SECTION 4.0

EVAPORATION, DAMS AND RESERVOIR

4.0 EVAPORATION, RESERVOIRS AND DAMS

4.1 Overview

PFRD maintains and operates two evaporation stations which are located at Sulphur Creek Dam and Villa Park Dam. Each station has a weather bureau-type class A land evaporation pan which is 48 inches in diameter and 10 inches deep and constructed of galvanized sheet metal. In addition, records are kept for six historical evaporation stations. **Figure 27** shows the location for historical and active evaporation stations.

Table **50** lists the name and number, location and period of record for each evaporation station. Monthly evaporation for the Villa Park Dam (1974-2002) and Sulphur Creek Dam (1978-2002) are listed in **Tables 51 and 52.**

There are seven major flood control and water conservation dams in and near Orange County as shown in **Figure 28** and described in **Table 53**. Two of the dams, Villa Park and Sulphur Creek, are operated by PFRD.

Season reservoir operation summaries for the two dams are presented in **Tables 54 and 55**. **Table 56** provides an operational summary for Villa Park Dam (1965-2002).

The maximum storage for Villa Park and Prado Dams from 1965-2002, as percent capacity at the spillway crest, is shown in **Figure 29**.

4.2 2001-2002 Data Presentation

The maximum monthly evaporation for Villa Park Dam was recorded in July 2001 at 6.88 inches. The total evaporation for the season was 59.08 inches which is 3.26 inches greater than the long term average.

Villa Park Dam recorded a peak inflow and outflow on January 27 of 5 cfs and September of 20 cfs, respectively. The total dam inflow and outflow for the season was 126 and 172 acre feet, respectively. The maximum storage of 45 acre feet was recorded on May 19.

The total season evaporation for Sulphur Creek Dam was 59.18 inches which was 2.18 inches greater than the long term average. The maximum monthly total of 6.91 inches was recorded in July whereas the lowest monthly total of 2.83 inches was recorded in January.

Sulphur Creek Dam recorded a peak outflow on November 24 of 60 cfs. The total inflow and outflow volumes for Sulphur Creek Dam were 249 and 249 acre feet, respectively.

Prado Dam recorded a maximum storage for the season of 4370 acre feet which was 2.3 percent of the dam's maximum capacity.

Table 50

EVAPORATION SUMMARY

HISTORICAL / PRESENT STATIONS

PFRD NO.	STATION NAME	LATITUDE NORTH	LONGITUDE WEST	ELEVATION m	ELEVATION ft	RECORD FROM	RECORD TO
23	Prado Dam	33-53-24	117-38-09	175	575	07/30	12/69
125	Irvine Evaporation	33-40-38	117-45-33	60	197	01/46	01/73
126	Fullerton Airport	33-52-23	117-58-24	29	96	01/35	06/77
127	Huntington Beach	33-43-22	118-02-00	5	15	08/34	12/45
173	Villa Park Dam	33-48-53	117-46-00	174	573	12/63	Present
174	Atwood	33-51-48	117-50-30	73	240	04/70	06/77
176	El Toro	33-37-39	117-41-26	139	455	09/65	06/77
216	Sulphur Creek Dam	33-32-59	117-42-20	58	190	06/75	Present

Table 51

VILLA PARK DAM

Station 173

MONTHLY EVAPORATION SUMMARY

(1974 -2002 in inches)

