Chapter 2

Water Supply and Resource Management

2.1 Existing Water Facilities and Demands

Zone 7 serves a population of about 183,000 as the wholesaler of treated potable water to its retail contractors for municipal and industrial (M&I) uses. Zone 7 also supplies untreated water for agricultural, golf course and other uses. The four major retailers, which provide water for M&I use, are the City of Pleasanton, the Dublin San Ramon Services District (DSRSD), the City of Livermore and California Water Service Company (CWS). Zone 7's water supply comes from three sources: 1) Imported surface water from the State Water Project (SWP), 2) local runoff into Lake Del Valle (LDV), and 3) stored groundwater. Zone 7's major existing water facilities are shown in Figure 2.1.

Water Supply, Conveyance and Storage

Imported Surface Water—Zone 7 has a contract with the California Department of Water Resources (DWR) for water deliveries through State Water Project (SWP) facilities. This contract allows Zone 7 to import water from Lake Oroville via the Sacramento-San Joaquin Delta and the South Bay Aqueduct (SBA). The Zone 7 maximum annual entitlement for the year 2004 is 80,619 AF/year. The long-term average yield of SWP water is believed to be about 75% of the contractual entitlement (total SWP demand is 4.1 MAF/year). Zone 7 also has contracted with Byron-Bethany Irrigation District (BBID) and DWR for water transfer of 2,000 AF of BBID water for delivery through SWP facilities.

Zone 7 uses imported surface water by either delivering directly to untreated and (after treatment) treated water customers or after storage in the local groundwater basin through pumping during peak demand periods and during dry years. Untreated water deliveries, typically for agricultural irrigation, are made directly from the SBA turnouts. Treated water is produced at and then delivered from the Zone 7 Patterson Pass Water treatment plant (PPWTP) and Del Valle Water Treatment Plant (DVWTP). Zone 7 recharges water for storage in the local groundwater basin using the valley Arroyos.

Zone 7 has also purchased water storage rights (65 TAF) in the Semitropic Water Storage District groundwater basin located in south-central California near Bakersfield. Zone 7 is allowed by contract to store excess SWP water in the Semitropic groundwater basin in wet years and to then pump additional water from the delta during dry years in exchange for the water pumped from storage in Semitropic for use by downstream SWP contractors.

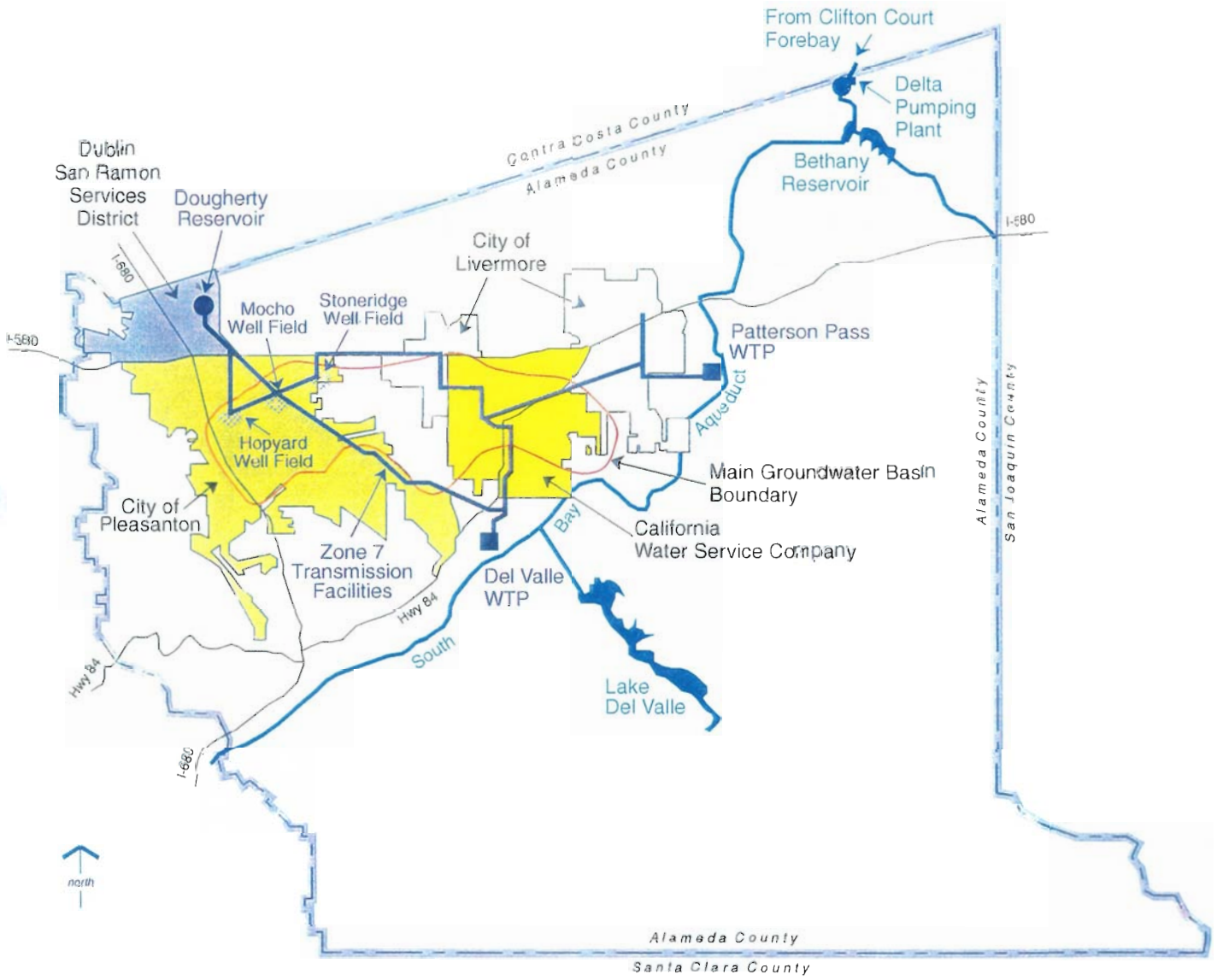

Figure 2.1
Zone 7 Water Facilities and Retail Service Areas

Local Runoff Into Lake Del Valle —Zone 7 shares the water rights with Alameda County Water District (ACWD) for the local runoff into Lake Del Valle. The average local runoff into Lake Del Valle is about 22 TAF/year. Some of this runoff during wet years is lost as flood releases. Zone 7's existing contract with DWR allows Zone 7 to store local water in the lake and use it in the following calendar year. The Zone 7 average yield from Lake Del Valle at current demand levels is about 8,000 AF/year. This is expected to increase to 9300 AF/year as the treated and untreated water demand during the wet season increases.

Zone 7's share of local runoff into Lake Del Valle can be delivered directly for untreated uses, treated at DVWTP and delivered for M&I uses, or stored for future use. Zone 7 can release available local water into the arroyos for groundwater basin recharge to the extent recharge capacity is available during dry conditions.

Local Groundwater Basin—The local groundwater basin has a storage capacity of over 240,000 AF. The annual average natural recharge into the groundwater basin is about 13,000 AF. The natural groundwater recharge sources include rainfall recharge, irrigation water recharge, natural stream recharge and net subsurface groundwater inflow. In addition to the natural recharge, Zone 7 artificially recharges the basin by making untreated water releases from the South Bay Aqueduct into Arroyo Mocho and Arroyo Valle. Zone 7's existing artificial recharge capacity ranges from 12,300 AF/Y in wet years to 20,000 AF/Y in dry years (Table 2.1).

Table 2.1, Artificial Groundwater Basin Recharge Capacity

	DRY YEAR	*AVERAGE YEAR*	*WET YEAR*
Arroyo Mocho	12,000	10,000	7,300
Arroyo Valle	8,000	7,000	5,000
Total Artificial Recharge Capacity	20,000	17,000	12,300

Surface Water Treatment and Groundwater Production Wells

The existing treated water production facilities include the two surface water treatment plants owned and operated by Zone 7 and the groundwater production wells owned and operated separately by Zone 7, the City of Pleasanton and CWS. The Del Valle water treatment has a maximum design capacity of 36 mgd and Patterson Pass has a maximum design capacity of 19.5 mgd. The total surface water treatment design capacity is 55.5 mgd. Actual current capacity is slightly less and varies with Del Valle Reservoir water blend in SBA flow (Table 2.2, 2004).

Zone 7 has seven existing active production wells with a total production capacity of 32 mgd. Pleasanton has three existing active wells with a production capacity of 11 mgd and CWS has 12 existing active wells with a production capacity of 10 mgd (Table 2.3, 2004). Pleasanton, CWS and DSRSD have annual groundwater pumping quotas of 3500, 3069

Table 2.2

ZONE 7 WATER AGENCY
WATER RESOURCES
TREATED WATER PRODUCTION CAPACITIES
2004

SURFACE WATER TREATMENT PLANTS

FACILITY		SUSTAINED CAPACITY FOR PLANNING*					PEAK CAPACITY
		MGD	GPM	CFS	AF/DAY	AF/MONTH	MGD
DEL VALLE	W/ LAKE DEL VALLE BLEND	36	25,000	55.8	110.5	3,370	36
	W/O LAKE DELL VALLE BLEND	25	17,360	38.8	76.8	2,340	26
PATTERSON PASS	TOTAL	18	12,500	27.9	55.3	1,685	19.5
	PPWTP CONVENTIONAL	12	8,330	18.6	36.8	1,123	13.5
	PPWTP UF	6	4,170	9.3	18.4	562	6.0
TOTAL	CURRENT W/ LDV BLEND	54	37,500	83.7	165.8	5,055	55.5
SURFACE	CURRENT W/O LDV BLEND	43	29,860	66.7	132.0	4,025	45.5

GROUNDWATER PRODUCTION WELLS

FACILITY	AVG.CAPACITY GPM	SUSTAINED CAPACITY FOR PLANNING*		3 Month Avg sust. Capacity	Power** consumption		PEAK CAPACITY
		MGD	AF/MONTH	MGD	KWH/AF	KWH/AF/FT	MGD
HOPYARD WELL FIELD	4,980	6.5	610	6.5			7.2
HOPYARD 9	1,240	1.6	152	1.6	619		1.8
HOPYARD 6	3,740	4.9	459	4.9	603	1.7	5.4
MOCHO 1&2 WELL FIELD	4,660	6.1	571				6.8
MOCHO 1	2,370	3.1	290		587		3.4
MOCHO 2	2,290	3	281		587		3.3
MOCHO 3&4 WELL FIELD	7,790	10.2	955	18.5			11.3
MOCHO 3	4,130	5.4	505		652	1.6	6.0
MOCHO 4	3,660	4.8	449		782	1.5	5.3
STONERIDGE	4,660	6.1	571		684	2.0	6.8
TOTAL GROUNDWATER	22,090	29	2,710	25			32.0

TOTAL CAPACITY W/ LAKE DEL VALLE BLEND	83	7,765	79			88
TOTAL CAPACITY W/O LAKE DEL VALLE BLEND	72	6,735	68			78

*10% average GPM capacityis reserved for daily peaking and outages. Sustained capacityused for monthly scheduling.
1 mgd = 1.55 cfs = 3.07 AF/Day = 93 AF/Month = 1120 AF/Year

