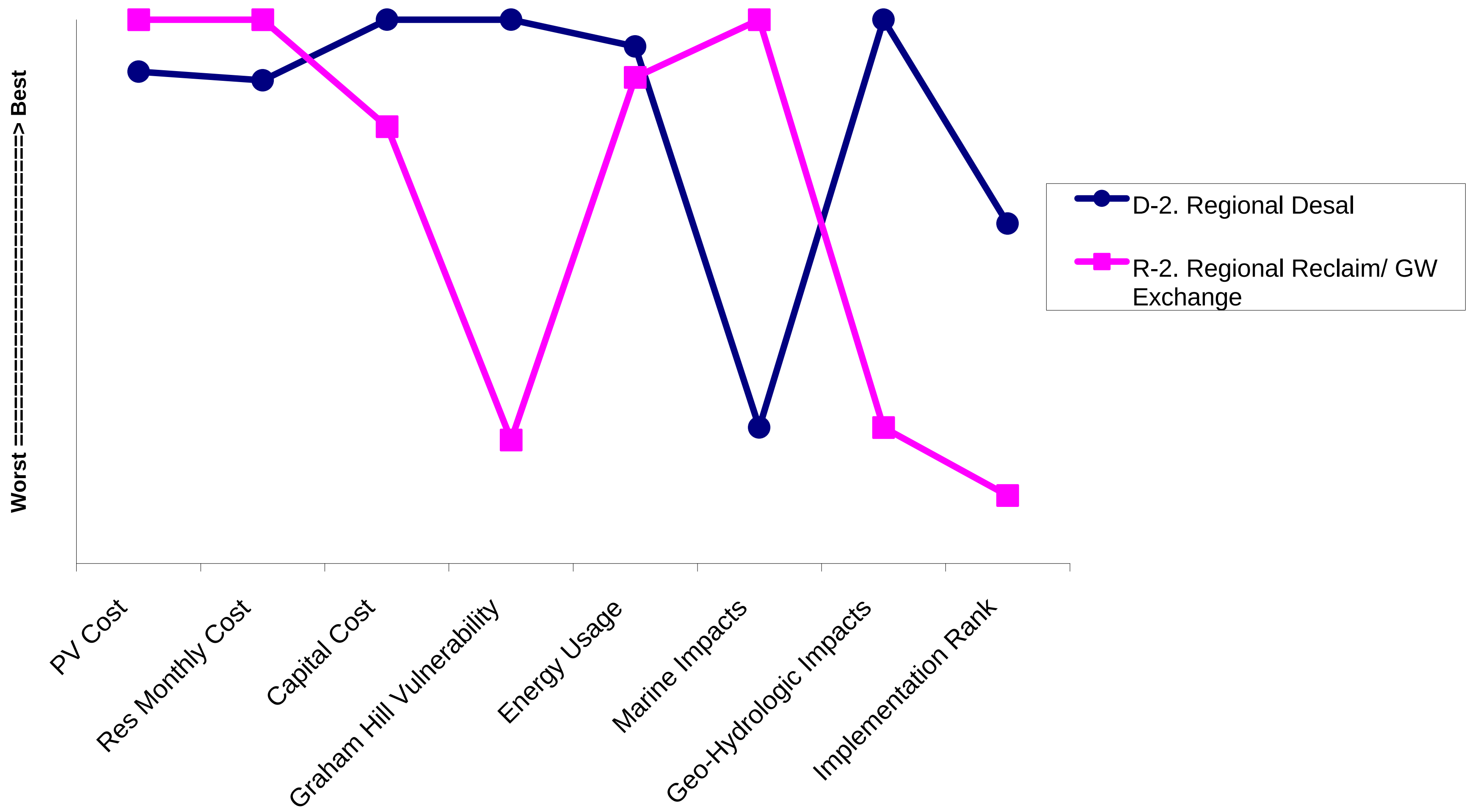
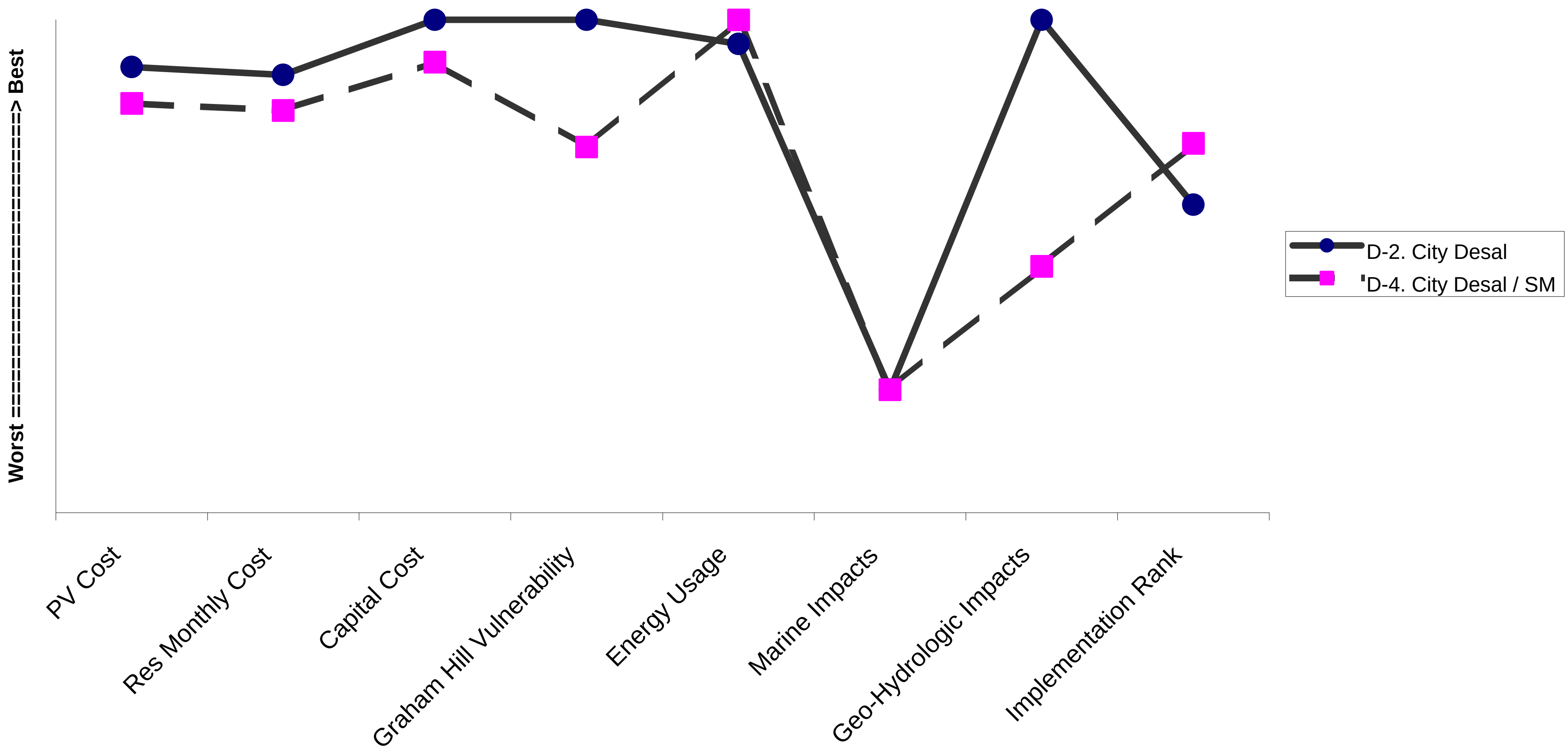


CHART VI-18

Regional Desal (D-2) vs. Regional Downsized Desal with Santa Margarita (D-4) (Curtailment Profile 2)



VII. IMPLEMENTATION

This chapter outlines the actions that must be taken to implement one of the preferred strategies that were recommended in Chapter VI. The discussion is divided into the following sections:

- Near-Term Actions
- Key Decisions
- Long-Term Schedule

A. NEAR TERM ACTIONS

Over the next 12-18 months, the City must begin or continue the following activities:

Environmental Review. The environmental consultant has been an active participant in the development of the IWP. As a result, once the recommendations of the IWP are accepted by the City Council, the transition into the Environmental Impact Report (EIR) will be as seamless as possible.

Preliminary Design. Some preliminary design of the desalination plant and associated facilities will be undertaken parallel to the preparation of the EIR. This will ensure that adequate engineering information sufficient to properly size project components is available for the EIR analysis. There is some risk to this simultaneous preliminary design, namely that if, as a result of the environmental review, the City decides not to move forward with the desalination alternative, the preliminary design work will no longer be applicable.

Conservation Programs. The SCWD will continue to move aggressively with implementation of the water conservation programs that were included in the Water Conservation Plan approved by the City Council. As discussed above, all resource strategies include these conservation programs.

B. KEY DECISIONS

In addition to the public involvement efforts described in Chapter I, the IWP has been the subject of extensive and ongoing review by the Integrated Water Plan Committee (IWPC). This report was then reviewed by the IWPC which, on February 10, 2003, sent it on to the City's Water Commission. On March 3, 2003, the Water Commission recommended its acceptance by the City Council. Acceptance by the Council will trigger the following actions:

- The EIR on the IWP will begin.
- As described above, the preliminary design of the desalination facilities will begin.

- Negotiations with the Soquel Creek Water District will be undertaken to develop the parameters of the agreement that would be needed if the City ultimately adopts a regional strategy.

Final adoption of the IWP by the City Council will take place when the EIR is certified.

C. LONG-TERM SCHEDULE

Development and adoption of the EIR, including preliminary engineering sufficient to adequately define project components for the EIR analysis, is expected to take approximately 12 months.

Subsequent to adoption of the IWP and EIR, additional engineering and final design is expected to take approximately 36 months. The project level EIR and permitting would occur concurrently with the design phase.

Construction of facilities is expected to take approximately 36 months following final project approval. The facility should be on-line in late 2009 or early 2010.

GLOSSARY

Acre-foot. The volume of water that will cover an acre to the depth of one foot. An acre-foot equals approximately 325,850 gallons.

Aquifer. An underground bed or layer of earth, gravel, or porous stone that yields water.

Base case. The water system configuration which includes current supplies and infrastructure as well as those system enhancements which the Santa Cruz Water Department intends to make independent of the IWP.

Cubic feet-per-second (cfs). A measure of flow, used in Santa Cruz for streamflows and transmission flows. A flow of 1 cfs is equivalent to approximately 0.65 *mgd* (see below).

Conservation. Water savings by customers that can be relied upon to reduce water *demands* (see below) for an extended and predictable period of time. There are two major categories of conservation:

- *Programmatic conservation* refers to savings attributed to utility-sponsored conservation programs, over and above those savings that would have occurred without the programs.
- *Naturally-occurring conservation* are those savings that are expected to occur without any utility intervention, due, for example, to state or federal plumbing codes.

Curtailment. Short-term water use reductions imposed on customers during conditions of water *shortage* (see below), which may entail some degree of customer hardship.

Curtailment profile. A description of a specific level of *water supply reliability* (see below) that might be achieved on the Santa Cruz system. The profile is described in terms of expected frequencies and magnitudes of seasonal *curtailments* (see above).

Demand. The unconstrained quantity of water expected to be required by customers in any time period. Summer demands vary as a function of weather conditions. There are two types of water demand:

- *Gross demand* is the demand prior to water *conservation* (see above) programs.
- *Net demand* is the demand after expected conservation savings are subtracted.

Entrainment. The process by which small organisms in the intake seawater flow pass through the mesh of the intake screens and are drawn through the screens and pipes and into the processing system.

Gallons per minute (gpm). A measure of flow, often used to measure the rate at which groundwater wells can produce water.

Impingement. The process by which organisms too large to pass through intake screens are caught in the water flow and on the screens of the intake.

Millions of gallons (mg). A typical measure of volume. One million gallons equal approximately 3.07 *acre-feet* (see above).

Millions of gallons per day (mgd). A flow of 1 mgd is equivalent to approximately 1.55 *cfs* (see above).

Operating cost. The cost to run a water system component (e.g. water supply, reservoir, treatment plant). There are two types of operating costs:

- *Fixed operating costs* are primarily labor costs, which do not depend on the level at which the system component is run.

- *Variable operating costs* are either power or chemical costs, which vary with the quantity of water produced by or passed through the system component.

Planning period (horizon). The future period with which a planning process is concerned. The planning period for the Santa Cruz IWP is through the year 2030.

Present value. A discounted value of a stream of future costs or revenues, which reflects the time value of money, specifically the fact that a future expenditure has less value than a current one.

Reclamation. Intensive (i.e. tertiary) treatment of wastewater to make it fit for certain outdoor irrigation uses. Reclaimed water must meet State of California health standards and may not be used as a potable supply.

Salt-water intrusion. The migration of seawater into coastal groundwater *aquifers* (see above), thereby degrading the quality of that groundwater.

Shortage. A situation in which, for some period of time, the water that the water system is able to supply to customers is less than the water customers are demanding. A shortage results in customer *curtailments* (see above).

Strategy. A combination of *conservation* (see above) and supply options, and the associated operating rules, designed to maintain a particular *curtailment profile* (see above) through the *planning period* (see above).

Water supply reliability. The degree to which available supplies can serve all water *demands* (see above). The degree of water supply reliability is described by a *curtailment profile* (see above).

Yield. The annual (or seasonal) available supply or savings that can be relied upon from a water source or a *conservation* (see above) program.

APPENDICES

APPENDIX A

Key Features of the Confluence Water Supply Planning Model

APPENDIX A. KEY FEATURES OF THE *CONFLUENCE* WATER SUPPLY PLANNING MODEL

A. CONSTRUCTING THE WATER SUPPLY AND DELIVERY SYSTEM

The *Confluence* interface permits a water supply system schematic of any complexity to easily be created and/or modified. Supply sources of various types, storage reservoirs, treatment plants, transmission links, and demand nodes can be added, named, and located through simple “point, click, and drag” techniques. Double clicking on any system component will allow the user to view and edit the data underlying that component. The appearance (e.g. colors, font sizes, icons) of the schematic can also be easily modified.

1. Defining System Components

The characteristics of each supply source, reservoir, treatment plant, and transmission link can be readily specified through the user interface.

a) Supply and Treatment Plant Characteristics

The model allows the user to define each supply or treatment plant at the start of the study period in terms of its delivery capacity, costs, operating characteristics, and qualitative values (water quality, environmental impacts, ease of implementation etc.). The user can then add incremental supply or treatment capacity during the study period. The user specifies all capacity, cost, financing, cash flow, and qualitative characteristics for each stage, as well as the year in which each stage becomes operational.

Constraints on the operation of any supply are set by the user and are intended to mimic real-world operating conditions. Examples of such constraints include annual production limits, daily rainfall-driven turbidity limits, discrete pumping capacities, and hydraulic relationships with the production of other supplies. The delivery of water produced by any supply source can also be constrained to a user-specified group of demand nodes.

The available supply for each river diversion is constrained by a historical record of monthly average or daily streamflows and by user-defined water rights, including, where applicable, instream rights.

b) Reservoir Characteristics

Confluence allows the user to easily specify a wide variety of operating parameters for storage reservoirs, including delivery capacity, total (spillway) storage volume, dead storage volume, preferred minimum storage volume, and the downstream reservoir, if any, which receives spills. Reservoirs can provide water to the transmission grid or can augment stream flows.

As is the case for supplies and treatment plants, the user can specify staged additions to the base reservoir.

Reservoir operation is completely generalized and is governed through a set of user-specified rule curves, which define multiple zonal boundaries, which vary monthly. User-specified shadow prices for each zone determines the rate at which the reservoir is drawn down (and, if applicable, refilled from other supply sources). This permits recognition of the value of maintaining water in storage over the course of a summer season and allows regulation of carryover storage from one year to the next.

The level of each reservoir at the end of any time step depends on natural inflows, refills from other supplies or reservoirs, rain-on-surface gains, and evaporative losses. Drawdowns can be constrained by downstream flow requirements.

