LAWRENCE & ASSOCIATES
Engineering Geologists • Ground-Water Hydrologists

2001 MARKET ST., RM 523
REDDING, CALIFORNIA 96001
TELEPHONE (916) 244-9703
FAX (916) 244-5021

DAVID A. LAWRENCE, C.E.G. 618
CLAYTON E. COLES, R.G. 5007

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CONJUNCTIVE-USE STUDY

GROUND WATER AND CASPAR CREEK

NEAR

CASPAR, CALIFORNIA

August 12, 1992

Prepared for:

Mendocino City Community Services District
P.O. Box 1029
Mendocino, California 95460

Table of Contents

Text **Page**

Introduction 1
Conjunctive-use operation 2
Scope of investigation 3
Findings 4
Conclusions 5
Ground-water geology 6
Storage capacity of the aquifer supplying the property 7
Available surface water from Caspar Creek 8
Operation study 9
Projected yield of pond 11

Tables

1. Aquifer properties of terrace deposits 6

Figures (following text)

1. Site map
2. Caspar Creek drainage area
3. Conjunctive use operation study, average monthly discharge, gpm
4. Conjunctive use operation study, average annual ground-water extraction
5. Conjunctive use operation study, Caspar Creek diversion vs. ground-water pumping

Appendix

Table A-1 - Determination of Caspar Creek diversion

Introduction

This study was performed to evaluate an alternative water supply for the Mendocino City Community Services District (MCCSD) from conjunctive use of ground water and surface water in the Caspar Creek drainage near Caspar.

The investigation is a feasibility-level analysis based on geologic and hydrologic information from published and unpublished sources. No field work, other than a site inspection, has been conducted as part of this study.

The impetus for this study is due in part to the willingness of Oscar Smith, owner of the Caspar Cattle Company, to work with the MCCSD on developing a water supply.

The area for conjunctive use operation includes an area of approximately 140 acres lying adjacent to and east of Highway 1 and immediately north of Caspar Creek. The area includes an existing pond and several wells.

The boundary of the aquifer unit, as shown on Figure 1, is based on hydrologic conditions and not property lines.

Conjunctive-use operation

The conjunctive-use concept includes taking water from a surface-water source during months of high stream flow, and storing this water in an aquifer for later retrieval during months of low river flow.

The water-supply plan envisioned for the Caspar Creek drainage includes,

(a) diversion from Caspar Creek,

(b) recharging the shallow aquifer located to the north of the Creek with diverted water using spreading basins or galleries, and

(c) extracting the recharged water through wells, ponds, or galleries.

Scope of investigation

The scope of this investigation included:

(a) synthesis of monthly flows on Caspar Creek during the 35-year period October 1950 through September 1985,

(b) a monthly operation study of historical flows from Caspar Creek to determine the amount of water available for diversion, recharge, storage, and extraction, and

(c) evaluate the potential of pumping ground water from the on-site pond.

The operation study assumed the maximum ground-water extraction would be 350 gpm, regardless of the month.

Geohydrologic information used to evaluate the water-supply potential for the pond and property at Caspar was obtained from the Mendocino County Coastal Ground Water Study, California Department of Water Resources (DWR), June 1982.

Findings

1. The operation study, based on 35 years of estimated flow in Caspar Creek, shows that aquifer storage at the project site can provide 350 gpm consistently for most years, but is limited to less than 100 gpm during dry years typical to the drought year of 1976-77.

2. The average yield from the aquifer during the five lowest years is estimated to be 223, 292, 311, 317, and 321 gpm, and the lowest monthly yield was 39 gpm during September of 1977.

3. The long-term (180 days) yield of the on-site pond is estimated to be less than 40 gpm, assuming the aquifer is full at the start of the 180-day period.

Conclusions

1. The operation study indicates sufficient water is available from Caspar Creek for diversion and spreading to support a ground-water yield of 350 gpm most of the time, but not during drought years.

2. Extraction of ground water from the shallow aquifer equivalent to its potential yield could not be accomplished by pumping the existing pond.

3. The most efficient method for extracting ground water from the shallow aquifer would be through a perimeter drain set on the contact between the terrace deposits and the underlying bedrock shale.

4. Although the operation study indicates a good supply could be developed, the study is based on assumed hydrologic properties that would have to be verified in the field. Of all the field work to be performed, the most important would be large-scale percolation tests to evaluate recharge potential.

Ground-water geology

Ground water of the Caspar area is primarily found in terrace deposits that overlie Franciscan bedrock. The Caspar property is overlain by the terrace deposits with an average thickness thought to be about 30 feet. Average values of terrace-aquifer properties of the designated "unit VI", which includes the Caspar property, (DWR, 1982) are listed in Table 1.