TABLE 2.3

ZONE 7 WATER AGENCY
WATER RESOURCES
RETAILER'S MUNICIPAL SUPPLY WELLS
December 2003 WELL STATUS

PURVEYOR	WELL	STATE WELL	HP	GPM	MGD	AF/M	AF/Y	LONG TERM STATUS
City of Pleasanton	#5	3S/1E 16L 5	200	2000	2.9	269	3226	ACTIVE
	#6	3S/1E 16L 7	200	2150	3.1	289	3468	ACTIVE
	#7	3S/1E 18A 5	150	1900	2.7			INACTIVE
	#8	3S/1E 16A 2	450	3200	4.6	430	5162	ACTIVE
	TOTAL			9250	13.3	988.0	11856	
OPERATIONAL TOTAL Pleasanton				**7350**	**10.6**	**988.0**	**11856**	

California Water Service	004-01	3S/2E 8H 1	50			0	0	INACTIVE
	005-01	3S/2E 16B 1	25	70	0.1	9	113	ACTIVE
	008-01	3S/2E 8P 1	25	370	0.5	50	597	ACTIVE
	009-01	3S/2E 9Q 1	40	730	1.1	98	1177	ACTIVE-N
	010-01	3S/2E 8F 1	60	725	0.9	97	1169	ACTIVE-N - V
	012-01	3S/2E 9P 1	60	850	1.2	114	1371	ACTIVE
	014-01	3S/2E 8N 2	50	1000	1.4	134	1613	ACTIVE
	015-01	3S/2E 16C 1	60	975	1.4	131	1573	ACTIVE
	017-01	3S/2E 9L 1	50	460	0.7	62	742	ACTIVE-N
	019-01	3S/2E 8G 1	60	620	0.9	83	1000	ACTIVE-N
	020-01	3S/2E 18B 1	60	280	0.4	38	452	ACTIVE
	024-01	3S/2E 7P 3	100	450	0.6	60	726	ACTIVE
	031-01	3S/2E 7R3	125	750	1.1	101	1210	ACTIVE
						877.7	10533	
OPERATIONAL TOTAL CWS				**7280.0**	**10.3**	**506.1**	**6073**	

ACTIVE-N = High nitrate wells that require blending
ACTIVE-V = High VOC -Require blending.

New CWS Well 031-01 on line June 12, 2003.

and 645 AF, respectively. The total combined groundwater pumping capacity for Zone 7 and the retailers is about 53 mgd.

Distribution System

The Zone 7 treated water distribution system conveys treated water from the treatment plants and wells to the retailer turnouts. The Zone 7 distribution system includes treated water storage reservoirs, booster pump stations and distribution pipelines. Zone 7 has a treated water storage capacity of 2 MG at PPWTP, 7.5 MG at DVWTP and 4 MG in the Dougherty reservoir. The treated water storage reservoirs help meet hourly demand fluctuations. The water from the treatment plants flows into the system by gravity. The rate control stations along the transmission pipelines regulate the amount of flow from each plant. Treated water produced at the surface water treatment plants and by Zone 7 production wells is delivered to the retailer turnouts at various locations throughout the Zone 7 system.

The retailers own and operate their own water distribution systems serving their M&I customers. Pleasanton and CWS pump groundwater according to their groundwater pumping quotas (GPQ) directly into their retail distribution systems. The Zone 7 booster pump stations at Airway Blvd and at Silver Oaks Way are used only during extreme conditions to pump water from the wellfields to the higher elevation service areas in the east. Untreated deliveries are made directly from the aqueduct to untreated water turnouts.

Existing Demand

Zone 7's 2004 treated water demand is about 40,600 AF and the retailers groundwater pumping quota (GPQ) is about 7200 AF/year. The total treated water demand in the valley (Zone 7 plus GPQ) is therefore about 47,800 AF/year. Zone 7 water facilities are sized to meet 100% of the maximum day demand. The maximum day demand varies from 170% to 200% of the average day demand. For water facilities planning, the more conservative 200% of average day demand has been used. In year 2004, the Zone 7 treated water demand of 40,600 AF corresponds to a maximum day demand of 73 mgd. This maximum day demand is about 83% of Zone 7's existing production capacity (36 mgd DVWTP + 19.5 mgd PPWTP + 32 mgd wells). Zone 7 2004 untreated water demand is about 6,000 AF/year. Recycled water use in the valley is about 500 AF/year.

2.2 Historic Water Operations Plan

Prior to the most recent seven-year drought (1987-92), Zone 7 water operations planning served primarily to satisfy DWR contract requirements. From the lessons learned during the drought, Zone 7 instituted more comprehensive water operations planning efforts to help improve water supply reliability during dry years. The goals and major components of the subsequent water operations planning program developed and implemented during

the 1993-99 period (historic water operations plan) for managing Zone 7 water resources are described below.

Water Operations Planning Goals

The historic water operations planning effort was guided by the following major goals:

- Provide water delivery schedule information to DWR (contract requirements).
- Meet 100% of treated and untreated water demands for the current year.
- Maintain enough storage to meet 100% of demand through a typical historic six-year drought.
- Maximize delivery of surface water by minimizing groundwater pumpage.
- Minimize operational cost.

The historic water operations planning program consists of the following three major components:

1) Five-Year Demand Projections and DWR Delivery Schedule
2) Annual Water Supply and Storage Probability Analysis
3) Monthly Water Operations Plan (MWOP)

Five-Year Demand Projections and DWR Delivery Schedule

Each year Zone 7's treated and untreated water contractors submit their water demand estimates for the upcoming five years based upon projected land use developments. These demand estimates are analyzed for reasonableness and other contract requirements such as maximum day demand and for conformity to a DWR total contract amount maximum monthly limit of 11%. This five-year demand data is then used for water supply operations planning.

DWR requires all SWP contractors to submit a preliminary five-year delivery schedule by October 1 of each year that assumes 100% SWP entitlement delivery. DWR also requires that all contractors submit a one-year delivery schedule assuming 50% and 30% SWP entitlement delivery for the first of the five years. DWR uses this information to plan their water operations.

Based upon the amount of Zone 7 local water storage in LDV, local groundwater storage, Zone 7 storage in the Semitropic Water Storage District groundwater basin, and projected demands, a monthly five-year delivery schedule for each demand category is prepared assuming 100% SWP entitlement delivery. The first priority is to schedule surface water to meet 100% of the untreated (agricultural) water demands. The remaining Zone 7 SBA capacity is used to schedule surface water for the treatment plants up to plant capacities and demand limits.

If there is still SBA capacity available, then that capacity is used to schedule water for groundwater recharge through Arroyo Mocho and Arroyo Valle. Any remaining surface water supplies are scheduled for delivery to increase Zone 7's Semitropic water storage. The maximum amount of surface water is delivered directly to meet demands and groundwater is pumped only for daily peaking. This strategy minimizes cost and maximizes the delivery of low TDS surface water to customers.

For the 50% and 30% SWP entitlement delivery schedules for the first year, water operations planning becomes more complicated. For these two cases a detailed monthly water operations plan (discussed later in this section) is prepared. The surface water is first used to meet untreated demand and the remaining surface water is scheduled for the treatment plants. Groundwater is pumped as needed to supplement the surface water supply to meet 100% of the demand. Based upon groundwater pumping capacity, local groundwater basin storage and Zone 7 Semitropic storage, required Semitropic pump back is calculated. Typically a 30% SWP entitlement case would require some Semitropic pump back to meet 100% of demands.

In December of each year, DWR announces the approved deliveries as a percentage of entitlement based upon water year-to-date actual runoff and projected runoff and assuming that 90% probability of exceedence conditions (dry conditions) will occur during rest of the water year. With this announcement, DWR requests all contractors to submit a revised one-year delivery schedule. Zone 7 prepares a monthly operations plan based upon this announcement and submits the revised one-year delivery schedule.

Annual Water Supply and Storage Probability Analysis

In addition to the five-year DWR delivery schedule, the DWR process calls for the preparation of a Water Supply Forecast (which provides a range of contingent operational strategies on an annual basis) and for preparation of a detailed Monthly Water Operations Plan.

The Water Supply Forecast is prepared in December of each year for the following calendar year. The Water Supply Forecast shows how Zone 7 would operate to make full deliveries under a wide range of hydrologic conditions ranging from critically dry to extremely wet. The Water Supply Forecast is designed around the following elements and goals:

- Evaluate the beginning of year water storage in the local groundwater basin, local LDV storage and Zone 7 storage in Semitropic.
- Estimate available water supplies from various sources (i.e., natural groundwater recharge, local LDV water, SWP water, etc.) under various hydrologic conditions.
- Plan to meet 100% of demand under all conditions.
- Prioritize water utilization to conserve or increase storage to prepare Zone 7 to meet 100% of demand in a typical seven-year drought assuming the next year as the first year of a six-year drought.

- Prioritize the use of sources to minimize operational cost to meet 100% demand, while maintaining or increasing storage to prepare for a six-year drought.

As an example, Table 2.4 presents an annual summary of the Water Supply Forecast for 2004 under seven probability of exceedence conditions ranging from critically dry (99% exceedence, i.e., 99% probability that a subsequent year would be wetter) to extremely wet (1% exceedence). The Water Supply Forecast is divided into five sections: 1) Beginning of year storage; 2) New supply; 3) Demand; 4) Artificial recharge; and 5) End of year storage.

Figure 2.2 presents the variations in the key water supply forecast components under different hydrologic conditions (dry to wet). The first graph presents the forecasted variation in SWP entitlement water deliveries (the Zone 7 2004 maximum annual SWP entitlement is 80,619 AF). In a critically dry year, the SWP project deliveries could be as low as 10% of entitlements while in normal or wet years the SWP deliveries could be 100% of entitlement. Similarly, the second graph presents the potential variations in the local Lake Del Valle water supply.

The third graph presents the variations in required groundwater pumpage to meet 100% demand. Under dry conditions when the surface water supplies are not enough to meet 100% of demand, more groundwater pumpage is required. Under wet conditions, the groundwater pumpage has historically been required only for daily or seasonal peaking.

The fourth graph presents potential variations in available artificial groundwater recharge capacity and planned artificial recharge. Under dry conditions, the available artificial recharge capacity would be at its maximum but planned artificial recharge would be at its minimum due to the lack of water supplies with which to recharge. Under wet conditions, the planned artificial recharge is increased up to the available artificial recharge capacity and storage space limits. The "Water Supply Forecast for 2004, January 1, 2004" memorandum describes the Water Supply Forecast in more detail (Reference I).

Monthly Water Operations Plan (MWOP)

The Water Supply Forecast addresses water management decisions on an annual basis. The Monthly Water Operations Plan addresses water management decisions on a monthly basis. The Monthly Water Operations Plan includes a series of tables that indicate how Zone 7 proposes to operate its water system and meet water needs for the year on a monthly basis. Each year in July, Zone 7 prepares preliminary versions of the Monthly Water Operations Plans for the following three years. This July version of the Monthly Water Operations Plan is used to determine O&M costs for budgeting purposes.

