

Restoration of the Salton Sea

Volume 1: Evaluation of the Alternatives

Appendix 1B: Hydrologic Analysis – Flood Study

Contents

Page

Hydrologic Analysis	1
I. Introduction and Background	1
A. Project and Basin Description.....	1
II. Probable Maximum Flood Analysis	3
III. Frequency Flood Analysis	4
A. Australian Method Precipitation	4
B. Rainfall-Runoff	5
IV. Results and Conclusions	6
V. Acknowledgements	6
VI. References.....	6

Tables

Table 1.—Salton Sea Subbasins	B-2
Table 2.—Basin Parameters	B-3
Table 3.—Salton Sea PMF Summary	B-4
Table 4.—Frequency Flood Summary.....	B-5

Figures

Figure 1.—Salton Sea subbasins.....	B-2
-------------------------------------	-----

Attachments

Attachment A
Attachment B
Attachment C

Hydrologic Analysis

This hydrologic analysis was requested as part of Reclamation's ongoing work on the Salton Sea restoration project. Public Law 108-361 titled the Water Supply Reliability and Environmental Improvement Act includes a requirement that:

"Not later than December 31, 2006, the Secretary of the Interior, in coordination with the State of California and the Salton Sea Authority, shall complete a feasibility study on a preferred alternative for Salton Sea restoration."

Specifically, flood frequency hydrographs and probable maximum flood (PMF) hydrographs were requested to analyze the mid-sea embankment options. The embankment location shown on preliminary documents [1] was about 5 miles south of the Riverside and Imperial County border. The study was conducted to estimate inflows into Salton Sea. The North model estimated inflows from tributaries discharging north of the embankment location. The South model estimated inflows from tributaries discharging south of the embankment location.

I. Introduction and Background

A. Project and Basin Description

The Salton Sea is located in southeastern portion of California, south of Indio. The drainage basin extends south into Mexico. Digital elevation maps were obtained from the USGS and were used to delineate the basin. The program Watershed Modeling System (WMS) [2] was used to delineate the basin, determine subbasin locations, and compute hydrologic parameters such as stream lengths and slopes. The total drainage area was computed as 8,274 mi². The lake surface was determined to be 100 mi² and was considered a separate subbasin. The remaining land surface was divided into four subbasins. The subbasins are described in Table 1 and shown on the map on Figure 1.

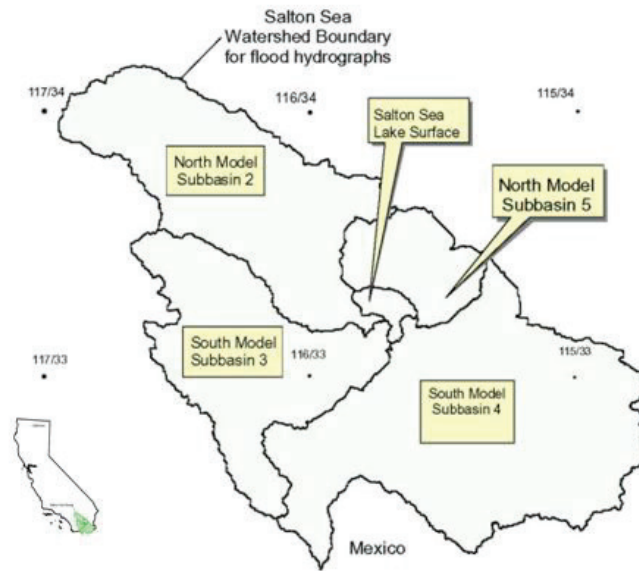


Figure 1.—Salton Sea subbasins.

Table 1.—Salton Sea Subbasins

Subbasin Number	Primary Drainage Name	Drainage Area (mi ²)
1	Salton Sea Lake Surface	100
2	Whitewater River	2,222
3	San Felipe Creek	1,824
4	Alamo River and New River	3,508
5	Salt Creek	620

Inflows from subbasins 2 and 5 discharge into Salton Sea north of the proposed embankment location. These two subbasins, plus half of the lake surface area, were combined into the North model. Inflows from subbasins 3 and 4 discharge into Salton Sea south of the proposed embankment location. These two subbasins, plus half of the lake surface area, were combined into the South model.

The basin is bordered by the Little San Bernardino and Chocolate Mountains on the east and the San Jacinto and Santa Rosa Mountains on the west. The basin consists of a mix of desert landscape, irrigated agricultural areas and urban areas. Elevations within the basin vary from a lake surface elevation of approximately 277 feet below sea level, to a high elevation of 10,831 feet at San Jacinto Peak.

II. Probable Maximum Flood Analysis

PMFs were computed for the north basin (subbasins 2 and 5) and for the south basin (subbasins 3 and 4) separately. The lake surface area was divided in half, with half added to the north basin and half added to the south basin. The probable maximum precipitation (PMP) was computed for each basin separately, using Hydrometeorological Report (HMR) No. 58 and 59 [3,4], the most recent National Weather Service publications for the area. The general storm PMP was computed. The 72-hour PMP totals were 13.84 inches for the north basin and 9.75 inches for the south basin.

The computer program HEC-1 [5], developed by the Corp of Engineers was used to perform the rainfall runoff computations. The standard Reclamation PMP rainfall distribution, where the peak rainfall occurs at the two-thirds point in the storm duration, was used. The southwest desert dimensionless unit hydrograph was used. Infiltration rates were determined using the STASTGO soils database [6]. The basin dimensions were determined from the WMS model. WMS does not compute L_{ca} , so it was estimated to be $0.6 \cdot L$. A constant infiltration rate was applied, with no initial infiltration applied. The initial infiltration was assumed to have been satisfied by antecedent rainfall. The basin characteristics are summarized in table 2.

Table 2.—Basin Parameters

Subbasin	Infiltration (in/hr)	C	L (miles)	L_{ca} (miles)	Slope (ft/mile)	Lag (hrs)
2	0.16	2.0	114.0	68.4	41.7	20.8
5	0.15	2.0	51.8	31.1	35.9	12.7
3	0.13	2.0	82.6	49.5	49.1	16.4
4	0.14	3.0	152.2	91.3	7.92	49.7

A higher C value was used for subbasin 4 because of higher percent of irrigated crop land and the very low slope value.

The resulting PMF hydrographs are tabulated and graphed in attachment A. Table 3 summarizes the peak and volume.