SEASON	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
1973-74	7.42	6.61	5.24	4.81	2.25	2.51	1.88	4.16	1.55	5.00	5.03	7.21	53.67
1974-75	6.23	6.52	6.07	3.33	3.60	3.39	2.51	2.07	3.08	3.64	5.23	4.88	50.55
1975-76	7.63	7.01	6.18	4.26	4.51	3.32	5.22	3.10	3.70	4.30	4.13	7.74	61.10
1976-77	6.71	6.24	3.15	4.96	4.84	4.11	3.00	3.09	4.12	4.38	4.18	5.17	53.95
1977-78	8.24	6.18	5.33	3.80	3.61	2.14	1.74	1.67	1.63	3.63	6.46	6.90	51.33
1978-79	8.14	6.91	5.72	4.30	2.14	2.04	1.99	2.52	2.76	4.25	5.00	6.26	52.03
1979-80	5.49	6.07	6.27	3.57	3.37	2.93	2.14	2.60	3.84	5.11	4.34	6.62	52.35
1980-81	7.98	6.70	4.66	4.78	4.32	3.62	2.66	3.20	3.91	4.32	5.61	8.33	60.09
1981-82	7.66	7.30	6.14	5.28	3.38	2.05	2.70	2.46	3.21	4.69	3.92	5.35	54.14
1982-83	7.15	7.32	4.72	5.52	2.86	2.45	2.65	1.96	3.21	4.06	5.14	4.14	51.18
1983-84	7.45	7.07	6.53	4.42	2.22	1.79	3.37	3.94	5.07	5.82	7.08	6.52	61.28
1984-85	7.98	7.85	6.08	6.22	2.68	2.75	2.90	3.23	3.88	4.99	5.80	7.26	61.62
1985-86	7.94	7.66	5.93	4.20	3.11	3.05	3.09	2.55	3.40	5.29	6.08	6.94	59.24
1986-87	7.64	7.21	5.17	4.01	3.50	2.05	2.86	3.42	3.11	3.58	4.89	5.16	52.60
1987-88	6.51	6.70	5.31	4.80	2.95	2.88	2.99	4.42	6.16	4.66	6.87	6.52	60.77
1988-89	6.43	7.33	5.17	3.94	2.68	3.12	3.23	2.33	4.25	5.86	6.12	5.84	56.30
1989-90	7.62	7.35	5.74	4.41	5.04	3.31	3.01	2.28	3.43	3.78	5.73	6.40	58.10
1990-91	7.57	6.36	4.81	4.54	4.13	2.81	2.25	3.00	4.15	5.18	6.15	5.84	56.79
1991-92	5.80	5.83	5.65	4.51	3.41	2.68	2.81	2.54	3.31	4.79	5.32	6.84	53.49
1992-93	6.71	6.40	5.59	4.71	3.69	2.62	2.19	2.41	3.70	4.80	5.59	6.39	54.80
1993-94	7.49	7.18	5.98	5.09	4.03	3.21	3.41	3.19	3.98	4.87	5.16	6.85	60.44
1994-95	6.90	7.63	6.21	4.62	2.63	2.48	1.98	1.94	3.15	4.27	4.40	4.76	50.97
1995-96	7.08	7.52	6.10	5.25	4.01	3.15	1.74	2.13	2.97	4.49	5.24	6.71	56.39
1996-97	7.49	7.17	6.01	4.22	3.14	2.77	2.02	3.41	3.97	4.68	5.45	6.40	56.73
1997-98	6.65	6.42	6.14	3.87	3.16	2.59	1.98	1.49	3.68	4.02	5.21	6.37	51.58
1998-99	7.39	6.80	6.07	5.01	2.95	2.85	2.69	2.92	3.81	3.95	5.61	6.88	56.93
1999-00	7.75	7.28	5.91	4.59	3.36	3.08	2.78	2.39	3.32	4.53	5.47	6.47	56.93
2000-01	7.59	6.82	5.16	3.82	3.39	3.01	2.43	1.57	3.36	4.14	4.98	5.99	52.26
2001-02	6.88	7.24	6.29	5.75	4.39	3.43	2.97	2.37	3.76	4.14	5.37	6.49	59.08
MEAN	7.22	6.92	5.63	4.57	3.43	2.83	2.66	2.70	3.57	4.52	5.36	6.32	55.82
MAXIMUM	8.24	7.85	6.53	6.22	5.04	4.11	5.22	4.42	6.16	5.86	7.08	8.33	61.62
MINIMUM	5.49	5.83	3.15	3.33	2.14	1.79	1.74	1.49	1.55	3.58	3.92	4.14	50.55

Table 52

SULPHUR CREEK DAM

Station 216

MONTHLY EVAPORATION SUMMARY

(1978-2002 in inches)