In September of each year, these three-year Monthly Water Operations Plans are updated to reflect the latest demand requests from Zone 7 contractors and are used for preparing the DWR water delivery schedules. In January of each year, the Monthly Water Operations Plan for the current year is updated with more accurate DWR water supply projections for most probable conditions. As the year unfolds from January through April,

ZONE 7
WATER RESOURCES

WATER SUPPLY FORECAST
2004 CALENDAR YEAR

January 1, 2004
ACRE FEET

		PROBABILITY OF EXCEEDENCE						
		99%	90%	75%	50%	25%	10%	1%
	Hydrologic Year Type	CRITICALLY DRY	DRY	BELOW NORMAL	ABOVE NORMAL	WET	EXTREMELY WET	
BEGINNING OF YEAR STORAGE								
1) STATE WATER PROJECT CARRYOVER		35,000	30,000	11,400	6,200	2,000	0	0
2) ZONE 7 LAKE DEL VALLE		0	0	0	0	0	0	0
3) GROUNDWATER		203,000	203,000	203,000	203,000	203,000	203,000	203,000
4) SEMITROPIC		68,000	68,000	68,000	68,000	68,000	68,000	68,000
SUPPLY								
1) STATE WATER PROJECT								
PERCENT OF ANNUAL ENTITLEMENT		35%	40%	60%	80%	90%	95%	100%
AMOUNT	*	28,220	32,250	48,370	64,500	72,560	76,590	80,620
TURN BACK WATER		500	0	0	0	0	0	0
ARTICLE 21 WATER		0	0	0	0	0	0	0
2) ZONE 7 LAKE DEL VALLE		0	0	0	0	0	0	0
DIRECT USE OF INFLOW	*	0	230	3,740	6,450	10,340	11,980	14,140
PRIOR RIGHTS RELEASES		0	770	1,060	1,380	1,570	1,650	2,040
STORED INFLOW	*	0	0	0	630	2,680	2,740	5,640
STORED WATER USED FOR DELIVERIES		0	0	0	0	0	0	0
EVAPORATION		0	0	0	(80)	(220)	(230)	(430)
3) BBID		2,000	2,000	2,000	1,000	1,000	1,000	1,000
4) GROUNDWATER NATURAL RECHARGE		4,770	5,180	6,200	8,790	14,210	19,160	27,360
5) RECYCLED WATER (NON - DEMINERALIZED)		500	500	500	500	500	500	500
TOTAL SUPPLY		35,990	40,930	61,870	83,170	102,640	113,390	130,870
DEMAND								
1) ZONE 7 UNTREATED WATER DEMAND								
UNTREATED, SURFACE WATER		5,980	5,980	5,980	5,980	5,980	5,980	5,980
2) ZONE 7 TREATED WATER DEMAND								
TREATED, SURFACE WATER		35,160	35,160	35,160	35,160	35,160	35,160	35,160
SEMITROPIC RETURN (component of SW)	*	0	0	0	0	0	0	0
ZONE 7 GROUNDWATER PUMPING	*	8,800	8,800	8,800	8,800	8,800	8,800	8,800
TOTAL TREATED		43,960	43,960	43,960	43,960	43,960	43,960	43,960
ZONE 7 TOTAL DEMAND		49,940	49,940	49,940	49,940	49,940	49,940	49,940
3) PURVEYOR GROUNDWATER PUMPING								
CWS		3,070	3,070	3,070	3,070	3,070	3,070	3,070
PLEASANTON		3,500	3,500	3,500	3,500	3,500	3,500	3,500
4) MINING USE		3,470	3,210	2,960	2,690	2,500	2,300	2,210
5) OTHER M&I AND DOMESTIC GROUNDWATER		1,110	1,060	1,010	980	950	900	860
6) AGRICULTURE GROUNDWATER		1,210	1,200	1,190	1,180	1,170	1,160	1,150
7) RECYCLED WATER DEMAND		500	500	500	500	500	500	500
TOTAL DEMAND		62,800	62,480	62,170	61,860	61,630	61,370	61,230
ARTIFICIAL RECHARGE (Stream + COL)								
MAIN BASIN								
1) TOTAL ARTIFICIAL RECHARGE CAPACITY (including COL)	*	29,520	28,640	27,820	25,990	23,690	22,670	21,810
2) ZONE 7 SUPPLEMENTAL ARTIFICIAL RECHARGE	*	13,840	12,600	13,630	24,610	22,120	21,020	19,770
3) PRIOR RIGHTS RECHARGE		0	770	1,060	1,380	1,570	1,650	2,040
4) UNUSED ARTIFICIAL RECHARGE CAPACITY		15,680	15,270	13,130	0	0	0	0
SEMITROPIC								
1) ZONE 7 STORAGE TRANSFER CAPACITY TO SEMITROPIC		50,000	30,000	25,000	9,600	9,600	8,000	6,000
2) ZONE 7 ACTUAL STORAGE TRANSFER TO SEMITROPIC		5,740	5,740	5,740	5,740	5,740	5,740	5,740
END OF YEAR STORAGE								
1) SWP CARRYOVER		5,000	5,000	5,000	6,650	10,000	10,000	10,000
2) ZONE 7 LAKE DEL VALLE								
STORED WATER USED FOR DELIVERIES		0	0	0	0	0	0	0
STORAGE CHANGE		0	0	0	550	2,460	2,510	5,210
END OF YEAR STORAGE		0	0	0	550	2,460	2,510	5,210
3) MAIN GROUNDWATER BASIN								
STORAGE CHANGE		(2,550)	(2,290)	360	14,560	17,900	22,100	29,580
END OF YEAR GROUNDWATER STORAGE		200,450	200,710	203,360	217,560	220,900	225,100	232,580
4) SEMITROPIC								
STORAGE TRANSFER LOSSES (10%)		574	574	574	574	574	574	574
STORAGE CHANGE		5,166	5,166	5,166	5,166	5,166	5,166	5,166
END OF YEAR SEMITROPIC STORAGE		73,166	73,166	73,166	73,166	73,166	73,166	73,166
SAN BENITO COUNTY POTENTIAL OBLIGATION		3,000	3,000	3,000	3,000	3,000	3,000	3,000
UNUSED SWP ENTITLEMENT		0	0	0	0	6,900	11,670	19,110

* DATA PLOTTED IN FIGURE 1

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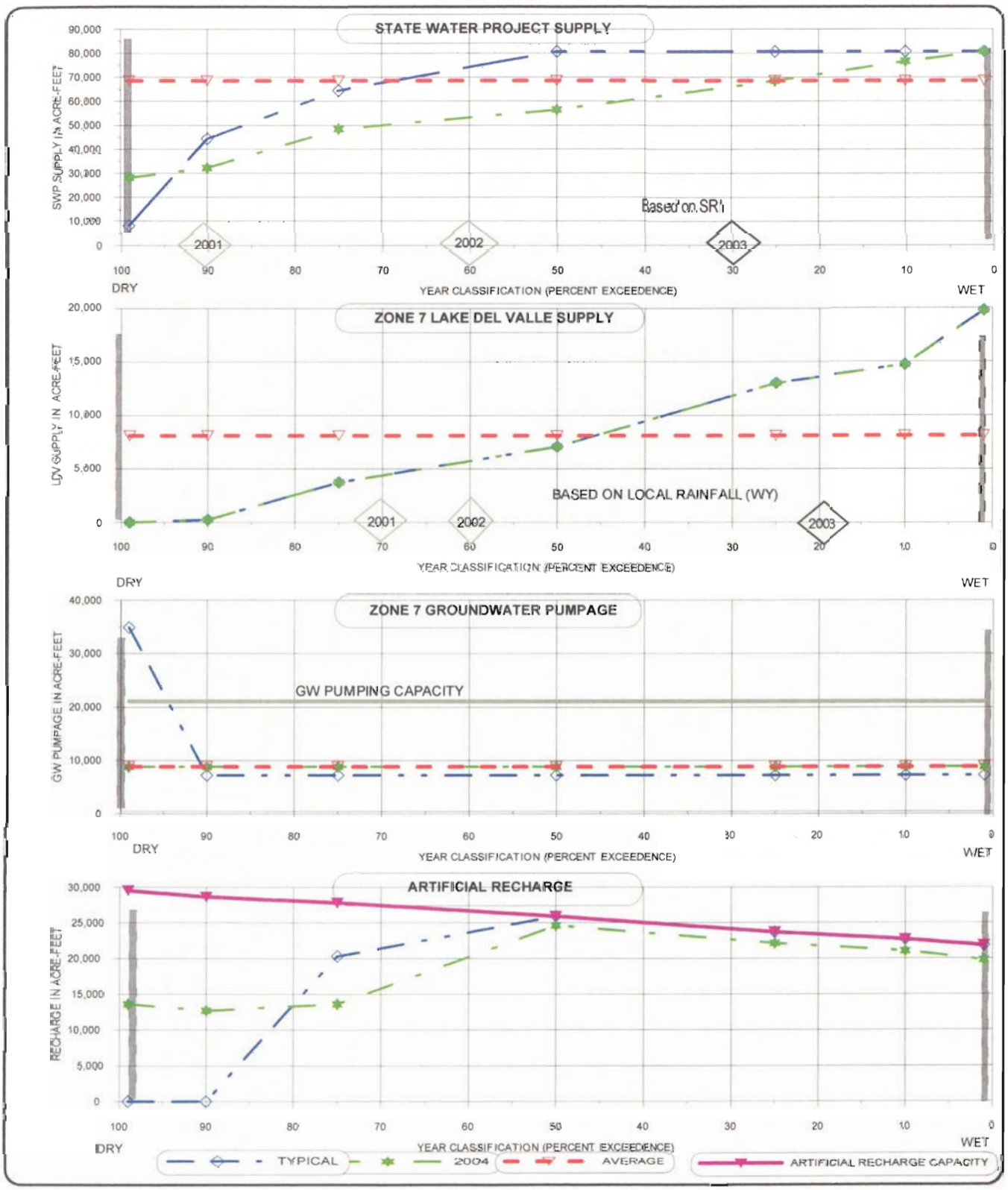
04/01/04

ZONE 7
WATER RESOURCES

FIGURE 2.2

2004 WATER SUPPLY FORECAST

January 1, 2004



the amount of uncertainty in supply is reduced. In April of each year, after DWR has announced the firm rest-of-year deliveries, Zone 7 develops a Monthly Water Operations Working Plan. This monthly plan is then updated monthly for the rest of the year with actual year-to-date data and as such reflects adjustments made to meet water operational objectives.

An example of the Monthly Water Operations Plan is shown in Table 2.5. The Monthly Water Operations Plan is organized into seven categories. The first category in Table 2.5 is Treated Water Production. This shows what Zone 7's treatment plants and wellfields would need to produce each month to meet full deliveries. The second category displays surface water deliveries from SBA supplies to meet untreated water demands and deliveries for artificial stream recharge. The untreated water deliveries include Zone 7's agricultural customers and municipal demands for untreated water. The deliveries for artificial stream recharge include releases into Arroyo Mocho and Arroyo Valle for groundwater recharge.

The third category includes the possible use of the aquifer storage and recovery (ASR) wells. ASR recharge is the amount of treated water scheduled to be injected into the groundwater basin for storage. ASR storage is the total ASR storage available at the end of the month for operations use. The fourth category shows municipal pumping by retailers including scheduled pumpage and average historic pumpage for Pleasanton and CWS. Dublin San Ramon Service District's pumping quota is shown, but is accounted for in CWS' scheduled pumpage (since CWS purchased DSRSD's quota for 1999). The fifth category lists the South Bay Aqueduct deliveries scheduled by Zone 7, ACWD and SCVWD. The sixth category shows the estimated average TDS in mg/L of the composite Zone 7 production. The seventh category shows the monthly and annual total estimated costs for power and chemical usage for Zone 7's surface water treatment plants and wells.

2.3 Proposed Water Operations Plans

The historic water operations planning strategy prepared Zone 7 to make full deliveries each year and to accumulate enough water in storage reserves (local groundwater basin and Semitropic storage) to make full deliveries under typical six-year drought conditions (1987-92). This strategy minimized O&M costs by delivering the maximum amount of surface water and pumping groundwater as needed to supplement surface water supplies during peak demand and drought periods. This strategy provided sustainable water supply at minimum O&M cost but did not address groundwater basin water quality (TDS) impacts due to net salt loading on the basin.