The user can define reservoir groups for coordinated operation. The model will permit transfers among the reservoirs within any of these user-defined groups, subject to transmission availability and rule-curve economics.

c) Transmission Characteristics

For each node-to-node transmission link, the user specifies the on-line year and operating life, and the bi-directional capacities, losses, and pumping costs. Capital costs and financing parameters are also specified. The line capacities can vary due to a number of user-defined hydraulic constraints.

d) Demand Characteristics

Demand growth can be either deterministic or stochastic. In either case, growth rates can differ among demand nodes as well as seasonally. If desired, separate demand growth functions can be defined for each class of service within each node. In addition, the user can specify the daily variation of demand as a function of historical temperature and precipitation, thereby exposing any system capacity bottlenecks which limit the ability to serve demand on high-demand days.

The user can also define fixed demands to be added to designated nodes, as well as a set of blocked unserved demand shadow prices which are used in the simulation to regulate the manner in which unserved demand is allocated to nodes and, if desired, the manner in which stored volumes will be preserved for carryover storage.

e) Conservation Programs

The user can define an unlimited number and variety of water conservation programs. For each program, the user specifies the savings, cost, and participation characteristics, including parameters which define the manner in which savings are distributed over time and space and the manner in which costs are divided between the utility and the participating customer. Free-ridership and natural replacement concerns are also captured by the conservation module.

2. The Simulation

Once all system components are defined, the simulation can be run. *Confluence* simulates the operation of the system for each time step in the study period. The simulation logic consists primarily of a network configuration module, a supply availability module, and a system dispatch module. The network configuration module determines the available transmission paths for all potential node-to-node transactions, and allows the user to control priorities for use when multiple paths between a set of nodes are available. The supply module determines the supply availability and price for each potential supply resource available to the system. The dispatch module uses the transmission network and supply information, along with demand data, in an attempt to meet demand in each demand node as inexpensively as possible, taking into account actual variable operating costs or user-assigned shadow prices of system components. The model permits the recognition of real-world institutional, policy, or environmental constraints, which may not allow for true cost minimization.

The user must specify the parameters that govern the simulation, including:

- The study start and end dates;
- The number of simulations;
- The manner in which the distributions of historical streamflow and weather will be sampled;
- If applicable, the manner in which the distribution of future demand growth paths will be sampled;
- The time-step resolution (monthly, daily, or sub-daily) for each month of the year;
- The months included in the "peak season"; and
- A variety of underlying financial data.

3. Model Outputs

After the simulation is run, the output results can be viewed. The current version of *Confluence* offers about 50 chart options for individual studies as well as a series of chart options that provide comparisons of user-selected study pairs. These charts can be modified or added to as dictated by the needs of the user. In addition, the data from any chart can be easily viewed, copied to the Windows clipboard, and pasted into any other application for additional analysis. The user can easily make changes in chart format, titling, units, etc.

These charts are designed to serve not only as valuable analytical tools, but also to be used to convey results to different types of audiences with differing levels of expertise. In particular, the chart results are very appropriate for presentations to policymakers and lay citizen and stakeholder groups.

In addition, *Confluence* has a dynamic charting capability which permits the viewing of the changes in a variety of demand, supply, transmission, and storage parameters in real time as the simulation is running. This capability facilitates diagnostics and enables a visual understanding on the part of audiences of the manner in which the system operates.

The model can also produce a myriad of complex diagnostic reports which allow the analyst to gain a deeper comprehension of the simulation results. These reports are particularly useful to achieve an understanding of the reasons for particular results, and to guide the assessment of alternative system additions or modifications.

a) Charts of Individual Study Results

Following are brief descriptions of sample charts of individual study results.

Reliability. *Confluence* produces several charts that permit a thorough understanding of the multiple dimensions of supply reliability. Parameters displayed include:

- Seasonal and monthly expected unserved demand by demand node.
- Expected seasonal shortage ratios for user-specified peaking events.
- Seasonal and daily unserved demand duration curves.
- Unserved demand exceedance curves and probabilities of user-designated shortages.

Economics

- Mean cost time series by category and by resource
- Utility and societal present value cost components
- Capital expenditures

- Costs of individual sources
- Costs incurred at each demand node

Demand. *Confluence* outputs allow the user to easily track the demand characteristics associated with any simulation. These outputs include:

- A series of charts showing expected nodal gross and net monthly demands, the variation of demands along the different sampled demand growth paths, and duration curves of daily demands by node.
- Charts of expected local supplies and duration curves illustrating the distribution of those supplies.

Supply. *Confluence* chart outputs display key supply parameters, including:

- Daily traces of overall production, storage levels, demands, and shortages for user-specified years and months.
- Expected monthly production of user-designated supplies.
- Duration curves for daily and annual production of user-designated supplies.
- Duration curves for daily instream flows.
- Charts of annual and monthly conservation savings by program and by node.

Reservoirs. Charts of the following reservoir parameters are available:

- Duration curves for daily and end-of-month reservoir storage content.
- Traces of end-of-month storage levels and monthly reservoir inflows and outflows.
- Use of storage below user-specified preferred minimum levels.

Treatment and Transmission

- Mean daily treatment plant production or transmission link flow.
- Duration curves for daily plant production or transmission flow.

Qualitative Factors. Various charts of the values over the planning period of user-specified qualitative indices.

APPENDIX B

Description of IWP Base Case

APPENDIX B. DESCRIPTION OF IWP BASE CASE

This Appendix documents the assumptions that underlie the base case. It is divided into the following sections:

- Water supplies
  - Flowing supplies
  - Groundwater supplies
  - Loch Lomond reservoir
- Treatment plants
- Transmission system
- Water demands
- Water conservation programs
- Annual curtailment planning

A. WATER SUPPLIES

Available supplies are dispatched to meet demands in the order (lowest to highest) of shadow prices specified for each supply. The supplies are used in the following order:

1. North Coast

    a. Laguna/Reggiardo and Liddell (same dispatch priority)

    b. Majors

2. San Lorenzo River

3. Tait St. Wells

4. Live Oak Wells

5. Loch Lomond reservoir (see discussion below of reservoir operation)

In addition, water is diverted at Felton to Loch Lomond.

1. Flowing Supplies

In any time step, the production of a diversion project is constrained by its production capacity, stream flow, and water rights. All diversion projects have fixed annual operating and maintenance (O&M) costs. Some also have variable energy costs for pumping. In addition, these sources may be subject to various other operating constraints.

2. Groundwater Supplies

The City currently draws water from two well fields. In any time step, the production of a groundwater project is constrained by its production capacity. Groundwater projects have fixed annual O&M costs as well as variable energy costs for pumping. The shallow wells at Tait Street are hydraulically connected to the San Lorenzo River (SLR), and are constrained both by the SLR water right and the production capacity of the SLR diversion pumps. These wells, therefore, are treated as if they add to the river flows at Tait Street, but do not increase the overall maximum production capacity at the river.

The assumptions for the surface water and groundwater supplies are summarized in Table B-1. [27]

3. Loch Lomond Reservoir

In any time step, the production of a Loch Lomond is determined by a variety of factors. Water is added to storage through daily Newell Creek inflows, water pumped from Felton, and rainfall on the surface of the reservoir. Water is drawn from storage to meet instream flow requirements, San Lorenzo Valley obligations, and demands, as well as evaporative losses.

Reservoir operation is constrained by a number of factors:

- Total storage capacity is 2810 mg, of which 100 mg is "dead" (i.e. not useable for any purpose) and an additional 1000 mg is not useable to meet demands. (It is, however, used as necessary to meet instream flow requirements and San Lorenzo Valley obligations.)
- Instream flow requirements are 1 cfs. As long as there is any water in the reservoir, these requirements are met.
- Newell Creek is deemed to be totally appropriated in the months of June-September. As a result, no inflows during those months are stored; instead, they are passed downstream. If

[27] In this and all subsequent tables, all costs are expressed in year 2000 dollars. All costs other than power costs are assumed to remain constant in real terms (i.e. to increase over time at the rate of inflation). Power cost escalation is based on assumptions provided by the California Energy Commission.

inflows are less than the instream flow requirement of 1 cfs, the remainder must be met from water in storage.

- Annual withdrawals cannot exceed 3200 acre-feet, or 1042.5 mg, of which 102.1 mg goes to the San Lorenzo Valley Water District, leaving a maximum withdrawal to meet Santa Cruz demands of 940.5 mg.

- The San Lorenzo Valley entitlement of 102.1 mg/year is assumed to be met through daily withdrawals of 0.28 mg, or 0.43 cfs.

For each of the two sources of reservoir fill, namely the natural inflows from Newell Creek and the San Lorenzo River water diverted at Felton, there is a 30-day "last-in-first-out" (LIFO) withdrawal constraint. That is, water from either source cannot be withdrawn for 30 days from the most recent day on which water from that source was stored. Daily Newell Creek inflows are only deemed "stored" if the inflow exceeds the sum of instream flow requirements, demands, and evaporative losses, net of rain-on-surface.[28]

Reservoir withdrawals are governed by a set of rule curves. Each storage zone between adjacent rule curves is assigned a shadow price. The shadow prices increase as the reservoir is drawn down. All of these shadow prices are higher than those assigned to the surface and groundwater supplies, thus ensuring that, during any time period, other available supplies are exhausted prior to any reservoir withdrawal.

The zonal shadow prices are in the same range as shadow prices assigned to blocks of unserved demand. If the shadow price of reservoir supply exceeds the shadow price of a portion of the hitherto unserved demand, that demand will not be served. Thus, depending on the level of the reservoir, some portion of demand may be unserved in a particular time step. In most water years, the reservoir will contain sufficient water so that all demand will be served (i.e. the reservoir will always be in the highest, or least expensive, zone). However, in some years, storage levels will stray into lower zones.

As storage levels decrease, greater portions of demand will be unserved. The base case rule curves are designed to withdraw all useable storage by the end of a 1976-77 drought event, so that that event ends with stored water about at the 1100 mg level (i.e. the unusable storage). The rule curves are shown in Figure B-1. The relationship between the zonal shadow prices and the unserved demand shadow prices is illustrated in Figure B-2. Thus, if the reservoir high (i.e. in Zone 1), all blocks of unserved demand will be served. On the other hand, if it is in Zone 3, only 4 of the 10 unserved demand blocks will be served.

The reservoir is assumed to have fixed annual O&M costs of $6,000, and no variable production costs.

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28 The ability to meet demand out of current-day inflows is equivalent to assuming a right of direct diversion.

B. WATER TREATMENT PLANTS

The system has two plants: Graham Hill and Beltz. The latter plant treats the water produced by the Live Oak wells. Graham Hill treats water produced by all other sources. Each plant is constrained by its maximum capacity. Each plant has fixed annual O&M costs as well as variable power and chemical costs. These characteristics are displayed in Table B-2.

C. TRANSMISSION SYSTEM

Each transmission link is characterized by the following parameters:

- Capacity. If a link can move water in two directions, a maximum capacity is specified for each direction. In the case of the link between the Felton Booster and Loch Lomond, the capacity is a function of the storage level in the reservoir.
- Pumping Costs. In cases where pumping is required, a pumping cost is specified.
- Losses. A portion of the flows through the North Coast main is lost. These losses are specified as a percent of flows. These losses are assumed to ratchet down over time due to anticipated main rehabilitation.

Table B-3 describes the key transmission system parameters.

D. WATER DEMANDS

Forecast treated water demand is estimated separately for the peak and off-peak seasons. An estimate is also made of north coast agricultural demand for raw water.

1. Peak-Season Treated Water Demand

Peak-season (May-October) per-capita daily demands are estimated in the simulation based on historical daily temperature and rainfall data. The regression model used to estimate these daily demands is as follows:

$$\begin{aligned}\text{Daily Demand Per Capita} = {} & a + b_1\text{*Current Day Temp} + b_2\text{*Previous Day Temp} \\ & + b_3\text{*}2^{nd}\text{ Previous Day Temp} + b_4\text{*}3^{rd}\text{ Previous Day Temp} \\ & + b_5\text{*Current Day Rainfall} + b_6\text{* Previous Day Rainfall} \\ & + b_7\text{*}2^{nd}\text{ Previous Day Rainfall} + b_8\text{*}3^{rd}\text{ Previous Day Rainfall} \\ & + c_1\text{*JUNE} + c_2\text{*JUL} + c_3\text{*AUG} + c_4\text{*SEP} + c_5\text{*OCT}\end{aligned}$$

Temperature variables are daily maxima in degrees Fahrenheit. Rainfall variables are 24-hour totals in inches. The final five variables take on a value of 1 for days during the designated month and zero otherwise. Their purpose is to shape the seasonal demand curve.

The estimated coefficient values are shown in Table B-4. For example, per-capita demand increases by approximately 0.6 gallons per day for each degree that the current day temperature rises, 0.2 gallons for each degree increase in the previous day temperature, etc. In addition to temperature and rainfall variation, daily per-capita demands in June are some 9 gallons higher than in May, July demands are about 19 gallons per day higher than May, etc.

The daily per-capita demands produced by this model are then multiplied by the service area population forecast by Maddaus and Weber in their 1998 demand investigation[29] to estimate future year weather-driven daily demands. The total peak-season forecasts produced by the model under average weather conditions are then calibrated to a somewhat-modified version of the weather-normalized forecasts produced by Maddaus and Weber. The modification was based on the SCWD staff determination that actual year 2000 demand was significantly below that forecast by Maddaus/Weber.

Actual year 2000 peak-season demand was 2.4 billion gallons. Using the daily weather-driven model described above, the forecast demand for year 2000 with 2000 weather conditions was 2.36 billion gallons, a discrepancy of about 1.5%. This calibration factor was then applied to the model-predicted year 2000 demand *under average weather conditions* to estimate that demand at 2.49 billion gallons.

It was then assumed that annual demand in 2020 will match that forecast by Maddaus and Weber, 5.2 billion gallons, of which 2.9 billion gallons is assumed to occur during the peak season. It was also assumed that peak-season demand between 2000 and 2020 would grow at a uniform rate, which turned out to be 0.79% annually. After 2020, seasonal demand was assumed to grow at an annual rate of 0.34%, consistent with Maddaus/Weber.

Finally, calibration factors for future years were calculated that reflected the ratio between these weather-normalized seasonal demands and the model-predicted average-weather seasonal demands. These calibration multipliers are incorporated in the model data. They are displayed in Table B-5. In no year does the required adjustment exceed 3%.

2. Off-Peak Season Treated Water Demand

Off-peak-season (November-April) demands are estimated differently than peak-season demands. Staff determined that an appropriate estimate for total year 2000 off-peak season demand is 1.9 billion gallons. This demand is assumed to be uniformly distributed across the

[29] Maddaus Water Management. *Final Report: Water Demand Investigation*. March 1998.

181-day season, at about 10.5 mgd. Off-peak season demand is assumed to grow at the same rate as the peak-season demand.

3. Coast Agriculture Raw Water Demand

Consistent with the Maddaus/Weber forecast, coast agricultural demand is assumed to stay at a constant annual level of 30.8 mg, of which 5.4 mg of "base" demand is distributed uniformly over the year and 25.4 mg outdoor demand is distributed uniformly over the 6-month peak season.

Based on the foregoing assumptions, Table B-6 presents the weather-normalized seasonal demand forecast.

E. WATER CONSERVATION PROGRAMS

The conservation assumptions in the *Confluence* base case are taken from the 2000 Water Conservation Plan.[30] Consistent with that document, the following conservation programs are included:

- Ultra-low-flush toilet rebates for single family, multi-family, and commercial customers.
- Indoor and outdoor conservation reviews and measure installation for single-family and multi-family customers.
- Indoor water reviews, measure installation, and rebates for commercial customers and the University of California, Santa Cruz.
- Residential conservation kit distribution.
- Time-of-resale plumbing fixture ordinance for single family and multi-family customers.
- Single and multi-family efficient clothes washer rebates.
- Submeter rebates for existing apartment buildings.
- Large landscape water use reviews for residential, commercial, and golf course customers.
- Parks water use reviews and system upgrades.

[30] Gary Fiske & Associates, Jennifer J. Stout–Water and Energy Consulting. *Santa Cruz Water Department. Water Conservation Plan: Final Report.* February 2000.