SEASON	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
1977-78	8.48	7.31	6.10	4.79	3.65	1.52	2.57	3.50	2.97	4.78	7.25	7.43	60.35
1978-79	8.42	7.31	6.64	4.43	2.84	2.06	2.30	2.86	3.81	5.76	6.03	5.42	57.88
1979-80	7.92	6.82	6.73	4.28	3.37	2.85	3.13	1.86	4.54	5.18	6.03	6.91	59.62
1980-81	7.97	7.22	5.52	5.02	3.66	2.64	2.65	3.15	4.26	4.90	6.65	7.80	61.44
1981-82	8.26	7.85	5.59	4.22	3.09	1.92	2.42	2.22	3.76	5.11	4.77	4.88	54.09
1982-83	7.81	6.58	5.13	5.00	2.98	2.33	2.57	1.90	4.80	4.95	6.29	5.70	56.04
1983-84	7.92	5.29	6.09	2.26	3.62	3.49	2.63	3.41	4.36	3.61	6.89	6.53	56.10
1984-85	8.06	6.91	6.27	4.61	3.83	2.82	2.24	2.74	3.79	4.78	6.32	7.57	59.94
1985-86	8.06	6.41	5.84	4.77	2.95	2.52	2.70	2.85	3.95	5.61	6.55	6.88	59.09
1986-87	7.66	8.05	4.59	4.00	3.57	3.91	3.40	2.94	3.53	5.66	6.17	6.70	60.18
1987-88	4.81	7.03	5.24	3.51	2.30	1.92	3.32	3.62	5.33	5.30	6.95	6.65	55.98
1988-89	7.48	6.87	5.18	4.35	2.50	2.27	2.60	2.37	4.08	6.14	5.54	6.04	55.42
1989-90	7.49	6.95	5.77	4.19	2.74	4.27	1.56	1.80	3.93	4.96	6.13	7.00	56.79
1990-91	8.39	5.83	4.78	4.79	3.79	1.99	2.48	3.09	3.07	4.99	4.55	4.66	52.41
1991-92	5.96	7.80	5.64	4.69	3.74	2.55	2.52	2.58	3.48	5.23	5.08	5.89	55.16
1992-93	6.81	6.37	5.77	3.98	3.36	2.41	1.91	2.59	4.18	5.24	6.22	6.62	55.46
1993-94	7.48	6.98	5.79	4.51	3.20	2.62	2.87	2.65	3.77	4.84	5.96	6.69	57.36
1994-95	7.21	7.02	6.03	4.71	2.98	2.39	2.18	2.26	3.47	4.67	5.19	6.08	54.19
1995-96	7.39	7.41	5.87	4.21	3.12	2.49	2.17	1.94	3.24	4.81	5.87	6.51	55.03
1996-97	7.68	7.01	5.98	4.41	3.25	2.09	1.79	2.95	4.27	5.29	6.31	6.67	57.70
1997-98	7.50	6.89	5.62	4.99	3.08	2.49	2.40	1.70	3.98	4.88	5.45	6.58	55.56
1998-99	7.61	7.11	5.82	4.32	3.19	2.65	2.58	2.89	4.02	5.06	6.27	6.81	58.33
1999-00	6.95	6.70	5.52	4.28	3.29	2.72	2.66	1.97	3.95	4.76	5.78	6.29	54.87
2000-01	7.64	7.03	5.90	4.41	3.52	2.99	2.21	1.84	3.87	4.96	5.90	6.68	56.95
2001-02	6.91	7.13	5.81	4.54	3.43	2.91	2.83	3.02	4.12	5.31	6.40	6.77	59.18
MEAN	7.51	6.96	5.73	4.37	3.24	2.59	2.51	2.59	3.94	5.07	6.02	6.47	57.00
MAXIMUM	8.48	8.05	6.73	5.02	3.83	4.27	3.40	3.62	5.33	6.14	7.25	7.80	61.44
MINIMUM	4.81	5.29	4.59	2.26	2.30	1.52	1.56	1.70	2.97	3.61	4.55	4.66	52.41

