APPENDIX 1B

Design-Storm Runoff, Sutter County, California
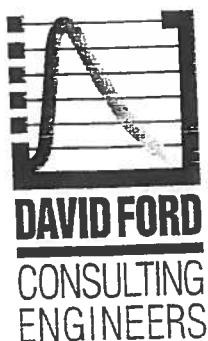
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Design-storm runoff:
Sutter County, California

Public Works – Road Department
Sutter County, California

July 1998

PO Box 188529
Sacramento, CA 95818

2115 J Street, Suite 212
Sacramento, CA 95816

Ph. 916.447.8779
Fx. 916.447.8780

DAVID FORD
CONSULTING
ENGINEERS

Table 2. SCS rainfall temporal distributions

Time (hours) (1a)	Fraction of 24-hour total		Time (hours) (1b)	Fraction of 24-hour total	
	Type IA (2a)	Type I (3a)		Type IA (2b)	Type I (3b)
0.0	0.000	0.000	12.5	0.683	0.706
0.5	0.010	0.008	13.0	0.701	0.728
1.0	0.022	0.017	13.5	0.719	0.748
1.5	0.036	0.026	14.0	0.736	0.766
2.0	0.051	0.035	14.5	0.753	0.783
2.5	0.067	0.045	15.0	0.769	0.799
3.0	0.083	0.055	15.5	0.785	0.815
3.5	0.099	0.065	16.0	0.800	0.830
4.0	0.116	0.076	16.5	0.815	0.844
4.5	0.135	0.087	17.0	0.830	0.857
5.0	0.156	0.099	17.5	0.844	0.870
5.5	0.179	0.112	18.0	0.858	0.882
6.0	0.204	0.126	18.5	0.871	0.893
6.5	0.233	0.140	19.0	0.884	0.905
7.0	0.268	0.156	19.5	0.896	0.916
7.5	0.310	0.174	20.0	0.908	0.926
8.0	0.425	0.194	20.5	0.920	0.936
8.5	0.480	0.219	21.0	0.932	0.946
9.0	0.520	0.254	21.5	0.944	0.956
9.5	0.550	0.303	22.0	0.956	0.965
10.0	0.577	0.515	22.5	0.967	0.974
10.5	0.601	0.583	23.0	0.978	0.983
11.0	0.623	0.624	23.5	0.989	0.992
11.5	0.644	0.655	24.0	1.000	1.000
12.0	0.664	0.682	-	-	-

