City of Santa Barbara
2005 Urban Water Management Plan

Back-up Data in Response to Follow-up Request by DWR

Average Monthly Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total / Average
Average ETo:	1.8	2.3	3.6	4.8	5.0	5.0	5.6	5.4	4.0	3.1	2.2	1.8	44.6
Average Rainfall:	0.6	2.1	2.6	3.9	4.5	3.2	1.2	0.3	0.1	0.0	0.1	0.4	19.0
Average Temperature:	54.5	55.3	56.4	58.0	60.7	62.6	65.4	66.2	65.7	62.3	58.4	54.5	60.0

Current and Planned Water Supplies

(Actual data for 2005 - Projected average supplies for 2010-2025)

	2005	2010	2015	2020	2025
State Water Project	1,917	2,249	2,249	2,249	2,249
Gibraltar Reservoir	1,879	5,436	5,436	5,436	5,436
Mission Tunnel	1,585	incl. w/ Gibraltar	incl. w/ Gibraltar	incl. w/ Gibraltar	incl. w/ Gibraltar
Devil's Canyon Creek	70	incl. w/ Gibraltar	incl. w/ Gibraltar	incl. w/ Gibraltar	incl. w/ Gibraltar
Cachuma Project	8,015	8,109	8,109	8,109	8,109
Groundwater	0	1,299	1,299	1,299	1,299
Recycled Water	719	900	900	900	900
Desalination	0	286	286	286	286
Net Other Potable	-972	0	0	0	0
	13,213	18,279	18,279	18,279	18,279

Groundwater Management Plan

Has management plan?

Yes, groundwater supplies are managed under the City of Santa Barbara Long-Term Water Supply Program
Copy of Long-Term Water Supply Program attached, along with relevant EIR groundwater sections

Description of Basins:

See attached LTWSP and related EIR excerpts

Basin is adjudicated?

No.

Quantified amount of legal pumping right?

The City asserts primary rights to groundwater in the vicinity of Santa Barbara pursuant to Pueblo rights.

DWR identified, or projected to be, in overdraft?

No.

Plan to eliminate overdraft?

Not applicable.

Amount of Groundwater Pumped (AFY)

Basin Name	2000	2001	2002	2003	2004	2005
Foothill Basin	171	63	0	0	0	274
SB Storage Unit No. 1	91	0	0	0	0	191
SB Storage Unit No. 3	0	0	0	0	0	0
Total:	262	63	0	0	0	465
% of Water Supply:	1.7%	0.4%	0.0%	0.0%	0.0%	3.5%

City of Santa Barbara - 2005 Urban Water Management Plan

Detail Data in Response to Request by DWR, Page 2

Projected Groundwater Pumping (AFY)

Basin Name	2010	2015	2020	2025
Foothill Basin	454	454	454	454
SB Storage Unit No. 1	845	845	845	845
SB Storage Unit No. 3	0	0	0	0
Total:	1,299	1,299	1,299	1,299
% of Water Supply:	7.0%	7.0%	7.0%	7.0%

Groundwater supplies are modeled using the Multiple Objective Optimization Model (MOOM), a MODFLOW based groundwater model coupled with optimization software to verify that groundwater goals can be met without violating head constraints set to prevent seawater intrusion into the Storage Unit No. 1. MOOM was developed for the City by USGS. It simulates the City's overall water supply, with particular attention to the hydrology of the City's groundwater basins, over the full period of available hydrologic data. Originally this included 62 years from 1917 through 1979. Model runs have since been expanded to model performance of the City's water supply during the 76-year period from 1917 to 1993, in order to analyze performance of the water supply during the drought of the early 1990's. This effectively analyzes the sufficiency of groundwater during anticipated future drought events, as well as during periods of normal surface water availability. MOOM modeling is the basis for data shown in Figure 12, Page 32 of the City's Urban Water Management Plan.

Water Use and Unaccounted By Sector, Actual & Projected - 2000 through 2025

Note: All accounts are metered.

					Based on Low End Demand Projection, per Figure 9, 2005 UWMP							
	2000		**2005**		**2010**		**2015**		**2020**		**2025**	
	# of Accts.	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**
Single Family	16,692	5,943	16,850	5,722	16,929	5,797	17,008	5,797	17,088	5,797	17,168	5,797
Multi-Family	5,458	3,284	5,786	3,060	5,813	3,100	5,840	3,100	5,867	3,100	5,894	3,100
Commercial	2,350	2,398	2,364	2,218	2,375	2,223	2,386	2,198	2,397	2,173	2,408	2,148
Industrial	51	381	53	362	53	367	53	367	53	367	53	367
Institutional/Govt.	-	-	-	-		-		-		-		-
Landscape	617	679	680	645	683	628	686	603	689	578	692	553
Agriculture	-		-			-		-		-		-
Recycled	65	796	76	706	76	765	76	815	76	865	76	915
Total Deliveries:	25,233	13,481	25,809	12,713	25,929	12,880	26,049	12,880	26,170	12,880	26,291	12,880
Unaccounted		1,400		464		1,120		1,120		1,120		1,120
Total Production:		14,881		13,177		14,000		14,000		14,000		14,000

Note: All accounts are metered.

					Based on High End Demand Projection, per Figure 9, 2005 UWMP							
	2000		**2005**		**2010**		**2015**		**2020**		**2025**	
	# of Accts.	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**	**# of Accts.**	**Deliveries (AFY)**
Single Family	16,692	5,943	16,850	5,722	16,929	5,987	17,008	6,176	17,088	6,366	17,168	6,555
Multi-Family	5,458	3,284	5,786	3,060	5,813	3,202	5,840	3,303	5,867	3,404	5,894	3,506
Commercial	2,350	2,398	2,364	2,218	2,375	2,296	2,386	2,344	2,397	2,392	2,408	2,441
Industrial	51	381	53	362	53	379	53	391	53	403	53	415
Institutional/Govt.	-	-	-	-		-		-		-		-
Landscape	617	679	680	645	683	649	686	646	689	643	692	639
Agriculture	-		-			-		-		-		-
Recycled	65	796	76	706	76	789	76	862	76	935	76	1,009
Total Deliveries:	25,233	13,481	25,809	12,713	25,929	13,301	26,049	13,722	26,170	14,143	26,291	14,564
Unaccounted		1,400		464		1,120		1,120		1,120		1,120
Total Production:		14,881		13,177		14,421		14,842		15,263		15,684

CITY OF SANTA BARBARA

LONG TERM WATER SUPPLY PROGRAM

Prepared by the
Public Works Department of the City of Santa Barbara

Adopted July 5, 1994
By Resolution No. 94-086
of the
Council of the City of Santa Barbara

CITY OF SANTA BARBARA

LONG TERM WATER SUPPLY PROGRAM

Introduction

During 1990, the City of Santa Barbara initiated a comprehensive review of its long-term water supply in response to a severe drought and changes in the long-term yield of existing water supply sources. This review is contained in the "Long-Term Water Supply Alternatives Analysis and Urban Water Management Plan" (LTWSAA) dated April 1991 and conceptually approved by the City Council on April 2, 1991. A summary of the LTWSAA is included below under the section entitled "Summary of the Background and Analysis of the Long-Term Water Supply Program."

As a result of the LTWSAA, the City Council conceptually approved a Long-Term Water Supply Program (LTWSP). The conceptual LTWSP was subsequently amended on August 27, 1991 to reflect the June 4, 1991 voter approval of City participation in the State Water Project (SWP) and to define the desalination element of the LTWSP as the conversion of the temporary desalination plant to a permanent facility. At the same time the conceptual program was declared a project for purposes of environmental review, which culminated in the Long-Term Water Supply Program EIR, certified by the Environmental Review Committee on April 15, 1994, and by City Council on May 24, 1994 following an appeal. On July 5, 1994, Council formally adopted the LTWSP and directed City staff to use the program as a guide in the development, administration, and maintenance of the City water supply system.

Program Elements

The City's Long-Term Water Supply Program, for the period through the year 2009, shall be based on the following elements:

1. Water demand is projected to be 17,900 acre-feet per year (AFY) by the year 2009, based on provisions and restrictions adopted as part of the initiative measure known as Measure E, incorporated into the Charter of the City of Santa Barbara as Section 1508.

2. A safety margin of 1,800 AFY, which is 10% of the projected demand, is appropriate to add to the projected water demand in recognition of the potential that demand may exceed projections, or that the yield from water supply sources may be less than projected. For purposes of water supply planning, the resulting amount of 19,700 AFY shall be the total projected demand for the period of this program.

3. For purposes of water supply planning, the standard for the maximum acceptable water shortage shall be 10% in the worst year of the critical drought period.

4. A water conservation program sufficient to reduce water demand in the year 2009 by 1,500 AFY, in addition to conservation savings achieved prior to January 1, 1991, shall be implemented by the City, and such 1,500 AFY shall be used as one component to meet the total projected demand of 19,700 AFY.

5. In addition to water supplies available to the City prior to the adoption of this program, new long-term water supply will be provided by:

   A. Participation in the Coastal Branch of the State Water Project at a level of 3,000 AFY, combined with a 3,000 AFY City share in a permanent desalination facility provided by conversion of the City's temporary desalination plant to a permanent facility;

   B. 2,000 AFY of additional City share in the converted desalination facility for interim or substitute needs until the Coastal Aqueduct is making full deliveries of contracted water; and

   C. 5,000 AFY of additional desalination capacity for potential regional use.

6. A permanent 4,500 AFY groundwater pumping capacity, consisting of existing and proposed production wells, and an artificial recharge capacity consistent with that capacity will be developed and maintained.

Summary of the Background and Analysis of the Long-Term Water Supply Program

I. Introduction

During the 1980's, the City of Santa Barbara (City) recognized that its water supplies were insufficient to meet demand and made significant but unsuccessful efforts to augment its water supplies. The drought of the late 1980's and early 1990's emphasized the susceptibility of the City's supplies to drought. This catalyzed increased efforts to acquire new City water supplies. In October 1990, the City initiated the LTWSAA to take a comprehensive look the current City water supply-related plans, goals, and policies, the existing water supplies, and the major water supply alternatives available to the City to make up current deficits and meet future needs. This analysis was presented at a series of joint Council/Water Commission meetings held between October 30 and December 18, 1990. The product of the meetings was a technical document, the LTWSAA, which provided direction for the City and information for interested parties.

The recommendations of the LTWSAA were developed into a Long-Term Water Supply Program (LTWSP). After the June 4, 1991 election approved connection to the SWP and development of permanent desalination capability, the LTWSP was amended to include the SWP. The LTWSP was conceptually approved by the City Council on August 27, 1991 and subsequently underwent environmental review which culminated in an Environmental Impact Report certified by the City's Environmental Review Committee in April 1994. This section describes the amended LTWSP as formally adopted by City Council on July 5, 1994, and summarizes the LTWSAA which was the basis of the LTWSP.

The LTWSAA had the following purposes:

1. Review the Master Water Plan (MWP) and the Five-Year Water Policy and Action Plan (FYWPAP).

2. Review water supply-related goals, objectives, and policies of the City.

3. Identify and discuss planning concepts for developing an adequate water supply.

4. Review the adequacy of existing supplies and system.

5. Project water demands for existing and future customers.

6. Develop and evaluate water conservation programs based on community goals and appropriate costs.

7. Review information on major water supply alternatives, including fiscal impacts.

8. Make recommendations regarding future long-term water supply policies and programs, including water conservation programs.