F. ANNUAL CURTAILMENT PLANNING

The base case attempts to model the manner in which the Department will actually determine required curtailment levels in the spring of any year. Department managers must make these decisions based on imperfect information about the upcoming summer. Prudent management requires that conservative assumptions be made about summer streamflows and weather. To mimic this decision process, the following assumptions are made:

Streamflows: The *Confluence* base case discounts all peak-season streamflows by 10% to reflect the uncertainty faced by Department managers each spring.

Weather: The base case assumes that peak-season weather will duplicate that experienced in 1976, which was a warmer than average summer.

Table B-1

Base Case Assumptions for Water Supplies

Project		Maximum Production (cfs) [1]	Production Steps	Water Rights	Turbidity Constraints	Hydraulic Constraints	Stream Flushing Constraints	Fixed O&M Costs ($/year)	Power Cost ($/mg)
North Coast									
Liddell		2.47		Unlimited	T-1			$3,100	0
Laguna/Reggiardo		6.27		Unlimited	T-1			$4,100	0
Majors		2.09		Unlimited	T-2	H-1		$3,100	0
San Lorenzo River		11.52	P-1	R-1	T-2			$20,800	$98.13
Tait St. Wells		1.86 [2]						$2,400	
Felton Diversion		13.53	P-2	R-2	T-2		F-1	$20,800	$76.83
Beltz Wells		1.47 [3]						$4,800	$156.08

1. These maximum production capacities reflect anticipated down time as follows:
North Coast supplies and Beltz Wells: 5%; San Lorenzo River, Tait St. Wells, and Felton Diversion: 2%.
2. The production capacity of the Tait St. wells is treated as additional San Lorenzo River flow.
Total SLR/Tait production is constrained by the SLR pumps and water rights.
3. Beltz production capacity assumed to double to 2.94 cfs in 2006.

Notes

Production Steps:
P-1: SLR permissible production levels are at 43.6%, 77.7%, and 100% of maximum production.
P-2: Felton permissible production levels are at 31.9%, 43.2%, 53.2%, 61.3%, 70.2%, 74.2%, 78.9%, 85.5%, 91.2%, and 100% of maximum production.
All other supplies can produce at any level up to and including the maximum production capacity.

Water Rights:
R-1: SLR diversion right is 12.2 cfs year-round, including Tait St. well production. There are no instream flow requirements.
R-2: Felton diversion right is unlimited, subject to instream requirements of 23 cfs in the months of Jan-May and Nov-Dec, 13 cfs in Sept and 28 cfs in Oct. In addition, annual diversions at Felton are limited to 978 mg.

Turbidity Constraints:
T-1: Liddell and Laguna/Reggiardo turned out on all days that rainfall at GHWTP is at least 0.67 inch. Sources remain off on following day. Turn in occurs on 2nd day.
T-2: Majors, SLR and Felton turned out on all days that rainfall at GHWTP is at least 0.67 inch. Turn in occurs x days later, where x = three times initial day rainfall in inches.

Hydraulic Constraints:
H-1: Majors production is constrained by production at Laguna/Reggiardo. Specifically, Majors production in cfs cannot exceed 3.4 - 0.825*L/R production.

Flushing Constraints:
F-1: In any year beginning September 1, water cannot be diverted from Felton before the occurrence of two days of 100 cfs flows at Big Trees.

Figure B-1

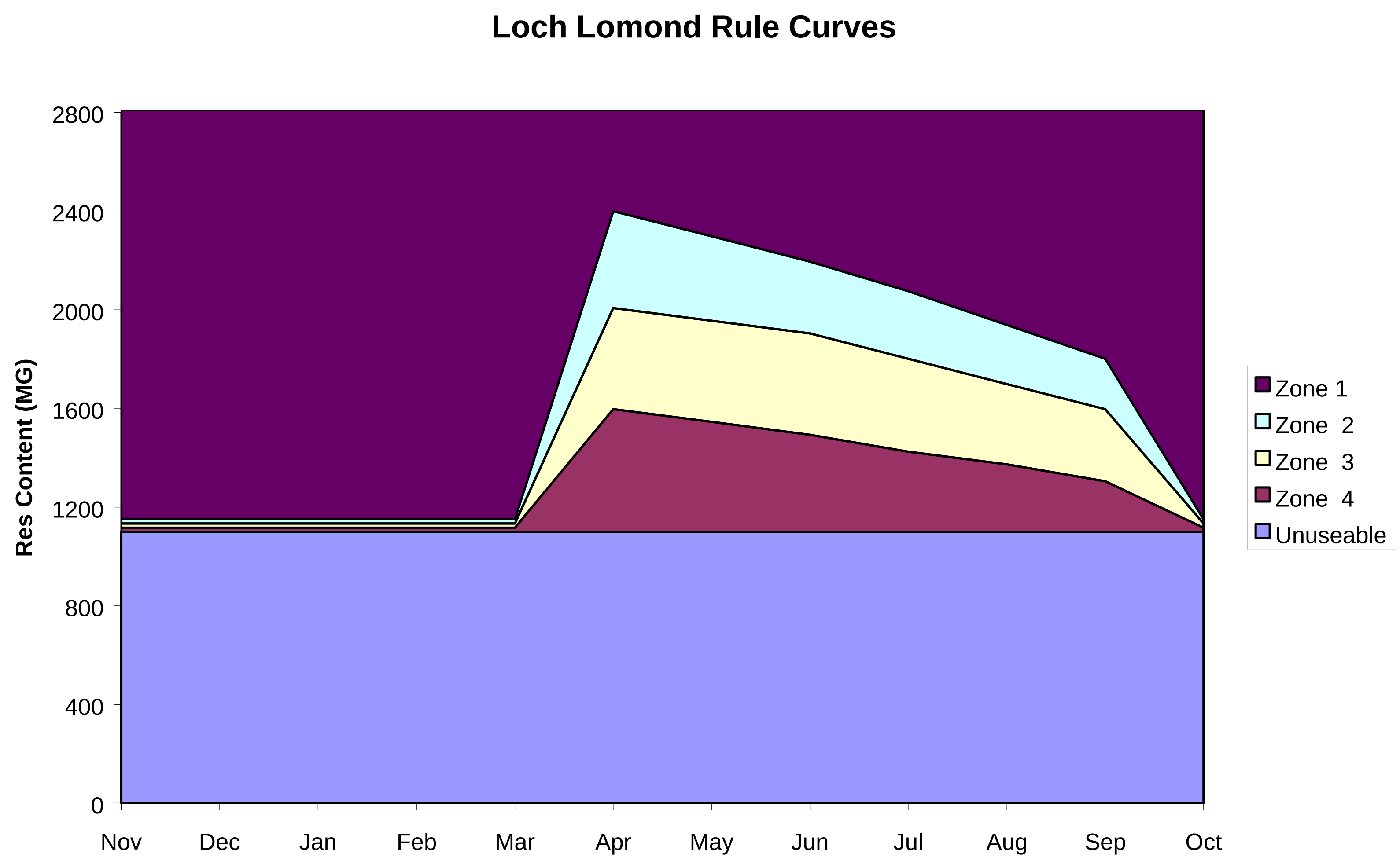
Loch Lomond Rule Curves
Res Content (MG)
2800
2400
2000
1600
1200
800
400
0
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Zone 1
Zone 2
Zone 3
Zone 4
Unuseable

Figure B-2

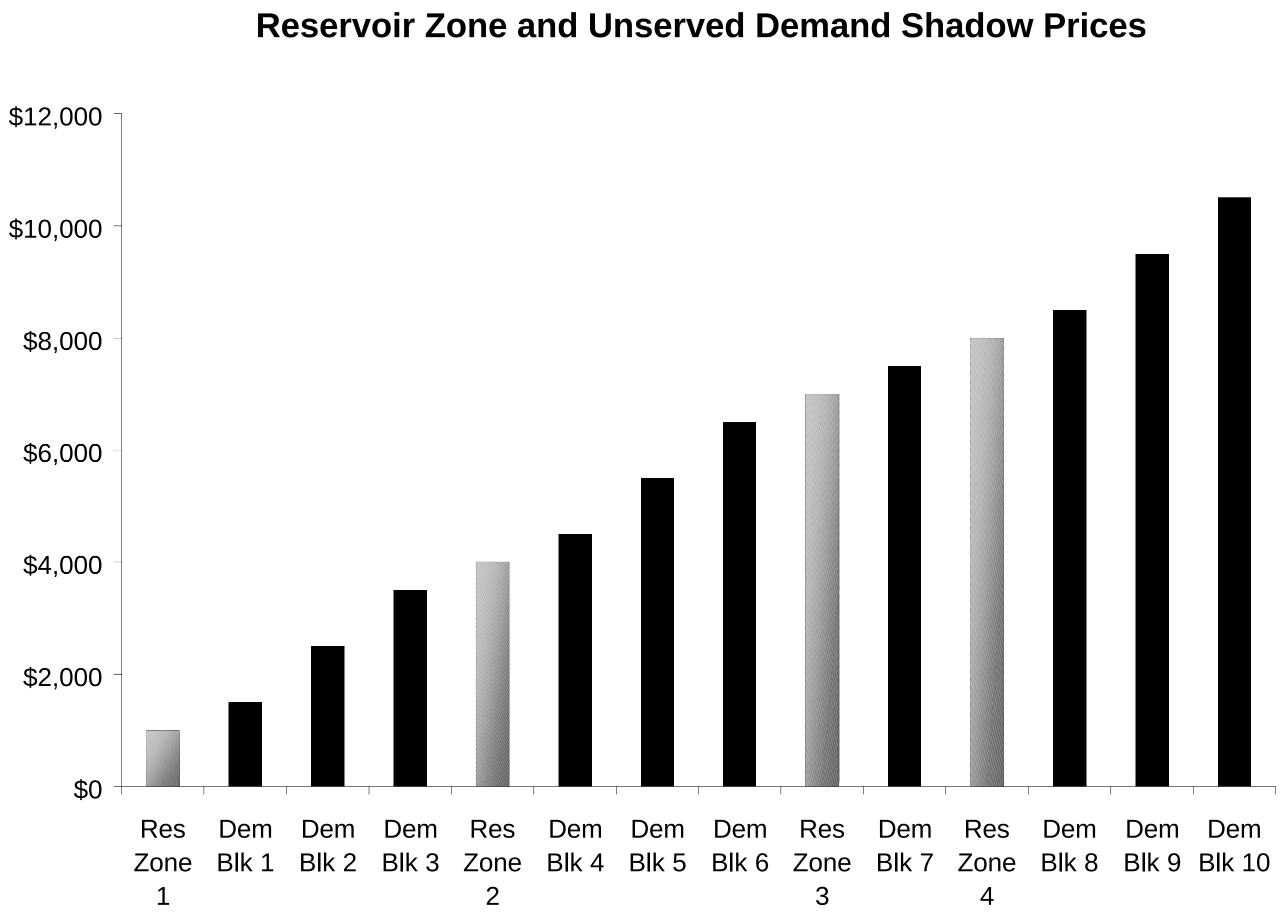
Reservoir Zone and Unserved Demand Shadow Prices
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Res Zone 1
Dem Blk 1
Dem Blk 2
Dem Blk 3
Res Zone 2
Dem Blk 4
Dem Blk 5
Dem Blk 6
Res Zone 3
Dem Blk 7
Res Zone 4
Dem Blk 8
Dem Blk 9
Dem Blk 10

Table B-2

Base Case Assumptions for Water Treatment Plants

Plant	Maximum Production (cfs)	Fixed O&M Costs ($/year)	Power Cost ($/mg)	Chemical Cost ($/mg)
Graham Hill	31	$542,000	$19.93	$53.00
Beltz	1.55 [1]	$12,000	$89.05	7.52

Notes

1. Beltz plant capacity assumed to double to 3.1 cfs in 2006.

Table B-3
Base Case Assumptions for Transmission System

Transmission Link Name	Node 1	Node 2	Maximum Capacity (cfs) Node 1 => Node 2	Maximum Capacity (cfs) Node 2 => Node 1	Pumping Cost ($/mg) Node 1 => Node 2	Pumping Cost ($/mg) Node 2 => Node 1	Losses (%)
Coast Main	Liddell	Coast Pump	9.2	0	$0.00	$0.00	15% => 1% [2]
Coast-River	Coast Pump	River Pump	11.6	0	$98.19	$0.00	0
River-GH	River Pump	Graham Hill	20.9	0	$0.00	$0.00	0
Felton Booster-Loch Lomond	Felton Booster	Loch Lomond	12.4 [1]	24.8	$88.74	$0.00	0
Newell Creek Pipeline	Felton Booster	Graham Hill	20.4	0	$88.74	$0.00	0

1. The capacity of this transmission link is a function of the current storage level in Loch Lomond. When Loch Lomond is full, the capacity is reduced by 50%.

2. It is assumed that the North Coast transmission system will be upgraded in stages over 15 years beginning in 2006.

Table B-4
Daily Demand Regression Model
(Adjusted R^2=0.65)

Variable	Coefficient	Standard Error	T-Test
Intercept	62.45	4.33	23.65
Current Day Temp	0.61	0.05	11.35
Previous Day Temp	0.24	0.06	3.74
2nd Prev. Day Temp	0.07	0.06	1.04
3rd Prev. Day Temp	0.17	0.05	3.21
Current Day Rain	-21.39	2.37	-9.01
Previous Day Rain	-10.70	2.42	-4.43
2nd Prev. Day Rain	-11.30	2.21	-5.12
3rd Prev. Day Rain	-10.86	2.32	-4.69
JUN	9.24	0.96	9.68
JUL	18.67	0.96	19.44
AUG	16.36	0.97	16.84
SEP	4.37	0.97	4.48
OCT	-6.10	0.94	-6.46

Table B-5
Peak-Season Demand Calibration Factors

Year	Factor
2000	1.02
2005	1.00
2010	1.00
2015	1.01
2020	1.03
2040	1.03

Table B-6
Weather-Normalized Seasonal Demand Forecast

Year	Peak-Season Demand (bg)	Off-Peak Season Demand (bg)	Total Annual Demand (bg)
2000	2.5	1.9	4.4
2005	2.6	2.0	4.6
2010	2.7	2.1	4.8
2015	2.8	2.1	5.0
2020	3.0	2.2	5.2
2025	3.0	2.3	5.3
2030	3.1	2.3	5.4

APPENDIX C

IWP Environmental Analysis

APPENDIX C. IWP ENVIRONMENTAL ANALYSIS

A. INTRODUCTION

The attached tables present the results of the environmental screening conducted on the Integrated Water Plan Strategies. The primary purpose of the environmental screening was to preliminarily identify and describe potential impacts and the prospects of mitigating those impacts. The impacts are labeled *potential* because, at this point, the physical detail associated with the strategies is known only at a conceptual level. For example, it may not be known precisely where a new facility would be built, or what rights-of-way pipelines would follow. Such details as pipe size, building footprint, height, or color are also not known at this time. All of these issues are necessary to evaluate environmental impacts. Thus, the assessment of impacts could change once more detail is available. It is intended that the necessary preliminary engineering design would be complete and available for a more comprehensive analysis of these impacts during the development of the EIR.

B. SCREENING CRITERIA

The environmental screening criteria were consistent with those used for CEQA documentation. Thus, this initial stage of environmental screening would serve as preliminary analysis and provide an efficient transition to the CEQA analysis. The following potential impacts were examined for each strategy:

- Marine Resources
- Direct Land Use
- Indirect Land Use (growth-inducement)
- Traffic
- Recreation
- Visual Resources
- Hydrology (surface & groundwater)
- Public Health & Safety
- Fisheries
- Wetlands, Wildlife & Plants
- Cultural Resources
- Air Quality
- Noise

For each category, an assessment was made of the potential for impact, corresponding to the following scores:

1 = No Impact

2 = Low Impact

3 = Moderate Impact

4 = High Impact

Note that, particularly for criteria scoring 3 and 4, it is possible that mitigation measures may be utilized which would reduce the impact. These mitigation possibilities will be thoroughly investigated in the EIR.

Results

The results of the screening process are presented in the following tables. Table C-1 presents the overall results of the screening for desalination strategies; Table C-3 presents the overall results for all of the reclamation/groundwater exchange strategies. For both of these tables, the criteria that were reviewed are in the left-hand column (e.g., marine resources, traffic, etc.); the strategy reviewed is in the very top row. An explanation or description of the potential impacts and how they were assessed is provided within each box, with the resulting score of 1 through 4 nested within that larger box.