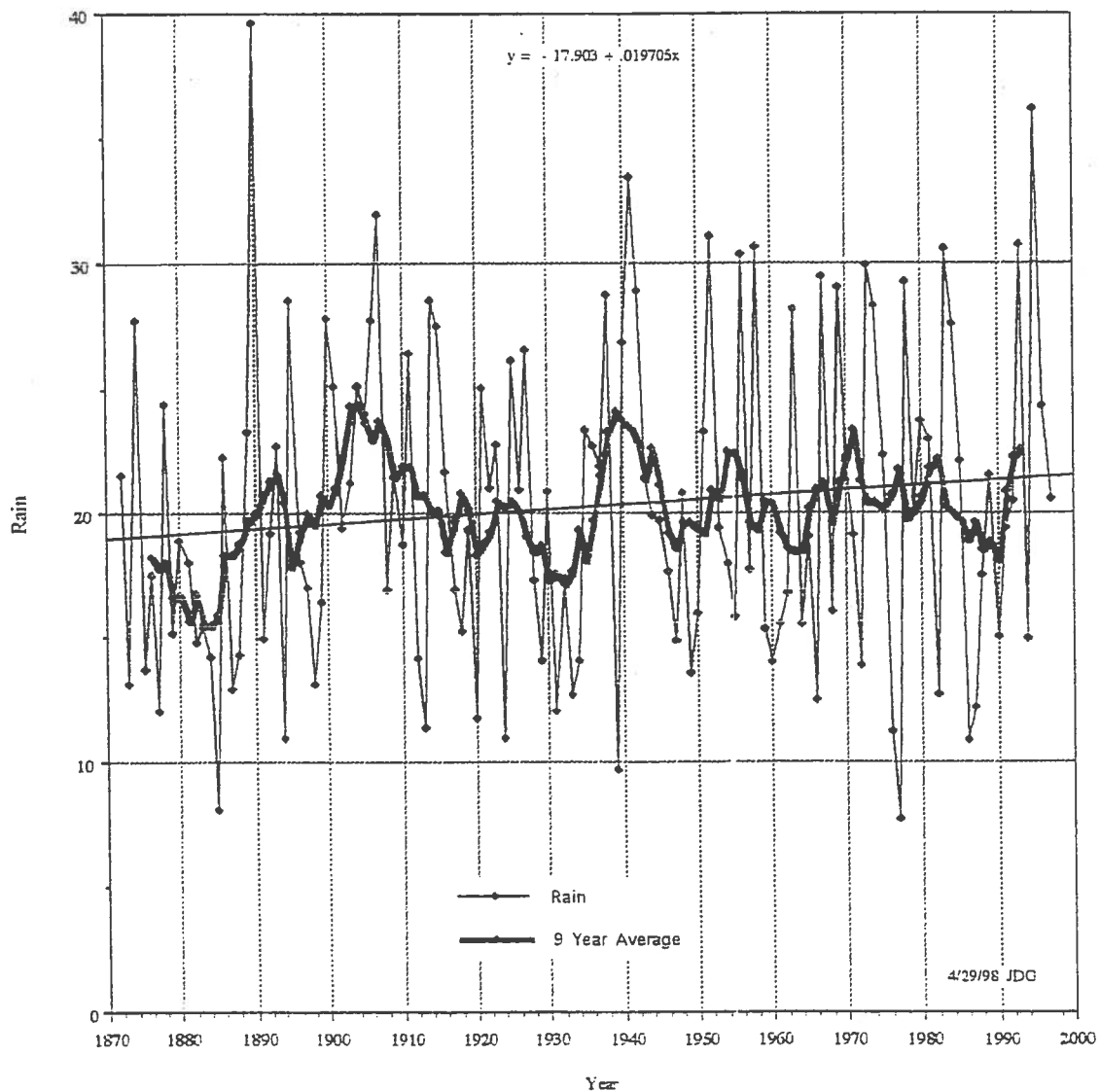## Runoff-volume computation

Loss model

In the absence of data to develop other methods, we recommend the SCS curve number (CN) model for estimation of stormwater runoff volumes. This model estimates the volume of direct runoff per unit area, P_e, as:

$$P_e = \frac{(P - I_a)^2}{P - I_a + S} \tag{1}$$

Design Rainfall Study for Sutter County

Rainfall at Marysville 1872 to 1997

$y = -17.903 + .019705x$

4/29/98 JDG

Prepared By James D. Goodridge

Consulting Engineer, CE 14608

PO Box 970

Mendocino, CA 95460

707 937 4709

June 11, 1998

Sutter County Design Rainfall – 25 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.30	0.40	0.48	0.64	0.86	1.14	1.35	1.81	2.42	3.23	4.06	4.72	5.18	5.63	5.89	6.55	7.00	7.85	8.74	10.35	14.68	23.74
16	0.31	0.42	0.49	0.66	0.88	1.18	1.39	1.86	2.48	3.32	4.20	4.90	5.39	5.86	6.13	6.83	7.31	8.24	9.19	10.90	15.51	25.32
17	0.32	0.43	0.51	0.68	0.90	1.21	1.43	1.91	2.55	3.41	4.34	5.08	5.60	6.09	6.38	7.10	7.63	8.62	9.65	11.44	16.33	26.91
18	0.33	0.44	0.52	0.69	0.93	1.24	1.47	1.96	2.62	3.50	4.48	5.26	5.81	6.32	6.62	7.38	7.95	9.01	10.11	11.99	17.15	28.49
19	0.34	0.45	0.53	0.71	0.95	1.27	1.51	2.01	2.69	3.59	4.62	5.44	6.02	6.55	6.86	7.66	8.27	9.40	10.57	12.53	17.97	30.07
20	0.35	0.46	0.55	0.73	0.97	1.30	1.54	2.06	2.75	3.68	4.76	5.62	6.24	6.78	7.10	7.94	8.59	9.78	11.03	13.08	18.79	31.66
21	0.35	0.47	0.56	0.75	1.00	1.33	1.58	2.11	2.82	3.77	4.90	5.80	6.45	7.01	7.34	8.21	8.90	10.17	11.48	13.62	19.61	33.24
22	0.36	0.48	0.57	0.77	1.02	1.37	1.62	2.16	2.89	3.86	5.04	5.98	6.66	7.24	7.58	8.49	9.22	10.56	11.94	14.17	20.43	34.82