Table 3.—Salton Sea PMF Summary

Model	Peak Inflow (cfs)	Volume (acre-feet)
North	601,240	1,102,660
South	354,730	1,316,130

III. Frequency Flood Analysis

A. Australian Method Precipitation

Flood frequency hydrographs were developed using the Australian method. The Australian Institution of Engineers developed and published an approach for estimating large to extreme floods in 1999 and revised the method in 2001 [7]. The procedures involved in the Australian Rainfall-Runoff Method are based on flood frequency analysis and rainfall-runoff modeling. This approach emphasizes the use of “annual exceedance probability (AEP)-neutral” parameters in the rainfall-runoff modeling process. The infiltration rates and lag times are selected to reflect the desired return periods instead of a maximized event such as the PMF.

Included within the Australian method is a precipitation extrapolation method developed by Siriwardena and Weinmann [7]. This method can be used when there are regional estimates of precipitation beyond the 100-year return period. NOAA Atlas 14 [8] contains the National Weather Service analysis for precipitation frequency in the Southwest United States, including the Salton Sea area. Precipitation values were derived from NOAA Atlas 14 for the 500- and 1,000-year return periods, the maximum return periods available. The NOAA Atlas 14 values were point precipitation values. These values were adjusted for basin area by applying the areal reduction values determined from HMR 58. The HMR 58 areal reduction factors are somewhat conservative, but no other values have been determined for basins of these sizes, for storm durations greater than 24 hours, or for return periods beyond 500 years. This adjusted precipitation data were extrapolated to the PMP using the method prescribed by Siriwardena and Weinmann.

The Siriwardena and Weinmann method uses the slope of the estimates from the upper segment of the known frequency curve, the 500- and 1,000-year values in this case, as the initial points of extrapolation. The slope flattens as the precipitation approaches the probable maximum precipitation (PMP). A series of equations defines the intervening slope and allows computation of the precipitation values for return periods between the upper end of known design values and the PMP. Because this is essentially a curve fit approach between the known frequency values and the PMP, a return period must be assigned to the PMP.

Assigning an AEP to the PMP is inconsistent with the upper limiting concept of the PMP. However, an operational estimate must be made of the AEP of the PMP so a curve fit routine can be applied. This operational definition is an estimate only. The Australian method assigns an AEP to the PMP based on the drainage basin size. For a drainage area corresponding to the north and south basins of the Salton Sea, the estimated recommended AEP of the PMP is 1×10^{-5} . This AEP estimate indicates the probability of a PMP event occurring in any part of the year. As an independent check, the NOAA Atlas 14 values for the 500- and 1,000-year precipitation data were extrapolated, using a natural logarithmic equation, until the PMP was intercepted. This occurred at values in the 10^5 return period ranges.

The Siriwardena and Weinmann method was used to estimate the 72-hour total precipitation for return periods out to the 10^5 PMP estimate. Computation sheets summarizing this method are given in attachment B.

B. Rainfall-Runoff

HEC-1 was used as the rainfall-runoff model. The same precipitation distribution as the PMF model was used. AEP-neutral characteristics were estimated by increasing the lag times and infiltration rates by five percent over the PMF values. The unit hydrograph for each subbasin was adjusted for these changes.

The resulting frequency hydrographs, for return periods from 500- to 50,000-years, are given in attachment C. A summary of the peak and volume for each return period are given in Table 4. The 50 mi² added to each the north and south model to account for the lake surface were modeled by directly converting rainfall to inflow. No lag time or losses were applied. This accounts for the initial spike in the hydrographs.

Table 4.—Frequency Flood Summary

	North Model		South Model	
Return Period	Peak Inflow (cfs)	Volume (acre-feet)	Peak Inflow (cfs)	Volume (acre-feet)
500-yr	96,610	180,280	74,000	264,110
1,000-yr	125,030	233,710	95,310	346,300
5,000-yr	211,980	397,190	156,660	579,310
10,000-yr	263,890	494,910	188,540	699,500
20,000-yr	330,450	623,020	226,560	842,930
50,000-yr	447,290	853,240	285,640	1,077,390

IV. Results and Conclusions

The results of the PMF analysis are summarized in Table 3 and detailed in attachment A. The flood frequency hydrographs, computed to a return period of 50,000 years, are summarized in Table 4 and detailed in attachment C. The HEC-1 files and other background data are retained in the Flood Hydrology Group files.

This study used readily available, preliminary data. No field trip was done to verify assumptions made in this study, including soil conditions and land use assumptions. The GIS data available for the portion of the drainage area located in Mexico does not have the same degree of accuracy as the data available in California. The models were not adjusted for road or canal embankments or for potential storage capacity within the basins.

Other uncertainties of this study include assumptions built into the precipitation extrapolation techniques used. It is unknown how accurately the available precipitation extrapolation techniques represent these extreme return periods. The areal reduction values to convert the NOAA Atlas 14 values from point precipitation to drainage area values came from HMR 58 and are most likely conservative. Current National Weather Service areal reduction factors for non-PMP determinations do not extend beyond a drainage area of 500 mi², a return period of 500-years or a storm duration of 24 hours.

These uncertainties should be acknowledged in the application of the results of this study to the Salton Sea.

V. Acknowledgements

This study was conducted by Monica Norval of the Flood Hydrology Group. Peer review was provided by Kenneth Bullard. Any questions regarding this study can be addressed to Monica Norval at 303-445-2545.

VI. References

- [1] "Proposal to Conduct a Feasibility Study of Salton Sea Restoration Alternatives", Bureau of Reclamation, Denver, Colorado, April 28, 2005.
- [2] Watershed Modeling System (WMS) version 7.0, Brigham Young University, Utah, June 1, 2004.

- [3] Corrigan P., D.D. Fenn, D. R. Kluck, and J.L. Vogel, Probable Maximum Precipitation for California, Calculation Procedures, Hydrometeorological Report No. 58, National Weather Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Springs Maryland, 1998.
- [4] Corrigan P., D.D. Fenn, D. R. Kluck, and J.L. Vogel, Probable Maximum Precipitation for California, Hydrometeorological Report No. 59, National Weather Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Springs Maryland, 1998.
- [5] U.S. Army Corps of Engineers, HEC-1: Flood Hydrograph Package, Generalized Computer Program, Hydrology Engineering Center, 1990.
- [6] “State Soil Geographic (STATSGO) Database”, Natural Resources Conservation Service,
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- [7] “Estimation of Large to Extreme Floods: Book VI in Australian Rainfall and Runoff, A Guide to Flood Estimation”, Institution of Engineers, Nathan, R.J. and Weinmann, P.E., Australia, 2001
- [8] National Weather Service (NWS); 2004; NOAA Atlas 14 – Precipitation Frequency Data Server, Hydrometeorological Design Studies Center;
<http://hdsc.nws.noaa.gov/hdsc/pfds/sa/ut_pfds.html>.