Table 53

MAJOR FLOOD CONTROL AND WATER CONSERVATION DAMS

SPECIFICATION SUMMARY

DAM	DATE COMPLETE	OPERATED BY	OPERATION	WATER SOURCE	DRAINAGE AREA (SQ. MI.)	STORAGE CAPACITY at SPILLWAY (AC-FT)	MAXIMUM REGULATED (CFS)
BREA DAM	3/42	CORP OF ENGINEERS	FLOOD CONTROL	BREA CREEK	21.5	4,090	1,400
CARBON CANYON DAM	2/61	CORP OF ENGINEERS	FLOOD CONTROL, CONSERVATION	CARBON CREEK	19.5	7,030	1,100
FULLERTON DAM	10/41	CORP OF ENGINEERS	FLOOD CONTROL	FULLERTON CREEK	5.1 **(1)**	743	250
PRADO DAM		CORP OF ENGINEERS	FLOOD CONTROL	SANTA ANA RIVER	1,485 **(2)**	187,600	5,000
SANTIAGO DAM	12/31	SERRANO IRRIGATION DISTRICT	CONSERVATION, IMPORTED STORAGE	SANTIAGO CREEK	63.1	25,000	**(3)**
VILLA PARK DAM	1/63	PFRD	FLOOD CONTROL, CONSERVATION	SANTIAGO CREEK	20.3 **(4)**	15,400	6,000
SULPHER CREEK DAM	8/65	PFRD	FLOOD CONTROL, RECREATION	SULPHUR CREEK	4.6	510	110

1. Includes 3.5 sq. mi. from Loftus Diversion
2. Does not include 750 sq. mi. above Lake Elsinore
3. Water released as required for irrigation
4. Does not include 63.1 sq. mi. above Santiago Dam

Table 54

VILLA PARK DAM

RESERVOIR OPERATION SUMMARY

(2001-2002)

END OF MONTH	WATER SURFACE ELEVATION FT	RESERVOIR STORAGE AC-FT	RESERVOIR CHANGE AC-FT	TOTAL INFLOW AC-FT	TOTAL OUTFLOW AC-FT
JUL	501.5	81	-6	27	33
AUG	497.6	34	-47	20	67
SEP	496.4	26	-8	12	20
OCT	497.0	29	3	12	9
NOV	497.7	34	5	12	7
DEC	498.1	37	3	9	6
JAN	498.6	40	3	10	7
FEB	498.9	42	2	8	6
MAR	499.0	43	1	6	5
APR	499.2	44	1	5	4
MAY	499.2	45	1	5	4
JUN	498.8	41	-4	0	4
	SEASON TOTALS			126	172

Maximum Inflow:	5 cfs on 1-27-02
Maximum Outflow:	20 cfs on 09-13-01
Max. Water-Stage Elev.:	499.3 feet on 5-19-02
Maximum Storage:	45 acre feet on 5-19-02

SPECIFICATIONS:

Outlet Gate Sill	Elevation 484 ft = 0 Ac-Ft Storage
Debris Pool	Elevation 510 ft = 552 Ac-Ft Storage
Spillway Crest	Elevation 566 ft = 15,400 Ac-Ft Storage

Table 55

SULPHUR CREEK DAM

RESERVOIR OPERATION SUMMARY

(2001-2002)

END OF MONTH	WATER SURFACE ELEVATION FT	RESERVOIR STORAGE AC-FT	RESERVOIR CHANGE AC-FT	TOTAL INFLOW AC-FT	TOTAL OUTFLOW AC-FT
JUL	189.10	386	0	12	12
AUG	189.10	386	0	12	12
SEP	189.10	386	0	12	12
OCT	189.12	387	1	14	13
NOV	189.28	392	5	71	66
DEC	189.12	387	-5	30	35
JAN	189.10	386	-1	24	25
FEB	189.10	386	0	15	15
MAR	189.12	387	1	21	20
APR	189.10	386	-1	14	15
MAY	189.10	386	0	12	12
JUN	189.10	386	0	12	12
	SEASON TOTALS			249	249

Maximum Inflow: 360 cfs on 11-24-01
Maximum Outflow: 60 cfs on 11-24-01
Max. Water-Stage Elev.: 190.90 feet on 11-24-01

SPECIFICATIONS:

Lower Outlet Elevation 161 ft = 0 Ac-Ft Storage
Upper Outlet Elevation 174 ft = 45 Ac-Ft Storage
Auxiliary Outlet Elevation 189 ft = 382 Ac-Ft Storage
Spillway Crest Elevation 192 ft = 508 Ac-Ft Storage

Table 56

VILLA PARK DAM

OPERATIONAL SUMMARY
(1965-2002)