Sutter County Design Rainfall – 50 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.34	0.45	0.53	0.71	0.95	1.26	1.50	2.00	2.67	3.57	4.55	5.29	5.79	6.28	6.53	7.23	7.66	8.57	9.58	11.34	16.02	25.51
16	0.34	0.46	0.55	0.73	0.97	1.30	1.54	2.06	2.75	3.67	4.70	5.49	6.02	6.54	6.80	7.54	8.00	9.00	10.08	11.94	16.92	27.21
17	0.35	0.47	0.56	0.75	1.00	1.33	1.58	2.11	2.82	3.77	4.86	5.70	6.26	6.80	7.07	7.85	8.35	9.42	10.58	12.53	17.81	28.92
18	0.36	0.49	0.57	0.77	1.03	1.37	1.62	2.17	2.90	3.87	5.01	5.90	6.50	7.05	7.33	8.15	8.70	9.84	11.09	13.13	18.71	30.62
19	0.36	0.50	0.59	0.79	1.05	1.40	1.66	2.22	2.97	3.97	5.17	6.10	6.73	7.31	7.60	8.46	9.05	10.26	11.59	13.73	19.61	32.32
20	0.37	0.51	0.60	0.81	1.08	1.44	1.71	2.28	3.04	4.07	5.33	6.30	6.97	7.57	7.87	8.76	9.40	10.68	12.09	14.33	20.50	34.02
21	0.38	0.52	0.62	0.83	1.10	1.47	1.75	2.33	3.12	4.17	5.48	6.50	7.21	7.83	8.14	9.07	9.75	11.11	12.59	14.93	21.40	35.72
22	0.40	0.53	0.63	0.85	1.13	1.51	1.79	2.39	3.19	4.26	5.64	6.70	7.44	8.08	8.41	9.38	10.09	11.53	13.10	15.52	22.29	37.42

Sutter County Design Rainfall – 100 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.37	0.49	0.58	0.77	1.03	1.38	1.64	2.19	2.92	3.90	5.02	5.85	6.38	6.92	7.15	6.66	8.32	9.26	10.38	12.28	17.28	27.16
16	0.38	0.50	0.60	0.80	1.06	1.42	1.68	2.25	3.00	4.01	5.19	6.07	6.64	7.20	7.44	6.94	8.70	9.71	10.92	12.92	18.25	28.97
17	0.39	0.52	0.61	0.82	1.09	1.46	1.73	2.31	3.08	4.12	5.36	6.29	6.90	7.49	7.73	7.22	9.08	10.17	11.47	13.57	19.22	30.78
18	0.40	0.53	0.63	0.84	1.12	1.50	1.77	2.37	3.16	4.23	5.53	6.52	7.16	7.77	8.03	7.51	9.46	10.62	12.01	14.22	20.18	32.59
19	0.41	0.54	0.64	0.86	1.15	1.53	1.82	2.43	3.24	4.33	5.71	6.74	7.42	8.05	8.32	7.79	9.83	11.08	12.56	14.86	21.15	34.40
20	0.42	0.56	0.66	0.88	1.18	1.57	1.86	2.49	3.33	4.44	5.88	6.96	7.68	8.34	8.61	8.07	10.21	11.53	13.10	15.51	22.12	36.21
21	0.43	0.57	0.68	0.90	1.21	1.61	1.91	2.55	3.41	4.55	6.05	7.18	7.94	8.62	8.91	8.35	10.59	11.99	13.65	16.16	23.08	38.02
22	0.44	0.58	0.69	0.92	1.24	1.65	1.95	2.61	3.49	4.66	6.22	7.41	8.20	8.90	9.20	8.64	10.97	12.45	14.19	16.81	24.05	39.83