Chapters 8 through 10 describe various alternative water operation strategies that would serve to sustain or improve groundwater basin water quality. To implement such strategies for sustainable water supply along with sustainable water quality, the historic Water Operations Plan goals would need to be revised. The details on how these goals would need to be revised to allow Zone 7 to address sustainable water quality along with water supply are discussed in Chapter 12.

Table 2.5

ZONE 7
WATER RESOURCES
2004 WATER OPERATIONS PLAN (65% SWP Allocation)
IN ACRE-FEET

		Actual			FORECAST									
1	***TREATED WATER PRODUCTION***	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
	DEL VALLE TREATMENT PLANT	0	0	1278	1491	2221	2181	2630	2573	2106	1656	1166	952	18254
	PATTERSON PASS TREATMENT PLANT (Total)	845	761	541	1492	1700	1700	1700	1700	1700	1657	1167	952	15915
	CONVENTIONAL	*830*	*544*	*254*	*932*	*1140*	*1140*	*1140*	*1140*	*1140*	*1097*	*607*	*392*	*10356*
	ULTRAFILTRATION	*15*	*217*	*287*	*560*	*560*	*560*	*560*	*560*	*560*	*560*	*560*	*560*	*5559*
	TOTAL TREATED SURFACE WATER	845	761	1819	2983	3921	3881	4330	4273	3806	3313	2333	1904	34169
	MOCHO 1 (capacity 290AF/MO)	104	89	0	0	0	27	50	50	25	25	0	0	370
	MOCHO 2 (Capacity 280 AF/MO)	136	159	152	0	0	27	50	50	25	25	0	0	624
	MOCHO 3 (Capacity 500 AF/MO)	45	138	170	0	25	170	150	200	110	144	0	0	1152
	MOCHO 4 (Capacity 450 AF/MO)	0	3	317	54	54	180	250	250	110	140	0	0	1358
	STONERIDGE WELLFIELD	453	275	50	50	50	300	550	500	450	275	150	150	3253
	HOPYARD WELLFIELD	300	217	212	0	50	250	270	250	250	0	0	0	1799
	HOP 6	300	217	211	0	50	200	220	200	200	0	0	0	1598
	HOP 9	0	0	1	0	0	50	50	50	50	0	0	0	201
	SHALLOW WELLFIELD (380 AF/M cap)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Future Wells (Deep) (120 AF/M CAP)	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL TREATED GROUNDWATER	1038	881	901	104	179	954	1320	1300	970	609	150	150	8556
	TOTAL TREATED WATER PRODUCTION	1883	1642	2720	3087	4100	4835	5650	5573	4776	3922	2483	2054	42725
2	**UNTREATED WATER DELIVERY FROM SBA**	4	35	83	434	819	968	1064	974	560	491	231	32	5695
3	**ARTIFICIAL RECHARGE OPERATIONS**													
	ARTIFICIAL STREAM RECHARGE RELEASES- Arroyo Valle -Sycamore Park	145	226	245	600	619	600	619	619	600	619	600	491	5983
	ARTIFICIAL STREAM RECHARGE RELEASES- Arroyo Valle -Vineyard Trib	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL ARROYO VALLE RELEASE	145	226	245	600	619	600	619	619	600	619	600	491	5983
	DIVERSION INTO SHADOWCLIFS	0	0	0	180	185	180	185	185	180	185	180	185	1645
	ARTIFICIAL STREAM RECHARGE RELEASES - Arroyo Mocho	724	657	860	930	1120	1200	930	930	1200	1240	800	720	11311
	DIVERSIONS INTO LAKE-I FOR ARTIFICIAL RECHARGE	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL ARROYO MOCHO RELEASE	724	657	860	930	1120	1200	930	930	1200	1240	800	720	11311
	TOTAL ARTIFICIAL RECHARGE	869	883	1105	1530	1739	1800	1549	1549	1800	1859	1400	1211	17294
4	***MUNICIPAL PUMPING BY RETAILERS***													
	PLEASANTON PUMPING	76	89	167	224	364	475	524	486	396	277	193	161	3432
	PLEASANTON AVERAGE PUMPAGE IQ (Independent Quota) = 3500 AF/YR	137	119	144	224	364	475	524	486	396	277	193	161	3500
	CWS PUMPING	2	133	223	221	345	394	440	404	335	230	156	138	3021
	CWS AVERAGE PUMPAGE GPQ = 3069 AF/YR	123	128	155	221	345	394	440	404	335	230	156	138	3069
	DSRSD PUMPING GPQ = 645 AF/YR (Pumped by Zone 7 from Mocho)	54	54	54	54	54	54	54	54	54	53	53	53	645
5	***SOUTH BAY AQUEDUCT DELIVERIES***													
	ZONE 7 46TAF ENTITLEMENT (11%of40TAF+18% of 6TAF = 5480 AF/mo)	1718	1679	3007	4947	6479	6649	6943	6796	6166	5663	3964	3147	57158
	ACWD SBA DEMAND (11% = 4620 AF/mo)	1388	1379	1698	1643	3324	3811	3942	3938	3811	3719	1649	3704	34006
	SCVWD SBA DEMAND (11% = 11000 AF/mo)	3081	2677	6000	7000	8800	9100	9200	9800	8400	6300	6000	6000	82358
	TOTAL SBA DEMAND, AF	6187	5735	10705	13590	18603	19560	20085	20534	18377	15682	11613	12851	173522
	TOTAL SBA DEMAND, CFS	100	103	174	228	302	328	326	333	308	254	195	208	2857
	ACWD & SCVWD TOTAL, CFS	72	73	125	145	197	216	213	223	205	162	128	157	1916
6	***ZONE 7 DELIVERED TDS TO RETAILERS***	382	367	323	281	249	273	287	304	319	301	305	333	301
7	***TOTAL ESTIMATED ZONE 7 POWER AND CHEMICAL USAGE COST***	$30,954	$26,674	$64,295	$97,986	$130,632	$132,151	$149,961	$147,512	$130,298	$110,445	$77,069	$62,904	$1,160,881

2.4 Proposed Treated Water Facilities and Demands

The total 2004 treated water demand in the valley is about 47,800 (40.6 TAF Zone 7 and 7.2 TAF GPQ). This total demand is expected to increase to about 66,000 AF (59 TAF Zone 7 and 7.2 TAF GPQ) by the year 2020. The valley-wide maximum day demand is projected to increase to 118 mgd (105 mgd for Zone 7). To meet this projected treated water demand, Zone 7 is in the process of acquiring additional surface water supplies that would be delivered through the SWP/SBA system. Zone 7 is in the process of SBA expansion to to increase the conveyance capacity for the transmission of these additional supplies to the valley.

Zone 7 would also need to upgrade and expand its existing treatment and distribution facilities to meet projected treated water demands and future water quality regulatory requirements. In February 2000, Zone 7, with assistance from consultants Camp Dresser & McKee prepared a "Treated Water Facilities Master Plan." This master plan categorized the proposed facilities into three phases. Table 2.6 (ref. Table E-6, Treated Water Facilities Master Plan) lists the recommended treated water facilities for near-term (1999-2005), mid-term (2006-2010), and long-term (2011-2020). Figure 2.3 shows the recommended near-term treated water facilities and Figure 2.4 shows the recommended mid-term and long-term treated water facilities (ref. Figure E-5 and E-6 of Treated Water Facilities Master Plan).

The sizing of the surface water treatment plants in the Master Plan is based upon the assumption that 15% of the typical maximum day demand would be provided by groundwater production. The projected year 2020 groundwater production required to supplement surface water production on a typical maximum day would be 16 MGD. The Treated Water Facilities Master Plan also includes the construction of groundwater demineralization facilities. Zone 7 is also in the process of preparing a Well Master Plan (WMP) to construct new wells to meet Zone 7's goal of achieving a valley-wide groundwater production capacity equal to 75% of the maximum day demand for reliability purposes.

In year 2020, 75% of the valley-wide maximum day demand is projected to be 89 mgd. One of the WMP goals is to identify the locations for future wellfields and an implementation plan to increase the valley-wide production capacity to achieve 75% reliability goal. Figure 2.5 shows the potential wellfield locations to be studied under the WMP. The projected 88 MGD of groundwater production capacity would provide increased reliability and operational flexibility particularly if Zone 7 chose to increase the use of groundwater over the historic 85% SW to 15% GW ratio.

2.5 Proposed Untreated Water Facilities and Demands

The projected untreated water demand, consisting primarily of agricultural water demands, is expected to increase from 6,000 AF/year (year 2004) to approximately 26,800 AF/year by year 2020. The existing and projected future untreated water demand areas are shown in Figure 2.6 (Water Supply Planning Study Update, February 1999). The

TABLE 2.6

Recommended Near-Term Treated Water Facilities

Near-term Recommendations (1999 – 2005) [1]	*Year*	*Capital Cost ($1M)*
Use Existing Zone 7 wells to meet near-term water treatment plant capacity shortfalls	Immediate	-
Complete evaluation of AWTP sites to select a site, perform environmental evaluations, and purchase site	2000	-
Construct North Livermore Pipeline	2000-2001	2
Expand DVWTP to 40 mgd [2]	2001	15
Construct regulatory driven improvements at DVWTP	By 2005	14
Continue evaluation of use of Del Valle Reservoir storage (DWR negotiations) and feasibility of ASR operations	2000-2005	-
Continue groundwater monitoring and evaluation of feasibility of ASR operation	2000-2005	-
Construct East Dublin Pipeline Reaches I and II to Dougherty (Highway 580 Crossing)	2005	3
Construct regulatory driven improvements at PPWTP	By 2005	8
Add 6 to 8 mgd Membrane Capacity at PPWTP	2001-2002	14
Construct 3 mgd RO Demineralization Project [3]	2001	10
Construct new 24 mgd groundwater wells	2004-2006	14
Construct 24 mgd AWTP	2004-2006	50
Construct Treated Water Pipelines for AWTP (42 mgd ultimate capacity)	2004-2006	39
Subtotal		$169
Mid-term Recommendations (2006 – 2010) [1]		
Construct Livermore Dublin Connector – Required only if WTPs expanded and Mocho well field not used for maximum day peaking [4]	2006-2010	8
Subtotal		$8
Long-term Recommendation (2011 – 2020)		
Construct B4-A Pipeline as required [5]	2011	$21-26
Based on decisions on use of FCS and feasibility of using additional groundwater wells:	2011	
1. Expand DVWTP to 48 and AWTP to 34 mgd, or		31
2. Expand AWTP to 42, or		31
3. Increase ASR maximum day groundwater production to 42 mgd		11
Subtotal		$32-57
TOTAL		$209-234

[1] Recommendations based on maintaining 85 percent of maximum day production from water treatment plants.
[2] Does not include pump station improvements.
[3] Does not include transmission and concentrate disposal pipeline or pump station costs.
[4] If the new Mocho well field is not used for peaking, this parallel piping to serve East Dublin is required.
[5] Based on Water Transfer Associates cost estimate.