Salton Sea, California

Hydrologic Analysis

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Attachment A

**Salton Sea, California
North Basin PMF Inflow**

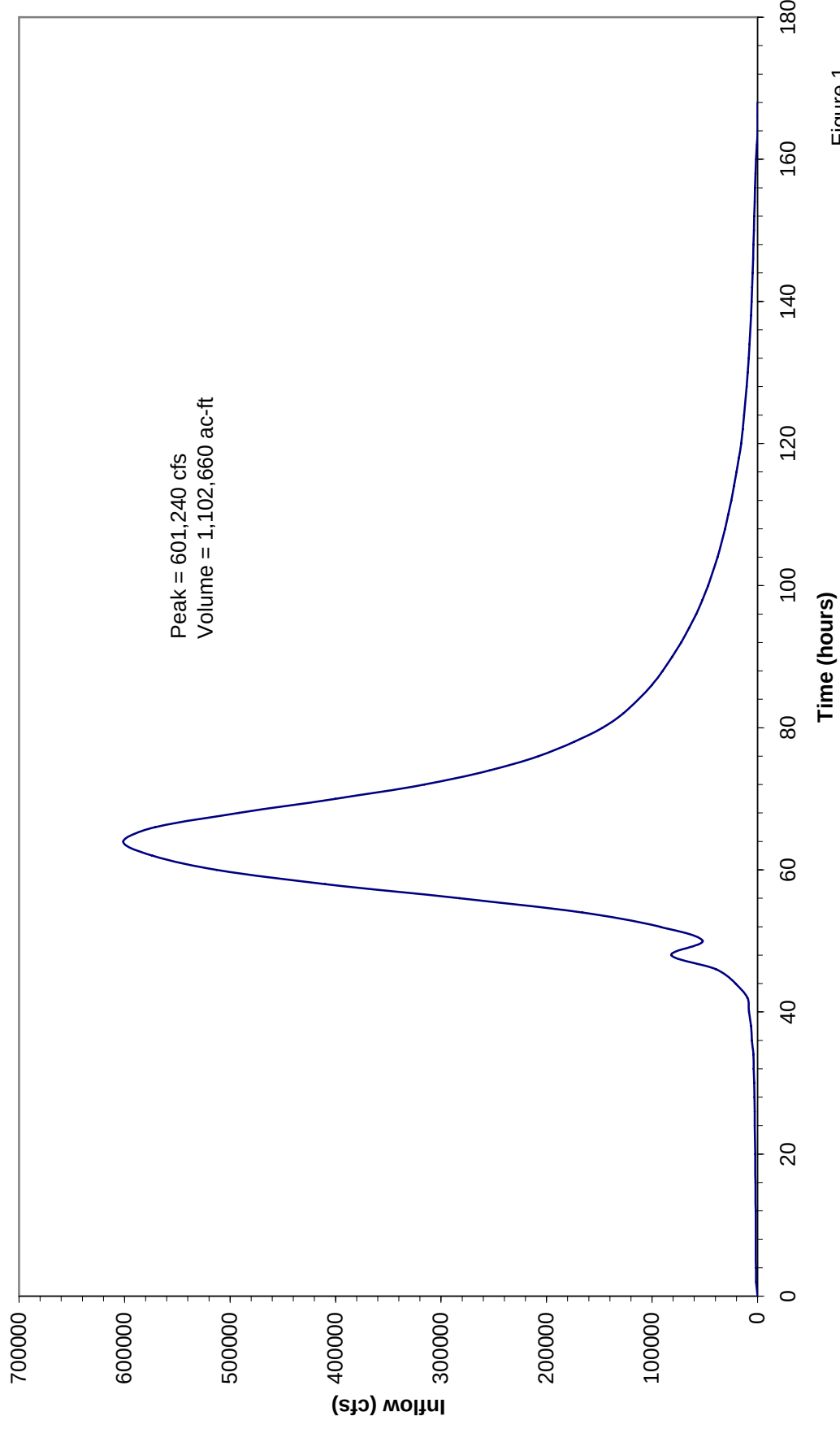


Figure 1

Table 1
Salton Sea, California
North Inflow PMF - subbasins 2, 5 and 1/2 lake surface

Time (hrs)	Inflow (cfs)	Time (hrs)	Inflow (cfs)
0	0	86	100,357
2	1,563	88	89,839
4	1,563	90	80,731
6	1,786	92	72,490
8	1,786	94	64,941
10	1,786	96	58,227
12	1,786	98	52,309
14	2,010	100	46,858
16	2,010	102	42,272
18	2,233	104	38,037
20	2,233	106	34,205
22	2,456	108	30,774
24	2,680	110	27,749
26	2,680	112	24,994
28	2,903	114	22,455
30	3,126	116	20,047
32	3,573	118	17,855
34	4,019	120	15,616
36	5,359	122	14,146
38	6,280	124	12,740
40	8,231	126	11,583
42	9,732	128	10,419
44	20,863	130	9,412
46	39,322	132	8,467
48	81,857	134	7,657
50	52,092	136	6,955
52	92,257	138	6,280
54	166,027	140	5,696
56	282,697	142	5,074
58	409,686	144	4,655
60	512,900	146	4,202
62	573,808	148	3,849
64	601,239	150	3,494
66	570,788	152	3,152
68	491,458	154	2,799
70	400,207	156	2,485
72	315,819	158	1,981
74	254,301	160	1,476
76	207,777	162	620
78	174,038	164	77
80	147,029	166	17
82	127,359	168	0
84	112,776		