Tables C-2 and C-4 are more detailed notes and explanations of the potential impacts to wetlands, wildlife and plant impacts. In these tables, the potential impact is described in the left-hand column; the strategy reviewed is in the top row. If a strategy has the potential impact as described, this is indicated by an X in the corresponding box.

Only those criteria that distinguished among strategies were considered in the IWP strategy selection process. As indicated in the tables, there were three such criteria:

- Marine resources
- Geo-hydrology
- Direct land use

TABLE C-1: DESALINATION STRATEGY SCREENING

	Strategy D-1: City Desalination (Curtailment Profile 2)	Strategy D-2: Regional Desalination (Curtailment Profile 2)	Strategy D-3: City Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)	Strategy D-4: Regional Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)
Marine Resources	• Has the potential to entrain organisms – if listed or vulnerable, then the impacts could be adverse. Marine habitat could be substantially degraded if prey organisms are lost to entrainment. • Under Curtailment Profile 2, water would be withdrawn from the ocean almost every year. However, only in approximately 12 % of the years in 2010 or 17 % of the years by 2020 (or 1 to 2 years out of every 10) would the intake of seawater be substantial. In those peak years, 2.5 to 4.5 mgd of water would be withdrawn. Most of the intake of seawater would be between May and October, which avoids the period of peak larval abundance for many species. In most years (8 or 9 out of every 10) seawater intake would average less than 1 mgd, primarily in late summer and fall when the larvae of many species are least abundant. • For Curtailment Profile 2, entrainment is considered a moderate impact because a relatively small volume of water (2.5 to 4.5 mgd maximum) would be taken primarily during the less sensitive time of year and the desalination plant would operate a significant amount of time only 1 to 2 years out of every 10. Curtailment Profile 1 would entail a greater intake of water (5 to 8 mgd maximum) but would require operation a similar number of years, also primarily during summer and fall. Therefore, the impacts though greater would potentially be moderate. • Curtailment Profile 3 would have impacts similar to Curtailment Profile 2. • Has the potential to kill fishes through impingement at the intake, including vulnerable species such as listed salmonids and invertebrates. Impacts may be mitigable to moderate or low through design of the intake to reflect the best available technology to minimize impingement. • Has the potential to damage kelp and reef habitat by in-water construction. Construction impacts can be mitigated to low through construction techniques. • It is anticipated that impact of brine disposal would be minimal due to mixing and dilution before outfall. **3**	• Although the maximum daily intake volume would be similar to Strategy 1, the impingement and entrainment impacts would be more substantial because the plant would operate every year and over most of the year. Thus, larvae would be lost during the period of peak larval abundance. Impingement probably could be mitigated to low by design of the intake. Entrainment might be mitigable to low if a very fine screen (0.5 mm mesh) and low through-screen velocity (less than 0.5 feet per second) were used, but it is not clear at this time if such a design would be feasible. • Construction impacts and mitigation would be similar to Strategy 1. • Brine disposal impacts would be similar to Strategy 1. **4**	• The impacts of Strategy 6a would be similar to Strategy 1 because the plant would operate a similar number of years primarily in the summer and fall. Daily intake volume would be similar. However, the percentage of years with significant operation would be less than Strategy 1 (10% for 2010 and 11% for 2020). Therefore entrainment impacts would be slightly less than for Strategy 1. • Impingement and construction impacts and mitigation would be similar to Strategy 1. • Brine disposal impacts would be similar to Strategy 1. **3**	• The impacts of Strategy 7a would be similar to those of Strategy 2 because the plant would operate every year over most of the year. However, the average daily flow would be slightly lower for all curtailment profiles for Strategy 7a compared to Strategy 2. • Entrainment and impingement impacts are potentially high because the plant would operate every year, in most months. Impingement probably could be mitigated to low by design of the intake. Entrainment might be mitigable to low if a very fine screen (0.5 mm mesh) and low through-screen velocity (less than 0.5 feet per second) were used, but it is not clear at this time if such a design would be feasible. • Impingement and construction impacts and mitigation would be similar to Strategy 1. • Brine disposal impacts would be similar to Strategy 1. **4**

1 = No Impact
2 = Low Impact
3 = Moderate Impact
4 = High Impact
Note that these scores represent *potential* impacts.

EDAW, Inc.

TABLE C-1: DESALINATION STRATEGY SCREENING

	Strategy D-1: City Desalination (Curtailment Profile 2)	Strategy D-2: Regional Desalination (Curtailment Profile 2)	Strategy D-3: City Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)	Strategy D-4: Regional Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)
Direct Land Use	***Facility*** • Need 2-2.5 acre site for facility at Terrace Point (owned by UCSC and available to City) or Industrial Park (difficult to acquire). • Both sites are within the Coastal Zone and could require an LCP amendment; a desalination facility is a coastal-dependent use that could be considered compatible with existing and future uses at both sites. • Both sites could require zoning amendment to Community Facility. The Industrial Park site is zoned industrial. The Terrace Point site is adjacent to the Younger Lagoon on the west and industrial and educational land uses to the north and east. • The General Plan requires a specific plan for Terrace Point prior to development. The 1998 Specific Plan established land uses, infrastructure, and a design framework for the site. • All strategies assume the same facilities for the three Curtailment Profiles. ***Pipelines*** • All pipelines would follow existing road right-of-ways. Construction-related effects could occur in areas designated for recreation or residential uses. • Intake and brine disposal pipelines: Terrace Point Alternative I pipeline would traverse several land uses including residential, Moore Creek flood plain, and ocean front recreation. Terrace Point Alternative II pipeline would head directly from the facility to the ocean. Industrial Park Alternative I pipeline would traverse residential and ocean front recreation land uses. Industrial Park Alternative II pipeline would head south through a residential area and across the beach. • Finished water distribution pipeline: Terrace Point pipeline would traverse agricultural, residential, Moore Creek flood plain, industrial, and commercial land uses. Industrial Park pipeline would traverse residential, industrial, and commercial uses. **2**	***All of the same site specific issues of Strategy 1 facilities plus:*** ***Pipelines*** • Regional distribution: Alternatives I and II would traverse a Community Commercial zone and then into SC County through a mix of land uses, mostly urban. They would cross Rodeo Creek. • Neither Alternative I nor II would be located within the Coastal Zone. • When Alternative II enters the County area, it crosses an area that is included in the City General Plan as residential, community facilities, commercial, and natural area (over Arana Gulch). • Alternative III would traverse land uses that include commercial, residential, industrial, flood plain (along San Lorenzo River), and small craft harbor (base of Arana Gulch). It would then enter the County where it would traverse a mix of land uses, including crossing Rodeo Creek. It would be within the Coastal Zone through most of its route. **2**	***Santa Margarita Aquifer:*** • Expansion of the Beltz Treatment Facility is not likely to require purchase of additional land or a change in zoning but may require an amendment to the existing facility's permit under the LCP. • Test well development for one (or two?) well(s) in residential area under County jurisdiction. ***Pipeline*** • Distribution pipeline alignment unknown, but assumed to be within existing roadways. Construction would not have significant long-term effects. ***Desalination:*** • Same as Strategy 1. **2**	***Santa Margarita Aquifer:*** • Same as Strategy 6a. • No distinction between Curtailment Profiles. ***Desalination:*** • Same as Strategy 2. **2**

TABLE C-1: DESALINATION STRATEGY SCREENING

	Strategy D-1: City Desalination (Curtailment Profile 2)	Strategy D-2: Regional Desalination (Curtailment Profile 2)	Strategy D-3: City Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)	Strategy D-4: Regional Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)
Indirect Land Use	• Growth inducement is a potential effect of any project that increases water supplies if it removes an obstacle to growth. However, the facility would only be operated significantly approximately 1 to 2 years out of every 10 since the City has ample water 80% of the years. This limits the potential for direct growth inducement. • Reliability Profile 2 would still fall short of extreme drought year conditions, and would only provide 85% of the water needed in a drought. Reliability Profile 1 would provide the full drought year need. Reliability Profile 3 would provide a75% of drought year need. **2**	• There could be Soquel Creek Water District service area land use changes that occur as a result of the availability of water. If growth occurs or land uses intensify as a result of project development and an increase in water supply, the strategy would be growth inducing. • To minimize growth-inducing effects, the strategy could be sized to accommodate growth consistent with the City and County General Plan projections. • According to a letter from County Planning to Soquel Creek Water District, their planning projections are consistent with County General Plan growth projections. However, water would be made available to Soquel Creek Water District every year for average year shortfall which could be deemed to have growth-inducing impacts. **4**	***Santa Margarita Aquifer:*** • The strategy is constrained by yield of Santa Margarita Aquifer. With this constraint, the strategy would likely not induce growth ***Desalination:*** • Same as Strategy 1. **2**	***Santa Margarita Aquifer:*** • Same as Strategy65a. ***Desalination:*** • Same as Strategy 2. **4**
Traffic	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • New pipelines would be constructed across existing intersections increasing traffic hazards. • Emergency access routes could be affected during construction. **2**	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • The pipeline could cross Highway 1. • New pipelines would be constructed across existing intersections increasing traffic hazards. • Emergency access routes could be affected during construction. **3**	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • The pipeline could cross Highway 1. • New pipelines would be constructed across existing intersections increasing traffic hazards. • Emergency access routes could be affected during construction **2**	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • The pipeline could cross Highway 1. • New pipelines would be constructed across existing intersections increasing traffic hazards. • Emergency access routes could be affected during construction **3**
Recreation	• Intake/Brine disposal pipelines could cross the beach and could affect recreation during construction. **3**	• Intake/Brine disposal pipeline issues same as Strategy 1. • Regional pipeline alternatives abut some neighborhood parks and could have short-term construction effects. **3**	***Santa Margarita Aquifer:*** • No known impacts of well development. ***Desalination:*** • Same as Strategy 1. **3**	***Santa Margarita Aquifer:*** • No known impacts of well development. ***Desalination:*** • Same as Strategy 2. **3**
Visual Resources	• The treatment facilities could be located along a scenic route. • The treatment facilities would introduce new light and glare. • The treatment facilities could degrade the existing visual character of the site and surroundings. **3**	• The treatment facilities could be located along a scenic route. • The treatment facilities would introduce new light and glare. • The treatment facilities could degrade the existing visual character of the site and surroundings. **3**	• The treatment facilities could be located along a scenic route. • The treatment facilities would introduce new light and glare. • The treatment facilities could degrade the existing visual character of the site and surroundings. **3**	• The treatment facilities could be located along a scenic route. • The treatment facilities would introduce new light and glare. • The treatment facilities could degrade the existing visual character of the site and surroundings. **3**

TABLE C-1: DESALINATION STRATEGY SCREENING

	Strategy D-1: City Desalination (Curtailment Profile 2)	Strategy D-2: Regional Desalination (Curtailment Profile 2)	Strategy D-3: City Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)	Strategy D-4: Regional Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)
Hydrology (Surface & Ground-water)	• This strategy would not utilize surface water or groundwater supplies or alter the operation of these supplies and therefore would have no impact on those sources. **1**	• This strategy would not utilize surface water or groundwater supplies or alter the operation of these supplies and therefore would have no impact on those sources. **2**	***Santa Margarita Aquifer:*** • The strategy is constrained by yield of Santa Margarita Aquifer and potential hydraulic connection to Purisima aquifer. The aquifer would produce its full 100 mg nearly every year. ***Desalination:*** • No impact. • Same impacts for Curtailment Profiles 1 and 3. **3**	***Santa Margarita Aquifer:*** • The strategy is constrained by yield of Santa Margarita Aquifer and potential hydraulic connection to Purisima aquifer. The aquifer would produce its full 100 mg nearly every year. ***Desalination:*** • No impact. • Same impacts for Curtailment Profiles 1 and 3. **3**
Public Health & Safety	• Operation of a desalination facility would require police and fire services to the site. • Treatment of water involves the generation and use of chemicals, some of which are hazardous. • Potential to encounter below-ground soil/water contamination during construction. Prior to construction, site-specific environmental assessments would be required. **2**	• Same as Strategy 1. **2**	***Santa Margarita Aquifer:*** • Treatment of water involves the generation and use of chemicals, some of which are hazardous. • Potential to encounter below ground soil/water contamination during construction. Prior to construction, site-specific environmental assessments would be required. ***Desalination:*** • Same as Strategy 1. **2**	***Santa Margarita Aquifer:*** • Treatment of water involves the generation and use of chemicals, some of which are hazardous. • Potential to encounter below ground soil/water contamination during construction. Prior to construction, site-specific environmental assessments would be required. ***Desalination:*** • Same as Strategy 2. **2**
Fisheries	• Potential for impact limited to construction of conveyance and distribution system at stream crossings. • Potential impacts can be mitigated by application of best management practices. **2**	• Potential for impact limited to construction of conveyance and distribution system at stream crossings. • Potential impacts can be mitigated by application of best management practices. **2**	• Potential for impact limited to construction of conveyance and distribution system at stream crossings. Potential impacts can be mitigated by application of best management practices. • Potential for groundwater withdrawal to influence streamflows is considered minimal due to depth of withdrawal (800 feet) and proximity to the coastline **2**	• Potential for impact limited to construction of conveyance and distribution system at stream crossings. Potential impacts can be mitigated by application of best management practices. • Potential for groundwater withdrawal to influence streamflows is considered minimal due to depth of withdrawal (800 feet) and proximity to the coastline **2**
Wetlands, Wildlife, and Plants	• Numerous potential impacts to wetlands, wildlife and plants with some variance depending on the site chosen for the plant. More detail on these impacts is provided in Table C-2. • Note that the additional level of detail for this analysis does not indicate that this criterion is of greater importance or impact than the other criteria but that more detailed information was available for the assessment. **3**	• Same as Strategy 1, see Table C-2 for more detail. **3**	• Same as Strategy 1, see Table C-2 for more detail. **3**	• Same as Strategy 1, see Table C-2 for more detail. **3**

TABLE C-1: DESALINATION STRATEGY SCREENING

	Strategy D-1: City Desalination (Curtailment Profile 2)	Strategy D-2: Regional Desalination (Curtailment Profile 2)	Strategy D-3: City Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)	Strategy D-4: Regional Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)
Cultural Resources	• Two recorded cultural resources are present in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources. **3**	• Two recorded cultural resources are present in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources **3**	• Two recorded cultural resources are present in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources **3**	• Twenty-nine recorded cultural resources are present within and in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources **3**