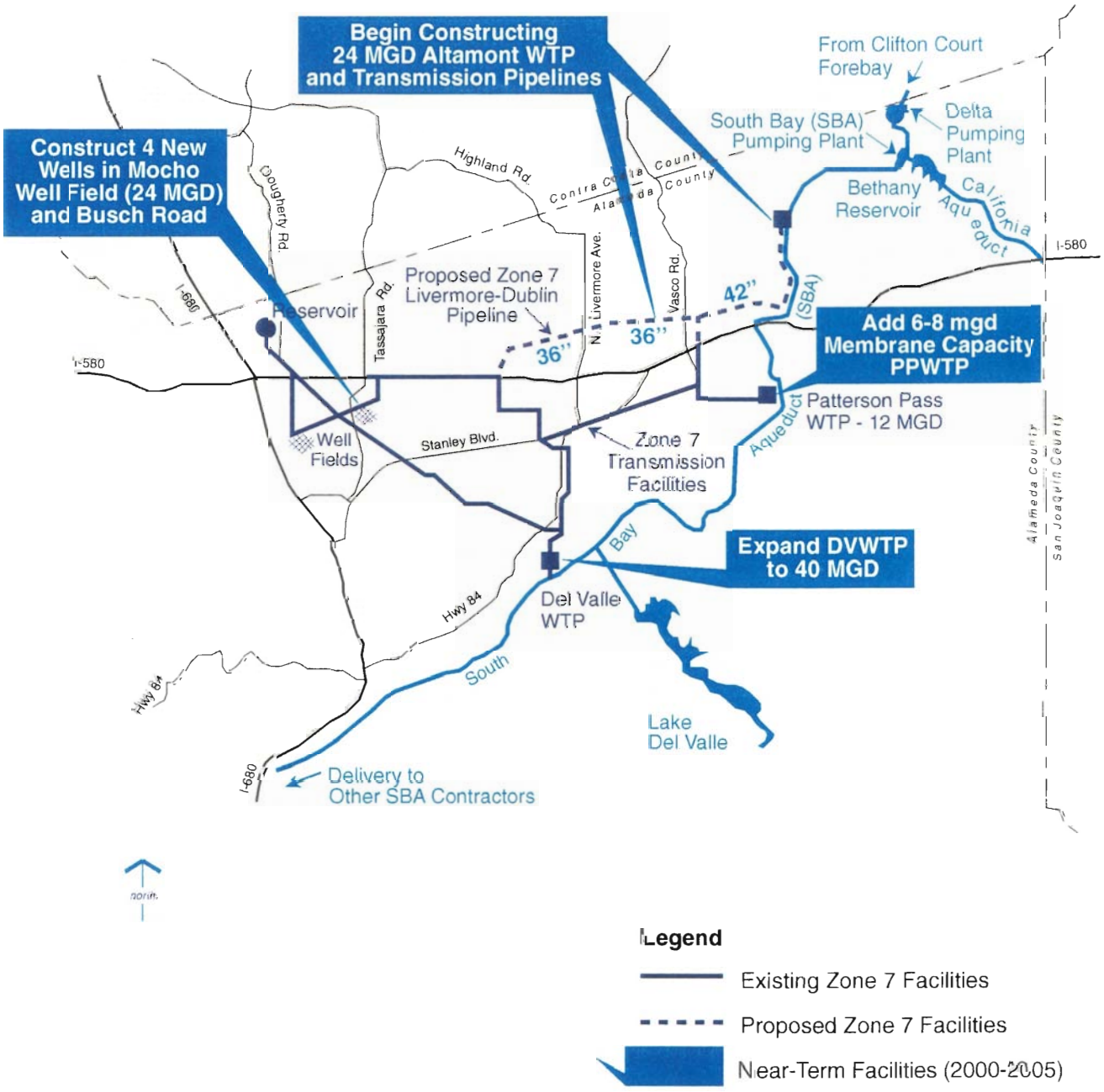


FIGURE 2.3
Recommended Near-Term Facilities

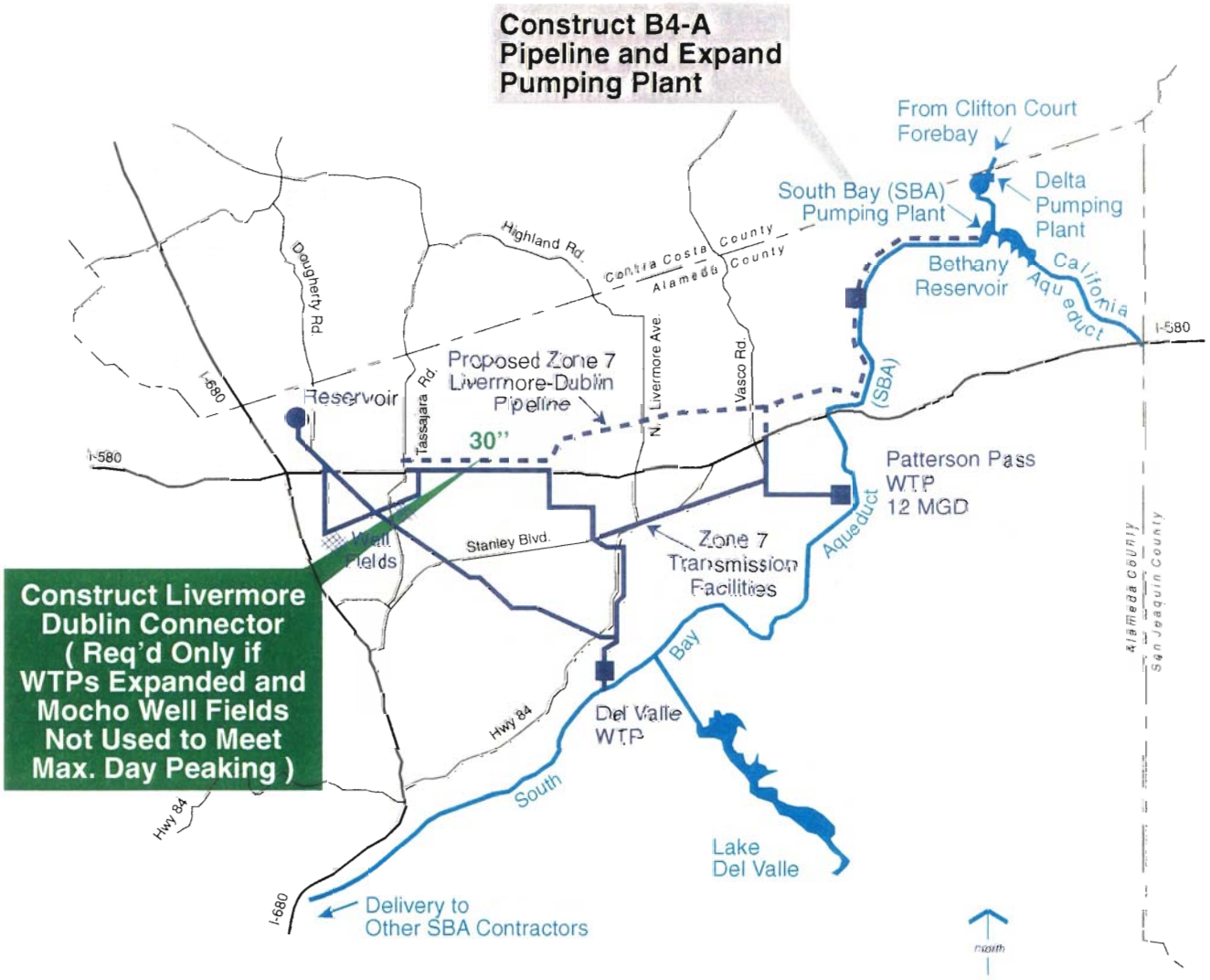


FIGURE 2.4
Recommended Mid-Term and Long-Term Facilities

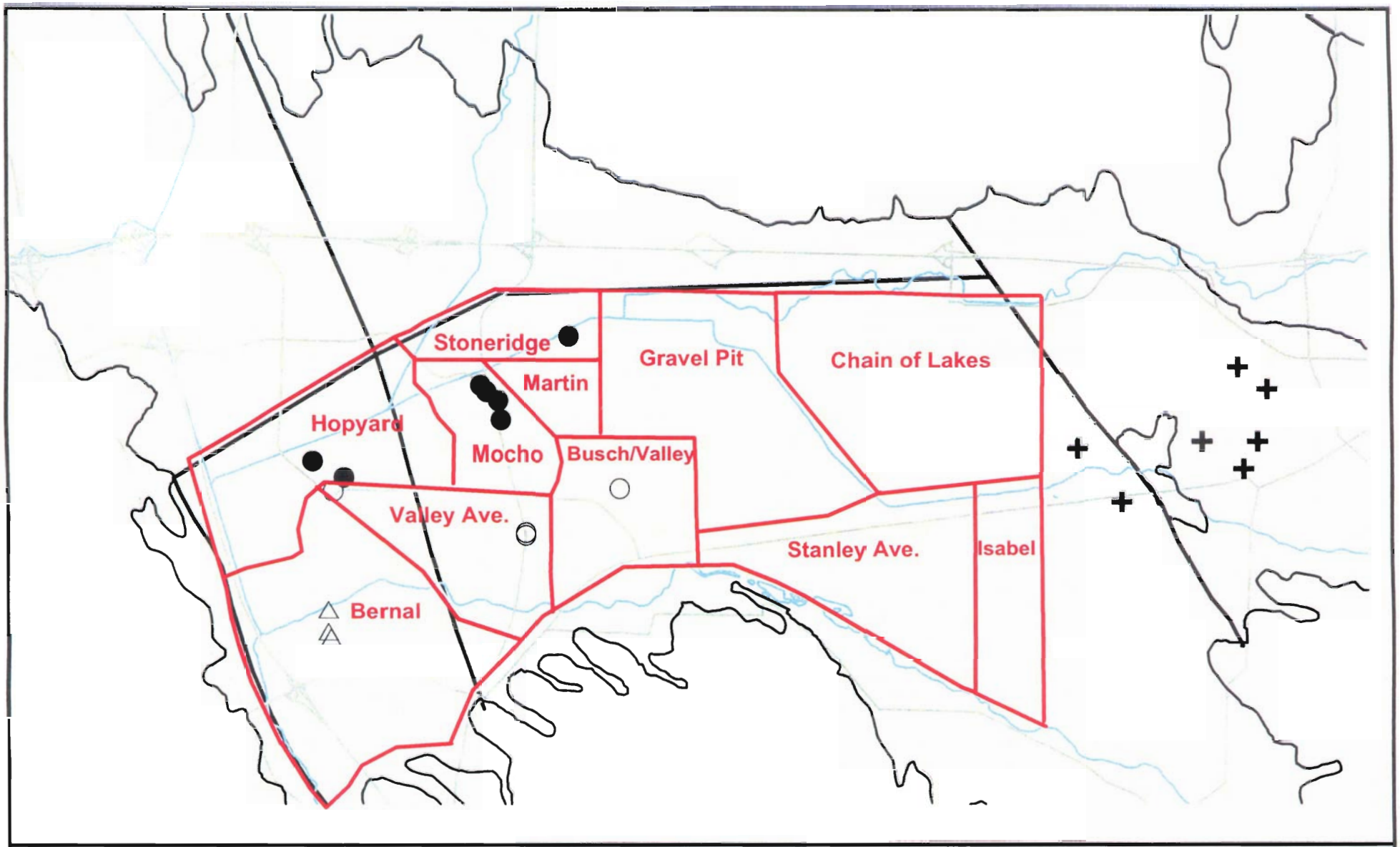


FIGURE 2.5
POTENTIAL NEW WELLFIELD LOCATION
ZONE 7 WATER AGENCY
WELL WATER PLAN

CH2MHILL

projected future untreated demand areas can be generally divided into two major areas: South Livermore and North Livermore.