Table 1
Aquifer Properties of Terrace Deposits

Storage capacity unit VI, AF	=	2280
Area of unit VI, Ac =		1460
Saturated thickness of aquifer, Ft	=	23
Average specific yield, % =		8

Note: Unit designation and values from DWR, 1982

storage capacity of the aquifer supplying the property

The storage capacity of the shallow aquifer adjacent to Caspar Creek is estimated to be about 260 AF (acre-feet), based on an area of 140 acres, a saturated interval of 23 feet, and a specific yield of 8 percent.

The configuration of the storage area is based on a unit defined between drainage boundaries of Caspar Creek to the south, an unnamed drainage to the north, and an aquifer limit to the west.

Available surface water from Caspar Creek

Table A-1 of the Appendix presents an estimate of surface-water discharge in Caspar Creek during a period from October 1950 through September 1985. These estimated flows are based on unit-runoff values in cubic-feet/square mile (cfs/mi^2) multiplied by the drainage area of Caspar Creek (8.173 mi^2), as mapped in Figure 2.

The unit-runoff values were derived from flows measured at the USGS gauging station located on the Navarro River at Fort Bragg for the period described above, versus the known drainage area providing these flows.

Maximum-available diversion from Caspar Creek is determined by subtracting the lowest monthly estimated flow of Caspar Creek for a given year from the estimated monthly discharge for each month of the same given year. This leaves flow in Caspar Creek during the summer equal to or greater than the lowest observed base flow.

Operation study

The operation study conducted for conjunctive use of ground water and surface water included the following assumptions:

(a) Storage capacity of the aquifer available for retrieval was limited to 80 percent of the total storage, or about 210 AF.

(b) No limitation was placed on extraction; that is, it was assumed if the water could be recharged it could be retrieved through pumping.

(c) No limitation was placed on recharge; that is, if the water was available from Caspar Creek it was assumed it could be recharged.

(d) No adjustment to the operation study was made due to direct precipitation on the aquifer unit or from seepage and evapotranspiration losses of spread water.

(e) The maximum diversion from Caspar Creek was fixed at 550 gpm, a level that would provide the greatest amount of ground-water yield.

The monthly ground-water yield from the operation study is shown on Figure 3. The average-annual yield is shown on Figure 4. The relationship between ground-water yield and diversion is shown on Figure 5.

During the course of the 35-year operation study, 350 gpm is available from storage for most of the period, recharged by a maximum surface-water diversion of 550 gpm. A maximum diversion of 550 gpm was used based on the curve shown in Figure 5, which shows that 550 gpm will provide ground-water pumping at an average rate of nearly 339 gpm for the 35-year period.

However, there are several time intervals during the operation study when the projected available ground-water discharge will be below 350 gpm for one or more consecutive months, as shown on Figure 3. For example, based on the estimated flows of Caspar Creek in 1977, only 181 gpm, 46 gpm, 39 gpm, and 87 gpm are available for pumping during the respective months of July, August, September, and October.

projected yield of pond

The yield of the on-site pond was based on transmissivity and storage values estimated from drawdown data from local wells (DWR, 1982).

DWR reported the average well yield in the area was 13.7 gpm and the drawdown was 13.6 feet. Using these values in the Theis nonequilibrium equation gave a transmissivity of 920 gpd/ft, based on an assumed test-pumping time of 4 hours.

The Theis equation used is,

$s = (114.6 \times Q \times W(u))/T$, where:

s = drawdown in pumping well

Q = pumping rate, gpm (variable)

T = transmissivity, gpd/ft

W(u) = well function of u, an exponential integral determined by:

$(-0.5772)-(\log \text{ base } e(u))-(u)-(u^2/2x2!)+(u^3/3x3!)-(u^4/4x4!)+\ldots$, where:

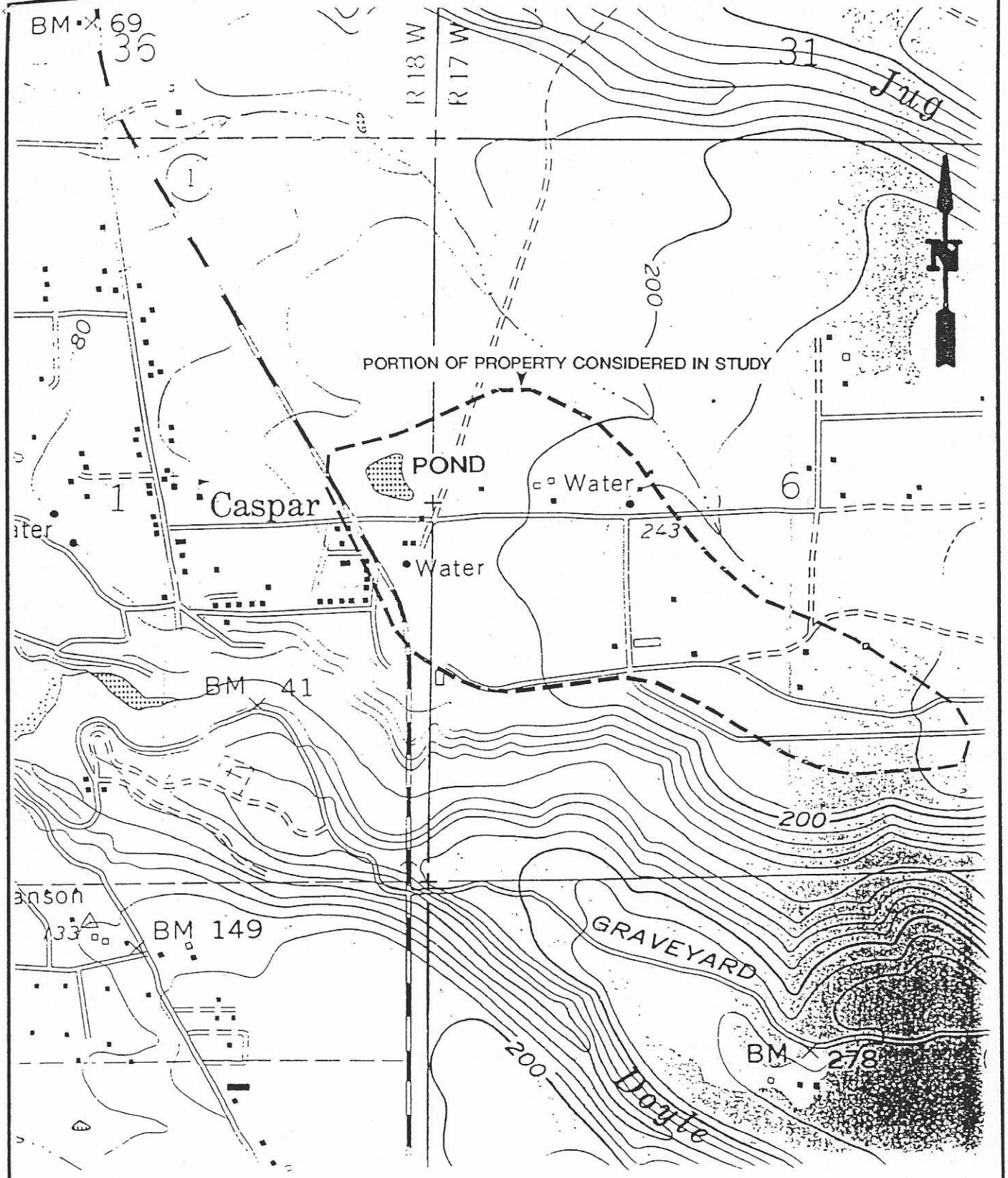
$u = (1.87 \times r^2 \times S)/(T \times t)$, where:

r = radius of pond opening, ft = 125
S = storage coefficient, dimensionless = 0.068
t = time since pumping began (assumed to be 180 days)