TABLE C-1: DESALINATION STRATEGY SCREENING

	Strategy D-1: City Desalination (Curtailment Profile 2)	Strategy D-2: Regional Desalination (Curtailment Profile 2)	Strategy D-3: City Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)	Strategy D-4: Regional Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)
Air Quality	• **Conflict with Air Quality Attainment Plans.** The emissions inventories used for development of the region's air quality attainment plans are primarily based on projected population growth and vehicle miles traveled for the region which are derived, in part, on the predicted growth identified in regional and community plans. Therefore, projects that would result in an increase in population or employment growth beyond that identified in regional or community plans, could result in increases in vehicle miles traveled (VMT) and, as a result, increases in mobile source emissions could conflict with the region's air quality planning efforts. • Growth inducement is a potential effect of any project increasing water supplies if it removes an obstacle to growth. However, under this strategy, the proposed facilities would be sized to accommodate growth consistent with the City's General Plan projections and would not remove obstacles that would allow additional growth beyond that already planned. Consequently, implementation of this strategy would not be anticipated to result in an increase in projected emissions that would conflict with or obstruct implementation of the region's air quality attainment plans. This impact would be considered low. • **Violation of Ambient Air Quality Standards.** Long-term operational air quality impacts attributable to this strategy would be primarily associated with the indirect generation of emissions due to the increased electrical demands of the proposed facilities. However, emissions associated with the generation of electricity either occurs at plants that are outside of the San Francisco Bay Area Air Basin or are offset through the use of pollution credits. As a result, long-term air quality impacts attributable to this strategy would be considered minor. • Short-term construction-generated emissions, particularly uncontrolled fugitive dust emissions, could potentially exceed ambient air quality standards at nearby sensitive receptors. As a result exposure to short-term increases in construction-generated emissions would be considered to have a potentially high impact to nearby sensitive receptors. Implementation of BAAQMD-recommended mitigation measures would likely reduce this impact to low. • **Increase in Odors.** The proposed strategy does not include the construction or operation of any major source of odors. Brine waste would be disposed via the City's existing wastewater outfall. Long-term odor impacts associated with this strategy would be considered low.	• **Conflict with Air Quality Attainment Plans.** There could be Soquel Creek Water District service area land use changes that occur as a result of the availability of water. If growth occurs or land uses intensify as a result of project development and an increase in water supply, the strategy would be growth inducing. Additional growth could, therefore, conflict with the emissions inventories used for air quality attainment planning. Consequently, this impact would be considered potentially high. • **Violate Ambient Air Quality Standards.** The long-term operational and short-term construction-related air quality impacts associated with this strategy would be similar to those discussed for Strategy 1. Although long-term increases in regional criteria pollutants would be considered less than significant, short-term increases in construction-generated pollutants could potentially exceed ambient air quality standards at nearby sensitive receptors. Consequently, short-term increases in regional criteria pollutants would be considered potentially significant. Implementation of BAAQMD-recommended mitigation measures would likely reduce this impact to low. • **Substantial Increase in Odors.** The proposed strategy does not include the construction or operation of any major source of odors. Brine waste would be disposed of via the City's existing wastewater outfall. Long-term odor impacts associated with this strategy would be considered low.	• **Conflict with Air Quality Attainment Plans.** This strategy is constrained by yield of Santa Margarita Aquifer and, as a result, would not be anticipated to induce growth. Consequently, implementation of this strategy would likely be consistent with the emissions inventories used for air quality attainment purposes and would, therefore, be consistent with adopted air quality attainment plans. This impact would be considered low. • **Violate Ambient Air Quality Standards.** The long-term operational and short-term construction-related air quality impacts associated with this strategy would be similar to those discussed for Strategy 1. Although long-term increases in regional criteria pollutants would be considered less than significant, short-term increases in construction-generated pollutants could potentially exceed ambient air quality standards at nearby sensitive receptors. Consequently, short-term increases in regional criteria pollutants would be considered potentially significant. Implementation of BAAQMD-recommended mitigation measures would likely reduce this impact to low. • **Substantial Increase in Odors.** The proposed strategy does not include the construction or operation of any major source of odors. Brine waste would be disposed of via the City's existing wastewater outfall. Long-term odor impacts associated with this strategy would be considered low.	• **Conflict with Air Quality Attainment Plans.** There could be Soquel Creek Water District service area land use changes that occur as a result of the availability of water. If growth occurs or land uses intensify as a result of project development and an increase in water supply, the strategy would be growth inducing. Additional growth could, therefore, conflict with the emissions inventories used for air quality attainment planning. Consequently, this impact would be considered potentially high. • **Violate Ambient Air Quality Standards.** The long-term operational and short-term construction-related air quality impacts associated with this strategy would be similar to those discussed for Strategy 1. Although long-term increases in regional criteria pollutants would be considered less than significant, short-term increases in construction-generated pollutants could potentially exceed ambient air quality standards at nearby sensitive receptors. Consequently, short-term increases in regional criteria pollutants would be considered potentially significant. Implementation of BAAQMD-recommended mitigation measures would likely reduce this impact to low. • **Substantial Increase in Odors.** The proposed strategy does not include the construction or operation of any major source of odors. Brine waste would be disposed of via the City's existing wastewater outfall. Long-term odor impacts associated with this strategy would be considered low.
	2	**3**	**2**	**3**

TABLE C-1: DESALINATION STRATEGY SCREENING

	Strategy D-1: City Desalination (Curtailment Profile 2)	Strategy D-2: Regional Desalination (Curtailment Profile 2)	Strategy D-3: City Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)	Strategy D-4: Regional Near-Term Santa Margarita GW/ Downsized Desal (Curtailment Profile 2)
Noise	• Exposure of receptors to permanent increases in ambient noise levels. Operation of the proposed facilities could result in an increase in ambient noise levels at nearby noise sensitive land uses. The potential increases would depend on the design and location of stationary noise-generating equipment. The location, design, and operational characteristics of these facilities have not been sufficiently defined at this time to accurately assess resultant noise impacts to nearby noise-sensitive receptors. Therefore, stationary source noise impacts associated with the proposed facilities are considered potentially moderate. • Exposure of receptors to temporary increases in ambient noise levels. Noise generated by construction equipment, including earthmovers, material handlers, and portable generators, can reach high levels. The U.S. EPA has found that average noise levels associated with the construction of public works facilities, such as those proposed, range from approximately 78 dBA L_{eq} to 89 dBA L_{eq} at 50 feet (U.S.EPA, 1971). • Because the precise location and construction of the proposed facilities has not yet been sufficiently defined, predicted noise levels at nearby noise-sensitive receptors cannot be accurately quantified at this time. However, given the close proximity of residential land uses in relation to the proposed facilities, short-term construction generated noise levels could potentially exceed applicable noise standards. As a result, construction of the proposed facilities could have a potentially high short-term noise impact. • Expose receptors to groundborne vibration. Based on equipment usage requirements associated with the construction of similar facilities, construction of the proposed facilities would not be anticipated to require the use of any equipment or processes that would result in potentially significant levels of ground vibration. Consequently, short-term increases in groundborne vibration levels would be considered less than significant. Required facilities associated with this strategy would include water conveyance pumps. Although not anticipated to result in structural damage to nearby buildings, large water conveyance pumps have been known to result in ground vibration levels that, when detectable, can result in increased annoyance to occupants of nearby buildings. Because the precise location, construction and operational characteristics of the proposed facilities have not yet been sufficiently defined, predicted vibration levels at nearby noise-sensitive receptors cannot be accurately quantified at this time. As a result, this impact is considered potentially moderate. **3**	• Noise- and vibration-related impacts would be similar to those discussed for Strategy 1. **3**	• Noise- and vibration-related impacts would be similar to those discussed for Strategy 1. **3**	• Noise- and vibration-related impacts would be similar to those discussed for Strategy 1. **3**

TABLE C-2: IMPACTS OF DESALINATION STRATEGIES TO WETLANDS, WILDLIFE AND PLANTS

	SE-State-listed Endangered FE-Federally-listed Endangered ST-State-listed Threatened FT-Federally-listed Threatened SSSC-State Species of Special Concern CNPS-California Native Plant Society 6th Inventory of Rare Plants	**Strategy D-1: City Desalination**			**Strategy D-2: Regional Desalination**			**Strategy D-3: City Near-Term Santa Margarita GW/Downsized Desalination**			**Strategy D-4: Regional Near-Term Santa Margarita GW/Downsized Desalination**		
		New Desalination Facility at Terrace Point	**New Desalination Facility in Industrial Area**	**Distribution System**	**New Desalination Facility at Terrace Point**	**New Desalination Facility in Industrial Area**	**Distribution System**	**New Desalination Facility at Terrace Point**	**New Desalination Facility in Industrial Area**	**Distribution System**	**New wastewater reclamation facility at Neary Lagoon WWTP**	**New satellite reclamation facility in industrial area**	**New satellite reclamation facility in UCSC campus**
Wetlands	11.6 acres of seasonal and estuarine wetlands on Terrace Point Site [8.1 acres of wet meadow; 0.9 acre seasonal wetland; 2.6 acre seasonal pond].	X			X			X					
	Antonelli Pond/Moore Creek Corridor and open space between Shaffer Road, Delaware Road, Swift Street and Highway 1 corridor.		X			X			X			X	
	Meder Creek (a.k.a. *lower Arroyo Seco* below Highway 1, or the *Lipton Ditch*) has wetland vegetation and hydrology. Restoration plans done by Lipton Co. to be constructed in summer 2002.		X			X			X			X	
	Stream, wetland or waterway crossings on pipeline routes may include San Lorenzo River, Carbonera Creek, Branciforte Creek, Arana Gulch, and Rodeo Gulch. Stream and waterway crossings are all routed at existing bridges.						X						
Wildlife	Tri-colored blackbird (*Agelaius tricolor*) [SSSC] noted in Antonelli Pond marsh habitat. May be found in outlying grasslands and seasonal wetlands.	X	X		X	X		X	X			X	
	Loggerhead shrike (*Lanius ludovicianus*) [SSSC] observed in site grasslands.	X			X			X					
	California red-legged frog (*Rana aurora draytonii*) [FT] is known to occur upstream in Moore Creek and ag ponds along Highway 1 corridor. CRLF may be present in upland areas during estivation and non-breeding dispersal periods. (CRLF not noted in CNDDB or other local listings for the specific "industrial area" sites). Existing agricultural California red-legged frog breeding ponds on the North Coast that may be used for reclaimed wastewater storage (equalization storage) may be adversely affected by water quality changes.		X			X			X			X	X
	California red legged frog (*Rana aurora draytonii*) [FT] known to occur in campus agricultural ponds and riparian corridors. CRLF may be present in upland areas during estivation and non-breeding dispersal periods		X										

TABLE C-2: IMPACTS OF DESALINATION STRATEGIES TO WETLANDS, WILDLIFE AND PLANTS

	SE-State-listed Endangered **FE-Federally-listed Endangered** **ST-State-listed Threatened** **FT-Federally-listed Threatened** **SSSC-State Species of Special Concern** **CNPS-California Native Plant Society 6th Inventory of Rare Plants**	**Strategy D-1: City Desalination**			**Strategy D-2: Regional Desalination**			**Strategy D-3: City Near-Term Santa Margarita GW/Downsized Desalination**			**Strategy D-4: Regional Near-Term Santa Margarita GW/Downsized Desalination**		
		New Desalination Facility at Terrace Point	**New Desalination Facility in Industrial Area**	**Distribution System**	**New Desalination Facility at Terrace Point**	**New Desalination Facility in Industrial Area**	**Distribution System**	**New Desalination Facility at Terrace Point**	**New Desalination Facility in Industrial Area**	**Distribution System**	**New wastewater reclamation facility at Neary Lagoon WWTP**	**New satellite reclamation facility in industrial area**	**New satellite reclamation facility in UCSC campus**
	Southwestern Pond Turtle (*Clemmys marmorata pallida*) [SSSC] may be present at Antonelli Pond and in adjacent upland habitat.		X			X			X			X	
	Raptors such as the Northern harrier (*Circus cyaneus*) [SSSC], peregrine falcon (*Falco perigrinus*) [SE], merlin (*Falco columbarius*) [SSSC] and burrowing owl (*Athene cunicularia*) [SSSC] have been seen feeding on the Terrace Point site. Northern harrier last bred on site in 1992.				X			X					
	Raptors utilize all grasslands in vicinity, including Northern harrier (*Circus cyaneus*) [SSSC], peregrine falcon (*Falco perigrinus*) [SE], merlin (*Falco columbarius*) [SSSC] and burrowing owl (*Athene cunicularia*) [SSSC] may be present. Scattered cypress, monterey pines and eucalyptus offer potential nesting and roosting habitat throughout the site(s).		X			X			X			X	
	Monarch butterfly [No Special Status] utilizes area eucalyptus groves for over-wintering habitat.		X			X			X			X	
	Ohlone tiger beetle (*Cicindela ohlone*) [FE] known to occur in remnant native grasslands on coastal terraces.												X
	Steelhead stream crossings and riparian habitat may be affected by pipeline construction along Northcoast Highway 1 corridor.												X
Plants	San Francisco popcorn flower (*Plagiobothrys diffusus*) [SE, CNPS List 1B] known to occur in Moore Creek and Wilder Creek watersheds north of proposed site.		X			X			X			X	X
	Santa Cruz clover (*Trifolium buckwestiorum*) CNPS List 1B												X
	Robust spineflower (*Chorizanthe robusta var. robusta*) CNPS List 1B												X

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TABLE C-3: RECLAMATION/GW EXCHANGE STRATEGY SCREENING

	Strategy R-1: City Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-2: Regional Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-3: City Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (City-Only) (Curtailment Profile 2)	Strategy R-4: Regional Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (Regional) (Curtailment Profile 2)
Marine Resources	• This strategy would not involve any activities or discharges in the ocean; therefore it would have no impact on marine resources. **1**	• This strategy would not involve any activities or discharges in the ocean; therefore it would have no impact on marine resources. **1**	• This strategy would not involve any activities or discharges in the ocean; therefore it would have no impact on marine resources. **1**	• This strategy would not involve any activities or discharges in the ocean; therefore it would have no impact on marine resources. **1**
Direct Land Use	***Treatment Facility*** • Limited space for expansion at existing WWTP. The site is zoned Public Facilities, with the Neary Lagoon Wildlife Refuge to the north and residences to the south, with potential effects. • Alternative sites include: - UCSC Site, currently zoned Public Facility - Industrial Park, zoned General Industrial. ***Pipelines*** • WWTP to North Coast: Would follow Highway 1 alignment, with agriculture/grazing and parks (Baldwin/Wilder) on either side. Between the WWTP and Highway 1 the pipeline would traverse residential land uses, within existing road rights-of-way. • Well field to Coast Pump Station: Upgrades to existing pipeline may have construction-related impacts. ***Well field*** • Well field development could affect agricultural land and/or parkland. • The effects of curtailment profiles could differ based on the amount of land needed for the well field development. Curtailment Profile 1 entails 5 wells, Profile 2 entails 3 wells, and Profile 3 entails 2 wells. ***Agricultural Land*** • Farmland abuts the southwestern side of Highway 1, with potential pipeline construction effects. • Potential benefit of keeping agriculture viable since current groundwater is high in TDS. See Hydrology. • Use of reclaimed water on agricultural lands in exchange for groundwater may have water quality impacts to the North Coast farmers. See Hydrology. **2**	***All of the same site specific issues of Strategy 3 plus:*** ***Pipelines*** • Regional conveyance from WWTP to Soquel: The pipeline would traverse a variety of land uses including the Neary Lagoon Wildlife Refuge, residential, CBD, flood plain (San Lorenzo River), Public Facilities, commercial, and then head into SC County where it would cover a mix of land uses, mostly urban but including Rodeo Creek. ***Well field*** • Same as Strategy 3. Again, curtailment profiles would differ based on the amount of land needed for the well field development. ***Agricultural Land*** • Same as Strategy 3. **2**	***Santa Margarita Aquifer:*** • Expansion of the Beltz Treatment Facility is not likely to require purchase of additional land or a change in zoning but may require an amendment to the existing facility's permit under the LCP. • Test well development for one (or two?) well(s) in residential area under County jurisdiction. • Only one curtailment profile because of the limits of the Santa Margarita aquifer. ***Pipelines*** • Distribution pipeline alignment unknown, but assumed to be within existing roadways Construction would not have significant long-term effects. ***Rec/GW Exchange:*** • Same as Strategy 3. Curtailment profiles would differ based on the number of wells and the amount of land needed for the well field development. **2**	***Santa Margarita Aquifer:*** • Same as Strategy 5b. Since only one well would be developed, there is no distinction between curtailment profiles. ***Rec/GW Exchange:*** • Same as Strategy 4. Curtailment profiles would differ based on the number of wells and the amount of land needed for the well field development. **2**

1 = No Impact
2 = Low Impact
3 = Moderate Impact
4 = High Impact
Note that these scores represent potential impacts.