The South Livermore Valley Specific Plan (May 1997) defines 2000 acres of agricultural area to be developed by year 2020. In addition to the area included in the South Livermore Valley Specific Plan, field and map reviews of the South Livermore Valley indicate that 5,000 acres of additional land is suitable for development as vineyards and orchards (J. Koltz memorandum dated December 5, 1997 and modified on July 27, 1998). Based on a water application rate of 2 AF/acre, new water use in the South Livermore area could increase to approximately 16,000 AF/year by the year 2020.

The North Livermore Project which is currently under a comprehensive re-evaluation identifies two sub-areas with potential untreated water demands, Zone A and Zone B. Zone A is the urban area extending south from a buffer zone below May School Road to I-580. Untreated water demand areas within Zone A include approximately 490 acres of parks, schools, creek and drainage corridors, primary road medians, and a greenbelt that separates Zone A from Zone B. The estimated ultimate untreated demand for Zone A is approximately 1,590 AF/year.

Zone B is considered to be the 700 acres of land set aside as potential irrigable land, north of May School Road. The proposed breakdown for Zone B is 200 acres of golf course, 300 acres of grape production, and 200 acres of other crops. The estimated untreated water demand for this area is approximately 1,800 AF/year at buildout (year 2020). These untreated water demand areas in Zone A and Zone B are still in the planning stages and as such projected potential demands could change.

The above South Livermore and North Livermore areas have a combined projected untreated water demand of 26,800 AF/year by the year 2020. Compared to the treated water demand projections, the untreated demand projections are likely to be more variable due to issues related to the affordability of water for agricultural purposes. If the agricultural development in the South Livermore area and the North Livermore area does not occur as projected, then the untreated demand from other areas is projected to increase only to 10,300 AF/year by year 2020. The salt management studies developed in Chapter 9 assume an untreated demand of 8,500 AF/year by year 2010. The salt loading impacts of the additional untreated demand from the South Livermore and the North Livermore areas would be evaluated on a project-by-project basis as they occur (see Chapters 11 and 12).

Zone 7 is in the process of conducting various studies (such as Integrated Water Supply Plan) to determine the best possible water supply sources and conveyance facilities to meet potential untreated water demands. In February 1999, Zone 7 completed the Water Supply Planning Study Update (Water Transfer Associates). The study concluded that Zone 7 needs about 95 mgd of additional conveyance capacity. Existing capacity as of 1999 is 11% of 40,000 AF plus 18% of 6,000AF = 5,480 AF/mo or 58.5 mgd. Several potential options were identified to provide Zone 7 with additional conveyance capacity:

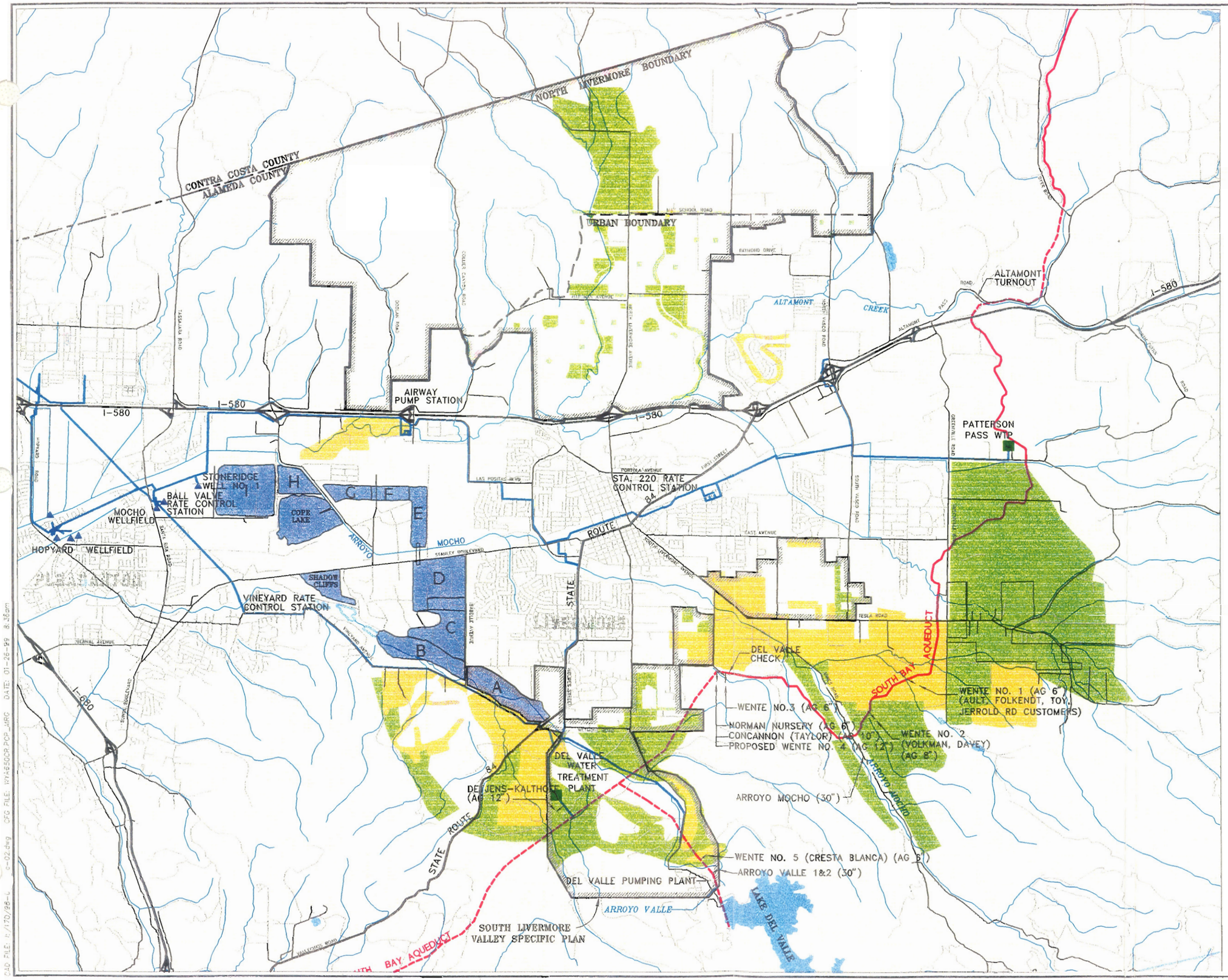


FIGURE 2.6

Zone 7 Water Supply
Planning Study
February 1999

EXISTING AND FUTURE UNTREATED WATER DEMAND AREAS

N

0 3000 6000
SCALE IN FEET

NOTES:

1. MAPPING BASED ON USGS DIGITAL LINE GRAPHS, 1:100,000 SCALE AND MAPS PROVIDED BY ZONE 7. PIPING SCHEMATICS ARE APPROXIMATE.

LEGEND:

- SBA AQUEDUCT, CANAL
- SBA AQUEDUCT, PIPELINE
- ZONE 7 TRANSMISSION SYSTEM
- WENTE No. 2 — UNTREATED WATER CONTRACTOR AND TURNOUT LOCATIONS
- ZONE 7 WELL
- ZONE 7 WATER TREATMENT PLANT
- H — CHAIN-OF-LAKES
- EXISTING UNTREATED WATER DEMAND AREAS
- POTENTIAL FUTURE UNTREATED WATER DEMAND AREAS

Water Transfer Associates

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- Acquisition of the Future Contractor's share of SBA. Zone 7 completed the acquisition in 1999 but the Water Supply Program EIR limits Zone 7 use of this new capacity for peaking to avoid impacts to Del Valle Reservoir levels during summer. As of 2004, Zone 7 peaking capacity is 68mgd (5,480 AF+770 AF).
- Physical expansion of the SBA
- New Zone 7 facilities parallel to the SBA and/or SWP facilities
- Use of the Chain-of-Lakes and an Untreated In-Valley Conveyance System

The recommended conveyance alternative included acquisition of the Future Contractor share of SBA capacity, improvements to the South Bay Pumping plant, improvements to the Brushy Creek Pipeline, possible construction of a parallel (B4-A) pipeline from BBID diversion point to the proposed Altamont Water Treatment Plant, and construction of a new In-Valley Conveyance System consisting of pipelines L1, L2 and L3A to serve the majority of the existing and future South Livermore untreated maximum day demands. The proposed untreated water facilities are shown on Figure 2.7.

The future Chain-of-Lakes (COL) is projected to be completed by year 2030. Lake H and Lake I of the future Chain-of-Lakes are projected to be available as early as year 2003. Once available, Zone 7 would be able to divert water from Arroyo Mocho (50 cfs) and Arroyo Valle (500 cfs) into the COL for recharge into the groundwater basin and/or for subsequent pumping to meet peak agricultural demands through the proposed In-Valley Conveyance system. In the salt management studies developed in Chapter 9, it was assumed that Zone 7 would be able to release 50 cfs from SBA turnouts into Arroyo Mocho in 2010 (current projected date year 2004). It was assumed that about 20 cfs would recharge along Arroyo Mocho and the remaining 30 cfs would be diverted into Lakes H and I.

2.6 Water System Operations Model

As part of the Salt Management Plan (SMP) investigations, Zone 7 staff, Zone 7 consultants, the GMAC and TAG identified the need to evaluate the impacts of various strategies on delivered water quality more thoroughly. All groups agreed that ideal salt management strategies would need to both maintain or improve delivered water quality and to better equalize delivered water quality in the east and west sides of the valley (see Chapter 7). Zone 7 staff determined that the best way to make these evaluations at future demand and operating conditions was to develop a water (amount and quality) routing model for the entire Zone 7 water system. This type of numerical model would be capable of evaluating the impacts on delivered water quality of multiple water operations options such as varying the use of specified groundwater wells and proposed groundwater demineralization facilities. Future system improvements and new sources of storage and supply could be integrated in such a model.

The water system operating model selected was similar to one developed for ACWD by Water Resources Management, Inc. (WRMI). Zone 7 contracted with WRMI to develop a model of the Zone 7 system based on the OASIS (Operation and Simulation of Integrated Systems) model with Operation Control Language (OCL). OASIS is a generalized linear

MODIFICATIONS TO DWR FACILITIES

- Upgrade SBA Pumps to Deliver Design Capacity of 345 cfs
- Increase Surge Tanks on Brushy Creek Pipelines to handle 345 cfs

NEW CONVEYANCE FACILITIES

- B4–A (24–inch diameter) Pipeline, 36,000 ft Including Modified Intake Structure & Expanded Pump Station

UNTREATED IN–VALLEY FACILITIES

•	L1	42–inch diameter	20,500 ft
•	L2	30–inch diameter	13,200 ft
•	L3A	36–inch diameter	32,500 ft

TOTAL ESTIMATED PROJECT COSTS (MILLION $)

Purchase of Future Contractor Share	=	46
Modifications to DWR Facilities	=	5
New Conveyance Facilities	=	12
In–Valley Facilities	=	32
		$95M

ADVANTAGES

- No Enlargement of the SBA pipelines or canals required
- Minimizes size and cost of the New Conveyance Facilities (B4–A), required to bring new water supplies into the Valley
- Altamont WTP location takes advantage of hydraulics and proximity to the Brushy Creek Pipelines
- In–Valley facilities provide Zone 7 the ability to:
  - phase projects in response to demands
  - maximize use of groundwater and available water resources
  - increase operational flexibility
  - integrate well with the proposed Salt Management plan
- Low Cost Alternative

DISADVANTAGES

- Does not allow for expansion at Patterson Pass WTP
- Allows Del Valle WTP to expand to only 40 mgd if treated and untreated demands buildout as projected
- Does not take advantage of excess capacity in Reach 4, downstream of Patterson Pass WTP