9. Develop an action plan to implement recommendations.

The LTWSAA was not directed at the shortages from the 1990-1991 drought. However, the analysis was based on existing supplies and capabilities, and recognized that existing water supplies were depleted and needed replenishment before normal operations could resume.

In 1990, water supply policies and programs were based on the MWP and the FYWPAP. The MWP, approved in 1985, recognized the need for additional water supplies and recommended improvements to Gibraltar Reservoir to achieve the majority of additional supplies. The FYWPAP was developed in 1988 to address the impending water supply and demand imbalance and to plan into the near future. Centered on a strong conjunctive use and groundwater management policy, it attempted to balance projected water demand for the following five years with a program of feasible supply sources, including enlarging Cachuma and Gibraltar Reservoirs. After the adoption of these plans, a continuum of changes to the City's water demand and supply picture occurred. These changes include:

- The difficulty of enlarging Gibraltar Dam and subsequent negotiation and adoption of the Upper Santa Ynez River Operations Agreement;

- Reduction in the yield of the Cachuma Project;

- The acceleration of the desalination project in response to the recent severe drought; and

- The Coastal Aqueduct election in June 1991.

Much had been accomplished since 1985 and yet the City experienced severe drought shortages in 1990 and 1991.

II. Water Supply Planning Concepts

In embarking on the process that culminated in the LTWSP, the City identified the planning concepts that are important in evaluating possible City water conservation and water supply programs. These concepts are summarized below:

- **Public Involvement**

  It was recognized that the development of a new water supply program for the City would require a full discussion of all issues in an open setting. This happened during biweekly City Council work sessions in the Fall and Winter of 1990-1991.

- **Demand Management**

  In concluding the General Plan Update Process and approving Measure E, Charter Section 1508-9, City Council and the voters have provided for a desired balance of future residential and commercial development. This level of future demand was a given for the LTWSAA and was the target for long-term water supply planning, consistent with the goals set out in Charter Section 1507.

- **Least-Cost Planning**

  Water conservation and water supply alternatives were evaluated on comparable financial bases, using life-cycle costs over a comparable time period.

- **Regional Cooperation**

  The analysis of water supply alternatives included consideration of regional implications. The analysis recognized the comparative cost advantages and disadvantages of each alternative for the City and other potential participants.

- **Priority of Uses for New Water Supplies**

  The priorities for new supplies as the water supply system is expanded over the long term are:

  - Recharging groundwater basins.
  - Buffering the impact of potential shortages for existing customers.
  - Providing for development pursuant to the FYWPAP and the General Plan as most recently amended by Measure E.

- **Acceptable Risk of Shortages**

  A way to limit the risk of unacceptable shortages is to resolve that a water supply is only as good as its performance in an extremely dry year. This concept is called drought period or critical period planning. For analyses done for the LTWSP, a 10% shortage was used as the acceptable maximum level of shortage in the worst year during the critical drought period. Water supply alternatives were evaluated by the Santa Ynez River Model (SYRM) to determine the level of additional supplies needed to meet the 10% maximum acceptable shortage standard.

III. Existing and Projected Water Supply Demand

A reasonable estimate of predrought "normal" demand is the average annual water use from 1985 to 1989, which was 16,300 AFY. For the year 2009 demand, the water demand projection which was included in the technical information developed for the General Plan Update is the most appropriate basis for current water demand projections. That projection showed a water demand of 17,600 AFY in the year 2009 which assumed the full 800 AFY of permanent water conservation savings called for under the FYWPAP. At the time of the LTWSAA, 300 AFY of that permanent conservation savings still needed to be achieved. When the unachieved savings are added back into the year 2009 projection, the total demand estimate becomes 17,900 AFY. This estimate does not include any permanent conservation savings achieved from January 1991 onward.

For water supply planning purposes, the estimate of 17,900 AFY water demand in the year 2009 is appropriate, but does not allow for errors or unanticipated events that could result in reductions in supplies or increases in demand. A safety margin would provide additional supplies to guard against these events, should they happen. A 10% safety margin would increase the year 2009 demand to 19,700 AFY. That demand target could be met by a combination of water conservation measures and the water supplies available from desalination, an enlarged Cachuma Reservoir, if feasible, or the State Water from the Coastal Aqueduct Project.

IV. Existing Water Supplies

The City's potable water supply has come, under historical average conditions, from Cachuma Reservoir (total capacity 190,000 AF) and Tecolote Tunnel (53%); Gibraltar Reservoir (capacity 8,500 AF) and Mission Tunnel (35%); and groundwater (12%). During the drought emergency, which was precipitated by the emptying of Gibraltar Reservoir and 45% cutbacks from Cachuma Reservoir, greater emphasis was placed on groundwater. After the rains of February 1991, surface water again became available and groundwater pumping was almost completely stopped to allow the groundwater basins to recover. Table 1 shows annual City water supply data from 1981.

TABLE 1. CITY OF SANTA BARBARA WATER SUPPLY DATA
WATER YEAR 1981 TO PRESENT

23-Jun-94 File: WSDAT10

Water Year		81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92	92-93	93-94
An. Production (AF)	1	13,694	14,284	15,452	15,963	15,985	16,367	16,351	16,092	13,461	8,972	9,195	10,665	10,803
City Annual Rain (in)	2	15.11	38.25	14.74	12.40	22.30	11.26	15.56	8.88	8.00	17.91	25.28	37.40	16.85
Gib. Annual Rain (in)	2	23.06	64.04	19.40	16.55	30.85	11.55	24.84	14.11	11.53	31.16	39.30	49.03	19.80
City Population		74,800	75,100	76,400	77,600	78,900	80,200	81,500	82,800	84,100	85,600	89,312	91,135	92,647
Adjusted Population	3	70,901	73,520	******	******	******	******	*******	*******	*******	*******	*******	*******	*******
City/Capita Usage (gpcd)		164	170	181	184	181	182	179	174	143	94	92	105	104
Adjusted/Cap. Usage	3	173	174	******	******	******	******	*******	*******	*******	*******	*******	*******	*******
Cachuma Draft (AF)	1	5,730	6,548	6,166	6,748	9,047	9,722	8,819	8,076	7,130	6,061	4,328	5,686	4,393
Gib. Draft (AF)	1	5,675	5,443	6,021	5,789	4,530	3,933	5,062	6,486	2,202	249	4,398	3,776	4,579
Tunnel Draft (AF)	1	1,534	1,627	2,009	1,469	813	754	780	1,139	653	520	613	1,490	1,313
Devils Canyon (AF)	1					******	109	181	81	24	162	467	557	432
Basin #1 Draft (AF)	1	755	666	1,124	2,072	1,535	1,308	822	5	2,901	1,445	0	0	0
Foothill Basin Dft (AF)	1		******	132	166	262	780	944	789	741	483	26	0	0
Basin #3 Draft (AF)	1					******	0	85	0	257	102	0	0	0
Total Groundwater (AF)		755	666	1,256	2,238	1,797	2,088	1,851	794	3,899	2,030	26	0	0
GWD Credit (AF) (Subtract				******	281	202	239	342	484	447	523	471	657	(789)
Other Supplies and Credits											473	(167)	(187)	(703)
Reclaimed Water (AF)	1	(Not included in Annual Production)							******	112	455	326	408	635

Calendar Year		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
An. Production (AF)	4	13,475	14,439	16,826	16,335	16,227	16,140	16,517	14,995	9,443	9,196	10,154	10,766	
City Annual Rain (in)	4	21.61	42.16	7.68	11.24	19.60	15.01	13.37	5.77	5.56	23.78	26.40	34.15	
Gib. Annual Rain (in)	4	30.56	65.39	13.72	12.97	24.35	17.12	23.93	9.31	10.87	38.13	41.04	43.78	
Devil's Canyon (AF)	4	223	138	63	99	317	91	236	51	24	236	499	752	

Notes:
1 Water year is from May 15 through May 14 of the following calendar year
2 Water year is from May 1 through April 30 of following calendar year
3 Adjustment due to overlap area (City residents served by Goleta Water District)
4 Calendar year

Recent developments have impacted the City's long-term water supply. The City's share of the yield of Cachuma Reservoir has been revised downward from 8,950 AFY to approximately 8,000 AFY. Gibraltar Reservoir will be operated according to the Upper Santa Ynez River Operations Agreement, for the short-term at least. The long-term supply from Gibraltar Reservoir, operated according to the Upper Santa Ynez Operations Agreement, should average approximately 4,600 AFY, plus approximately 1,000 AFY from Mission Tunnel. As an augmentation to its surface water supplies, the City has begun receiving 300 AFY from Jameson Reservoir (Juncal Dam). This water is owed to the City in return for having deeded land for Juncal Dam and Jameson Reservoir to Montecito Water District.

The City's groundwater basins have an estimated perennial safe yield of 1,400 AFY. The 11 production wells in the three groundwater storage units have a pumping capacity of over 4,500 AFY but that capacity is not well distributed. Increased pumping during the drought reduced the City's groundwater supplies. The drought had the positive impact of forcing development of additional pumping capacity which could make a conjunctive use program more effective. As of July 1994, water levels in Storage Unit 1 have returned to levels higher than at any time since 1985, suggesting that the effects of the drought in this unit have been erased. The Foothill Basin (Storage Unit 2) appears to be recovering also, though not as quickly. Storage Unit 3 has recovered substantially as well, though is not expected to play a significant part in the City's groundwater program. The drought also forced the City into an accelerated schedule for implementation of an emergency desalination project, which has been included as a part of the LTWSP as a long-term water supply. This project can supply the City with 3,181 AFY and is expected to be used during future drought periods to replace depleted surface water supplies.

The City's search for additional supplies has also identified bedrock-aquifer supplies and encouraged a more aggressive water conservation program. In response to the drought, the Water Reclamation Project was accelerated and Phase II was completed in 1992, freeing up an additional 400 AFY of potable supply.

Based on the recent changes in yields and production levels, and on the experience of the 1990-1991 drought, the yield of the City's predrought water supplies can be looked at from a number of perspectives -- safe, draft, and drought yields. Table 2 below summarizes this for each water supply.

Table 2. Water Supply Yield Comparison

Supply Source	Safe Yield (AFY)	Draft Yield (AFY)	1990 Drought Yield (AFY)
Cachuma	8,000*	9,100**	5,152
Mission Tunnel	1,070	1,070	400
Gibraltar	2,050	5,430	500
Local Ground Water	1,400	1,400	2,875
Juncal	300	300	0***
Reclaimed Water+	473	473	473
Goleta Overlap	85	85	85
Total Supplies	13,400	17,900	9,485
1990 Normal Demand	16,300	16,300	16,300
2009 Projected Demand	17,900	17,900	17,900

* City's share of the current safe yield estimate.
** City's share of draft yield used prior to latest revision of safe yield.
*** Supply not available in 1990.
\+ Extent to which potable supply is displaced.

Table 2 shows that the City's predrought supplies were not adequate when operated on a safe yield. Operated on a draft yield, the City's supplies were adequate when full surface supplies were available, but during drought, the City had a serious shortage. Based on an evaluation by the SYRM, using the predrought operation of supplies and the 1948-1951 critical drought period, the City's predrought supplies had a shortage of 5,800 AF in the worst year of the critical drought period. This is 36% of the predrought normal demand. If the acceptable shortage is 10%, this demonstrated that the City needed additional water supplies to meet its current commitments, let alone demand from future development.