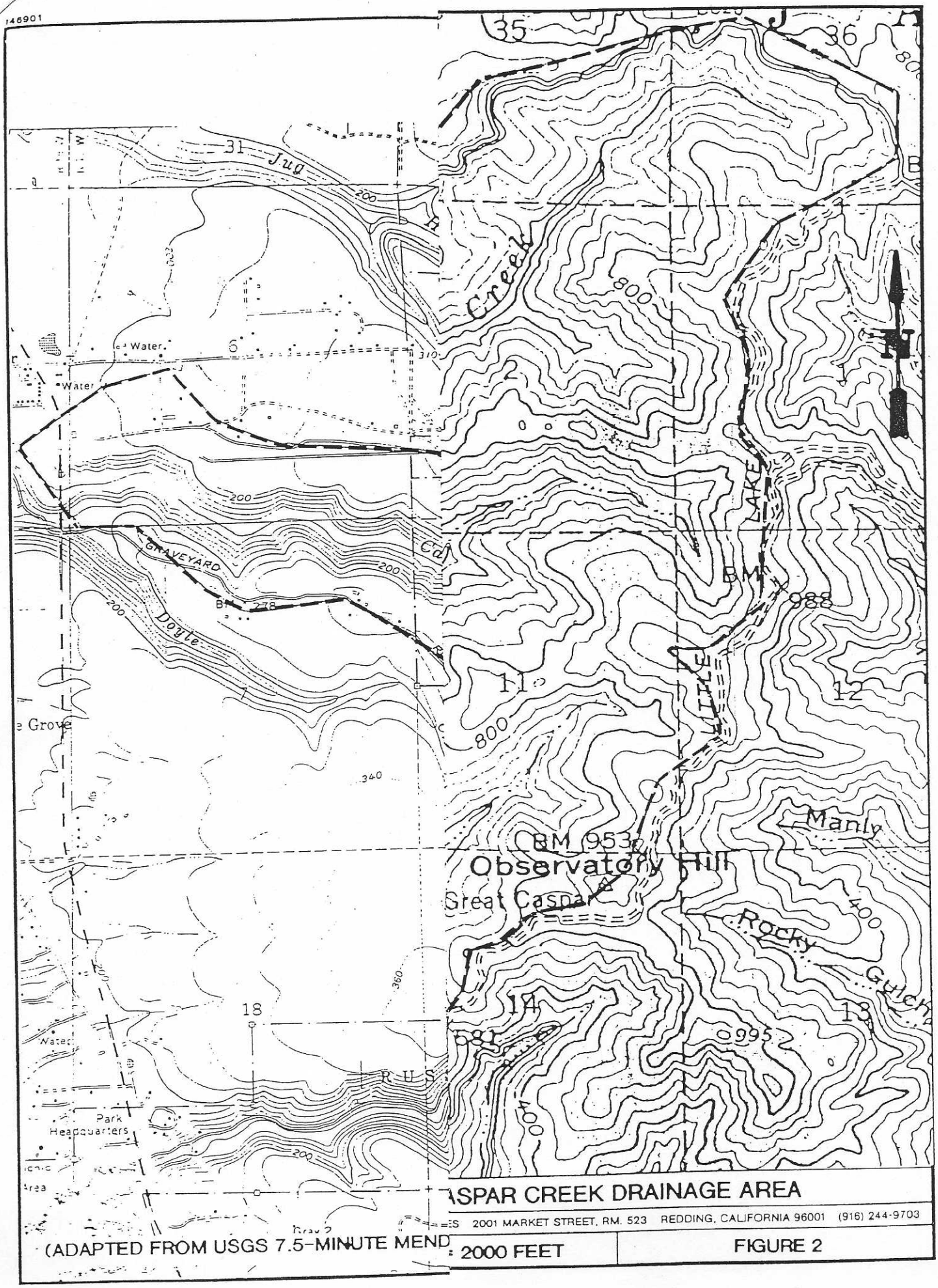
Using a transmissivity value of 920 gpm/ft in the above Theis equation gives a yield of about 38 gpm for the on-site pond at

the end of 180 days. The available drawdown in the pond was limited to 80 percent of the saturated interval of the aquifer, or about 18.3 feet, which is 80 percent of the assumed aquifer thickness of 23 feet.

146901



SITE MAP (ADAPTED FROM 7.5-MINUTE USGS TOPOGRAPHIC QUAD, MENDOCINO, CALIF., 1960)		LAWRENCE & ASSOCIATES 2001 MARKET STREET, RM. 523 REDDING, CA 96001 PHONE (916) 244-9703 FAX (916) 244-5021	SCALE: 1 INCH = 1000 FEET DATE: 8-11-92 JOB NO.: 92.08.01
CLIENT: MENDOCINO CCSD	PROJECT: CONJUNCTIVE-USE STUDY	DRAWN BY: B. GARTNER	FIGURE 1