Attachment B

Salton Sea, California South Basin PMF Inflow

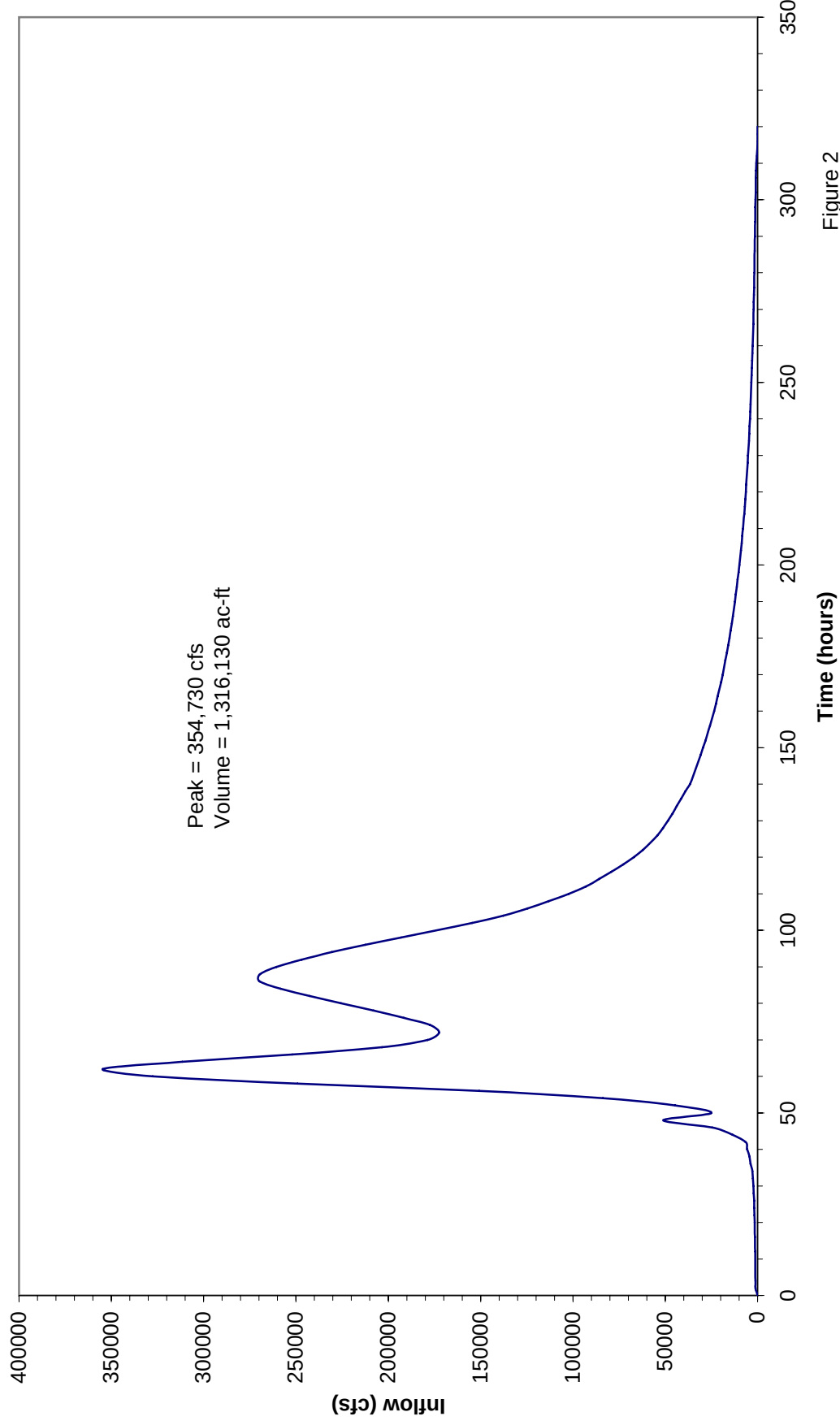


Figure 2

Table 2
Salton Sea, California
South PMF - Subbasins 3, 4 and 1/2 lake surface

Time (hrs)	Inflow (cfs)	Time (hrs)	Inflow (cfs)	Time (hrs)	Inflow (cfs)	Time (hrs)	Inflow (cfs)
0	0	92	246,873	184	13,962	276	1,888
2	1,101	94	230,581	186	13,356	278	1,823
4	1,101	96	212,413	188	12,784	280	1,756
6	1,259	98	193,066	190	12,247	282	1,689
8	1,259	100	173,659	192	11,778	284	1,623
10	1,259	102	154,636	194	11,309	286	1,558
12	1,259	104	137,643	196	10,813	288	1,492
14	1,416	106	124,515	198	10,326	290	1,427
16	1,416	108	113,035	200	9,888	292	1,363
18	1,573	110	102,250	202	9,477	294	1,302
20	1,573	112	93,121	204	9,045	296	1,248
22	1,730	114	85,827	206	8,633	298	1,212
24	1,888	116	79,071	208	8,268	300	1,130
26	1,888	118	72,858	210	7,920	302	1,037
28	2,045	120	67,077	212	7,554	304	993
30	2,202	122	62,021	214	7,220	306	962
32	2,517	124	57,952	216	6,934	308	889
34	2,832	126	54,164	218	6,670	310	757
36	3,775	128	51,198	220	6,404	312	479
38	4,405	130	48,621	222	6,133	314	72
40	5,676	132	46,087	224	5,844	316	8
42	6,442	134	43,771	226	5,587	318	1
44	13,449	136	41,383	228	5,386	320	0
46	24,533	138	39,145	230	5,172		
48	51,062	140	36,660	232	4,934		
50	25,129	142	35,042	234	4,714		
52	44,614	144	33,612	236	4,521		
54	83,727	146	32,177	238	4,324		
56	150,837	148	30,835	240	4,130		
58	249,274	150	29,537	242	3,944		
60	327,578	152	28,214	244	3,783		
62	354,730	154	26,985	246	3,627		
64	311,534	156	25,809	248	3,454		
66	252,073	158	24,673	250	3,314		
68	203,504	160	23,562	252	3,185		
70	178,619	162	22,515	254	3,053		
72	172,527	164	21,636	256	2,927		
74	177,239	166	20,676	258	2,807		
76	191,587	168	19,724	260	2,706		
78	207,918	170	18,908	262	2,561		
80	225,576	172	18,162	264	2,403		
82	242,657	174	17,398	266	2,301		
84	258,330	176	16,659	268	2,228		
86	269,620	178	15,948	270	2,152		
88	269,433	180	15,256	272	2,049		
90	260,412	182	14,603	274	1,951		

Appendix A: Hydrologic Analysis

Salton Sea, California
Subbasins 3 and 4 and 1/2 Lake Surface
Estimate Design Rainfall by Austrailian Procedure using Siriwardena and Weinmann method
for cases where Precipitation estimates are known beyond 100-Yr return period