V. Water Conservation

Many promising and acceptable water conservation measures are available to the City. The actual savings are difficult to quantify, but are significant. A conservation program for the 20-year period through the year 2009 should produce savings of 1,500 AFY by:

- Continuing the Ultra-Low-Flush-Toilet (ULFT) Rebate Program;
- Changing the drought assistance program to an ongoing home audit and large user Turf Audit Program;
- Increasing the City's efforts to promote low water use landscape techniques; and
- Continuing the block rate structure and an appropriate public information program.

This program would have an initial annual cost of $450,000. The water savings would have an amortized net present value cost of $690/AF. Table 3 summarizes the savings and costs of this program. It should be recognized that the total savings in Table 3 are achieved incrementally over 20 years, the annual costs are 1990 estimates, and the amortized cost per acre-foot is calculated by dividing the amortized net present value of the measure over 20 years by the average annual savings of the program during that period.

Table 3. Water Savings and Costs of the Water Conservation Program

Measure	Total Savings (AFY)	Initial Annual Cost	Amortized Cost Per AF
ULFT Rebate	660	$235,000	$780
Xeriscape	160	80,000	670
Home Audits	400	60,000	424
Block Rates	250	*	*
Public Information	**	75,000	**
Total Program	1,470	$450,000	$690

* No cost is assigned to block rates.

** No savings are assigned to public information although this measure will be necessary for other measures to achieve their targets.

It is important to recognize the importance of continuity with the recommended program because these savings will be produced incrementally over the 20-year period of implementation. Also important will be monitoring the results of the program. If the City is not achieving the projected savings, changes will have to be made or additional water supplies acquired. Over-achievement of savings objectives could allow new water supply acquisition to be reduced or could be added to the safety margin.

VI. New Water Supplies

The LTWSAA analyzed the use of the three major water supply alternatives to eliminate shortages identified with the current supply and to meet future demand: 1) desalination, 2) enlargement of Cachuma Reservoir, and 3) participation in the SWP via the Coastal Aqueduct. These water supply alternatives were being studied in 1990 by the City and other Santa Barbara County water purveyors because the severe drought emphasized the need for additional municipal, industrial, and agricultural water supplies for this area.

Desalination was selected as an emergency water supply to help the City meet the shortages incurred by the 1990-1991 drought emergency. The City completed an environmental review of an emergency desalination facility for a capacity of up to 10,000 AFY and the Temporary Emergency Desalination Project was completed in March 1992, with a total capacity of 7,500 AFY of which 3,181 AFY is the City's share. Desalination can also be used as a longer term supply. The LTWSAA recognized that a long-term desalination alternative could involve the conversion of the emergency desalination facility to permanent use, construction of a new facility at the site of the emergency facility, or construction of a new facility at a different site. Pursuant to Council direction in August 1991, the LTWSP was amended to include conversion of the temporary desalination plant to a permanent facility.

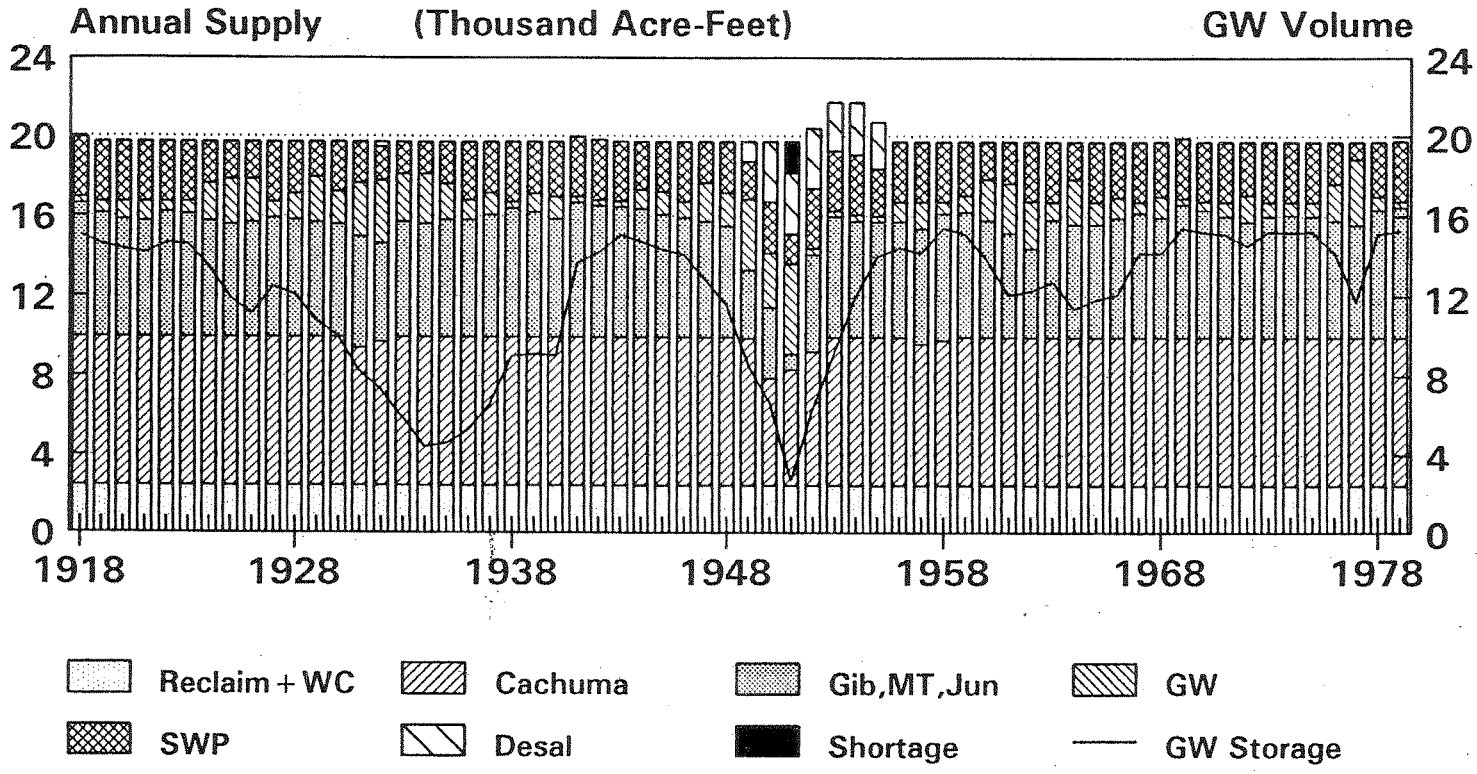
Cachuma Reservoir Enlargement was identified in 1985 as a least-cost water supply alternative and has been undergoing study since that time. This alternative would raise the height of Bradbury Dam 50 feet which would approximately double the storage capacity of Cachuma Reservoir. The City has an entitlement to 3,000 AFY of the increased yield in this project. This project's feasibility was made questionable because of uncertainties regarding the availability of rights for water from the Santa Ynez River. The June 1991 voter approval of bonding capacity for the Coastal Aqueduct in most of the districts that are potential participants in this project has effectively ended any further consideration of this project as a regional water supply.

SWP water through the Coastal Aqueduct had been proposed as a water supply alternative for San Luis Obispo County and northern Santa Barbara County. The severe drought renewed interest in extending this alternative to the South Coast as well. This alternative involves a 142-mile pipeline from the California Aqueduct to Cachuma Reservoir and would deliver the SWP entitlement of the City and other regional water purveyors. On June 4, 1991, City voters approved a ballot measure that requires the City to participate in the SWP. The City has joined the Central Coast Water Authority, a single-purpose joint powers agency, to facilitate completion of this water supply project. The City has an entitlement of 3,000 AFY in this project.

Evaluation by the SYRM for the LTWSAA determined that any of these three alternatives added to existing supplies, along with additional conservation savings of 1,500 AFY, can meet the projected demand for the year 2009. To meet this 19,700 AFY demand with desalination alone requires the addition of permanent desalination operated at a base annual level of 2,500 AFY with a 5,000 AFY total capacity for drought backup. The addition of enlarged Cachuma meets the target demand with a 3,000 AFY entitlement and the Coastal Aqueduct meets this demand with a 4,000 AFY entitlement. A combination of new supplies consisting of 3,000 AFY entitlement in the Coastal Aqueduct and 3,000 AFY capacity in a desalination facility for drought back-up will also meet this demand. Figure 1 shows the results of the modeling for this combination alternative which was eventually adopted as the new supply component of the LTWSP. The graph shows how the 17,900 AFY target demand, plus the 10% safety margin, is met for each year of the 62-year modeling period, using the various supply sources as constrained by operational and hydrologic limitations.

Figure 1. Long-Term Water Supply Program Evaluated by the Santa Ynez River Model

Includes 10% Safety Margin



Water supply target is 19,700
SWP entitlement is 3,000 AF
Desalination capacity is 3,000 AFY

Using the City's financial analysis approach, the costs of the new water supply additions range between $900 and $1,100/AF of increased yield. The differences in costs between these alternatives, considering the possible variation in the assumptions used to estimate yield and costs, and the total impact on the City's average cost of water, are not significant. The 10% safety margin approximately doubles the amount and incremental cost of needed water supplies and would add approximately $.30 per hcf to the City's average retail cost of water. With a 10% safety margin (1,800 AFY), the average monthly water charges after the drought were projected to be approximately $35.

The LTWSAA included a qualitative comparison of the characteristics of the long-term water supply alternatives. It concluded that neither enlarged Cachuma nor the Coastal Aqueduct by itself should be considered as long-term water supply alternatives because of uncertainties or inadequacies in yield, timing, feasibility, or the safety margin. It recommended that desalination alone, at a capacity of 5,000 AFY, or the Coastal Aqueduct with a capacity of 3,000 AFY combined with desalination with a capacity of 3,000 AFY, used as a reserve supply, would be sufficient to resolve the current water supply deficit, provide for expected growth to the year 2009, and provide a 10% safety margin. The LTWSAA's conclusion was that these two supply alternatives had similar costs, and were adequate or better in the qualitative criteria used to evaluate the major water supply alternatives.

VII. The Long-Term Water Supply Program

On December 18, 1990, the City Council conceptually approved a LTWSP (20-year) consisting of the recommendations listed above. The Council chose desalination at a 5,000 AFY capacity as the long-term water supply addition. City Staff was directed by Council to complete the LTWSAA Report for Council adoption, incorporating the conceptually approved LTWSP and responding to comments and questions raised during review of the draft chapters and public hearing. City Staff was also directed to prepare a work program, schedule and budget, including environmental review, for implementing the conceptually approved LTWSP.

In its review of the LTWSAA, the Water Commission desired to see evaluation of the water supply alternatives with a 20% maximum shortage and evaluation of longer droughts than the critical period used by the SYRM. Some Commissioners also expressed interest in looking at recovery of groundwater storage. The City Council directed that additional sensitivity analyses be performed to address these points.