ASPAR CREEK DRAINAGE AREA

ES 2001 MARKET STREET, RM. 523 REDDING, CALIFORNIA 96001 (916) 244-9703

FIGURE 2

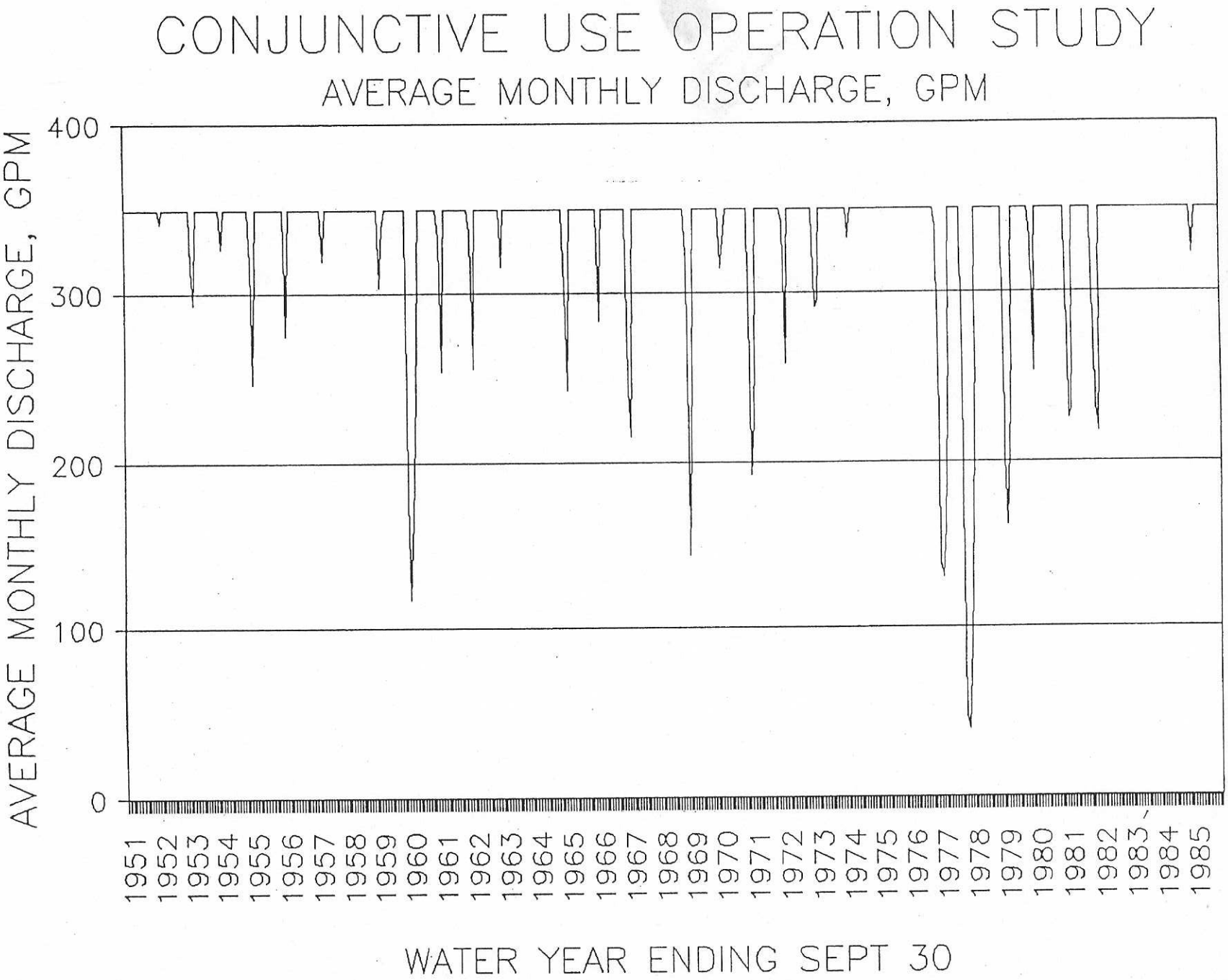

CONJUNCTIVE USE OPERATION STUDY
AVERAGE MONTHLY DISCHARGE, GPM
AVERAGE MONTHLY DISCHARGE, GPM
400
300
200
100
0
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
WATER YEAR ENDING SEPT 30