Local Precipitation			72-hr (Inches)	Areal Reduction applied = .56
NOAA 14 Point Precipitation 1 - Y1	500 Years		3.460	
NOAA 14 Point Precipitation 2 - Y2	1000 Years		4.01	
Gen PMP =	100000 Years		9.75	
			Zd =	2
72-HR PMP =	9.75 (inches)		Sgc =	0.352868
			Sgap =	0.319874
2-Hour Calculations				
Return Period (years)	gy	Ry	Exponet	
5000	0.35	1.2386	0.7470	
10000	0.50	1.3364	0.8060	
20000	0.65	1.4312	0.8632	
50000	0.85	1.5519	0.9360	
100000	1.00	1.6397	0.9890	
200000	1.15	1.7246	1.0402	
500000	1.35	1.8322	1.1051	
1000000	1.50	1.9101	1.1521	
Return Period (years)	72-hr Precip (inches)			
500	3.460			
1000	4.01			
5000	5.59			
10000	6.40			
20000	7.30			
50000	8.63			
100000	9.75			

Restoration of the Salton Sea
Volume 1: Evaluation of Alternatives

Salton Sea, California
Subbasins 2 and 5 and 1/2 Lake Surface
Estimate Design Rainfall by Australian Procedure using Siriwardena and Weinmann method
for cases where Precipitation estimates are known beyond 100-Yr return period

Local Precipitation			72-hr (Inches)	Areal Reduction applied = .64
NOAA 14 Point Precipitation 1 - Y1	500 Years		4.150	
NOAA 14 Point Precipitation 2 - Y2	1000 Years		4.82	
Gen PMP =	100000 Years		13.84	
			Zd =	2
72-HR PMP =	13.84 (inches)		Sgc =	0.316116
			Sgap =	0.335328
2-Hour Calculations				
Return Period (years)	gy	Ry	Exponet	
5000	0.35	1.2256	0.8372	
10000	0.50	1.3257	0.9055	
20000	0.65	1.4275	0.9751	
50000	0.85	1.5648	1.0688	
100000	1.00	1.6707	1.1411	
200000	1.15	1.7783	1.2146	
500000	1.35	1.9232	1.3136	
1000000	1.50	2.0348	1.3899	
Return Period (years)	72-hr Precip (inches)			
500	4.150			
1000	4.82			
5000	6.87			
10000	8.05			
20000	9.44			
50000	11.72			
100000	13.84			

Attachment C

Salton Sea, California North Basin Frequency Inflows

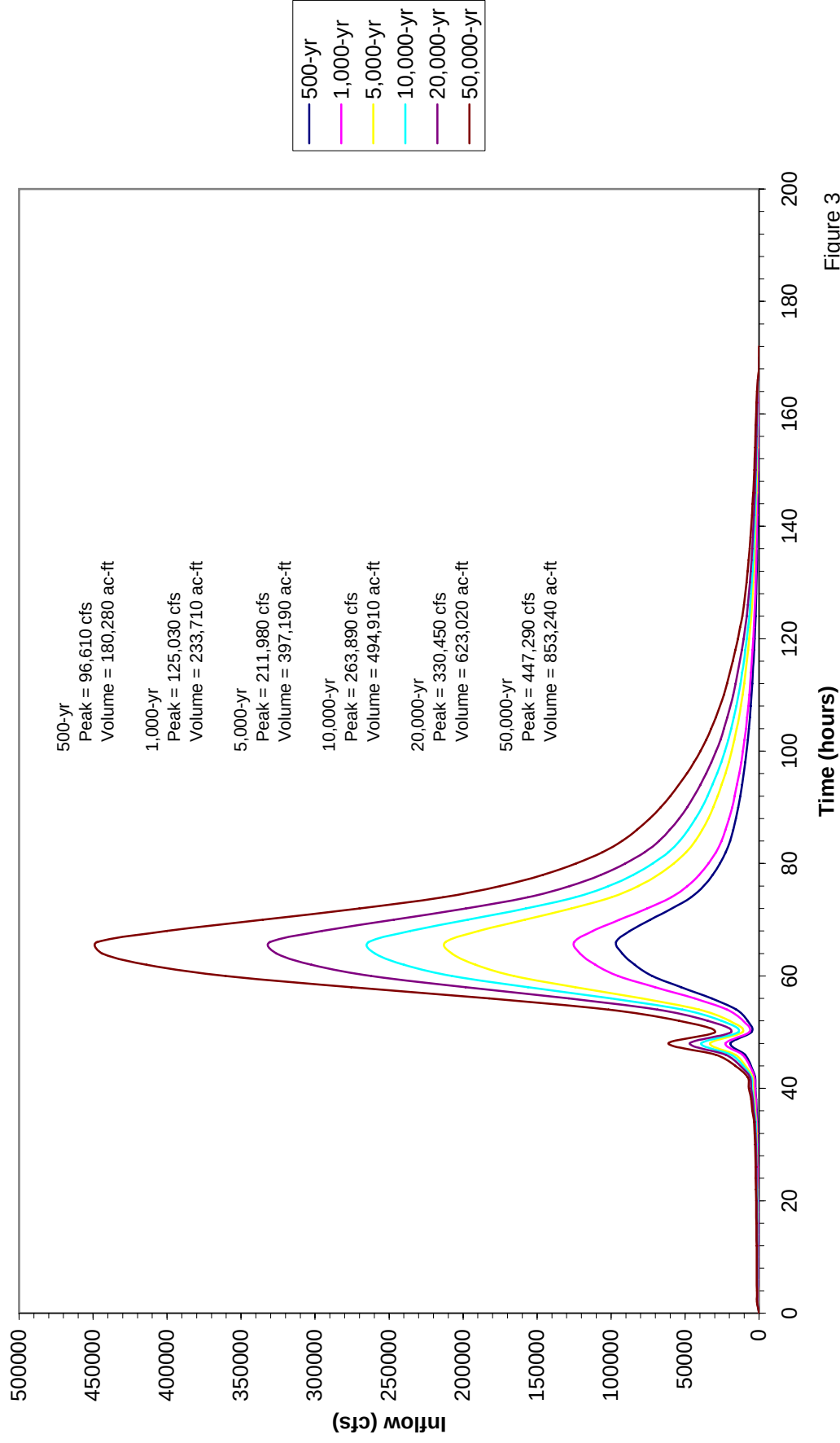


Table 3
Salton Sea, California
North Basin Frequency Inflows - subbasins 2, 5 and 1/2 lake surface