The sensitivity analyses examined a 20% maximum acceptable shortage with a five-year drought, which is the critical period modelled for the LTWSAA, and a six-year drought, which merely adds an additional year identical to 1951 to the critical period in the model, for both the desalination alone and the combination alternative. The analysis also looked at the recommended water supply alternatives through longer drought periods. The analyses showed that the water supplies developed for a 10% maximum shortage for a five-year drought (the base scenario considered in the LTWSAA) are equivalent to the water supplies developed for a 20% maximum shortage operated for a six-year drought. If droughts longer than six years occur, greater shortages will happen.

The analyses of groundwater recovery illustrated how groundwater storage would improve with a program to enhance the natural recovery by limiting groundwater pumping to a minimum and by using artificial recharge. The analyses showed that enhancing the recovery of depleted groundwater basins returns the water supply to safer levels more rapidly, should a drought return sooner than expected. A prudent operational rule would be to enhance groundwater recharge with artificial recharge after droughts or other periods of extensive pumping.

On June 4, 1991, City voters approved a ballot measure that required the City to participate in the SWP and to secure its full 3,000 AFY entitlement. The voters also approved an advisory measure which called for the City to construct a permanent desalination facility. During this same period, the final Environmental Impact Report for the temporary desalination project was completed. On August 27, 1991, Council amended the conceptually approved LTWSP to include 3,000 AFY from the SWP and 3,000 AFY provided by conversion of the temporary desalination plant to a permanent facility to be used for drought backup. This alternative was called the combination alternative in the LTWSAA.

Environmental review of the LTWSP was conducted during 1993 and early 1994. On April 15, 1994 the City's Environmental Review Committee certified the Environmental Impact Report on the LTWSP. The action was appealed to the City Council on May 24, 1994, at which time the Council denied the appeal and certified the document. On June 28, 1994, a joint worksession with the Council and the Water Commission was held to review the LTWSAA and the LTWSP. On July 5, 1994, the City Council voted to adopt Resolution No. 94-086 adopting the Long Term Water Supply Program.

With the water supply capabilities of the approved LTWSP the City will be able to meet water demands of the projected population in the year 2009 with a maximum 10% shortage in the driest years, assuming future droughts to be comparable to the severest in the historical record. Additionally, the LTWSP includes a safety margin for uncertainties due to changes in supplies and underestimated increases in demand. Actual demand levels and supply performance are monitored by City staff to verify that the system will continue to meet the established standards for water supply reliability.

In some cases, hydropneumatic stations are employed instead of reservoirs to serve areas that are too small to justify construction of a reservoir and pumping station. The areas served by the various reservoirs and hydropneumatic stations represent distinct pressure zones distinguished primarily on the basis of elevation. Pressure reducing valves are used to regulate pressure as water moves from a higher zone to a lower zone.

The "low zone" is the pressure zone that serves the largest portion of the City's distribution system. It includes the Downtown area, the Eastside, the Westside, the lower Mesa area, Hidden Valley, and the Las Positas Valley (Figure 2.4-2). A 1980 report by Boyle Engineering estimated average demand for the various pressure zones. Annual average demand for the low zone is estimated at 59 percent of total. The other large zones include the Sheffield Zone (8.1 percent), the Lauro Zone (12.1 percent), and La Vista Zone (10.2 percent).

When the desalination plant is operating, desalted water is pumped directly into a 12-inch water main which is part of the low zone. There is minimal storage provided at the desalination plant so all water must be put into the distribution system as it is produced. The extent of distribution of the desalted water is dependent on a number of factors, including the rate at which desalted water is being produced, customer demand in the low zone and in the system as a whole, the amount of groundwater, if any, being produced at the Ortega Well Treatment Plant, and the extent to which water may be transferred from the City's distribution system to the Goleta and Montecito Water Districts.

2.5 ELEMENTS OF THE LTWSP

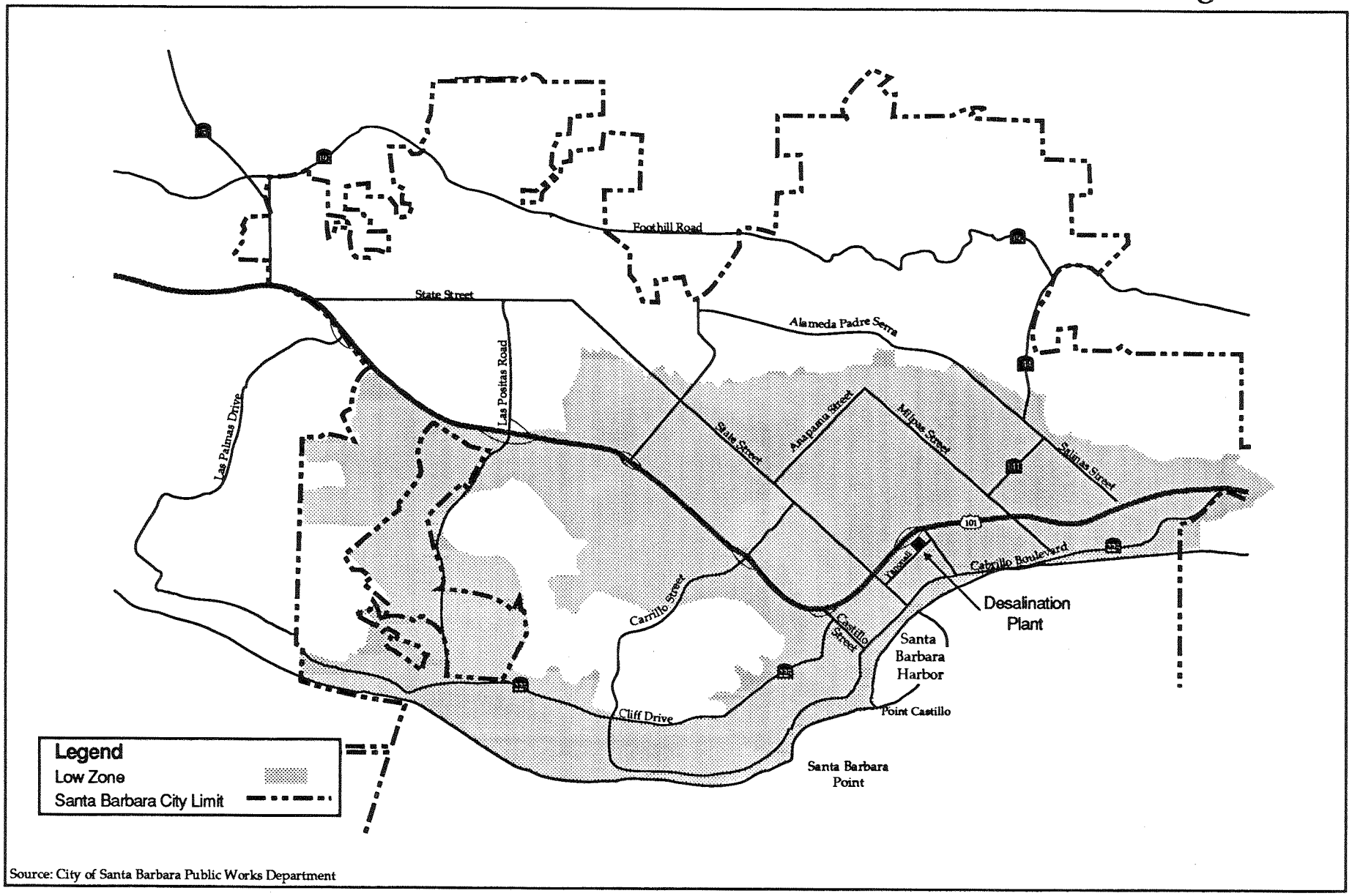
The LTWSP derives from analysis contained in the Long-Term Water Supply Alternatives Analysis (LTWSAA). In this document, the City's water supply system was evaluated using the Santa Ynez River Model (SYRM). The model was developed by the Santa Barbara County Water Agency using 62 years of hydrologic data as an estimate of typical water supply conditions in the region. A safety margin, as described below, is used to provide a cushion in case of greater than anticipated demand or less than anticipated yield from supply sources.

Assumptions used in the modeling reflect the reliability of each supply source, existing as well as proposed, so that performance of the water supply during the critical period could be evaluated. This method, analogous to "cash flow" analysis in financial matters, was used in lieu of an average yield analysis, which has the potential to mask shortages during drought periods.

The City's share of the Cachuma Project safe yield was conservatively estimated to be 7,570 AFY, with yield reduced to a low of 5,487 AFY during the critical period to reflect anticipated reductions in deliveries due to drought. Gibraltar Reservoir was assumed to be operated on a draft yield basis in accordance with the Upper Santa Ynez River Operations Agreement. Combined yields from Gibraltar and Mission Tunnel ranged from 500 to 6,405 AFY. The Water Reclamation Project was assumed to provide up to 1,200 AFY of reclaimed wastewater and replace 900 AFY of potable water toward the overall system demand.

Lower-elevation Pressure Zone

Figure 2.4-2



Source: City of Santa Barbara Public Works Department

Long Term Water Supply Program EIR

City of Santa Barbara

Scale 0 0.25 0.5 1 Miles

New supplies identified by the LTWSP (SWP and desalinated water) are those required in addition to the existing supplies available to the City. The year-by-year yield of the 3,000 AFY SWP entitlement was based on SWP hydrology and on Scenario A as described in the FEIR for the Coastal Aqueduct of the SWP. Scenario A represents a conservative assumption as to the completion of additional SWP facilities. In addition, to account for a possible worst case, the historical yield of the SWP was adjusted so the critical period coincided with the critical period on the Santa Ynez River. Under these assumptions, the SWP yields an average of 2,566 AFY (85 percent of entitlement) with a minimum of 870 AFY (29 percent of entitlement). The desalination plant is assumed to be available on a continual basis, as needed, with allowances for routine maintenance and unexpected downtime.

The Santa Barbara City Council has conceptually approved the LTWSP, which consists of the following:

1. Water demand is projected to be 17,900 AFY for the year 2009 based on existing zoning and Measure E (described in following subsection).

2. A safety margin of 1,800 AFY is added to the demand projection for water supply planning purposes, making the total demand 19,700 AFY in the year 2009, including the demand to be met by the conservation component.

3. The maximum acceptable shortage standard is ten percent in the worst year of the critical drought period.

4. A 20-year water conservation program savings of 1,500 AFY will be achieved by the year 2009 and used as one component to meet the projected demand of 19,700 AFY.

5. Additional long-term water supply will be provided by:

    a. 3,000 AFY entitlement from the Coastal Aqueduct of the State Water Project combined with a 3,000 AFY City share in a permanent desalination facility provided by conversion of the City's temporary desalination plant to a permanent facility;

    b. 2,000 AFY of additional City share in the converted desalination facility for interim or substitute needs until the Coastal Aqueduct is making full deliveries; and

    c. 5,000 AFY of additional desalination capacity for potential regional use.

6. A permanent 4,500 AFY groundwater pumping capacity and an artificial recharge capacity consistent with that capacity will be developed and maintained.

The individual elements of the LTWSP program are described more fully in the following discussion.

Total City Water Demand

Elements 1, 2 and 3 of the LTWSP described above are policy statements establishing the water supply goals of the City for the 20-year planning period (ending in 2009). The supply goals are determined by the combination of projected demand, a safety margin, and a standard for acceptable shortages during critical drought periods.

The projected demand of 17,900 AFY by the year 2009, identified in Element 1, is based on residential and commercial development currently allowed under the City's General Plan. The General Plan was amended most recently as a result of the 1989 voter approval of an amendment to the City Charter, Charter Section 1508 (Measure E) limiting commercial development for the next 20 years. Residential development had been restricted by zoning amendments in the mid-70s.