FIGURE 3

CONJUNCTIVE USE OPERATION STUDY

AVERAGE ANNUAL GROUND-WATER EXTRACTION

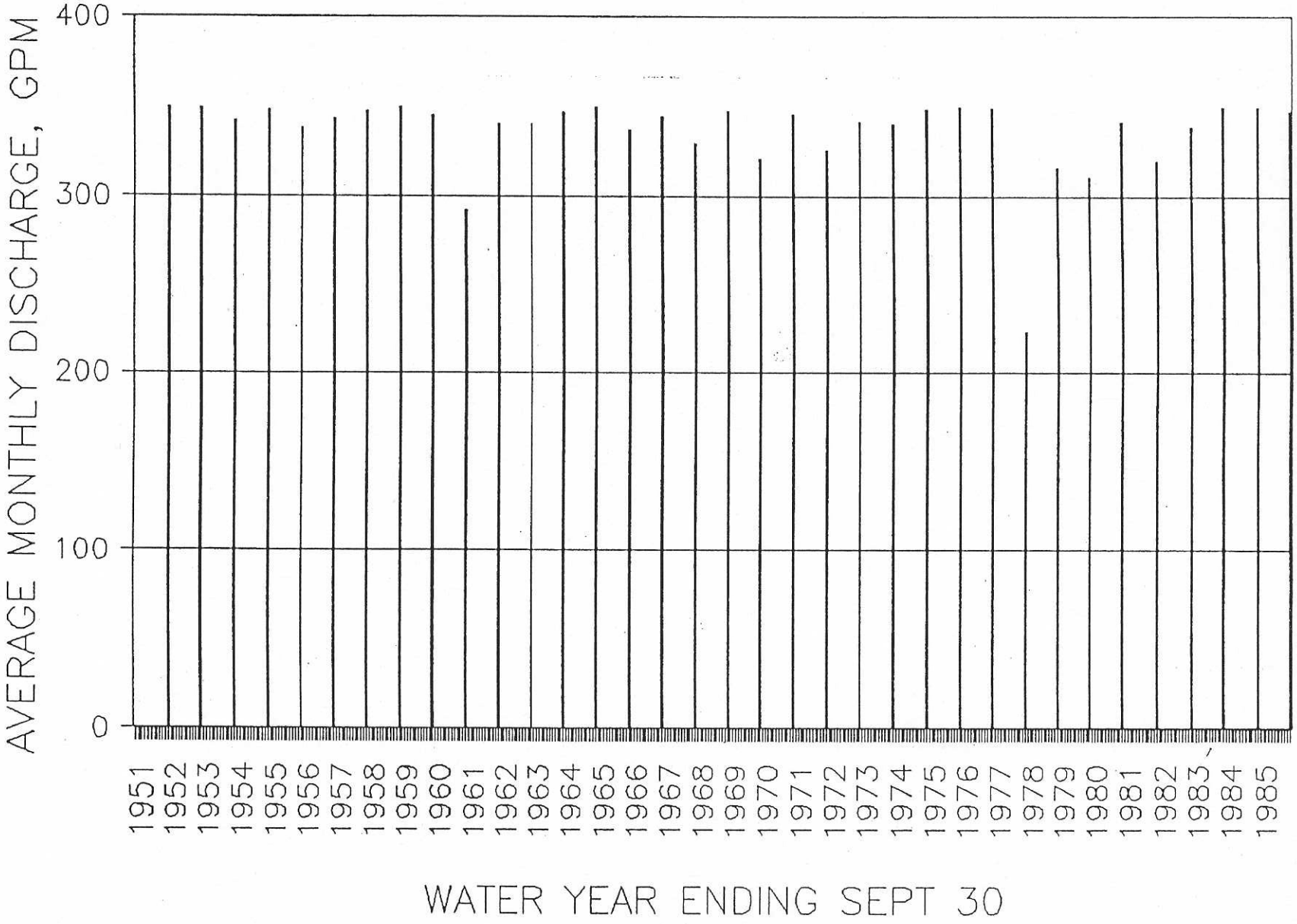


FIGURE 4

CONJUNCTIVE USE OPERATION STUDY

CASPAR CREEK DIVERSION VS. GROUND-WATER PUMPING

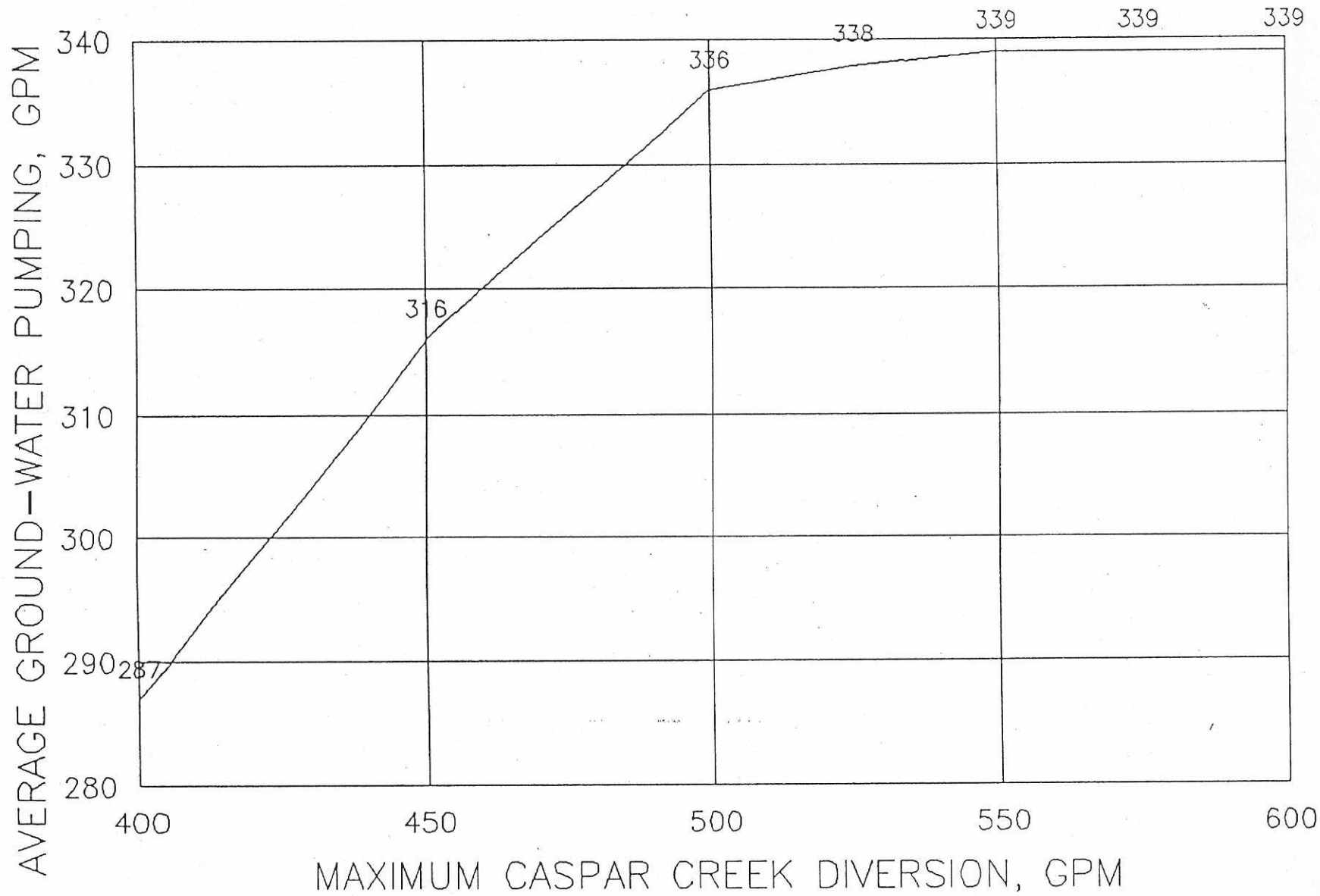


FIGURE 5

APPENDIX

Table A-1: Determination of Caspar Creek diversion

Table A-1
Determination of Caspar Creek diversion

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
OCT	1950	260.00	.855	3137	603982	3035	584368
NOV		520.00	1.711	6275	1207964	6173	1188350
DEC		1562.71	5.140	18857	3630187	18755	3610573
JAN	1951	2301.94	7.572	27777	5347414	27675	5327800
FEB		1525.46	5.018	18407	3543666	18305	3524052
MAR		883.10	2.905	10656	2051441	10554	2031827
APR		145.00	.477	1750	336836	1648	317222
MAY		176.52	.581	2130	410048	2028	390434
JUN		46.70	.154	564	108484	462	88871
JUL		22.32	.073	269	51856	167	32242
AUG		12.86	.042	155	29869	53	10255
SEP		8.44	.028	102	19614	0	0