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TABLE C-3: RECLAMATION/GW EXCHANGE STRATEGY SCREENING

	Strategy R-1: City Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-2: Regional Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-3: City Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (City-Only) (Curtailment Profile 2)	Strategy R-4: Regional Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (Regional) (Curtailment Profile 2)
Indirect Land Use	• Possible supply from North Coast is bracketed by the amount of irrigation potential from reclaimed water and/or the groundwater basin yield. • The available groundwater supply is assumed to be 700 mg/yr. With this source, plus water supply added due to a difference in reservoir operation, this strategy falls short of full drought year need by 15%. Thus, this strategy would not provide additional water supply that would induce growth. • Even at Curtailment Profile 1, with the largest quantity of water being produced, this Strategy just meets the full drought year need and thus would not be likely to induce growth. **2**	• There could be Soquel Creek Water District service area land use changes that occur as a result of the availability of water. If growth occurs or land uses intensify as a result of project development and an increase in water supply, the strategy would be growth inducing. The available groundwater supply is assumed to be 700 mg/yr. Reclamation could provide up to 700 mg/yr. • Soquel's future demand is 650 mg/yr and the full 500 mg/yr, if available, would go to Soquel during non-drought years. Soquel has an existing average year supply deficit and additional year round water supply could remove the constraint to growth. • Curtailment Profile 1 has the highest potential for growth-inducing effects because it provides the largest quantity of year-round water supply. **4**	***Santa Margarita Aquifer:*** • Annual production from this source is constrained by the assumed annual yield of Santa Margarita Aquifer. With this constraint, the strategy would likely not induce growth. ***Rec/GW Exchange:*** • Same as Strategy 3. **2**	***Santa Margarita Aquifer:*** • Same as Strategy 5b. ***Rec/GW Exchange:*** • Same as Strategy 4. **4**
Traffic	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • Construction of the pipeline along Highway 1 could increase congestion and increase traffic hazards. **2**	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • Construction of the pipeline along Highway 1 could increase congestion and increase traffic hazards. • The Soquel connection would cross Highway 1 potentially increasing congestion and traffic hazards. **3**	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • Construction of the pipeline along Highway 1 could increase congestion and increase traffic hazards. • New pipelines would be constructed across existing intersections increasing traffic hazards. • Emergency access routes could be affected during construction. **2**	• Construction of new pipelines along existing roadways could increase congestion and affect bicycle lanes. • Construction of the pipeline along Highway 1 could increase congestion and increase traffic hazards. • New pipelines would be constructed across existing intersections increasing traffic hazards. • Emergency access routes could be affected during construction. • The Soquel connection would cross Highway 1 potentially increasing congestion and traffic hazards **3**
Recreation	• Well field development could affect future recreational opportunities in State parklands. With five wells, Profile 1 would have the greatest effect. **2**	• Well field effects same as Strategy 3. • Regional conveyance pipeline from WWTP to Soquel crosses San Lorenzo River – potential construction effects. **2**	***Santa Margarita Aquifer:*** • No known impacts of well development. ***Rec/GW Exchange:*** • Same as Strategy 3. **2**	***Santa Margarita Aquifer:*** • No known impacts of well development. ***Rec/GW Exchange:*** • Same as Strategy 4. **2**
Visual Resources	• A new treatment facility could be located along a scenic vista. • A new tertiary treatment facility could introduce new light and glare. • A new tertiary treatment facility could degrade the existing visual character of the site and surroundings. **3**	• A new treatment facility could be located along a scenic vista. • A new tertiary treatment facility could introduce new light and glare. • A new tertiary treatment facility could degrade the existing visual character of the site and surroundings. **3**	• A new treatment facility could be located along a scenic vista. • A new tertiary treatment facility could introduce new light and glare. • A new tertiary treatment facility could degrade the existing visual character of the site and surroundings. **3**	• A new treatment facility could be located along a scenic vista. • A new tertiary treatment facility could introduce new light and glare. • A new tertiary treatment facility could degrade the existing visual character of the site and surroundings. **3**

TABLE C-3: RECLAMATION/GW EXCHANGE STRATEGY SCREENING

	Strategy R-1: City Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-2: Regional Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-3: City Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (City-Only) (Curtailment Profile 2)	Strategy R-4: Regional Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (Regional) (Curtailment Profile 2)
Hydrology (Surface & Ground-water)	• The strategy is constrained by yield of North Coast groundwater supply and subsequent potential of seawater intrusion. Since the strategy would primarily be utilized during the summer season, and there is likely to be adequate potential for recharge. • There are potential water quality and contamination issues from a landfill located upslope of the wellfield and reclaimed water applied above the aquifer. • For Curtailment Profile 1, the impacts would be greater, rated at a 4. • For Curtailment Profile 3, the impacts would be 3 or less. **3**	• The strategy is constrained by yield of North Coast groundwater supply and subsequent potential of seawater intrusion, especially since this strategy would be utilized on a year-round basis. • There are potential water quality and contamination issues from a landfill located upslope of the wellfield and reclaimed water applied above the aquifer. • Impacts would be the same for Curtailment Profiles 1 and 3. **4**	***North Coast Groundwater:*** • Same as Strategy 3. ***Santa Margarita Aquifer:*** • Annual production from this source is constrained by the assumed yield of Santa Margarita Aquifer and potential hydraulic connection to Purisima aquifer. However, since the strategy would not be used on a year-round basis, the potential for impact is low. • For Curtailment Profile 1, the impacts would be greater, rated at a 4. • For Curtailment Profile 3, the impacts would be 3 or less. **3**	***North Coast Groundwater:*** • Same as Strategy 4. ***Santa Margarita Aquifer:*** • Same as Strategy 5b. • Impacts would be the same for Curtailment Profiles 1 and 3. **4**
Public Health & Safety	• Treatment of water involves the generation and use of chemicals, some of which are hazardous. • Potential to encounter below ground soil/water contamination during construction. Prior to construction, site-specific environmental assessments would be required. **2**	• Same as Strategy 3. **2**	***Santa Margarita Aquifer:*** • Same as Strategy 3. ***Rec/GW Exchange:*** • Same as Strategy 3. **2**	***Santa Margarita Aquifer:*** • Same as Strategy 3. ***Rec/GW Exchange:*** • Same as Strategy 3. **2**
Fisheries	• Potential for impact limited to construction of conveyance and distribution system at stream crossings. • Potential impacts can be mitigated by application of best management practices. • Assume no change to streamflow levels from present conditions. **2**	• Potential for impact limited to construction of conveyance and distribution system at stream crossings. • Potential impacts can be mitigated by application of best management practices. • Assume no change to streamflow levels from present conditions. **2**	• Potential for groundwater withdrawal to influence streamflows is considered minimal due to depth of withdrawal (800 feet) and proximity to the coastline. • Potential for impact limited to construction of conveyance and distribution system at stream crossings and can be mitigated by application of best management practices. • Assume no change to streamflow levels from present conditions. **2**	• Potential for groundwater withdrawal to influence streamflows is considered minimal due to depth of withdrawal (800 feet) and proximity to the coastline. • Potential for impact limited to construction of conveyance and distribution system at stream crossings and can be mitigated by application of best management practices. • Assume no change to streamflow levels from present conditions. **2**
Wetlands, Wildlife, and Plants	• Numerous potential impacts with some variance depending on the sites chosen. Please see Table C-4 for more detail.. • Note that the additional level of detail for this analysis does not indicate that this criterion is of greater importance or impact than the other criteria but that more detailed information was available for the assessment. **3**	• Same as Strategy 3, see Table C-4 for more detail. **3**	• Same as Strategy 3, see Table C-4 for more detail. **3**	• Same as Strategy 3, see Table C-4 for more detail. **3**

TABLE C-3: RECLAMATION/GW EXCHANGE STRATEGY SCREENING

	Strategy R-1: City Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-2: Regional Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-3: City Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (City-Only) (Curtailment Profile 2)	Strategy R-4: Regional Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (Regional) (Curtailment Profile 2)
Cultural Resources	• Thirty recorded cultural resources are present within and in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources. **3**	• Twenty-nine recorded cultural resources are present within and in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources. **3**	• Ninety-eight recorded cultural resources are present within and in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources. **3**	• Ninety-three recorded cultural resources are present within and in the vicinity of the facilities. • Ground disturbing activities associated with these facilities may impact recorded cultural resources. • Ground disturbing activities within and in the vicinity of these facilities have the potential to impact undocumented cultural resources. **3**

TABLE C-3: RECLAMATION/GW EXCHANGE STRATEGY SCREENING

	Strategy R-1: City Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-2: Regional Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-3: City Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (City-Only) (Curtailment Profile 2)	Strategy R-4: Regional Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (Regional) (Curtailment Profile 2)
Air Quality	• **Conflict with air quality attainment plans.** The emissions inventories used for development of the regions air quality attainment plans are based primarily on projected population growth and vehicle miles traveled for the region based, in part, on the predicted growth identified in regional and community plans. Therefore, projects that would result in an increases in population or employment growth beyond that identified in regional or community plans, could result in increases in vehicle miles traveled (VMT) and, as a result, increases in mobile source emissions could conflict with the region's air quality planning efforts. • Growth inducement is a potential effect of any project increasing water supplies if it removes an obstacle to growth. However, under this strategy, possible supply from North Coast is bracketed by the amount of irrigation potential from reclaimed water and/or the groundwater basin yield. With these constraints, this strategy would not be anticipated to induce growth. Consequently, implementation of this strategy would not be anticipated to result in an increase in projected emissions that would conflict with or obstruct implementation of the region's air quality attainment plans. This impact would be considered low. • **Violate ambient air quality standards.** Long-term operational air quality impacts attributable to this strategy would be primarily associated with the indirect generation of emissions due to the increased electrical demands of the proposed facilities. However, emissions associated with the generation of electricity either occurs at plants that are outside of the San Francisco Bay Area Air Basin or are offset through the use of pollution credits. As a result, long-term increases in criteria pollutants attributable to this strategy would be considered less than significant. • Short-term construction-generated emissions, particularly uncontrolled fugitive dust emissions, could potentially exceed ambient air quality standards at nearby sensitive receptors. As a result exposure to short-term increases in construction-generated emissions would be considered to have a potentially significant impact to nearby sensitive receptors. Implementation of BAAQMD-recommended mitigation measures would likely reduce this impact to low. • **Substantial increase in odors.** This strategy would include tertiary water treatment facilities. Tertiary treatment facilities are not typically considered major sources of odorous emissions. Additional facilities associated with this strategy, such as new wells and distribution pipelines, would not be anticipated to result in substantial generation of odorous emissions. Consequently, the long-term odor impacts associated with this strategy would be considered low. **2**	• **Conflict with air quality attainment plans.** There could be Soquel Creek Water District service area land use changes that occur as a result of the availability of water. If growth occurs or land uses intensify as a result of project development and an increase in water supply, the strategy would be growth inducing. Additional growth could, therefore, conflict with the emissions inventories used for air quality attainment planning. Consequently, this impact would be considered potentially high. • **Violate ambient air quality standards**. The long-term operational and short-term construction-related air quality impacts associated with this strategy would be similar to those discussed for Strategy 1. Although long-term increases in regional criteria pollutants would be considered less than significant, short-term increases in construction-generated pollutants could potentially exceed ambient air quality standards at nearby sensitive receptors. Consequently, short-term increases in regional criteria pollutants would be considered potentially significant. Implementation of BAAQMD-recommended mitigation measures would likely reduce this impact to low. • **Substantial increase in odors.** The proposed strategy is not anticipated to include the construction or operation of any major source of odors. Therefore, long-term odor impacts associated with this strategy would be considered less than low. **3**	• **Conflict with air quality attainment plans.** This strategy is constrained by yield of Santa Margarita Aquifer and, as a result, would not be anticipated to induce growth. Consequently, implementation of this strategy would likely be consistent with the emissions inventories used for air quality attainment purposes and would, therefore, be consistent with adopted air quality attainment plans. This impact would be considered low. • **Violate ambient air quality standards.** The long-term operational and short-term construction-related air quality impacts associated with this strategy would be similar to those discussed for Strategy 1. Although long-term increases in regional criteria pollutants would be considered less than significant, short-term increases in construction-generated pollutants could potentially exceed ambient air quality standards at nearby sensitive receptors. Consequently, short-term increases in regional criteria pollutants would be considered potentially significant. Implementation of BAAQMD-recommended mitigation measures would likely reduce this impact to low. • **Substantial increase in odors.** Implementation of this strategy is not anticipated to include the construction or operation of any major sources of odorous emissions. Treatment of groundwater to reduce dissolved mineral concentrations, if required, would likely occur at the City's existing Beltz facility. Given the low organic concentrations anticipated within the groundwater, substantial increases in odorous emissions would not be anticipated. Therefore, long-term odor impacts associated with this strategy would be considered low. **3**	• Same as Strategy 4. **3**

TABLE C-3: RECLAMATION/GW EXCHANGE STRATEGY SCREENING

	Strategy R-1: City Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-2: Regional Reclamation/ GW Exchange (Curtailment Profile 2)	Strategy R-3: City Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (City-Only) (Curtailment Profile 2)	Strategy R-4: Regional Near-Term Santa Margarita GW/ Downsized Rec/GW Exchange (Regional) (Curtailment Profile 2)
Noise	• **Expose Receptors to Permanent Increases in Ambient Noise Levels**. Operation of the proposed facilities could result in an increase in ambient noise levels at nearby noise sensitive land uses. The potential increases would depend on the design and location of stationary noise-generating equipment. However, the specific location, design, and operational characteristics of these facilities have not been sufficiently defined at this time to accurately assess resultant noise impacts to nearby noise-sensitive receptors. Therefore, stationary source noise impacts associated with the proposed facilities are considered potentially high. • **Expose Receptors to Temporary Increases in Ambient Noise Levels**. Noise generated by construction equipment, including earthmovers, material handlers, and portable generators, can reach high levels. The U.S. EPA has found that average noise levels associated with the construction of public works facilities, such as those proposed, typically range from approximately 78 dBA L_{eq} to 89 dBA L_{eq} at 50 feet (U.S.EPA, 1971). • Because the precise location and construction requirement of the proposed facilities have not yet been sufficiently defined, predicted noise levels at nearby noise-sensitive receptors cannot be accurately quantified at this time. However, given the close proximity of residential land uses in relation to the proposed facilities, it is anticipated that short-term construction generated noise levels could potentially exceed applicable noise standards. As a result, construction of the proposed facilities would be considered to have a potentially significant short-term noise impact. • **Expose Receptors to Groundborne Vibration**. Based on equipment usage requirements associated with the construction of similar facilities, construction of the proposed facilities would not be anticipated to require the use of any equipment or processes that would result in potentially significant levels of ground vibration. Consequently, short-term increases in groundborne vibration levels would be considered low. • Required facilities associated with this strategy would include water conveyance pumps. Although not anticipated to result in structural damage to nearby buildings, large water conveyance pumps have been known to result in ground vibration levels that, when detectable, can result in increased annoyance to occupants of nearby buildings. Because the precise location, construction and operational characteristics of the proposed facilities have not yet been sufficiently defined, predicted vibration levels at nearby noise-sensitive receptors cannot be accurately quantified at this time. As a result, this impact is considered potentially high. **3**	• Noise- and vibration-related impacts would be similar to those discussed for Strategy 3. **3**	• Noise- and vibration-related impacts would be similar to those discussed for Strategy 3. **3**	• Noise- and vibration-related impacts would be similar to those discussed for Strategy 3. **3**

TABLE C-4: IMPACTS OF RECLAMATION/GW EXCHANGE STRATEGIES TO WETLANDS, WILDLIFE AND PLANTS

	SE-State-listed Endangered **FE-Federally-listed Endangered** **ST-State-listed Threatened** **FT-Federally-listed Threatened** **SSSC-State Species of Special Concern** **CNPS-California Native Plant Society 6th Inventory of Rare Plants**	**Strategy R-1: City Reclamation/Coast GW Exchange**			**Strategy R-2: Regional Reclamation/Coast GW Exchange**			**Strategy R-3: City Near-Term Santa Margarita GW/Downsized Reclaim Coast GW**		**Strategy R-4: Regional Near-Term Santa Margarita GW/Downsized Reclamation Coast GW Exchange**		
		New satellite reclamation facility in industrial Area	**New satellite reclamation facility in UCSC campus**	**Dist System**	**New satellite reclamation facility in Industrial Area**	**New satellite reclamation facility in UCSC campus**	**Dist System**	**New satellite reclamation facility in industrial facility**	**Dist System**	**New satellite reclamation facility in Industrial Area**	**New satellite reclamation facility in UCSC campus**	**Dist System**
Wetlands	Antonelli Pond/Moore Creek Corridor and open space between Shaffer Road, Delaware Road, Swift Street and Highway 1 corridor.	X			X			X		X		
	Meder Creek (a.k.a. *lower Arroyo Seco* below Highway 1, or the *Lipton Ditch*) has wetland vegetation and hydrology. Restoration plans done by Lipton Co. to be constructed in summer 2002.	X			X			X		X		
	Stream, wetland or waterway crossings on pipeline routes may include San Lorenzo River, Carbonera Creek, Branciforte Creek, Arana Gulch, and Rodeo Gulch. Stream and waterway crossings are all routed at existing bridges.						X					X
Wildlife	Tri-colored blackbird (*Agelaius tricolor*) [SSSC] noted in Antonelli Pond marsh habitat. May be found in outlying grasslands and seasonal wetlands.	X			X			X		X		
	Loggerhead shrike (*Lanius ludovicianus*) [SSSC] observed in site grasslands.											
	California red-legged frog (*Rana aurora draytonii*) [FT] is known to occur upstream in Moore Creek and ag ponds along Highway 1 corridor. CRLF may be present in upland areas during estivation and non-breeding dispersal periods. (CRLF not noted in CNDDB or other local listings for the specific “industrial area” sites). Existing agricultural California red-legged frog breeding ponds on the North Coast that may be used for reclaimed wasterwater storage (equalization storage) may be adversely affected by water quality changes.	X			X			X		X		X
	California red legged frog (*Rana aurora draytonii*) [FT] known to occur in campus agricultural ponds and riparian corridors. CRLF may be present in upland areas during estivation and non-breeding dispersal periods		X	X		X					X	
	Southwestern Pond Turtle (*Clemmys marmorata pallida*) [SSSC] may be present at Antonelli Pond and in adjacent upland habitat.	X			X			X		X		