Sutter County Design Rainfall – 200 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.40	0.53	0.63	0.84	1.12	1.49	1.77	2.37	3.16	4.22	5.48	6.39	6.96	7.54	7.74	8.52	8.96	9.91	11.15	13.17	18.19	28.71
16	0.41	0.54	0.64	0.86	1.15	1.54	1.82	2.43	3.25	4.34	5.67	6.64	7.24	7.85	8.06	8.88	9.37	10.39	11.73	13.87	19.21	30.63
17	0.42	0.56	0.66	0.88	1.18	1.58	1.87	2.50	3.34	4.46	5.86	6.88	7.52	8.16	8.38	9.24	9.78	10.88	12.32	14.56	20.23	32.54
18	0.43	0.57	0.68	0.91	1.21	1.62	1.92	2.56	3.42	4.57	6.04	7.12	7.81	8.47	8.69	9.60	10.18	11.37	12.90	15.26	21.25	34.46
19	0.44	0.59	0.70	0.93	1.24	1.66	1.97	2.63	3.51	4.69	6.23	7.37	8.09	8.78	9.01	9.96	10.59	11.86	13.48	15.95	22.26	36.37
20	0.45	0.60	0.71	0.95	1.27	1.70	2.02	2.69	3.60	4.81	6.42	7.61	8.38	9.09	9.33	10.32	11.00	12.34	14.07	16.64	23.28	38.28
21	0.46	0.62	0.73	0.98	1.31	1.74	2.07	2.76	3.69	4.93	6.61	7.85	8.66	9.40	9.65	10.68	11.41	12.83	14.65	17.34	24.30	40.20
22	0.47	0.63	0.75	1.00	1.34	1.79	2.12	2.83	3.77	5.04	6.79	8.10	8.95	9.71	9.97	11.04	11.81	13.32	15.24	18.03	25.32	42.11

Sutter County Design Rainfall - 2 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.17	0.22	0.26	0.35	0.47	0.62	0.74	0.99	1.32	1.76	2.07	2.37	2.58	2.83	3.07	3.47	3.73	4.34	4.74	5.67	8.20	14.69
16	0.17	0.23	0.27	0.36	0.48	0.64	0.76	1.01	1.36	1.81	2.14	2.46	2.69	2.94	3.20	3.61	3.90	4.55	4.99	5.97	8.65	15.67
17	0.17	0.23	0.28	0.37	0.49	0.66	0.78	1.04	1.39	1.86	2.21	2.55	2.79	3.06	3.32	3.76	4.07	4.77	5.23	6.27	9.11	16.65
18	0.18	0.24	0.28	0.38	0.51	0.68	0.80	1.07	1.43	1.91	2.28	2.64	2.90	3.18	3.45	3.91	4.24	4.98	5.48	6.57	9.57	17.63
19	0.18	0.25	0.29	0.39	0.52	0.69	0.82	1.10	1.47	1.96	2.35	2.73	3.00	3.29	3.57	4.05	4.41	5.19	5.73	6.86	10.03	18.61
20	0.19	0.25	0.30	0.40	0.53	0.71	0.84	1.12	1.50	2.01	2.42	2.82	3.11	3.41	3.70	4.20	4.58	5.41	5.98	7.16	10.49	19.58
21	0.19	0.26	0.31	0.41	0.54	0.73	0.86	1.15	1.54	2.05	2.49	2.91	3.21	3.52	3.83	4.35	4.75	5.62	6.23	7.46	10.95	20.56
22	0.20	0.26	0.31	0.42	0.56	0.75	0.88	1.18	1.57	2.10	2.56	3.00	3.32	3.64	3.95	4.49	4.92	5.83	6.48	7.76	11.41	21.54

Sutter County Design Rainfall - 3 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.20	0.26	0.31	0.42	0.56	0.75	0.88	1.18	1.58	2.11	2.48	2.85	3.21	3.50	3.78	4.27	4.56	5.35	5.85	6.98	10.07	17.49
16	0.20	0.27	0.32	0.43	0.57	0.77	0.91	1.21	1.62	2.17	2.56	2.96	3.34	3.65	3.93	4.45	4.76	5.61	6.16	7.34	10.63	18.66
17	0.21	0.28	0.33	0.44	0.59	0.79	0.93	1.25	1.67	2.22	2.65	3.07	3.47	3.79	4.09	4.63	4.97	5.88	6.47	7.71	11.19	19.82
18	0.21	0.29	0.34	0.45	0.61	0.81	0.96	1.28	1.71	2.28	2.73	3.18	3.60	3.93	4.24	4.81	5.18	6.14	6.78	8.08	11.75	20.99
19	0.21	0.29	0.35	0.46	0.62	0.83	0.98	1.31	1.75	2.34	2.82	3.29	3.73	4.08	4.40	4.99	5.39	6.40	7.08	8.45	12.32	22.16
20	0.22	0.30	0.36	0.48	0.64	0.85	1.01	1.35	1.80	2.40	2.90	3.40	3.86	4.22	4.55	5.17	5.59	6.67	7.39	8.82	12.88	23.32
21	0.23	0.31	0.37	0.49	0.65	0.87	1.03	1.38	1.84	2.46	2.99	3.51	3.99	4.36	4.71	5.35	5.80	6.93	7.70	9.18	13.44	24.49
22	0.24	0.32	0.37	0.50	0.67	0.89	1.06	1.41	1.88	2.52	3.07	3.62	4.12	4.51	4.87	5.53	6.01	7.19	8.00	9.55	14.01	25.66