OCT		21.32	.070	257	49533	155	29919
NOV		201.40	.663	2430	467854	2328	448240
DEC		2636.48	8.673	31814	6124573	31712	6104959
JAN	1952	2776.68	9.134	33505	6450244	33392	6428332
FEB		1682.64	5.535	20304	3908793	20190	3886881
MAR		1256.19	4.132	15158	2918148	15044	2896236
APR		223.47	.735	2697	519115	2583	497204
MAY		99.10	.326	1196	230203	1082	208291
JUN		54.23	.178	654	125984	541	104073
JUL		29.13	.096	351	67667	238	45756
AUG		13.77	.045	166	31998	52	10086
SEP		11.97	.039	144	27799	31	5887
OCT		9.43	.031	114	21911	0	0
NOV		31.99	.105	386	74305	272	52394
DEC		1575.03	5.181	19005	3658812	18892	3636901
JAN	1953	3760.39	12.370	45376	8735409	45172	8696228
FEB		298.00	.980	3596	692256	3392	653075
MAR		739.94	2.434	8929	1718876	8725	1679695
APR		332.93	1.095	4017	773407	3814	734225
MAY		213.97	.704	2582	497049	2378	457867
JUN		109.47	.360	1321	254292	1117	215111
JUL		36.61	.120	442	85052	238	45871
AUG		21.94	.072	265	50956	61	11775
SEP		16.87	.055	204	39181	0	0