Element 2 defines a 1,800 AFY safety margin for the City's water supply. This figure is approximately ten percent of the demand actually projected for the year 2009. The safety margin is intended to allow for uncertainties both in projecting demand and in forecasting the availability of individual supplies. The ten percent safety margin helps ensure that adequate supplies will be available even if demand has been underestimated or if a water supply project fails to produce as expected. The safety margin is added to the projected demand of 17,900 AFY for a total demand for planning purposes of 19,700 AFY.

Element 3 establishes a criterion for adequacy of the City's water supply system by defining the amount of shortage that is acceptable during a critical drought period. When considered in combination with the total long-term demand established in Elements 1 and 2, the ten percent maximum shortage criterion defines the amount of water which the system must be able to provide during projected critical drought periods.

Elements 1, 2, and 3 quantify the water supply needs of the City. The reliable capacity available from the City's existing water supplies and the need for additional supplies were evaluated in the LTWSAA, considering historic patterns of runoff and groundwater production. Elements 4, 5, and 6 of the LTWSP, described in the following sections, identify the water savings and new water supplies, which together with existing supplies, are proposed to meet the water supply needs during the planning period.

Water Conservation Program

The LTWSP quantifies water savings to be achieved through a 20-year water conservation program. The specific programs to be undertaken have not been defined in the LTWSP. Based on the discussion and analysis in the LTWSAA, the program will include major water conservation efforts, adopted in the City's Five Year Water Policy Action Plan in 1988, which are ongoing at this time. These include the continuation of an inverted block rate pricing structure for water billing, the toilet rebate program, low-flow plumbing fixture requirements for all new construction, free distribution of low-flow showerheads, and greater promotion of low water using, drought tolerant landscapes and water audits for residential and commercial customers. Implementation of these programs was accelerated and/or strengthened during the recent drought. The LTWSP would continue these programs at present levels, subject to availability of

funding and evaluation of effectiveness. Other programs may be added as appropriate. The City Council has become a signatory to the State of California Memorandum of Understanding (MOU) Regarding Urban Water Conservation. The Council, overseeing implementation of this MOU, may adopt new management practices, which may require adjustments to the City's Water Conservation Program.

The demand projection of 17,900 AFY in Element 1 of the LTWSP included 500 AFY of permanent demand reduction associated with conservation program activity prior to January 1, 1991. For the period from that date until the end of the planning period in 2009, the program includes additional permanent conservation savings of 1,500 AFY. The conservation program is considered one of several "supply" sources that contribute to the overall need for water. Therefore, this figure is added to other supply sources to determine the total water supply requirements of 19,700, including the safety margin. Since this conservation segment of the City's supply does not represent water that is actually produced and distributed, it is useful to note that the City's actual water supply capability would be 17,900 AFY minus 1,500 AFY "supplied" by conservation, or 16,400 AFY. When the safety margin is added, the supply capability would be 18,200 AFY.

Santa Barbara has implemented a water reclamation program, whereby wastewater is treated and used for non-potable uses, such as irrigation. Initially started in 1980, the water reclamation project was split into two phases because of funding limitations. Phase I and II of the City's reclamation project will provide up to 1,200 AF of reclaimed water each year for irrigation. Sites irrigated with reclaimed water include parks, golf courses, schools, retirement homes, and the zoo.

Groundwater

The groundwater component of the LTWSP involves the use of municipal wells to produce groundwater to augment the City's other water supplies. Groundwater will be produced from Storage Units I and III of the Santa Barbara Basin, and from the Foothill Basin, formerly known as Storage Unit II of the Santa Barbara Basin. Groundwater will be chemically treated in compliance with drinking water standards prior to introducing it into the distribution system. No change in current methods of treatment is proposed. The process will include, as necessary, disinfection, filtration and treatment to control corrosion and discoloration, all in conformance with State standards. With the exception of an estimated 300 AFY of groundwater pumping necessary to maintain the wells and meet peak delivery requirements, virtually all pumping will be reserved for periods of drought or other water shortage situations. This is a departure from past practice which involved a more constant production of groundwater from year to year. The proposed pumping scheme is intended as a conjunctive management program that will maximize yields from surface water supplies and reserve groundwater for use during periods when surface supplies are short.

The City's pumping from the three storage units during periods of shortage will occur at a combined maximum rate of up to 4,500 AFY. Maximum pumping amounts from individual storage units would be up to 3,500 AFY from Storage Unit I, up to 1,850 AFY from the Foothill Basin, and up to 250 AFY from Storage Unit III, though not more than 4,500 AF total in any one year. In Storage Unit I, most pumping

is expected to occur at the wells located in the upper portion of the unit including the existing Alameda Well and two wells proposed to be constructed. Existing wells in the lower portion of the unit (Ortega, Vera Cruz, City Hall, and Corporation Yard) and the Padre Well will be used as necessary to meet peak demands. In the Foothill Basin, pumping will occur at the Chuparosa Well, the Hope Avenue Well, Los

Robles Well, and the MacKenzie Well. Additional well sites may need to be developed in the Foothill Basin. Pumping in Storage Unit III will occur at the Valle Verde Well. Well locations are shown on Figure 2.5-1.

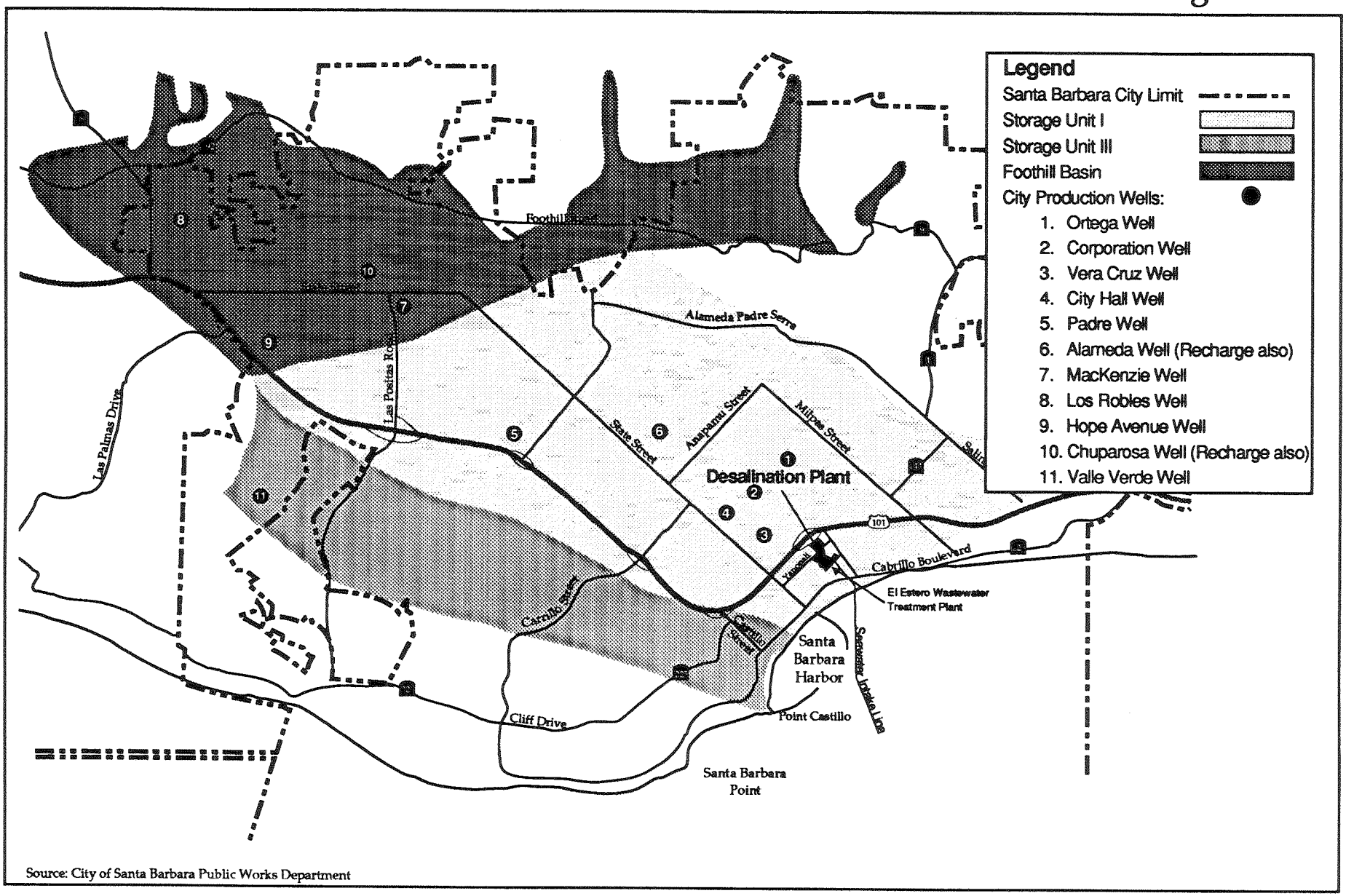
Figure 2.5-2 illustrates the annual total levels of pumping required based on the Santa Ynez River Model. The Santa Ynez River Model was one of the primary tools used to evaluate the City's water supply during the Long-Term Water Supply Alternatives Analysis. For purposes of comparison the drought of the late 1940's and early 1950's was very similar to the recent drought. For future use, the model is currently being updated and validated with data up to the 1990's. The model run includes assumptions that at least 300 AF, and no more than 4,500 AF, will be pumped each year; that there is a usable volume of 16,000 AF of groundwater; and that recovery of groundwater storage following periods of shortage is enhanced by use of artificial recharge at a rate of up to 2,000 AFY. The average annual City pumping shown in the model run is 1,300 AFY. This is in addition to 450 AFY of pumping in the Foothill Basin by parties other than the City. Artificial recharge will be accomplished by release of water into stream beds and by injection of water from the City's distribution system directly into the aquifers. Stream bed recharge will occur in Mission Creek in the vicinity of Oak Park using water from Gibraltar Reservoir and Mission Tunnel. Injection will occur at the upper wells in Storage Unit I, at the Chuparosa Well in the Foothill Basin, and at other locations as necessary to achieve desired recharge rates.

In addition to the alluvial wells mentioned above, Santa Barbara has three wells drilled into bedrock aquifers in the vicinity of the South Portal of Mission Tunnel. Based on operating data during 1991 and 1992, the three wells are capable of providing a combined amount of approximately 260 AFY. These wells are considered auxiliary but may be needed to meet the criteria established by the LTWSP.

Management of groundwater of the Foothill Basin will include development of a groundwater management program by the City and the La Cumbre Mutual Water Company (LCMWC). The program is an obligation under an agreement between the City and LCMWC that provides for conveyance of State Water Project water to LCMWC through the City's distribution system. The City and LCMWC will develop a detailed groundwater management program which will probably include the following elements: (1) a schedule for water extractions allowed under each foreseeable water use circumstance; (2) apportionment of the cost of management studies and groundwater enhancement efforts between the parties; (3) credit for water injected for storage into the groundwater basin; (4) a process for coordinating extractions; and (5) a process for dispute resolution. The specifics of the management program will be based to a large extent on work currently being undertaken by USGS as a part of the Multiple Objective Optimization Study, which is expected to be able to model a variety of extraction and injection scenarios. The

Groundwater Basins and Wells

Figure 2.5-1



Source: City of Santa Barbara Public Works Department

Long Term Water Supply Program EIR

City of Santa Barbara

Scale 0 0.25 0.5 1 Miles

agreement establishing the management program will be completed prior to delivery of SWP water to LCMWC. The agreement may also include other pumpers in the Foothill Basin.