Sutter County Design Rainfall - 5 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.22	0.30	0.35	0.47	0.63	0.84	0.99	1.32	1.77	2.36	2.86	3.30	3.65	3.98	4.25	4.77	5.12	5.89	6.48	7.70	11.06	18.79
16	0.23	0.30	0.36	0.48	0.64	0.86	1.02	1.36	1.82	2.42	2.96	3.43	3.80	4.14	4.42	4.97	5.35	6.18	6.82	8.11	11.67	20.05
17	0.23	0.31	0.37	0.49	0.66	0.88	1.04	1.40	1.86	2.49	3.06	3.56	3.94	4.30	4.60	5.18	5.58	6.47	7.16	8.52	12.29	21.30
18	0.24	0.32	0.38	0.51	0.68	0.91	1.07	1.43	1.91	2.56	3.15	3.68	4.09	4.47	4.77	5.38	5.81	6.76	7.49	8.92	12.91	22.55
19	0.25	0.33	0.39	0.52	0.70	0.93	1.10	1.47	1.96	2.62	3.25	3.81	4.24	4.63	4.95	5.58	6.05	7.05	7.83	9.33	13.53	23.81
20	0.25	0.34	0.40	0.53	0.71	0.95	1.13	1.51	2.01	2.69	3.35	3.93	4.39	4.79	5.12	5.78	6.28	7.34	8.17	9.74	14.15	25.06
21	0.26	0.35	0.41	0.55	0.73	0.97	1.15	1.54	2.06	2.75	3.45	4.06	4.54	4.95	5.29	5.98	6.51	7.63	8.51	10.14	14.77	26.31
22	0.26	0.35	0.42	0.56	0.75	1.00	1.18	1.58	2.11	2.82	3.55	4.19	4.69	5.12	5.47	6.19	6.75	7.91	8.85	10.55	15.38	27.57

Sutter County Design Rainfall - 10 Year Return Period

MAP	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	8 Day	10 day	15 Day	20 Day	30 Day	60 Day	Year
15	0.26	0.35	0.41	0.55	0.73	0.97	1.15	1.54	2.06	2.75	3.40	3.94	4.33	4.59	4.99	5.58	5.96	6.80	7.52	8.92	12.74	21.12
16	0.27	0.35	0.42	0.56	0.75	1.00	1.19	1.58	2.12	2.83	3.51	4.09	4.51	4.78	5.20	5.82	6.23	7.13	7.91	9.40	13.46	22.53
17	0.27	0.36	0.43	0.58	0.77	1.03	1.22	1.63	2.17	2.90	3.63	4.24	4.69	4.97	5.40	6.06	6.50	7.47	8.31	9.87	14.17	23.94
18	0.28	0.37	0.44	0.59	0.79	1.06	1.25	1.67	2.23	2.98	3.75	4.39	4.86	5.16	5.61	6.29	6.77	7.80	8.70	10.34	14.88	25.35
19	0.29	0.38	0.45	0.61	0.81	1.08	1.28	1.71	2.29	3.06	3.86	4.54	5.04	5.35	5.81	6.53	7.04	8.14	9.10	10.81	15.59	26.76
20	0.29	0.39	0.47	0.62	0.83	1.11	1.31	1.76	2.35	3.13	3.98	4.69	5.22	5.54	6.02	6.77	7.32	8.47	9.49	11.28	16.31	28.17
21	0.30	0.40	0.48	0.64	0.85	1.14	1.35	1.80	2.40	3.21	4.10	4.84	5.40	5.72	6.22	7.00	7.59	8.81	9.88	11.75	17.02	29.57
22	0.31	0.41	0.49	0.65	0.87	1.16	1.38	1.84	2.46	3.29	4.21	4.99	5.57	5.91	6.43	7.24	7.86	9.14	10.28	12.22	17.73	30.98