SEASON	MAX STORAGE		MIN STORAGE		PEAK INFLOW		PEAK OUTFLOW		TOTAL INFLOW AC-FT	TOTAL OUTFLOW AC-FT *
	AC-FT	DATE	AC-FT	DATE	CFS	DATE	CFS	DATE		
1965	102	10-Apr-65	0		55	09-Apr-65	2	22-May-65	114	94
1966	455	10-Apr-66	0		441	22-Nov-65	3	17-Apr-66	456	332
1967	455	14-May-67	0		971	06-Dec-66	43	23-Dec-66	2,448	1,030
1968	1,702	14-May-68	340	08-Nov-67	900	08-Mar-68	41	16-Apr-68	1,467	2,019
1969	17,673	25-Feb-69	0		10,981	25-Feb-69	6,003	25-Feb-69	63,559	62,262
1970	1,419	01-Jul-69	0		28	04-Mar-70	25	01-Oct-69	805	1,946
1971	190	02-Apr-71	0		169	21-Dec-70	30	21-Sep-70	327	422
1972	145	29-Dec-71	0		108	28-Dec-71	21	22-May-72	193	222
1973	1,094	16-Apr-73	0		625	11-Feb-73	3	28-Jun-73	1,248	374
1974	876	01-Jul-73	40	30-Jun-74	206	07-Jan-74	80	20-Dec-73	465	1,303
1975	957	28-Apr-75	0		106	08-Mar-75	2	24-Jun-75	185	208
1976	37	04-Mar-76	0		14	03-Mar-76	80	14-May-76	126	108
1977	26	10-May-77	0		25	09-May-77	160	19-Apr-77	58	61
1978	6,032	21-Apr-78	0		3,330	04-Mar-78	2,825	10-Feb-78	40,940	38,995
1979	4,126	10-Apr-79	781	20-Feb-79	500	27-Mar-79	60	02-Feb-79	4,540	2,902
1980	5,326	13-Mar-80	0		2,380	18-Feb-80	2,701	18-Feb-80	37,049	40,616
1981	316	21-Apr-81	0		215	29-Jan-81	4	01-Jun-81	648	625
1982	499	03-Apr-82	0		320	17-Mar-82	10	01-Apr-82	525	507
1983	5,967	01-Mar-83	0		4,167	01-Mar-83	1,201	01-Mar-83	23,672	22,375
1984	1,581	01-Jul-83	622	30-Jun-84	480	01-Oct-83	200	01-May-83	688	1,751
1985	622	01-Jun-84	166	30-Jun-85	180	28-Dec-84	4	19-Apr-85	457	995
1986	289	18-Mar-86	0		315	15-Feb-86	25	02-Aug-85	383	438
1987	54	01-Jul-86	0		0		5	07-Jul-86	0	54
1988	41	18-Jun-88	0		37	29-Jun-88	37	19-Jun-88	2,525	2,488
1989	165	10-Feb-89	0		62	25-Dec-88	37	30-Jun-89	4,133	4,124
1990	29	02-Jun-90	0		5	17-Feb-90	1	12-Jun-90	187	183
1991	566	30-Mar-91	0		151	27-Mar-91	74	04-Apr-91	690	488
1992	1,298	02-Apr-92	0		185	21-Mar-92	100	19-Jun-92	1,380	1,012
1993	3,224	27-Jan-93	0		3,056	18-Jan-93	3,000	18-Jan-93	55,470	55,458
1994	717	17-Jun-94	535	30-Dec-93	60	20-Feb-94	126	23-Jul-93	364	299
1995	3,853	28-Mar-95	0		2,850	6-Mar-95	3,000	6-Mar-95	23,649	24,309
1996	172	1-May-96	0		55	21-Feb-96	12	4-Mar-96	716	597
1997	172	2-Mar-97	20	23-Sep-96	266	26-Jan-97	24	14-Mar-97	810	741
1998	5,568	18-Jun-98	68	30-Sep-97	6000	24-Feb-98	3000	24-Feb-98	29,670	23,667
1999	5,194	1-Jul-98	0	22-Jul-99	15	26-Jan-99	26	3-Nov-98	709	5,869
2000	59	25-May-00	0		2	13-Jun-00	10	4-Aug-99	160	167
2001	277	16-May-01	17	2-Dec-00	4	26-Feb-01	5	29-Nov-00	326	259
2002	45	19-May-02	25	3-Oct-01	5	27-Jan-02	20	13-Sep-01	126	172