Time (hrs)	Return Period					
	72-hr Total Precipitation					
	500-yr 4.15 in. Inflow (cfs)	1,000-yr 4.82 in. Inflow (cfs)	5,000-yr 6.87 in. Inflow (cfs)	10,000-yr 8.05 in. Inflow (cfs)	20,000-yr 9.44 in. Inflow (cfs)	50,000-yr 11.72 in. Inflow (cfs)
0	0	0	0	0	0	0
2	469	544	776	909	1,066	1,324
4	469	544	776	909	1,066	1,324
6	536	622	887	1,039	1,218	1,513
8	536	622	887	1,039	1,218	1,513
10	536	622	887	1,039	1,218	1,513
12	536	622	887	1,039	1,218	1,513
14	603	700	998	1,169	1,371	1,702
16	603	700	998	1,169	1,371	1,702
18	670	778	1,108	1,299	1,523	1,891
20	670	778	1,108	1,299	1,523	1,891
22	737	855	1,219	1,429	1,675	2,080
24	804	933	1,330	1,559	1,828	2,269
26	804	933	1,330	1,559	1,828	2,269
28	870	1,011	1,441	1,688	1,980	2,458
30	937	1,089	1,552	1,818	2,132	2,647
32	1,071	1,244	1,773	2,078	2,437	3,025
34	1,205	1,400	1,995	2,338	2,742	3,404
36	1,607	1,866	2,660	3,117	3,655	4,538
38	1,875	2,177	3,104	3,637	4,265	5,295
40	2,410	2,800	3,990	4,676	5,483	6,814
42	2,678	3,111	4,434	5,195	6,107	7,705
44	5,490	6,377	9,089	10,653	12,601	16,065
46	9,590	11,206	16,149	19,005	22,650	29,331
48	19,402	22,777	33,101	39,073	46,887	61,305
50	5,052	6,551	11,138	13,871	18,833	29,698
52	7,656	10,668	19,885	25,389	34,683	54,047
54	15,389	21,586	40,546	51,754	68,600	101,760
56	31,945	43,547	79,045	99,890	128,528	182,406
58	52,669	70,301	124,249	156,123	198,266	275,649
60	72,244	95,246	165,624	207,501	262,052	360,356
62	83,999	110,468	191,456	239,893	302,422	413,817
64	92,468	120,824	207,583	259,416	325,980	443,669
66	96,611	125,029	211,978	263,891	330,452	447,291
68	87,220	112,370	189,324	235,510	295,185	400,023
70	73,387	94,276	158,192	196,677	246,686	335,254
72	58,909	75,644	126,850	157,750	198,116	270,065
74	45,993	59,227	99,718	124,180	156,241	213,678
76	37,571	48,439	81,690	101,740	127,962	174,997
78	31,330	40,416	68,215	84,962	106,856	146,102
80	26,406	34,093	57,612	71,772	90,302	123,538
82	22,449	29,038	49,198	61,327	77,209	105,719

Table 3
Salton Sea, California
North Basin Frequency Inflows - subbasins 2, 5 and 1/2 lake surface

Time (hrs)	Return Period					
	72-hr Total Precipitation					
	500-yr 4.15 in. Inflow (cfs)	1,000-yr 4.82 in. Inflow (cfs)	5,000-yr 6.87 in. Inflow (cfs)	10,000-yr 8.05 in. Inflow (cfs)	20,000-yr 9.44 in. Inflow (cfs)	50,000-yr 11.72 in. Inflow (cfs)
84	19,579	25,357	43,038	53,660	67,556	92,497
86	17,471	22,633	38,428	47,906	60,290	82,491
88	15,614	20,239	34,390	42,877	53,971	73,840
90	14,046	18,213	30,962	38,604	48,589	66,467
92	12,705	16,471	27,996	34,901	43,919	60,058
94	11,472	14,872	25,273	31,504	39,643	54,204
96	10,314	13,373	22,732	28,337	35,663	48,775
98	9,294	12,049	20,480	25,529	32,129	43,946
100	8,369	10,853	18,455	23,005	28,955	39,610
102	7,538	9,779	16,637	20,742	26,109	35,719
104	6,841	8,874	15,093	18,813	23,674	32,375
106	6,184	8,020	13,639	17,000	21,394	29,261
108	5,585	7,242	12,314	15,348	19,318	26,425
110	5,025	6,521	11,099	13,837	17,419	23,835
112	4,549	5,904	10,051	12,530	15,771	21,576
114	4,153	5,387	9,163	11,419	14,367	19,639
116	3,740	4,852	8,253	10,287	12,944	17,693
118	3,381	4,386	7,459	9,295	11,689	15,973
120	3,033	3,931	6,678	8,320	10,464	14,304
122	2,716	3,520	5,980	7,450	9,370	12,814
124	2,372	3,080	5,248	6,544	8,245	11,298
126	2,165	2,812	4,790	5,969	7,512	10,283
128	1,952	2,537	4,325	5,391	6,787	9,288
130	1,795	2,331	3,969	4,945	6,221	8,505
132	1,618	2,101	3,579	4,460	5,614	7,680
134	1,469	1,907	3,247	4,046	5,092	6,966
136	1,324	1,720	2,931	3,653	4,599	6,296
138	1,204	1,564	2,666	3,322	4,182	5,723
140	1,099	1,429	2,436	3,037	3,822	5,226
142	1,002	1,301	2,215	2,759	3,472	4,748
144	918	1,191	2,025	2,522	3,172	4,335
146	804	1,045	1,783	2,223	2,802	3,841
148	747	970	1,652	2,058	2,589	3,543
150	670	871	1,488	1,855	2,337	3,201
152	622	808	1,378	1,717	2,161	2,956
154	571	742	1,264	1,575	1,982	2,708
156	520	675	1,150	1,433	1,803	2,464
158	471	611	1,039	1,294	1,628	2,225
160	422	547	930	1,159	1,458	1,974
162	376	489	834	1,040	1,297	1,737
164	341	429	698	860	1,063	1,413
166	247	303	473	577	712	947

Table 3
Salton Sea, California
North Basin Frequency Inflows - subbasins 2, 5 and 1/2 lake surface

Time (hrs)	Return Period					
	72-hr Total Precipitation					
	500-yr 4.15 in. Inflow (cfs)	1,000-yr 4.82 in. Inflow (cfs)	5,000-yr 6.87 in. Inflow (cfs)	10,000-yr 8.05 in. Inflow (cfs)	20,000-yr 9.44 in. Inflow (cfs)	50,000-yr 11.72 in. Inflow (cfs)
168	0	0	0	5	23	65
170				0	0	11
172						0