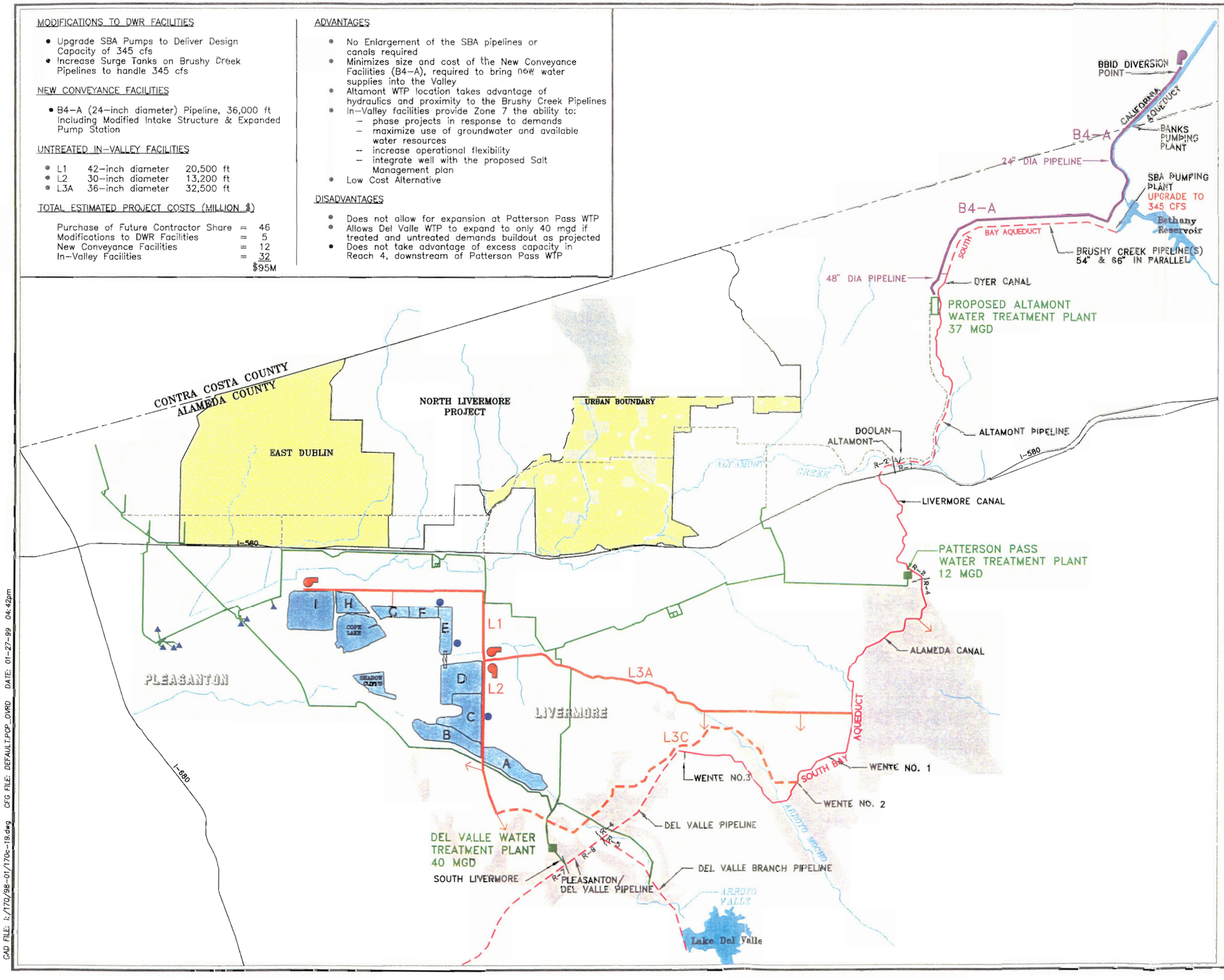

Figure 2.7

Zone 7 Water Supply Planning Study
February 1999

SCHEMATIC SUMMARY OF RECOMMENDED CONVEYANCE ALTERNATIVE 5

MINIMAL UPGRADES TO SBA FACILITIES AND IN–VALLEY FACILITIES SIZED TO MINIMIZE ENLARGEMENT OF THE SBA

N

NO SCALE

NOTES:

1. MAPPING BASED ON USGS DIGITAL LINE GRAPHS, 1:100,000 SCALE AND MAPS PROVIDED BY ZONE 7. PIPING SCHEMATICS ARE APPROXIMATE.

LEGEND:

- EXISTING SBA AQUEDUCT, CANAL
- EXISTING SBA AQUEDUCT, PIPELINE
- EXISTING ZONE 7 TRANSMISSION SYSTEM
- R–1 | R–2 SBA REACH
- PROPOSED WATER TREATMENT PLANT
- ZONE 7 WATER TREATMENT PLANT
- ZONE 7 PRODUCTION WELL
- PROPOSED ZONE 7 INJECTION/EXTRACTION WELL
- H CHAIN–OF–LAKES
- POTENTIAL NEW UNTREATED WATER DEMAND AREAS
- EXISTING UNTREATED DEMAND AREAS
- PROPOSED IN–VALLEY PIPELINE
- PROPOSED PUMP STATION
- PROPOSED DELIVERY POINT

Water Transfer Associates

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programming systems optimization-modeling program created by WRMI to analyze operations of water systems. The model is run to simulate water system performance over long periods of time. The time length of simulation is limited by the availability of time-series data.

System Schematics—The first step in building the model was to develop a schematic of the Zone 7 water system. Figures 2.8, 2.9, 2.10 and 2.11 represent the Zone 7 water system under projected year 2010 conditions with existing and planned facilities. The schematic shows the combination of interconnected nodes and arcs that define the system. A node is a junction point of two or more arcs. A node can represent a demand point, a reservoir, or a treatment plant. In the schematic, circles represent junction nodes, rectangles represent demand nodes, triangles are reservoir or storage nodes and diamonds represent treatment plants. Arrows that connect two nodes represent arcs. An arc represents a conveyance feature in the system. Any arc depicted with a small circle on it is reversible.

The major system features modeled include the South Bay Aqueduct, the complete distribution network including treatment plants, Zone 7 and retailer municipal wells, potential wellhead demineralization facilities, the DSRSD and Livermore RO recycled water facilities, groundwater subbasins, natural and artificial recharge in the Arroyos, mining operations, the future Chain of Lakes, and Del Valle Reservoir.

The representation of the Zone 7 system shown in Figure 2.8 includes all turnouts, which are represented by demand nodes numbered in the 100s. The general areas served by each demand node is shown in Figure 2.9. The demand node areas were estimated by Zone 7 based upon the geographical location of the turnouts. Exact areas served will vary depending on operational conditions. The demand at the treated water turnouts has been divided into internal use and external use. For example, Table 2.7 shows the demand inputs for demand node 120.

Table 2.7

Node 120 Demand Projected for Year 2010, AF

NODE	JUNCTION	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (AF)	% Total
120	Total Interior demand	71	71	71	71	71	71	71	71	71	71	71	71	854	41%
	Exterior TW	0	34	67	66	61	50	65	71	90	98	41	36	679	
	Recycled Water	0	1	17	36	76	96	106	100	69	43	14	6	565	
	Recycled RO Water	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Total Exterior demand	0	35	84	102	137	146	171	171	160	140	55	42	1243	59%
	Total	71	106	155	173	209	218	243	243	231	212	126	113	2098	100%

External use demand is represented by nodes numbered 701 to 797 (for simplification these are not shown on Figure 2.8). Each of the numbers in the 700 series corresponds to the nodes in the 100 series with the same last two digits. For example node 720 represents the external demand at node 120. Figure 2.10 shows how the external use node connects