* Includes evaporation, infiltration and lateral storage

Figure 27

EVAPORATION STATIONS
LOCATION MAP

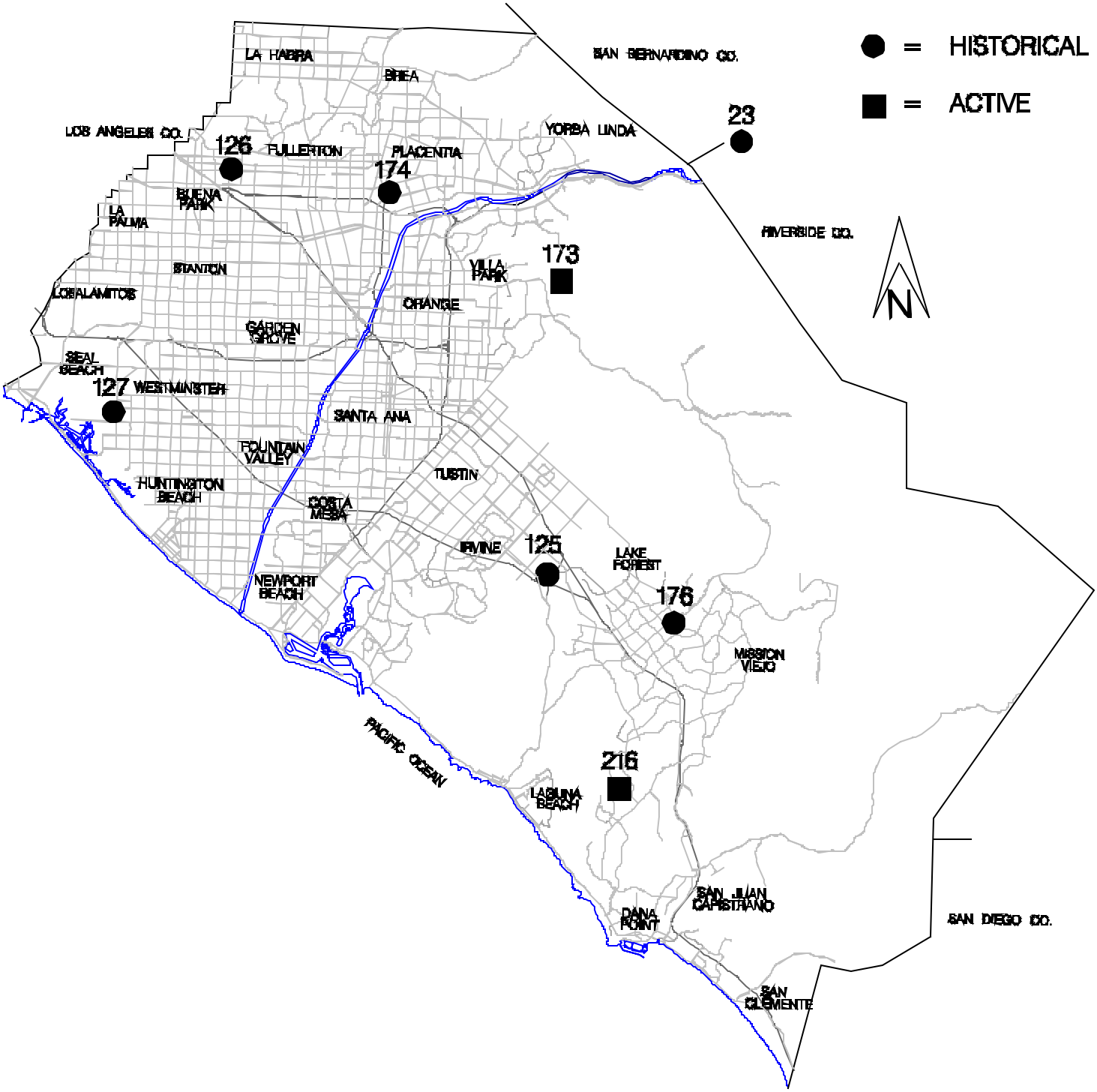


Figure 28