Salton Sea, California

South Basin Frequency Inflows

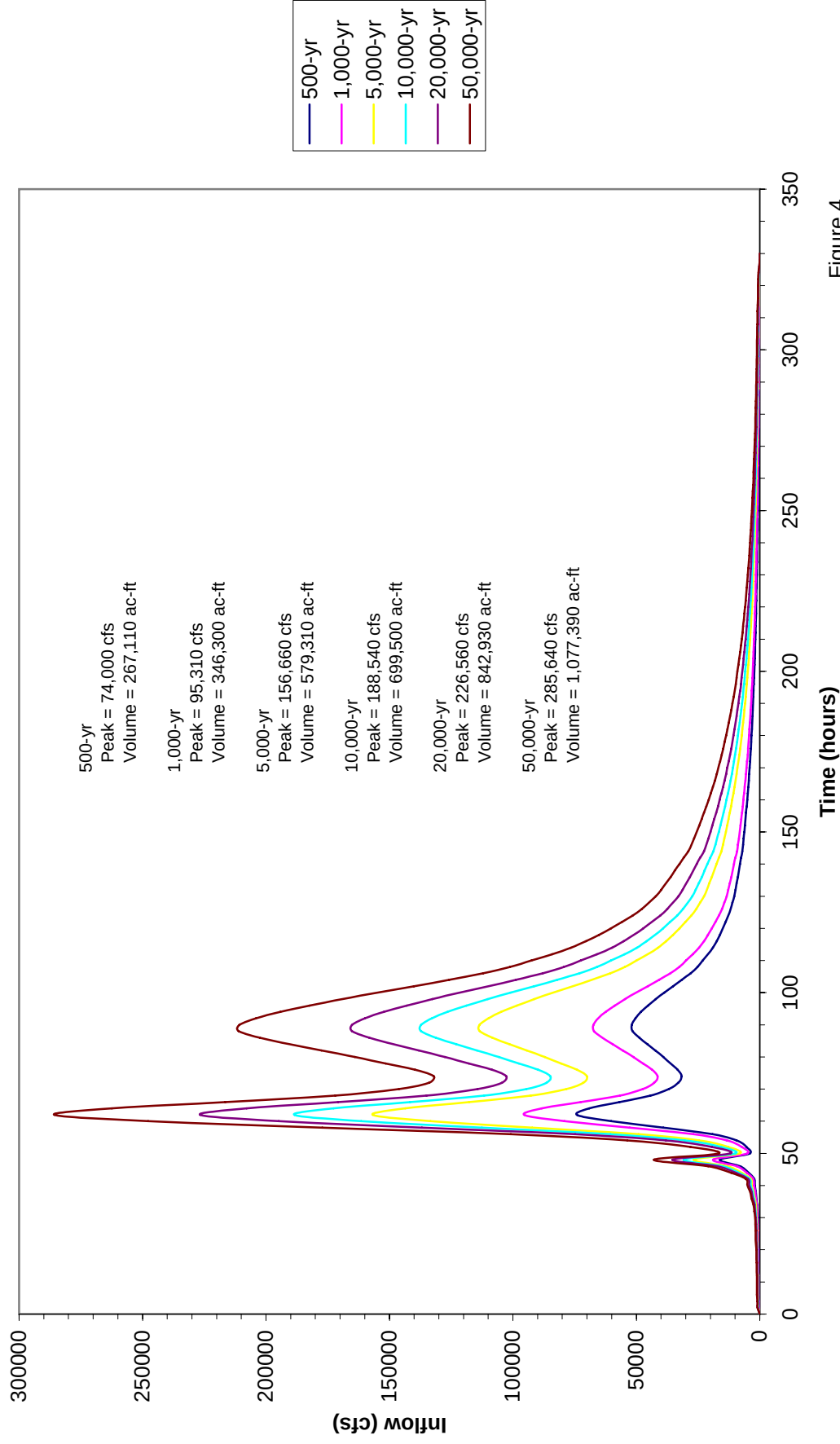


Table 4
Salton Sea, California
South Basin Frequency Inflows - subbasins 3, 4 and 1/2 lake surface

Time (hrs)	Return Period 72-hr Total Precipitation					
	500-yr 3.46 in	1,000-yr 4.01 in	5,000-yr 5.59 in	10,000-yr 6.40 in	20,000-yr 7.30 in	50,000-yr 8.63 in
	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)
0	0	0	0	0	0	0
2	391	453	631	723	824	975
4	391	453	631	723	824	975
6	447	518	722	826	942	1,114
8	447	518	722	826	942	1,114
10	447	518	722	826	942	1,114
12	447	518	722	826	942	1,114
14	502	582	812	929	1,060	1,253
16	502	582	812	929	1,060	1,253
18	558	647	902	1,033	1,178	1,392
20	558	647	902	1,033	1,178	1,392
22	614	712	992	1,136	1,296	1,532
24	670	776	1,082	1,239	1,413	1,671
26	670	776	1,082	1,239	1,413	1,671
28	726	841	1,173	1,342	1,531	1,810
30	782	906	1,263	1,446	1,649	1,949
32	893	1,035	1,443	1,652	1,885	2,228
34	1,005	1,165	1,623	1,859	2,120	2,506
36	1,340	1,553	2,165	2,478	2,827	3,342
38	1,563	1,812	2,525	2,891	3,298	3,899
40	2,010	2,329	3,247	3,717	4,240	5,013
42	2,233	2,588	3,608	4,130	4,711	5,608
44	4,578	5,305	7,396	8,467	9,675	11,594
46	7,992	9,312	13,112	15,061	17,269	20,856
48	16,136	18,876	26,761	30,802	35,404	42,905
50	3,987	5,089	8,274	9,906	11,962	16,657
52	5,432	7,333	12,820	15,639	19,415	28,068
54	9,402	13,325	24,630	30,443	38,014	53,666
56	19,113	26,831	49,055	60,495	74,795	100,847
58	39,034	52,742	92,192	112,518	136,862	177,242
60	60,185	79,062	133,386	161,492	194,877	247,765
62	74,002	95,312	156,657	188,538	226,562	285,641
64	69,074	88,288	143,646	172,610	207,848	262,460
66	56,807	72,498	117,788	141,563	170,815	216,450
68	44,197	56,640	92,675	111,602	134,986	171,963
70	36,852	47,464	78,348	94,512	114,288	146,106
72	33,035	42,811	71,449	86,384	104,478	134,049
74	31,729	41,423	69,990	84,833	102,635	132,047
76	33,303	43,590	74,013	89,768	108,494	139,593
78	36,138	47,318	80,465	97,588	117,839	151,525
80	39,096	51,201	87,144	105,683	127,566	164,025
82	42,392	55,495	94,452	114,522	138,170	177,542