New Water Supplies - State Water Project and Desalination

State Water Project

Two new long-term water supplies are to be developed by Santa Barbara to meet the water demand projections established in the LTWSP. The first is the addition of 3,000 AFY of delivery capacity to be provided through participation in the Coastal Aqueduct of the State Water Project (SWP). On June 4, 1991, voters approved a ballot measure that requires the City to participate in the SWP and to secure its full 3,000 AFY entitlement. Participation in the Coastal Aqueduct project requires construction of water transportation and treatment facilities to bring water from the existing terminus of the Coastal Aqueduct Phase I pipeline at Devil's Den in western Kern County to the City's water distribution facilities. The delivery of SWP is expected to begin by 1996.

All of the components of this project have been or currently are being reviewed under CEQA or NEPA by lead agencies other than the City of Santa Barbara. The City has participated in the review of these documents and will rely on them for any project-specific environmental analysis required for their participation in the Coastal Aqueduct project. For purposes of this environmental review of the City's LTWSP, only the potential environmental impacts of the policy decision to include SWP participation in the LTWSP will be considered.

Desalination

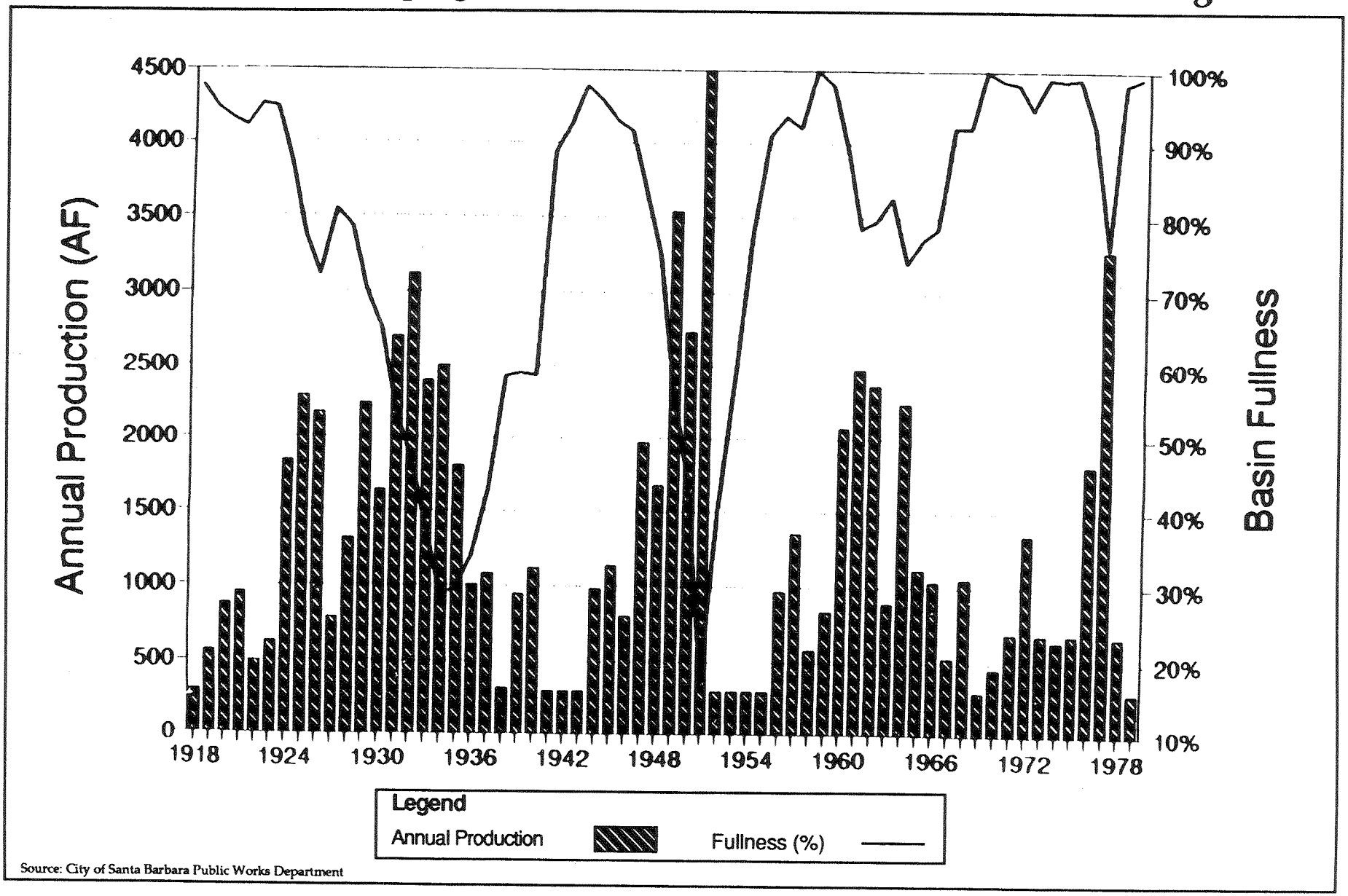
The second major new water supply for Santa Barbara is 3,000 AFY of production capacity to be provided through conversion of the City's temporary desalination plant to a permanent facility. The LTWSP also proposes that an additional 2,000 AFY of capacity from the desalination plant be available to the City on an interim or substitute basis until the Coastal Aqueduct is available. Finally, the LTWSP proposes that an additional 5,000 AFY of capacity from the desalination plant be considered for potential regional use, including potential use by the Goleta and Montecito Water Districts. The desalination plant would therefore, have a total of 10,000 AFY capacity until water from the Coastal Aqueduct is available. At the time the Coastal Aqueduct water becomes part of the City's supply, the output of the permanent desalination facility would be reduced by 2,000 AFY resulting in a permanent operating capacity of 8,000 AFY. If a marketing option for more desalinated water is pursued, supplemental analysis would be necessary (See Section 2.6, Marketing Option for Desalted Water).

2.6 COMPONENTS OF THE PERMANENT DESALINATION PLANT

The temporary desalination plant has been reviewed and approved by local, state, and federal agencies. The plant has been permitted for a capacity of up to 10,000 AFY and for operation for up to five years. The City certified the FEIR for the temporary plant on March 15, 1991.

LTWSP Groundwater Pumping - Based on SYRM Period of Record

Figure 2.5-2



Source: City of Santa Barbara Public Works Department

5.2 GROUNDWATER RESOURCES

INTRODUCTION

Groundwater resources in Santa Barbara County are the subject of an Environmental Impact Report completed for the Santa Barbara County Water Agency by Dames & Moore (SBC91-EIR-15). The EIR has not yet been certified by the County Board of Supervisors. That document contains discussion of general groundwater principles and other information related to groundwater resources in Santa Barbara County. Information specifically related to the groundwater component of the LTWSP is discussed herein.

ENVIRONMENTAL SETTING

The groundwater resources of the City of Santa Barbara were previously thought to be contained within three groundwater storage units of the Santa Barbara Groundwater Basin. The most recent work by the United States Geological Survey (USGS) has identified Storage Unit I and Storage Unit III as being part of the Santa Barbara Groundwater Basin, and Storage Unit II, together with what was formerly referred to as the Goleta East Sub-basin, as being a separate basin now referred to as the Foothill Basin.

The two basins each consist of unconsolidated deposits of sand, silt, and clay with occasional gravel layers. Consolidated sedimentary rocks underlie the basins and compose the surrounding hills. Natural recharge of the basins results from seepage from streams, infiltration of precipitation, and subsurface inflow from consolidated rock of the Santa Ynez Mountains and from adjacent storage units. Infiltration of irrigation water also contributes to groundwater recharge to some extent. Rainfall in the area occurs generally from November through March and averages 17.92 inches per year, with extremes ranging from 3.99 to 50 inches. The dominant land uses are urban residential, commercial, and some small amount of industrial. A small fraction of the land is occupied by agriculture, primarily avocado orchards.

The City of Santa Barbara produces groundwater from wells located in all three storage units, providing treatment as required, before introducing the water into the City's potable water distribution system. Facilities for artificial recharge have been constructed to enhance the natural recharge of the basins during times when water is available for such use. Pumping by entities other than the City occurs to varying degrees in the basins. Groundwater production represents a small fraction of the City's total water supply, though it is an important back-up for surface water supplies that are subject to drought impacts. Other potable water sources include surface water from Lake Cachuma and Gibraltar Reservoir, imported water from the State Water Project starting in 1996, and desalted seawater as necessary from the City's seawater

desalination facility. Reclaimed wastewater is provided to large landscaped areas to displace potable water use.

Santa Barbara Groundwater Basin

Storage Unit I

Storage Unit I covers an area of approximately seven square miles, including the downtown area of Santa Barbara. It is bounded by the Mission Ridge Fault on the northwest, by the foothills of the Santa Ynez Mountains at the Sycamore and Lagoon Faults on the northeast, by the Mesa Fault on the southeast, by the Montecito Groundwater Basin on the east, and by the Pacific Ocean on the southeast. The principal creeks in the area are Mission Creek and Sycamore Creek which run intermittently, particularly in the lower reaches. An unknown off-shore fault had been thought to seal the storage unit from the Pacific Ocean, though a report by Peter Martin (USGS, 1984) indicates that the fault is not an effective barrier to seawater intrusion.[1]

The unconsolidated deposits range in thickness from less than 200 feet at the Mission Ridge Fault to more than 1,000 feet at the southern corner of the storage unit adjacent to the Pacific Ocean.[2,3] They have been divided into five zones: (1) the shallow zone, (2) the upper producing zone, (3) the middle zone, (4) the lower producing zone, and (5) the deep zone.[4]

The shallow zone contains water bearing deposits of limited volume and continuity. The upper producing zone is approximately 50 feet thick, is continuous and distinct throughout most of the storage unit, and is one of the main water bearing portions of the basin. The middle zone ranges from 100 feet in thickness near the Mission Ridge Fault to 300 feet beneath the downtown area. There are only limited water-bearing deposits. The lower producing zone is confined or partly confined by the fine-grained deposits of the middle zone and ranges in thickness from approximately 50 feet near the Sycamore Fault to 200 feet beneath the downtown area. This zone is considered the major source of groundwater from wells in the basin.[5]

Recharge in Storage Unit I results from infiltration of precipitation, stream bed seepage, subsurface inflow from consolidated rocks, and some infiltration of imported water from surface reservoirs.[6] Earlier estimates of average annual recharge in the Santa Barbara Groundwater Basin as a whole range from 2,000 to 2,500 AFY, with infiltration of rainwater as the major source of recharge.[7] More recent work by USGS has estimated the steady-state recharge amount at 800 AFY, split equally between stream bed recharge and areal recharge. At steady state conditions this amount is offset by discharge to drains in the amount of 470 AFY and to subsurface flow to the ocean in the amount of 330 AFY.[8] Perennial yield, then, is equal to 800 AFY to the extent that discharge can be captured, which is readily accomplished by operation of municipal wells in the storage unit.