MAJOR FLOOD CONTROL AND WATER CONSERVATION DAMS

LOCATION MAP

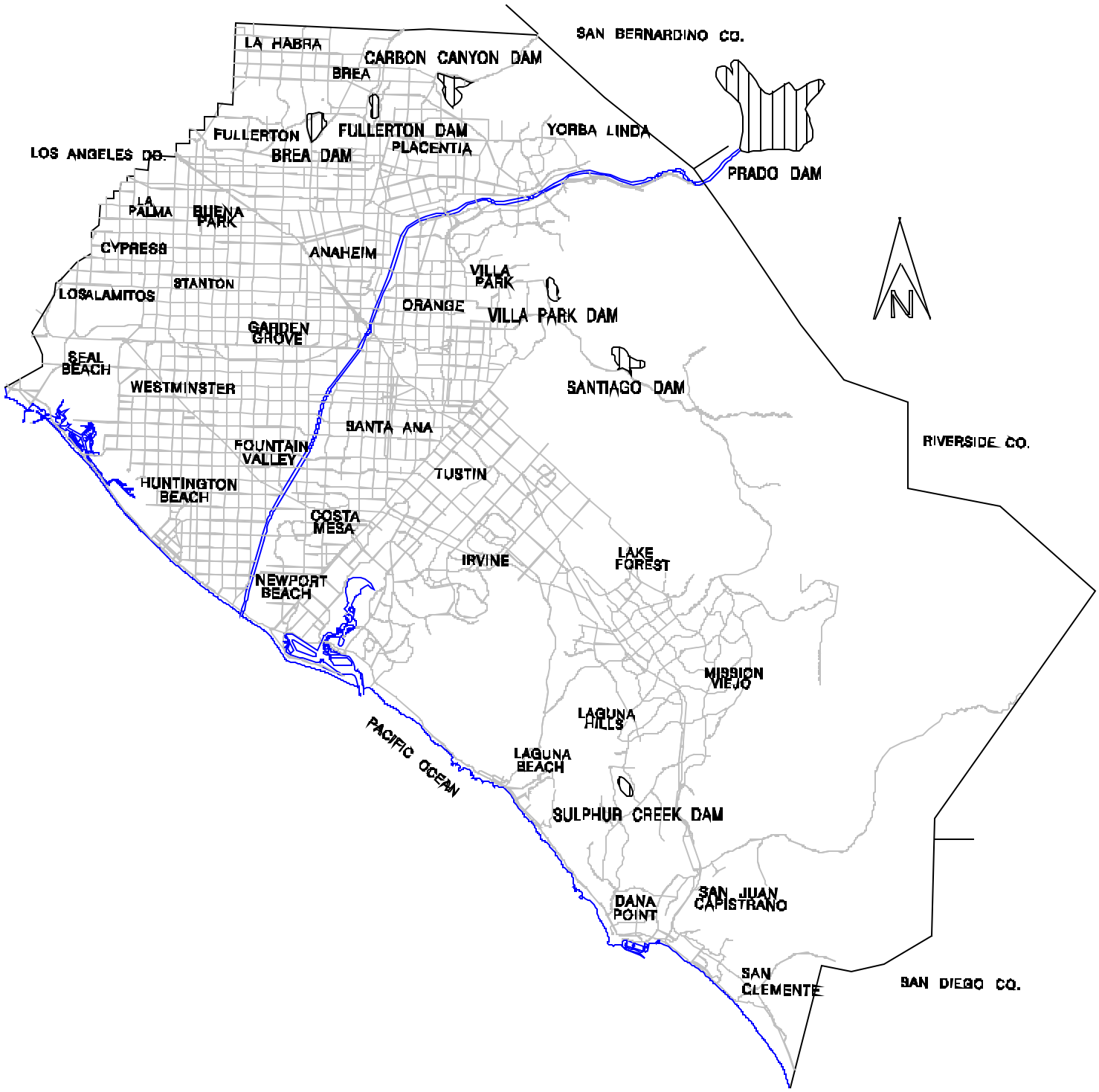
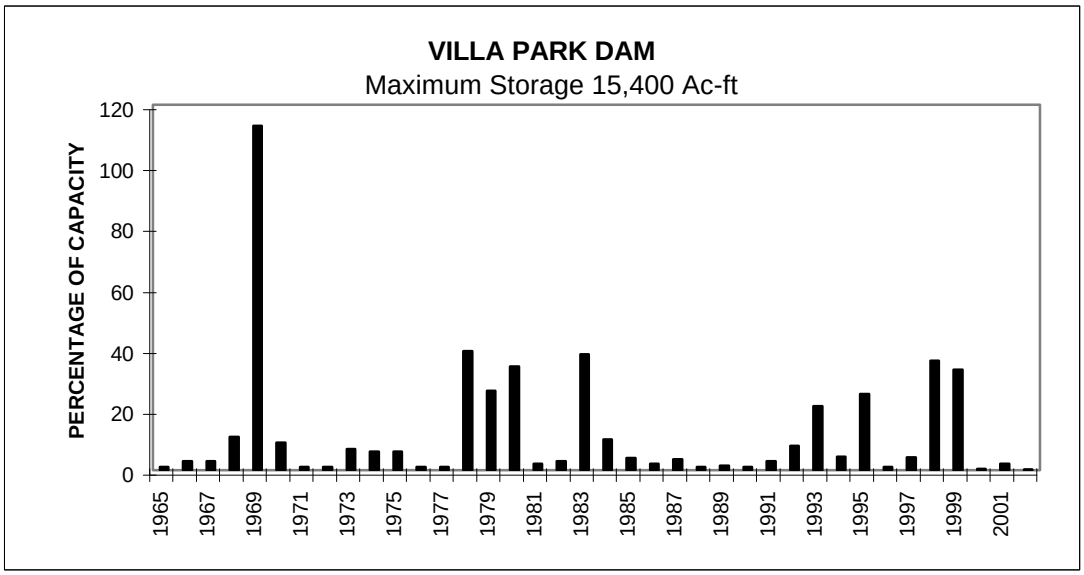