TABLE C-4: IMPACTS OF RECLAMATION/GW EXCHANGE STRATEGIES TO WETLANDS, WILDLIFE AND PLANTS

	SE-State-listed Endangered FE-Federally-listed Endangered ST-State-listed Threatened FT-Federally-listed Threatened SSSC-State Species of Special Concern CNPS-California Native Plant Society 6th Inventory of Rare Plants	**Strategy R-1: City Reclamation/Coast GW Exchange**			**Strategy R-2: Regional Reclamation/Coast GW Exchange**			**Strategy R-3: City Near-Term Santa Margarita GW/Downsized Reclaim Coast GW**		**Strategy R-4: Regional Near-Term Santa Margarita GW/Downsized Reclamation Coast GW Exchange**		
		New satellite reclamation facility in industrial Area	**New satellite reclamation facility in UCSC campus**	**Dist System**	**New satellite reclamation facility in Industrial Area**	**New satellite reclamation facility in UCSC campus**	**Dist System**	**New satellite reclamation facility in industrial facility**	**Dist System**	**New satellite reclamation facility in Industrial Area**	**New satellite reclamation facility in UCSC campus**	**Dist System**
Wildlife	Raptors such as the Northern harrier (*Circus cyaneus*) [SSSC], peregrine falcon (*Falco perigrinus*) [SE], merlin (*Falco columbarius*) [SSSC] and burrowing owl (*Athene cunicularia*) [SSSC] have been seen feeding on the Terrace Point site. Northern harrier last bred on site in 1992.											
	Raptors utilize all grasslands in vicinity, including Northern harrier (*Circus cyaneus*) [SSSC], peregrine falcon (*Falco perigrinus*) [SE], merlin (*Falco columbarius*) [SSSC] and burrowing owl (*Athene cunicularia*) [SSSC] may be present. Scattered cypress, monterey pines and eucalyptus offer potential nesting and roosting habitat throughout the site(s).	X			X			X		X		
	Monarch butterfly [No Special Status] utilizes area eucalyptus groves for over-wintering habitat.	X			X			X		X		
	Ohlone tiger beetle (*Cicindela ohlone*) [FE] known to occur in remnant native grasslands on coastal terraces.		X			X					X	
	Steelhead stream crossings and riparian habitat may be affected by pipeline construction along Northcoast Highway 1 corridor.			X			X					
Plants	San Francisco popcorn flower (*Plagiobothrys diffusus*) [SE, CNPS List 1B] known to occur in Moore Creek and Wilder Creek watersheds north of proposed site.	X	X		X	X		X		X	X	
	Santa Cruz clover (*Trifolium buckwestiorum*) CNPS List 1B		X			X					X	
	Robust spineflower (*Chorizanthe robusta var. robusta*) CNPS List 1B		X			X					X	

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APPENDIX D

Implementation Issues Associated With IWP Resource Strategies

APPENDIX D. IMPLEMENTATION ISSUES ASSOCIATED WITH IWP RESOURCE STRATEGIES

All eight water supply strategies under consideration involve to one degree or another a myriad of regulatory constraints, permits, information needs, agreements, and institutional obstacles at various levels of government that could potentially delay project development and must be addressed and overcome before a project can be commissioned. This evaluation criteria focuses on the key issues that affect the relative ease or difficulty of implementing a given strategy within the 2020 planning horizon. The following factors were considered in the evaluation for this criterion:

- Permits required
- Agreements/ partnerships required
- Land acquisition/easements
- Project schedule

The following discussion addresses each of these factors and describes how the different strategies compare, in terms of the ease of implementation for that specific factor alone, and overall, considering all the issues together.

A. PERMITS REQUIRED

Table D-1 presents a list of the potential permit requirements for the water supply strategies under consideration. Not all the permits listed would apply to every strategy. Some permits are technical reviews that stand a high chance of approval once complete information is provided and regulatory requirements are satisfied. Other permits pose greater uncertainty, due to the length of process involved, the specific concerns of the decision-making body, and the opportunities for appeal if a proposed project is controversial or is opposed outright. Discussed below are the permit requirements that are likely to place the strongest regulatory constraint on the water supply development process.

Four of the eight strategies involve desalination of seawater. These strategies vary in capacity and timing. All require the immediate construction of a raw water intake, treatment plant, distribution facilities and a means discharging waste effluent. Two of the four desalination strategies would involve operating jointly with the Soquel Creek Water District.

For a new desalination facility, the Central Coast Region Water Quality Control Board is the state agency with the primary responsibility for coordination and control of water quality. The Regional Board regulates discharges to State waters in accordance with the State Water Resource Control Board's Water Quality Control Plan for Ocean Waters of California (Ocean Plan), which sets effluent requirements for various water quality constituents. The Regional Board has the authority to approve the discharge location and to establish effluent limits for the brine wastewater generated by the desalination plant, which is regarded as an industrial waste and subject to stringent disposal regulations. The permit process would involve incorporating comments from various resource protection agencies, including the Monterey Bay National Marine Sanctuary, California Coastal Commission, and Department of Fish and Game, as well as other affected interests. Having Monterey Bay designated as a National Marine Sanctuary means special attention will be paid to protect against potential impacts from wastewater disposal. Moreover, there is a large, active constituency in the Santa Cruz area advocating and promoting ocean water quality protection. However, the designation as a marine sanctuary alone does not preclude the Regional Board from permitting the City to discharge if it can demonstrate compliance with effluent requirements and receiving water limitations.

The larger unknown in permitting a desalination facility is the coastal development permit required by the California Coastal Commission, which has regulatory jurisdiction over any development proposed on tide and submerged lands, and on public works plans located in the coastal zone. The Coastal Commission would scrutinize the City's environmental impact report for consistency with the State Coastal Act and for adequacy with regard to a variety of potential coastal resource impacts, ranging from air quality to construction, energy use, noise, hazardous waste releases, impacts to the marine ecosystem, public access, and recreation. It would require the City to mitigate any significant impacts with appropriate measures or could potentially force the City to pursue another water supply strategy if it were shown to have fewer environmental impacts.

With regard to cumulative impacts, the Coastal Commission has expressed concerned with the proliferation of individual desalination plants in water-short communities along the coast, therefore it may look more favorably upon a project that operates as a regional facility for both the City and Soquel Creek. Since such a plant would operate constantly, as opposed to only intermittently for a City-only project, the actual impacts of a regional plant on the marine environment may be greater. The risk to the City of going forward with a desalination strategy is not knowing what the outcome of the permit process will be with the California Coastal Commission. As a result of this uncertainty with the Coastal Commission, permitting is regarded as a major constraint to implementation for the four desalination strategies. It is presumed that the strategies with the smaller capacity have a greater likelihood of success than the larger capacity strategies.

In addition to the State Coastal Commission, a desalination plant would require a coastal development permit from the City and/or County in accordance with local coastal plan requirements.

The other four strategies under consideration involve reclaiming wastewater for reuse on commercial agriculture crops on the County's north coast, and the development of underlying groundwater supplies for municipal use. Like the desalination strategies, the reclamation/groundwater strategies vary in capacity and timing and two strategies are conceived as a regional project operating jointly with the Soquel Creek Water District.

The California Department of Health Services (DHS) is responsible for the adoption of regulations for the use of recycled water. The California Regional Water Quality Control Boards issue requirements for individual reclamation projects in conformance with the regulations adopted by DHS. The U.S. Environmental Protection Agency and local health agencies may also have a role in regulating recycled water use. Title 22 of the California Code of Regulations prescribes the wastewater reclamation criteria to regulate specific uses of reclaimed water. The City would have to satisfy both DHS and the Central Coast Regional Board that the treatment/quality of reclaimed water produced at the water pollution control facility was suitable and safe for food crop irrigation before the plant could be permitted and water delivered to growers.

With respect to the development and use of coast groundwater supplies for municipal purposes, the City would be required to submit an engineering report and Drinking Water Source Assessment to DHS before its domestic water supply permit could be amended. The source water assessment focuses on identifying and preventing potential contaminants that may reach the drinking water supply. With the proposal to apply recycled wastewater directly above the aquifer being tapped for municipal supply and given that the City is landfill located in the proximity of the groundwater aquifer, DHS would need to be assured that the new source is safe for human consumption before authorizing it as part of the public water supply system. The information that would need to be gathered to satisfy DHS is regarded as a considerable constraint on implementation regardless of the capacity of the strategy.

B. INSTITUTIONAL AGREEMENTS/PARTNERSHIPS FOR WATER SUPPLY STRATEGIES

The strategies that require the mutual cooperation with the greatest number of entities are the regional reclamation and groundwater exchange projects (R-2 and R-4). An interagency agreement would be needed between the City and the Soquel Creek Water District concerning the overall capacity of the project, cost sharing, management and operation of the system, and periods of use. This project would also require the approval and agreement with the State Parks Department for permission to utilize the groundwater underlying Wilder Ranch State Park for municipal supply purposes. (See discussion below.) the State's position on this matter was unknown.

Agreements would be needed with 6-7 individual growers that presently rely on local groundwater sources for irrigation purposes to accept reclaimed water instead and to limit their right to future groundwater extraction. Finally, an agreement would be needed with the University of California, which has committed to funding its share of needed water system improvements associated with the planned growth at the University under the 1988 Long Range Development Plan.

The strategies considered to be the next most difficult in terms of agreements and partnership are the City-only reclamation and groundwater exchange projects (R-1 and R-3). In this case, while no agreement would be needed with the Soquel Creek Water District, cooperation of all the other parties mentioned above would be needed for the project to proceed.

All reclamation/groundwater projects rely on the State Parks Department granting the City a permanent entitlement to extract groundwater under Wilder Ranch State Park for use outside the groundwater basin as a public drinking water source. At the time of this analysis (July 2002), the question of whether the State would be willing or able to authorize such an arrangement was unresolved,[31] but it was recognized that, State consent for groundwater extraction is a prerequisite for these strategies to go forward.

Although the regional desalination strategies (D-2 and D-4) require agreements with fewer parties, they are considered only slightly less difficult to implement than the City-only reclamation and groundwater exchange project. The City would need to reach an agreement with the District over similar issues as identified above. With respect to the University, this project could involve negotiations over the use of a portion of the Terrace Point property, which is owned by the University and is undergoing a planning process to develop a Coastal Long Range Development Plan (see below). The regional desalination strategies are rated as having a considerable constraint on implementation, in terms of agreements and partnerships.

The City desalination strategies (D-1 and D-3) would both require reaching only one agreement with the University over its share of project funding, and possible siting at Terrace Point. As such, these strategies are considered to have few constraints on implementation from the standpoint of agreements and partnerships.

A summary of the agreements/partnerships required for each strategy is presented in Table D-2.

C. LAND ACQUISITION, EASEMENT AND LEASES

The four desalination options would all involve acquiring 2-3 acres of land for a water treatment plant and pumping station. The general sites considered to be most viable based on proximity to intake, outfall and treated water storage facilities are the University property at Terrace Point and vacant industrial lands near the former Lipton plant on the west side of town. These alternatives may also require land leases with the State of California if seawater intake facilities are constructed on subtidal lands.

The four reclamation and groundwater exchange strategies would involve construction of tertiary treatment facilities at the City's wastewater treatment plant, and thus would not involve land acquisition. However permanent easements would be required to install and access reclaimed water conveyance pipelines to coast growers, and for siting new groundwater wells on State or private property. The regional reclamation and groundwater exchange project would potentially require substantial pumping to deliver groundwater across the City to the Soquel Creek Water District distribution facilities, and thus would involve acquiring a small amount of land for pumping stations.

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31 Since that time, the Department has sent a letter clarifying that it strongly opposes this project. This letter is included as Appendix E.

The assumption about siting tertiary treatment facilities at the existing wastewater plant is based on the findings contained in the March 2002 report on regional water supply alternatives by Carollo Engineers, which shows two possible space locations on the existing plant grounds. If more space were needed for tertiary facilities than anticipated or if the space needs at the existing plant were to change, making it impractical to site at the existing plant, implementation of the reclamation alternatives would become considerably more difficult.

Facilities to pump groundwater from the Santa Margarita aquifer in the Live Oak area would be located at the City's existing Live Oak well sites.

Among the eight options, the four desalination options are considered to have the most considerable constraint on implementation due to the challenges posed in selecting and acquiring land within the City limits for a future desalination facility. One reason is that the University has embarked on a planning program to provide for the expansion of the 102-acre Long Marine Lab site. Anticipated uses include marine research and teaching facilities, support and ancillary facilities, equipment storage and maintenance facilities, and housing.

While a decision about the future uses of this site has not been made, University officials have indicated a desire to utilize the site for academic and research purposes, rather than for siting a treatment plant. Alternatively, the possibility exists that the University may be interested in using its land at Terrace Point to offset its share of the cost for a new source of water supply as stipulated under the University assistance measures, and thereby reduce the impact on the University budget. In this case, implementation of the desalination alternatives would be somewhat easier, from the standpoint of both land acquisition and agreements and partnerships. The University's position on this matter is unknown at this time.

The regional reclamation and groundwater exchange options (R-2 and R-4) are considered to have some constraints on implementation on the basis of the number of easements and small amount of land potentially required. The City-only reclamation/groundwater options (R-1 and R-3) have the fewest constraints and pose the least difficulty since none would require land acquisition.

A summary of the land acquisition, easements and leases required for each strategy is presented in Table D-3.

D. SCHEDULE

The engineer's estimate for the minimum number of years to design, permit, and construct the desalination strategies ranges from 6 to 8 years. The reclamation and groundwater exchange options are estimated to take 5 to 7 years to develop and commission, not counting time to negotiate groundwater rights. These lengthy timelines before a new supply becomes available are regarded as a considerable constraint on implementation. If the permitting process is more difficult or protracted than anticipated, the risk exists that years can be added to the project schedule. The four options that include groundwater from the Santa Margarita in Live Oak are rated slightly higher because they provide some supply relief in the near term, since that component can be developed in as few as 2 to 3 years.

E. OVERALL RATING OF WATER SUPPLY STRATEGIES

Table D-4 provides a summary of how the eight strategies rate in each of the four implementation categories. The rating scale measures the degree of constraint posed and ranges from few (least difficult) to major (most difficult), based on the qualitative findings discussed above.

In absolute terms, none of the eight strategies are considered easy to implement. Each has at least one major constraint on implementation and some strategies have many considerable constraints as well.

An effort was made to rank the eight strategies from least difficult to most difficult. It should be noted the ranking process is highly subjective depending on the assumptions and judgment one uses, and different individuals will arrive at different conclusions. Based on the Integrated Water Plan Committee's input, we revised the initial ranking using a two-step process described below.