Table 4
Salton Sea, California
South Basin Frequency Inflows - subbasins 3, 4 and 1/2 lake surface

Time (hrs)	Return Period 72-hr Total Precipitation					
	500-yr 3.46 in	1,000-yr 4.01 in	5,000-yr 5.59 in	10,000-yr 6.40 in	20,000-yr 7.30 in	50,000-yr 8.63 in
	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)
84	45,477	59,540	101,396	122,941	148,312	190,353
86	48,806	63,784	108,324	131,235	158,196	202,571
88	51,543	67,127	113,394	137,181	165,203	211,063
90	51,872	67,404	113,471	137,148	165,135	210,821
92	50,416	65,436	109,959	132,838	159,949	204,136
94	48,123	62,404	104,720	126,460	152,258	194,232
96	45,324	58,723	98,404	118,789	143,005	182,342
98	42,148	54,562	91,310	110,186	132,634	169,043
100	38,669	50,026	83,633	100,896	121,447	154,732
102	35,132	45,410	75,803	91,414	110,017	140,157
104	31,547	40,760	68,007	82,001	98,695	125,785
106	27,971	36,182	60,488	72,972	87,874	112,091
108	25,238	32,667	54,663	65,960	79,423	101,295
110	23,087	29,869	49,942	60,251	72,524	92,468
112	20,967	27,130	45,378	54,749	65,910	84,074
114	18,999	24,606	41,221	49,752	59,912	76,466
116	17,475	22,639	37,946	45,806	55,153	70,383
118	16,183	20,966	35,144	42,423	51,075	65,164
120	14,966	19,389	32,496	39,226	47,224	60,255
122	13,858	17,949	30,075	36,301	43,699	55,764
124	12,762	16,541	27,748	33,501	40,339	51,502
126	11,838	15,349	25,767	31,114	37,465	47,847
128	11,103	14,398	24,175	29,193	35,147	44,888
130	10,369	13,459	22,634	27,343	32,930	42,082
132	9,834	12,767	21,476	25,946	31,242	39,916
134	9,367	12,160	20,456	24,714	29,755	38,011
136	8,901	11,555	19,440	23,486	28,278	36,119
138	8,480	11,008	18,519	22,372	26,931	34,385
140	8,046	10,437	17,544	21,190	25,505	32,571
142	7,623	9,886	16,615	20,067	24,152	30,849
144	7,097	9,220	15,538	18,780	22,620	28,928
146	6,798	8,833	14,892	17,998	21,668	27,699
148	6,540	8,497	14,321	17,306	20,833	26,628
150	6,278	8,157	13,749	16,616	20,003	25,567
152	6,020	7,823	13,187	15,937	19,187	24,524
154	5,793	7,525	12,680	15,322	18,444	23,571
156	5,549	7,208	12,145	14,677	17,668	22,581
158	5,311	6,900	11,628	14,052	16,917	21,622
160	5,093	6,616	11,150	13,474	16,221	20,731
162	4,882	6,342	10,686	12,912	15,544	19,865
164	4,678	6,076	10,234	12,366	14,886	19,026
166	4,466	5,803	9,782	11,822	14,234	18,196

Table 4
Salton Sea, California
South Basin Frequency Inflows - subbasins 3, 4 and 1/2 lake surface

Time (hrs)	Return Period 72-hr Total Precipitation					
	500-yr 3.46 in	1,000-yr 4.01 in	5,000-yr 5.59 in	10,000-yr 6.40 in	20,000-yr 7.30 in	50,000-yr 8.63 in
	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)	Inflow (cfs)
168	4,281	5,564	9,381	11,338	13,651	17,449
170	4,134	5,369	9,044	10,927	13,153	16,806
172	3,952	5,133	8,646	10,448	12,577	16,075
174	3,770	4,900	8,260	9,983	12,019	15,366
176	3,623	4,708	7,938	9,594	11,550	14,765
178	3,491	4,536	7,645	9,239	11,121	14,214
180	3,351	4,353	7,337	8,867	10,674	13,643
182	3,215	4,177	7,039	8,506	10,240	13,089
184	3,085	4,008	6,755	8,163	9,827	12,559
186	2,957	3,842	6,475	7,824	9,419	12,039
188	2,837	3,686	6,211	7,505	9,035	11,547
190	2,718	3,532	5,952	7,192	8,658	11,066
192	2,604	3,383	5,702	6,890	8,295	10,602
194	2,498	3,245	5,468	6,608	7,955	10,169
196	2,392	3,108	5,241	6,334	7,626	9,750
198	2,301	2,991	5,044	6,096	7,339	9,382
200	2,221	2,886	4,864	5,878	7,076	9,042
202	2,135	2,774	4,673	5,646	6,796	8,685
204	2,041	2,652	4,468	5,400	6,500	8,309
206	1,954	2,538	4,279	5,172	6,226	7,959
208	1,878	2,439	4,111	4,968	5,981	7,643
210	1,804	2,343	3,946	4,768	5,740	7,335
212	1,723	2,238	3,770	4,556	5,484	7,010
214	1,646	2,139	3,606	4,358	5,247	6,707
216	1,582	2,056	3,465	4,187	5,041	6,442
218	1,521	1,975	3,327	4,020	4,838	6,183
220	1,451	1,885	3,175	3,837	4,619	5,905
222	1,387	1,802	3,039	3,673	4,422	5,654
224	1,334	1,734	2,924	3,535	4,255	5,440
226	1,287	1,673	2,820	3,409	4,104	5,245
228	1,240	1,611	2,716	3,282	3,951	5,049
230	1,193	1,549	2,608	3,152	3,793	4,847
232	1,139	1,479	2,492	3,011	3,625	4,633
234	1,084	1,409	2,376	2,872	3,459	4,423
236	1,047	1,361	2,295	2,774	3,340	4,269
238	1,013	1,316	2,217	2,679	3,224	4,120
240	971	1,261	2,124	2,567	3,090	3,949
242	926	1,203	2,027	2,450	2,950	3,771
244	889	1,155	1,947	2,353	2,832	3,620
246	855	1,110	1,870	2,260	2,721	3,477
248	818	1,063	1,790	2,163	2,604	3,328
250	782	1,016	1,713	2,069	2,491	3,185