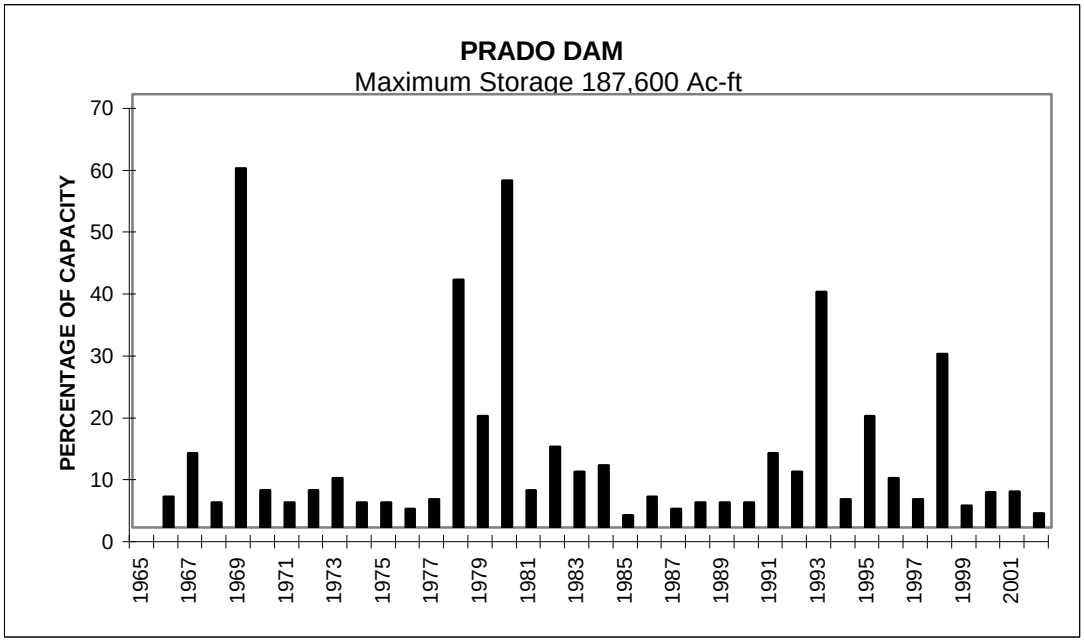


Figure 29

VILLA PARK DAM AND PRADO DAM
MAXIMUM STORAGE DURING SEASON

AS PERCENT OF CAPACITY AT SPILLWAY CREST
(1965-2002)