Estimates of total basin volume and usable storage have generally not distinguished between Storage Unit I and the other units because all units were previously thought to be part of the same basin. However,

the original description of the area's hydrogeology done by Muir[9] included an estimate of 108,800 AF of storage down to the elevation of 200 feet below sea level, which was thought to be the zone of maximum known water level fluctuations during 1959-64.[10]

Of the two streams within the basin, only Mission Creek is considered to have a significant amount of stream bed recharge. Recharge loss in Sycamore Creek is considered negligible due to the presence of clay layers beneath the creek which inhibit seepage.[11] The most significant amounts of seepage in Mission Creek occur in the section from Rocky Nook Park to Mission Street. Seepage losses of approximately 3.5 AF per day were measured on several occasions. Based on an estimated 73 days of flow per year, recharge from natural stream flow in this section is estimated to be approximately 235 AFY. It is estimated that a year-round controlled release of water from the South Portal of Mission Tunnel would provide approximately 1,200 AFY of recharge in this section of the creek.[12] Except for relatively infrequent periods when the water table in the shallow zone is below the bottom of the channel, seepage losses in the portion below Mission Street are minimal.[13]

Municipal pumping represents the most significant discharge in the storage unit and has ranged from 0 to 3,700 AFY during the period of 1978 to present. The following municipal production wells, identified by USGS well number, are located in Storage Unit I, and are shown on Figure 5.2-1:

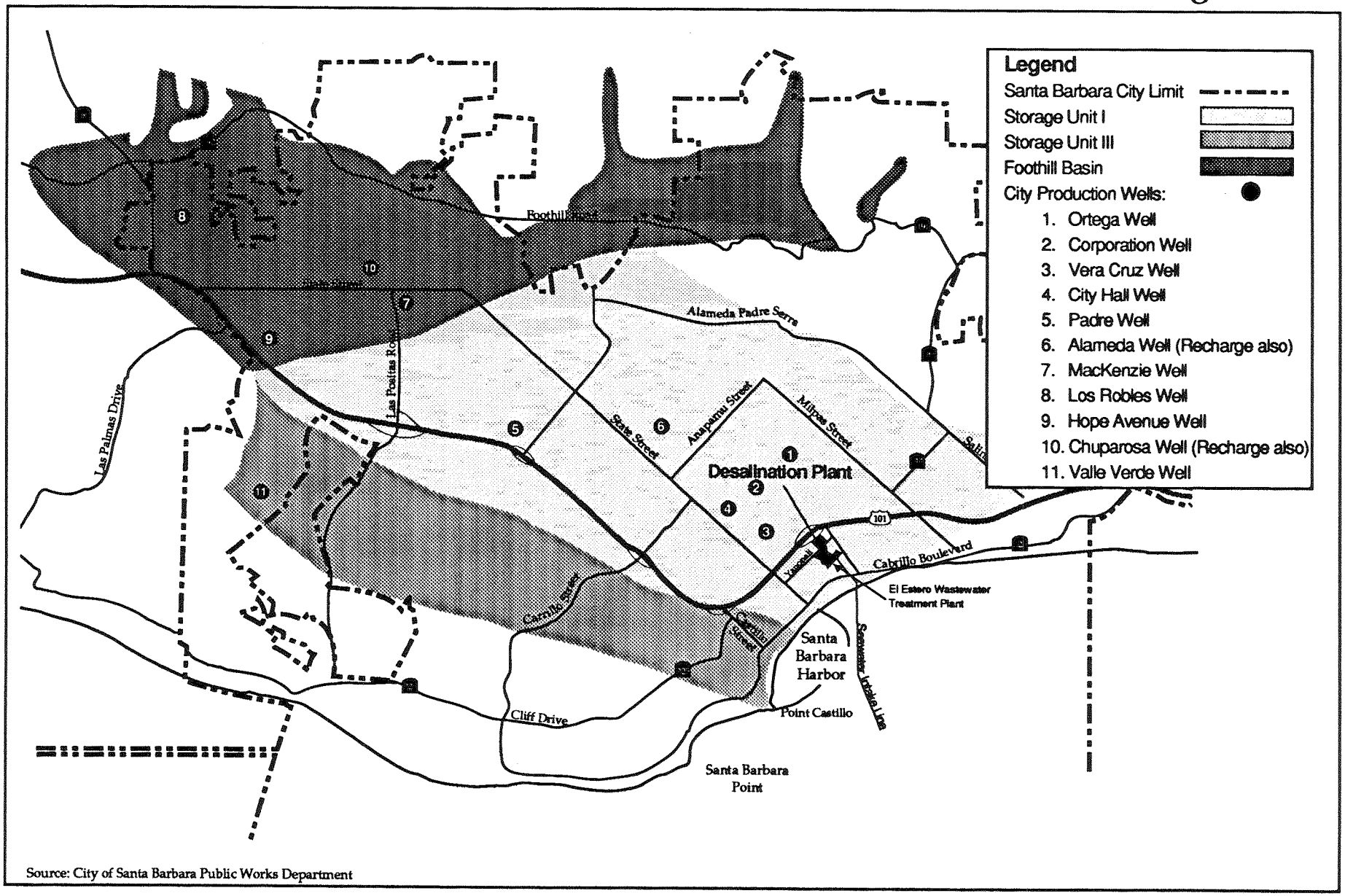
1.	Ortega Well	4N/27W-15J2
2.	Corporation Well	4N/27W-15Q10
3.	Vera Cruz Well	4N/27W-22B6
4.	City Hall Well	4N/27W-22C1
5.	Padre Well	4N/27W-16E2
6.	Alameda Well	4N/27W-15E2

These wells are capable of sustained production of about 3,300 AFY. Two additional wells are planned in the upper portion of the storage unit, based on USGS recommendations to add additional pumping capacity further from the coast. These are intended to reduce the impact of seawater intrusion during periods of pumping.

During periods of heavy pumping, water quality in the unit is subject to degradation by intrusion of seawater. Chloride levels of greater than 1,000 mg/L have occurred in four of six monitoring wells located between the coast and the municipal production wells. This has not resulted in significant degradation of production wells, but is an indication that contamination from seawater intrusion is related to pumping in the unit. Groundwater that is not affected by seawater intrusion or contamination from the deep zone shows moderate levels of total dissolved solids; 415-950 mg/L for the upper producing zone and 405-974 mg/L for the lower producing zone. In addition to degraded water quality from seawater intrusion, there is also the potential for migration of poorer quality water from the deep zone and contamination by organics from near-surface sources.[14]

Groundwater Basins and Wells

Figure 5.2-1



Source: City of Santa Barbara Public Works Department

Long Term Water Supply Program EIR

City of Santa Barbara

Storage Unit III

Storage Unit III covers an area of approximately 2.5 square miles. Its geology is much the same as Storage Unit I, though its volume is considerably smaller. The unit is bounded by the Mesa Fault on the north, the Hope Ranch Sub-Basin on the West, the Lavigia Fault on the south, and the offshore fault on the east. The unit is probably not as open to the ocean as is Storage Unit I, based on analysis of drilling logs for wells at the southeast end of the unit.[15] The unconsolidated portion of the unit is as much as 600 feet thick. The shallow zone is generally less than 160 feet thick. The upper producing zone is approximately 40 feet thick. The middle zone ranges from 50 to 300 feet thick. The lower producing zone is generally 100 feet thick and up to 140 feet thick near the Lavigia Fault. It is probably the major source of water to wells in the unit. The deep zone ranges from 80 to 120 feet thick and is underlain by consolidated rock.[16]

Recharge to the unit occurs through stream seepage (primarily in Arroyo Burro Creek), infiltration of rainwater, and some subsurface flow. The perennial yield of the unit has been accepted to be 150 AFY,[17] though a recent estimate by Hoover[18] put the perennial yield at 300-400 AFY. Available storage in this unit has been estimated by Muir to be 26,500 AF,[19] with a usable volume of 7,500 AF.[20] The USGS is currently preparing an updated report on this storage unit.

The City has one municipal production well in the unit, the Valle Verde Well (#11) (4N27W-18Q4) capable of producing approximately 350 AFY. The well was constructed in the mid-1980's and has pumped as much as 257 AFY. Relative to other groundwater produced by the City, the water quality is poor, though it is treated to meet potable water standards. It is thought that poor quality water in close proximity to consolidated rock at the bottom of the basin is contaminating water in the well. The other significant pumpers in this unit are La Cumbre Country Club (4N/27W-18N1), pumping up to 80 AFY, Las Positas Mutual Water Company (4N/27W-17M1-M5) pumping 30 AFY, and the two Parks family wells (4N/27W-18Q5 & R3) pumping 15-20 AFY.[21] These estimates would mean total pumping of 45 to 387 AFY in Storage Unit III.

Foothill Basin

The Foothill Basin underlies what is known as the Outer State Street area of Santa Barbara, covering an area of 4.5 square miles. Until recently, the east portion of the basin was regarded as Storage Unit II of the Santa Barbara Groundwater Basin, and the western portion was regarded as the East Sub-basin of the Goleta Basin. Freckleton presented data showing that these units comprise a separate groundwater basin. It is his work that is the source of most of the information contained herein on the Foothill Basin.[22] The basin is bounded by the Goleta Fault and consolidated rock of the Santa Ynez Mountains on the north, by the Goleta Fault on the northwest, by the Modoc, More Ranch and Mesa Faults on the southwest, and by the Mission Ridge Fault on the southeast.

The groundwater system consists of unconsolidated deposits up to 800 feet in thickness. The principal aquifer is the Santa Barbara Formation, composed of unconsolidated marine sand, silt, and clay up to 400 feet in thickness and overlain by older and younger alluvium also up to 400 feet in thickness. The aquifer is generally, though not completely, confined by a zone of low permeability in its upper portion that ranges from a few feet to more than 100 feet in thickness. The alluvial deposits are generally unconfined.

Recharge in the basin consists of stream seepage, infiltration of precipitation, and subsurface flow from consolidated rocks of the Santa Ynez Mountains. Some minor amount of recharge occurs from infiltration of imported water. Stream seepage is estimated to account for 160 to 460 AFY of recharge. Infiltration of rainfall provides about 320 AFY. Subsurface inflow is estimated to range from 25 to 300 AFY. During non-pumping conditions, these estimates indicate a total groundwater discharge of 500 to 1,100 AFY to streams and as underflow. The average annual recharge for steady-state conditions calculated by Freckleton is 905 AFY. This amount, plus an assumed five percent return flow, equals 953 AFY, which has been accepted by the Santa Barbara County Water Agency as the perennial yield of the basin.[23]

Groundwater has been pumped in the Foothill Basin since the 1800's. Freckleton cites pumpage ranging from 160 to 2,400 AFY during the period of 1935 to 1987. There was a decline of more than 60 feet in groundwater levels during the heavy pumping period of the early 1950's, with a period of increasing levels after that time up to 1984 when a period of general decline in water levels began. The City of Santa Barbara operates the following municipal production wells in the basin as shown on Figure 5.2-1:

7.	MacKenzie Well	(4N/27W-8L3)
8.	Los Robles Well	(4N/27W-7D1)
9.	Hope Avenue Well	(4N/27W-7Q5)
10.	Chuparosa Well	(4N/27W-5P1)

These wells are capable of sustained production of approximately 1,900 AFY. In addition to City pumping, the La Cumbre Mutual Water Company pumps up to 300 AFY from the basin. Other pumpage, including that done by the Goleta Water District, Sunset Mutual Water Company, San Vincenti Mobile Home Park, Calvary Cemetery, and the Lincolnwood development is estimated at approximately 150 AFY.