JDG

6/10/98

MERIDIAN

SUTTER

LIVE OAK

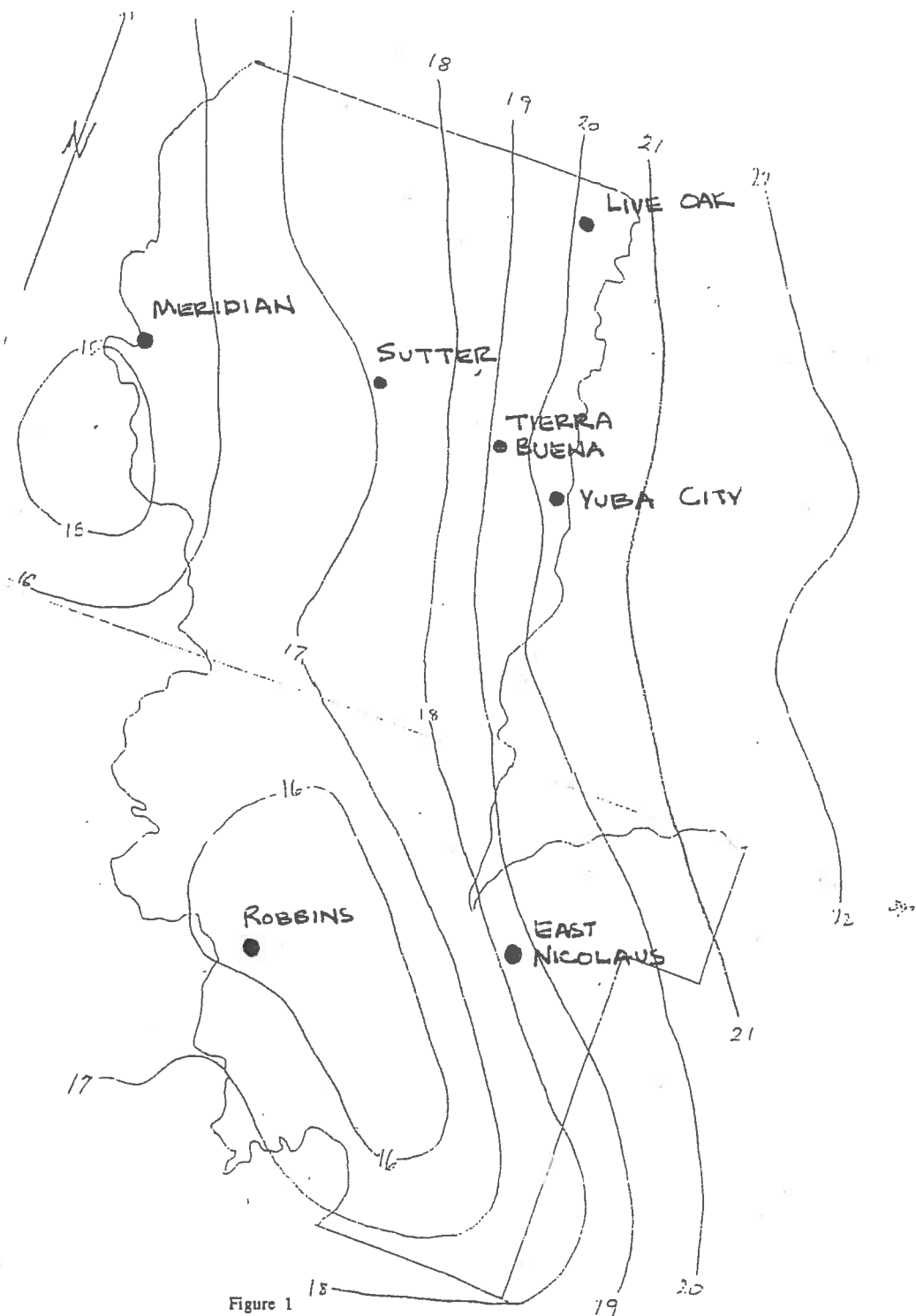TIERRA
BUENA

YUBA CITY

ROBBINS

EAST
NICOLAUS

Figure 1
Sutter County Design Rainfall Study
Lines of Equal Average Annual Rainfall
Based on or Corrected to the 1951 to 1980 Base Period
Prepared by James D Goodridge
Consulting Engineer

4/25/98

Click on the image to view full-size

Figure 1
Mean Annual Precipitation (MAP)
Lines of Equal Average Annual Rainfall (inches)

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