The first step was to rank the strategies into three levels based only on the first two factors in Table D-4. In doing so, we assume that permitting and agreement/partnerships are the most important factors influencing ease of implementation, and ignored for the time being the other two factors, land acquisition and schedule. Moreover, we judged that the interagency agreement with State Parks for the reclamation strategies to be the most significant constraint overall, more so than the permitting constraint with the State Coastal Commission.

The second step was to refine the initial rankings using the land acquisition and schedule factors.

This first step resulted in dividing the eight strategies into three categories. Referring to Table D-4, the four reclamation strategies are ranked the most difficult, given that they all require the consent of State Parks, and they all share a considerable constraint in terms of permitting. The least difficult strategies are D-1 and D-3, since they have comparatively few constraints with regard to agreements and partnerships. Strategies D-2 and D-4 (both of which are regional desalination strategies) are regarded as being moderately difficult to implement, given the rating in Table D-4 on agreements and partnerships. Still, they are regarded as less difficult to implement than any of the reclamation strategies.

The second step resulted in a further refinement of this primary ranking.

Of the two City-only desalination strategies ranked least difficult, D-3 is considered easier to implement than strategy D-1 due to the difference in rating for schedule.

Of the two regional desalination strategies ranked moderately difficult, D-4 is regarded as the easier of the two, again due to the difference in rating for schedule.

Of the four reclamation alternatives ranked most difficult, strategy R-3 is ranked easiest due to the relatively few constraints on land acquisition and schedule. Strategy R-1 was ranked next easiest given the few constraints with land acquisition, followed by strategy R-4, which had somewhat more constraints with land acquisition. The most difficult strategy overall is strategy R-2, the regional reclamation option.

Table D-5 shows the projects in rank order in terms of difficulty of implementation.

Table D-1. List of Potential Permit Requirements for Water Supply Strategies

Permit	Applies To	Agency	Desalination	Reclamation
FEDERAL				
Clean Water Act Section 404 permit	Pipeline Crossing Stream	U.S Army Corps of Engineers	✓	✓
ESA Section 7 Consultation	Any Federal Listed Species / Habitats	U.S. Fish and Wildlife Service	✓	✓
ESA Consultation	Any Federal Listed Species / Habitats	National Marine Fisheries Service	✓	✓
Marine Sanctuary Protection	Waster Discharge, Use of Sanctuary Resources	National Oceanic and Atmospheric Administration	✓	
NHPA Consultation	Cultural Resources	ACOE/SHPO	✓	✓
STATE				
Coastal Development Permit	Development in State reserved jurisdiction	California Coastal Commission	✓	✓
Streambed Alteration Agreement	Pipeline Crossing Streams	CA Department of Fish and Game	✓	✓
CESA Section 2081 Permit	Any California Listed Species / Habitats	CA Department of Fish and Game	✓	✓
Domestic Water Supply Permit	Water Source Changes/Additions	CA Department of Health Services	✓	✓
Right-of-Way Permit	Wells and Portion of Pipeline	CA Department of Parks and Recreation		✓
Encroachment Permit	Pipeline Crossing Highway 1	CA Department of Transportation		✓
Water Right Permit	Appropriation of Surface Water	State Water Resources Control Board		
NPDES/Waste Discharge Requirements	Wastewater Discharge	Central Coast Regional Water Quality Control Board		✓
Wastewater Reclamation Requirements	Wastewater Reclamation	Central Coast RWQCB, DOHS		✓
NPDES Permit / Storm Water Runoff	Construction Activities	Central Coast Regional Water Quality Control Board	✓	✓
Section 401 Water Quality Certification	Review of Federal Permits	Central Coast Regional Water Quality Control Board	✓	✓
State Lands Commission Right-Of-Way	Facilities in tidal and submerged lands	State Lands Commission	✓	
Native American Heritage Consultation	Cultural/Ethnographic Resources	SHPO, NAHC	✓	✓
Permit to Construct/Operate	Air Quality	Monterey Bay Unified Air Pollution Control District	✓	✓
LOCAL				
Coastal Development Permit	Development in Coastal Zone	City, County Planning Departments	✓	✓
Encroachment Permit	Pipelines in Roadways	County Public Works	✓	✓
Well Construction Permit	Wells in County Jurisdiction	County Environmental Health		✓

Table D-2. Institutional Agreements/Partnerships for Water Supply Strategies

		Desalination				Reclamation/Groundwater Exchange			
		D-1	**D-2**	**D-3**	**D-4**	**R-1**	**R-2**	**R-3**	**R-4**
Agreement	**Applies To**	City Desalination	Regional Desalination	City Downsized Desalination/ Groundwater Well	Regional Downsized Desalination/ Groundwater Well	City Reclamation/ North Coast Groundwater	Regional Reclamation/ North Coast Groundwater	City Downsized Reclamation/ North Coast Groundwater	Regional Downsized Reclamation/ North Coast Groundwater
California State Department of Parks and Recreation	Right to Use of Ground Water Consistency of action with DPR land use policies					✓	✓	✓	✓
University of California	Cost sharing Desalination facility siting	✓	✓	✓	✓	✓	✓	✓	✓
Soquel Creek Water District	Facility capacity Priority of Use Operation and Maintenance Cost sharing		✓		✓		✓		✓
Coast Growers	Use of Reclaimed Water Limitation on Use of Ground Water					✓	✓	✓	✓

Table D-3. Land Acquisition and Easements for Water Supply Strategies

		Desalination				Reclamation/Groundwater Exchange			
		D-1	D-2	D-3	D-4	R-1	R-2	R-3	R-4
Category	**Applies To**	City Desalination	Regional Desalination	City Downsized Desalination/ Groundwater Well	Regional Downsized Desalination/ Groundwater Well	City Reclamation/ North Coast Groundwater	Regional Reclamation/ North Coast Groundwater	City Downsized Reclamation/ North Coast Groundwater	Regional Downsized Reclamation/ North Coast Groundwater
Land Acquisition	Treatment plant, pump stations	✓	✓	✓	✓		✓		✓
Easements	Transmission pipelines on State lands and private property					✓	✓	✓	✓
Land Lease	Development on State subtidal lands	✓	✓	✓	✓				

Table D-4. Rating of Water Supply Strategies: Constraints on Implementation

	Desalination				Reclamation/Groundwater Exchange			
	D-1	D-2	D-3	D-4	R-1	R-2	R-3	R-4
Implementation Factor:	City Desalination	Regional Desalination	City Downsized Desalination/ Groundwater Well	Regional Downsized Desalination/ Groundwater Well	City Reclamation/ North Coast Groundwater	Regional Reclamation/ North Coast Groundwater	City Downsized Reclamation/ North Coast Groundwater	Regional Downsized Reclamation/ North Coast Groundwater
Permits Required	Major	Major	Major	Major	Considerable	Considerable	Considerable	Considerable
Agreements and partnerships	Few	Considerable	Few	Considerable	Major	Major	Major	Major
Land acquisition and easements	Considerable	Considerable	Considerable	Considerable	Few	Some	Few	Some
Schedule	Considerable	Considerable	Some	Some	Considerable	Considerable	Some	Some

Table D-5. Ranking of Water Supply Strategies: Difficulty of Implementation

Difficulty of Implementation	Rank Order	Strategy Number and Description
Least difficult	1	D-3 City Downsized Desalination/Groundwater Well
	2	D-1 City Desalination
Moderately difficult	3	D-4 Regional Downsized Desalination/Groundwater Well
	4	D-2 Regional Desalination
Most difficult	5	R-3 City Downsized Reclamation/ North Coast Groundwater
	6	R-1 City Reclamation/ North Coast Groundwater
	7	R-4 Regional Downsized Reclamation/ North Coast Groundwater
	8	R-2 Regional Reclamation/ North Coast Groundwater

APPENDIX E

Letters to City of Santa Cruz Regarding Reclamation/ Groundwater Exchange Supply Option

State of California • The Resources Agency

Gray Davis, Governor

DEPARTMENT OF PARKS AND RECREATION
SANTA CRUZ DISTRICT
600 OCEAN STREET
SANTA CRUZ, CA

Ruth G. Coleman, *Acting Director*

September 11, 2002

Bill Kocher
Director
Water Department, City of Santa Cruz
809 Center Street, Room 102
Santa Cruz, CA 95060

RE: Wastewater Reclamation-Water Supply Alternative
Wilder Ranch State Park

Dear Mr. Kocher:

California State Parks has carefully considered the Water Department's proposed water supply alternative involving a long-term exchange of city reclaimed wastewater for ground water at Wilder Ranch State Park. This is to inform you that State Parks is not interested in pursuing further consideration of this alternative.

This proposal, one of several alternatives to be thoroughly studied by the City, involves uncharted legal and complex policy issues having serious long-term implications of statewide consequence that go far beyond Wilder Ranch State Park and the City of Santa Cruz. The intent of setting aside state parklands for natural resource protection and provision of recreational opportunity is not served or enhanced by pursuing this alternative

Beyond difficult legal and administrative complexities, it is the Department's assessment that the use of reclaimed wastewater at Wilder Ranch could result in potential adverse impacts to sensitive natural resources, place possible constraints on recreational usage and adversely impact organic agricultural leasing operations at Wilder Ranch State Park.

This proposed water supply study alternative has no identifiable benefit to the California State Park System and clearly holds potential for adversely impacting natural and recreational resources. The Department is not prepared to commit scarce resources to pursuing this water supply alternative. While it is understandable that the City examine all reasonable alternatives, I ask that you remove this one from further consideration. The Department simply cannot support this water supply study alternative.

Sincerely,

David K. Vincent
District Superintendent

ROUTE 1 FARMS
917 Delaware Ave.
Santa Cruz, CA 95060

(831) 426-1075
FAX (831) 426-4139

September 21, 2002

Mr. Bill Kocher
Director
Water Department, City of Santa Cruz
809 Center St. Rm 102
Santa Cruz, CA 95060

Mr. Kocher:

I have tried to be open-minded in considering the exchange of Santa Cruz wastewater for the rights to use my well at Wilder Ranch State Park. I understand the city's desire to supplement the limited water resources challenging us but I cannot be a party to the city's plan.

It is essential for me as an organic farmer to use clean water to irrigate my crops. The California Organic Food Act of 1990 prohibits the use of treated wastewater in the production of certified organic crops. While the new Federal Organic Law does not prohibit the use of wastewater, we wish to continue growing in accordance with the stricter regulations proscribed by the state law and California Certified Organic Farmers. Our customers expect the very best, very purest produce- I cannot, in good faith, give them produce grow in wastewater. This is not only an ethical position but also, as small growers, we have courted the pure food market niche and cannot afford to lose their confidence. Also, we are certified to IFAOM standards for shipment to Europe and Asia. The certification laws in these nations are far more stringent than our own and prohibit wastewater irrigation.

Beyond issues pertaining to organic certification and marketing, I also have concerns regarding giving up the autonomy of my water supply. While I trust the city and its administrators, I worry that if I no longer had control of my well that in a crisis my water needs would be the least of the city's concerns.

While I try to be open minded to all ideas and proposals that come my way, I have to repeat what I told your representative when she came to pitch this trade: I am, in no way shape or form, interested in reclaimed wastewater being used in my farming operation nor am I interested in signing over my well to the city

Yours sincerely,

Jonathan Steinberg

Cc: David Vincent
Victor Roth
Santa Cruz City Council

Jonathan Steinberg
(831) 429-6365 home
(831) 429-0266 pager

Jeff Larkey
(831) 429-5561 home
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Jacobs Farm/Del Cabo
Pescadero, CA. 94060 - 0508
Tel (650) 879-0580 ext 216
Fax (650) 879-0930
larry@delcabo.com

September 24, 2002
Bill Kocher / Director
Water Department, City of Santa Cruz
809 Center Street, Room 102
Santa Cruz, CA 95060

Dear Mr. Kocher:

My company is opposed to the Water Department's proposal to exchange reclaimed wastewater for ground water at Wilder Ranch State Park.

We grow certified organic culinary herbs, beets, carrots, peas, black berries and fava beans at Wilder Ranch State Park. Food Safety and possible Salt/Chemical content of reclaimed water make it unacceptable.

1. **Food Safety** has been the subject of congressional hearings. It is a national concern shared by the public. We have invested considerable resources eliminating potential sources of contamination and implementing strict procedures to assure consumers that the food we grow and delivery to stores in Santa Cruz and across the country is SAFE. There is no benefit that can offset the smallest risk of illness or death from the use of reclaimed water on crops that are consumed fresh and not cooked.
2. **Salt and Chemical** content of water affects plant growth. As organic growers we work hard to create healthy soils. This is an environment that is not well understood by soil microbiologists and soil chemists. Changes in the soil environment can have adverse affects on soil flora and fauna which we need to produce healthy plants on organic farms. The use of reclaimed water would inadvertently add salts and chemicals to the soil environment.

The use of reclaimed water on organically grown fresh food crops creates unidentifiable risks to the health of plants and people.

We are in favor of recycling reclaimed water on golf courses, car washing, commercial landscaping and home landscaping but not on plants grown for food, and especially not on plants that are eaten uncooked.

Sincerely,

Larry Jacobs
CEO
Jacobs Farm / Del Cabo
HEALTHY SOILS, HEALTHY PLANT, HEALTHY PEOPLE®

GARY FISKE & ASSOCIATES
Water Resources Planning and Management

MEMORANDUM

TO: LINETTE ABBOTT

FROM: GARY FISKE

SUBJECT: ADDENDUM TO INTEGRATED WATER PLAN FINAL REPORT

DATE: MAY 24, 2005

This memo will serve as an addendum to the March 2003 *City of Santa Cruz Integrated Water Plan: Draft Final Report*. Section 2-E of that report described the operating constraints assumed by the Confluence® modeling of the City's water system. A follow-on analysis, performed in November 2004, tested the impacts of modifying certain of those assumptions. The following modifications were made:

- Relax the annual withdrawal limit from Loch Lomond. The original IWP runs assumed an annual limit of 940.5 mg, excluding the San Lorenzo Valley Water District entitlement. The modification assumes that this limit applies only to Newell Creek inflows, but not to water diverted from the San Lorenzo River at Felton.

- Slightly modify the San Lorenzo River diversion rate limits at Felton. Both the original and modified assumptions permitted diversions between September and May. In the original assumptions, the monthly diversion limit during those months was a constant 20 cfs. The modified assumptions reduced this figure in September to 7.8 cfs. Other months remained at 20 cfs. [1]

- Allow storage of Newell Creek flows in the months of June-September. Originally, no Newell Creek inflows were allowed to be stored in Loch Lomond Reservoir during those months; instead, they were assumed to be passed downstream.

[1] Note that, since the assumed physical capacity of the Felton Diversion is approximately 13.5 cfs, the 20 cfs diversion limit is never reached. Moreover, stream flushing requirements at Felton effectively preclude diversions in September. Thus, the diversion rate limits can have no effect on the actual diversions at this location.

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- Originally, for each of the two sources of Loch Lomond Reservoir fill, namely the natural inflows from Newell Creek and the San Lorenzo River water diverted at Felton, a 30-day “last-in-first-out” (LIFO) withdrawal constraint was assumed. That is, water from either source could not be withdrawn for 30 days from the most recent day on which water from that source was stored. The modified assumptions have eliminated the 30-day LIFO limitations on using stored water from both Newell Creek and the Felton diversion.

The Confluence model simulation was run with these modifications to test the extent to which these changes would affect the need for new desalination capacity. The conclusion was that these four assumption changes, individually and collectively, do not significantly affect system reliability and, therefore, do not result in a change in the need for desalination capacity to maintain drought-year peak-season shortages at or below the 15% level.

Errata for CITY OF SANTA CRUZ INTEGRATED WATER PLAN Draft Final Report, June 2003

Page V-10, second line.
Insert “The long-term phase is the period from 2005 through 2030 to synchronize with the planning horizon that would be identified in updated General Plans, with the knowledge and understanding the timing of, or need for future phases are dependent on growth that is prescribed by adopted future General Plans for the Cities of Santa Cruz and Capitola and the County of Santa Cruz, and any increase in water demand that may accompany that planned growth. The need for consideration of expansion of the desalination plant to its future increments would be confirmed upon update of the population projections in the applicable future General Plans and timed for decision when actual water demands warrant that consideration.” after “projections.”