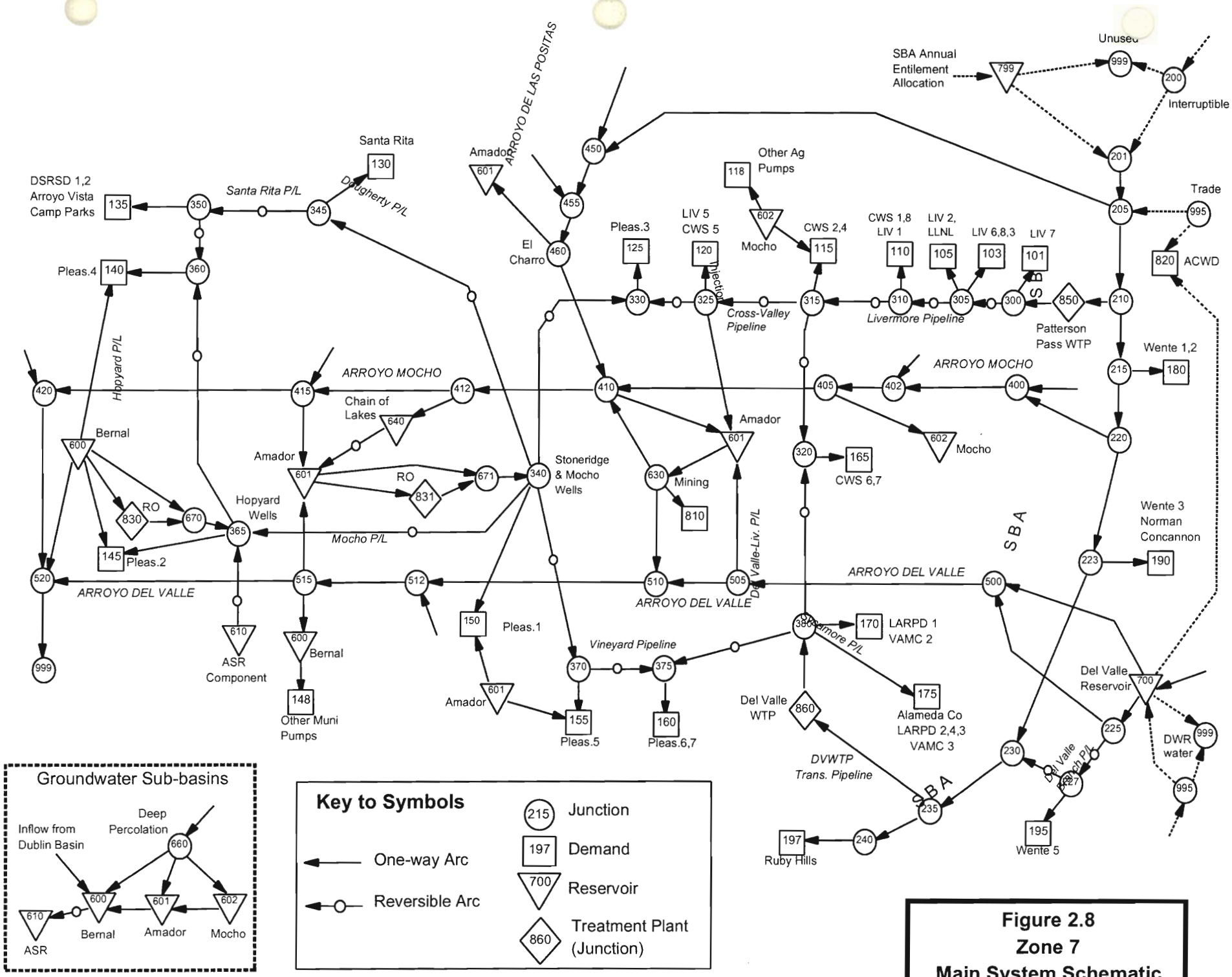
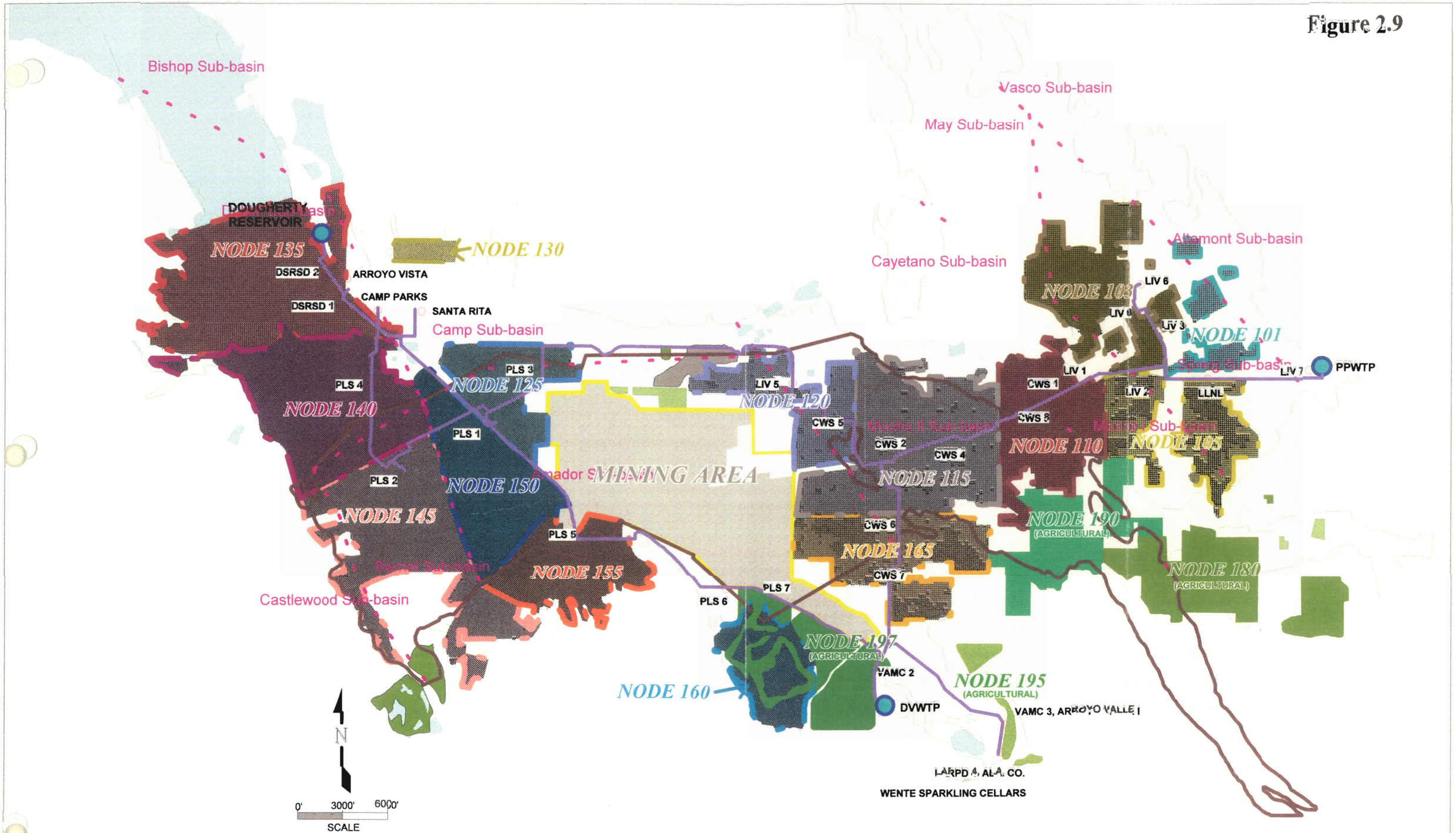


Figure 2.8
Zone 7
Main System Schematic

Figure 2.9



ZONE 7 WATER AGENCY
5997 PARKSIDE DRIVE PLEASANTON CA 94588

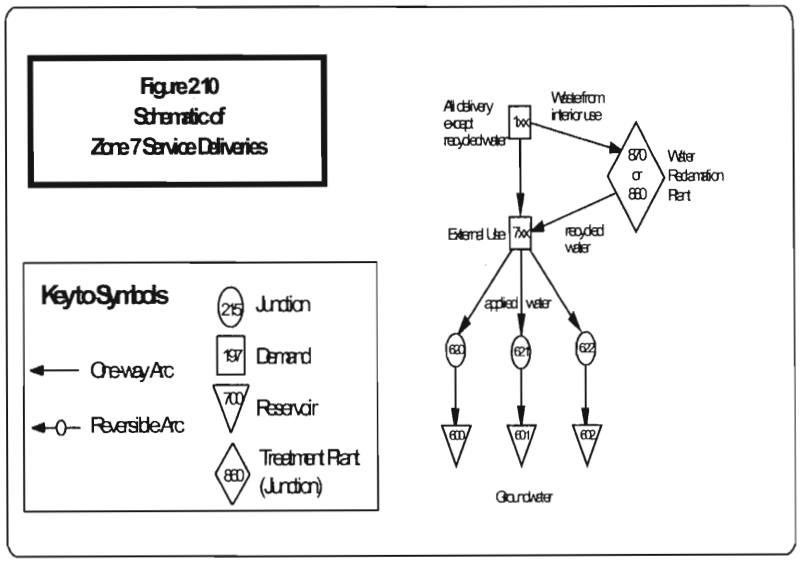
DRAWN	TODD WENDLER
DESIGNED	
CHECKED	JARNAIL CHAHAL
APPROVED	

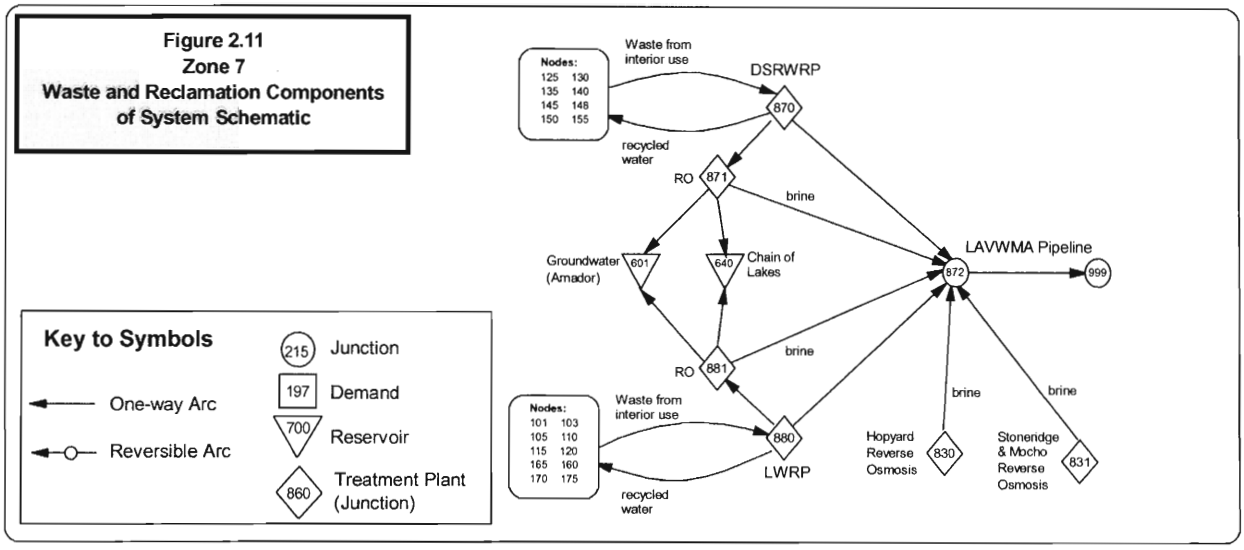
WATER RESOURCES ENGINEERING
SERVICE AREAS BY WRMI DEMAND NODES
1997 WATER YEAR

SCALE	1" = 6000'
DATE	19 November 1997
FILE NO.	mapinfo\cwre7_fw_sys.wor

to the main demand node. The "*xx*" in Figure 2.10 is to indicate that this same set of nodes and arcs is repeated for every one of the demand nodes. Node 1xx represents all delivery, internal and external, except for recycled water delivery for irrigation. Through arc 1xx.870 or 1xx.880, 100% of the internal use is sent back to the two wastewater treatment plants. Node 7xx represents the entire external use delivery. An arc from the wastewater treatment plant also delivers recycled water to this node for some demand nodes. A certain percentage of the external use percolates into the groundwater basin through intermediate nodes 620,621 and 622.

The Figure 2.11 schematic shows how demineralization (RO) plants are included in the model. Each RO plant has one or more output arcs and one brine waste arc. The TDS is reduced in the output arcs, while the balance of mass of TDS is preserved by concentrating it in the brine waste arc. Nodes 871 and 881 represent RO plants that demineralize recycled water from the LWRP and DSRSD wastewater plants. These plants are assumed to have 90% removal efficiency so that the volume of brine waste is 10% of the volume of inflow. This rule is enforced as a constraint command. Maximum flows on the input arcs represent the capacity of the plants. The model then automatically balances the mass of TDS in the brine waste arc. The permeate (product water) from these two RO plants can be either used for injection to the Amador subbasin or sent to the chain of lakes. The actual use of the permeate from these plants is under further steady. Similarly nodes 830 and 831 represent RO plants that treat groundwater pumpage and connect to the Zone 7 distribution system near the Hopyard and Mocho well fields.





Model Use and Operation—The model is completely data driven and controlled by the operation Control Language (OCL). The time length of simulation of this system is limited by the availability of time-series data. Since the purpose of the model is to predict the reaction of the system to variable conditions, the historical hydrologic data for the 1922-94 period was used for simulation. This period was chosen since it is the same as that used by the DWR DWRSIM model that produces the State Water Project (SWP) yield and delivery predictions. The DWRSIM study 2020c9b-SWRCB-411 computes the SWP yield at year 2020 demand levels. The SWP yield data from this DWRSIM run is used in the Zone 7 WRMI model as one of the inputs for available surface water supply.

The OASIS model uses a mixed integer linear programming approach and Operations Control language to run the simulations. Water routing decisions are solved by the linear programming using a priority-objective function. The linear programming portion basically contains the operating constraints and goals of the system. The OCL is generally used to handle the special rules of each simulation. The model uses all the constraints and rules to route the flow from various sources to various turnouts. Every flow component (i.e. water source) is associated with water quality (TDS). Further documentation on OASIS and the Zone 7/WRMI water system routing model can be found in the report "*Documentation for OASIS with OCL - Application for Zone 7 Water Agency, January 1999*" (Reference D).

This water system operations model can produce various output parameters on a monthly average basis including groundwater recharge, groundwater storage, treatment plant production, Lake Del Valle Storage, delivered water quality, flow at any point in the system, etc. Zone 7 used the model to evaluate various groundwater basin Salt Management Strategies. The most valuable output parameter for evaluating salt management strategies was the delivered water quality (TDS). The model provides the monthly water quality (TDS) of Zone 7 deliveries by turnout and by retailer average deliveries to their customers under varying hydrologic conditions equivalent to the historic 1922-94 period. The analysis of this output provides the range of delivered water TDS in

the overall distribution system. Section 10.4 describes in detail the use of this water system operations model for evaluating Salt Management Strategy delivered water quality impacts.