Water quality analysis indicates distinctive qualities as compared with other basins in the vicinity. All sampled water would be classified as very hard (greater than 300 mg/L as $CaCO_3$), as is typical of water throughout the region. Sodium concentrations exceeded 20 mg/L in all samples reported by Freckleton. Water produced by municipal wells is treated as necessary to meet applicable potable water quality standards. Management of groundwater resources in the basin will be done under the provisions of a Foothill Basin Groundwater Management Program as described in the Project Description.

Artificial Recharge

The City of Santa Barbara, based in part on recommendations made by USGS, has initiated a program of artificial recharge designed to enhance recharge of the basins, consistent with the groundwater component of the Long-Term Water Supply Program. During periods when the creek is not flowing, stream bed infiltration is enhanced through controlled releases of water from Mission Tunnel into Mission Creek near the tunnel's South Portal. A pilot injection program is underway at Alameda Well and at Chuparosa Well where water is injected into the basins from the municipal distribution system.

Standards of Significance

Impacts would be considered significant if implementation of the project would result in: (1) a reduction in the usable storage of groundwater basins, as evidenced by a reduction in well yields of 50 percent or greater, (2) a long-term decline in groundwater levels as measured by cumulative pumping amounts in excess of perennial yield, or (3) degradation of water quality at municipal wells such that pumped groundwater would not meet primary or secondary drinking water standards.

IMPACT DISCUSSION

Land Subsidence and Aquifer Compaction

A review of published reports on the City's groundwater basins reveals no evidence of subsidence or aquifer compaction from previous groundwater pumping. Since pumping levels proposed as a part of the LTWSP are generally comparable to or less than historical levels, as discussed below, no subsidence or compaction impacts are anticipated.

Long-Term Overdraft

The groundwater production levels included in the project were determined with reference to the estimated perennial yield of the basins and are aimed at avoiding long-term overdraft. The portion of the perennial yield of the basins that is available to the City is currently accepted to be approximately 1,400 AFY as discussed under the description of the environmental setting. Average annual groundwater production as modeled under the LTWSP is 1,304 AFY, meaning that long-term overdraft is not expected to occur. In the early years of the planning period, average groundwater production would be less. It should be noted that this information is based on an aggregate analysis of the City's basins. Water will be pumped from the storage units in approximate proportion to the perennial yield of each unit due to the location and pumping capacities of the wells. For example, the Foothill Basin has approximately 30 percent of the pumping capacity and contains approximately the same percentage of the total perennial yield that is available to the City. More specific definition of optimum pumping rates in each storage unit will be addressed in work currently being undertaken by USGS. The City has entered into a four-year contract with USGS to perform a "Multiple Objective Optimization Study." The goal of the study is to integrate existing information and models of the City's basins into one comprehensive model to be used to project water supply availability, minimize water production costs, and implement conjunctive management of groundwater supplies. The new model will be used to determine the effects of various pumping strategies

and their relationship to the overall management of the City's water system. The study was initiated in January 1993 and has a four-year term, subject to continued funding authorization. Work items include the following:

1. Development of data bases of existing geographic, geologic, and hydrologic data.

2. Cataloguing of legal and operational water management constraints.

3. Integration of existing groundwater models with an optimization model.

4. Testing and refining of the optimization model on single-objective and multiple-objective test cases.

5. Preparation of documentation on use of multiple-objective optimization model and training of City staff.

The groundwater management agreement and program in the Foothill Basin will reduce the likelihood of overdraft and contribute to better management of groundwater resources through better understanding of the effects of pumping and defined levels of extraction under various conditions of water supply availability.

Injection of Treated Water or Salt Water Intrusion

An analysis done for the City by BCI Geonetics addressed potential concerns regarding impacts on groundwater quality as a result of injection of treated water into the groundwater basin, including water from the Cater Treatment Plant and desalinated water. Preliminary groundwater sampling and geochemical modeling were conducted prior to actual injection. The results indicated no significant anticipated impacts as a result of injecting treated water, either from Cater Treatment Plant or from the desalination facility.[24] A follow-up analysis of injection water samples during the pilot injection program confirmed that there were no significant alterations in water quality as a result of treated water injection.[25] Monitoring of groundwater quality is a part of regular operating procedures and will therefore be part of the LTWSP. Accordingly, no impact to groundwater resources is anticipated.

The most recent USGS study of Storage Unit I[26] has identified water quality degradation through seawater intrusion as a potential impact of municipal pumping in this storage unit. The cause of the intrusion was identified as lowered groundwater levels in the southern portion of the storage unit as a result of extensive municipal pumping during 1978-80. The pumping during this period occurred entirely in the southern portion of Storage Unit I, south of De la Guerra Street, at an average rate of approximately 2,600 AFY. Martin estimated that it would take approximately 22 years for seawater contamination to reach the closest municipal wells if the constant pumping conditions of 1978-80 continued.

The LTWSP project description includes measures based on four recommendations made by Martin, including (1) reduced pumping, (2) increased recharge at Mission Creek, (3) artificial recharge by injection

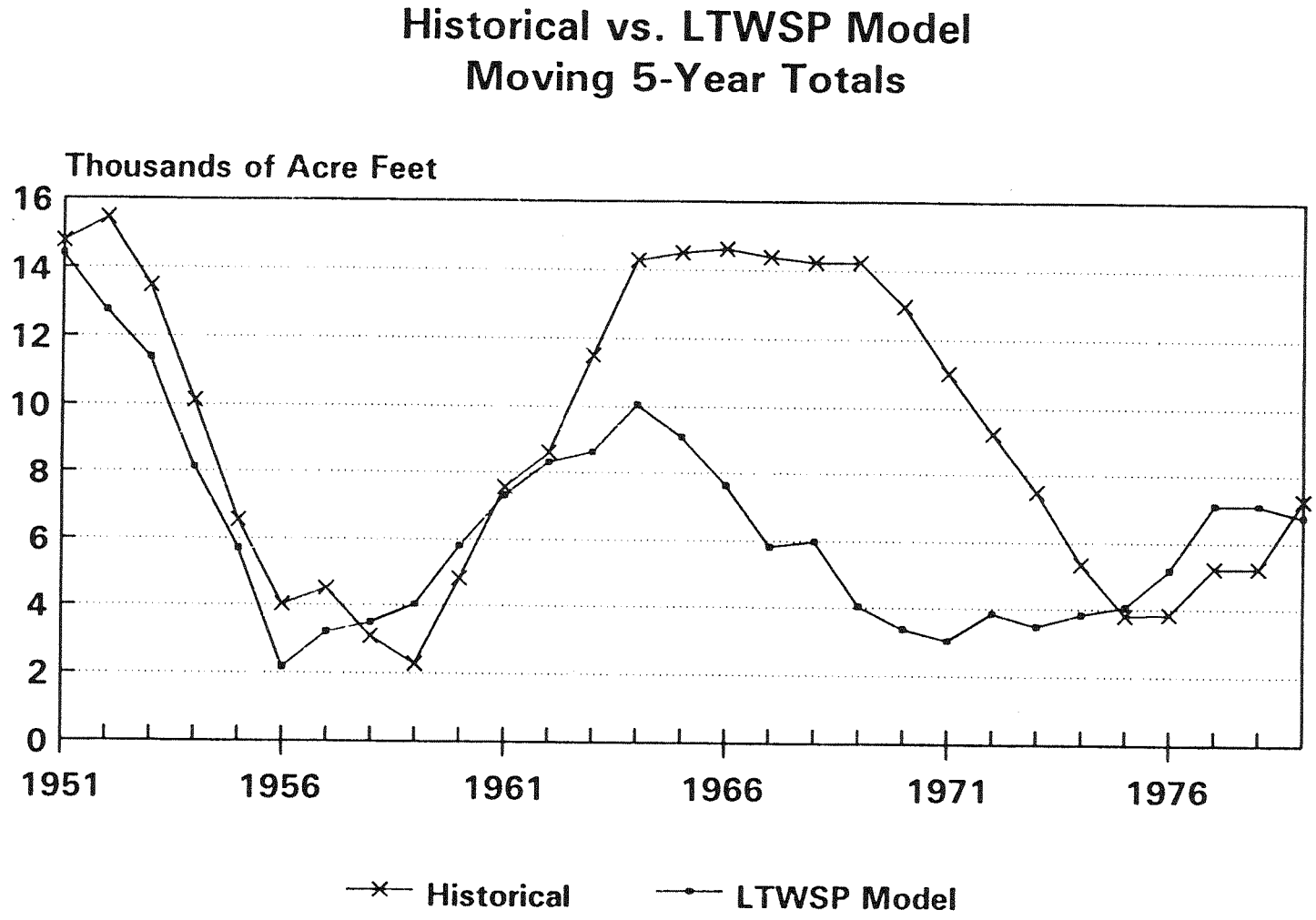
wells, and (4) development of new wells in the upper portion of Storage Unit I. As a result, the pumping impacts of the LTWSP are expected to be significantly different from the 1978-80 test conditions. With the use of the existing Alameda Well and the two new wells to be constructed in the upper portion of Storage Unit I, in addition to new wells that have been developed in the Foothill Basin, the need for pumping in the lower portion of Storage Unit I will be greatly reduced. Wells in locations other than lower Storage Unit I have a pumping capacity conservatively estimated at 3,000 AFY. During the 62-year period modeled for the LTWSP there are only four years when pumping in excess of this amount would be required. Furthermore, none of these years are consecutive, meaning that groundwater levels near the coastal area are expected to have a chance to recover between periods of heaviest pumping. As noted by Martin, groundwater levels recover quickly when pumping is stopped.[27] Recharge efforts at Mission Creek and at the Alameda Well, which are a part of the LTWSP, will also enhance the recovery of groundwater levels. The new production wells to be added in Storage Unit I will also be designed for injection of water into the groundwater basin.

The LTWSP as a whole results in increased water supplies available to the City through the addition of State Water and desalination, and a corresponding reduction in the need to pump groundwater. This is reflected in reduced overall groundwater pumping under the LTWSP as compared to historical levels. Figure 5.2-2 is a comparison of total pumping for a moving five-year period under historical conditions and under the LTWSP. Data is based on the period of 1947 through 1979, the period for which available historical pumping data coincides with the period modeled for the LTWSP. Total historical pumping for the period is 61,564 AF compared to 44,017 AF for the same period as modeled for the LTWSP. The general reduction in pumping levels combined with specific strategies associated with controlling seawater intrusion mean that the project will have beneficial impacts on groundwater resources.

The project description includes measures that have been incorporated into the LTWSP for the purpose of avoiding adverse impacts associated with groundwater pumping (See Section 2.5, Groundwater). These measures include implementation of the four USGS recommendations discussed above and incorporation of pumping limitations based on the estimated perennial yield and recharge capability of the groundwater basins. Based on these measures and on the anticipated beneficial impacts from the project, no mitigation measures are required with regard to the groundwater element of the LTWSP.

Annual Groundwater Pumping Levels

Figure 5.2-2



Source: City of Santa Barbara, Public Works Department

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