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
OCT		21.97	.072	265	51031	62	11850
NOV		228.50	.752	2757	530807	2554	491626
DEC		226.61	.745	2734	526424	2531	487242
JAN	1954	2003.77	6.591	24179	4654783	23927	4606310
FEB		1607.79	5.289	19401	3734899	19149	3686425
MAR		1048.87	3.450	12656	2436536	12405	2388062
APR		924.97	3.043	11161	2148705	10910	2100231
MAY		121.48	.400	1466	282208	1214	233735
JUN		67.70	.223	817	157268	565	108794
JUL		28.52	.094	344	66243	92	17770
AUG		22.23	.073	268	51631	16	3157
SEP		20.87	.069	252	48473	0	0
OCT		24.39	.080	294	56651	42	8178
NOV		250.57	.824	3024	582068	2772	533595
DEC		742.32	2.442	8957	1724421	8706	1675948
JAN	1955	768.74	2.529	9276	1785794	9162	1763725
FEB		223.43	.735	2696	519026	2581	496958
MAR		144.29	.475	1741	335188	1626	313119
APR		533.87	1.756	6442	1240176	6327	1218108
MAY		230.55	.758	2782	535566	2667	513497
JUN		46.23	.152	558	107400	443	85332
JUL		22.97	.076	277	53354	163	31286
AUG		12.39	.041	149	28775	35	6707
SEP		9.50	.031	115	22069	0	0
OCT		13.22	.043	160	30709	45	8640
NOV		54.10	.178	653	125675	538	103606
DEC		3834.26	12.613	46267	8907012	46152	8884943
JAN	1956	3436.45	11.304	41467	7982904	41339	7958234
FEB		2554.21	8.402	30821	5933460	30693	5908790
MAR		594.10	1.954	7169	1380092	7041	1355421
APR		137.27	.452	1656	318872	1528	294201
MAY		71.97	.237	868	167182	740	142511
JUN		38.00	.125	459	88274	330	63604
JUL		21.06	.069	254	48933	126	24263
AUG		13.52	.044	163	31398	35	6728
SEP		10.62	.035	128	24670	0	0
OCT		35.31	.116	426	82025	298	57354

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
NOV		41.80	.138	504	97102	376	72431
DEC		31.23	.103	377	72538	249	47867
JAN	1957	418.52	1.377	5050	972216	4860	935648
FEB		1159.00	3.813	13985	2692366	13795	2655798
MAR		1267.77	4.170	15298	2945049	15108	2908481
APR		295.40	.972	3565	686217	3375	649648
MAY		467.42	1.538	5640	1085819	5450	1049250
JUN		103.63	.341	1251	240741	1061	204172
JUL		32.32	.106	390	75086	200	38517
AUG		15.74	.052	190	36569	0	0
SEP		32.60	.107	393	75730	203	39161
OCT		366.97	1.207	4428	852469	4238	815900
NOV		240.33	.791	2900	558296	2710	521728
DEC		685.97	2.256	8277	1593508	8087	1556940
JAN	1958	1692.29	5.567	20420	3931204	20241	3896591
FEB		5521.79	18.164	66630	12827152	66450	12792539
MAR		1255.65	4.130	15152	2916874	14972	2882261
APR		1820.50	5.988	21967	4229036	21788	4194423
MAY		143.97	.474	1737	334438	1557	299825
JUN		75.63	.249	913	175697	733	141084
JUL		35.03	.115	423	81380	243	46767
AUG		18.87	.062	228	43837	48	9225
SEP		14.90	.049	180	34613	0	0
OCT		15.61	.051	188	36269	9	1656
NOV		46.07	.152	556	107013	376	72400
DEC		47.97	.158	579	111429	399	76817
JAN	1959	1364.94	4.490	16470	3170756	16386	3154577
FEB		1917.79	6.309	23141	4455031	23057	4438853
MAR		271.10	.892	3271	629760	3187	613581
APR		155.53	.512	1877	361305	1793	345127
MAY		52.61	.173	635	122220	551	106042
JUN		26.80	.088	323	62257	239	46078
JUL		12.65	.042	153	29382	69	13204
AUG		6.96	.023	84	16179	0	0
SEP		17.52	.058	211	40691	127	24513
OCT		15.00	.049	181	34845	97	18666
NOV		14.93	.049	180	34690	96	18512

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
DEC		25.81	.085	311	59949	227	43770
JAN	1960	297.42	.978	3589	690908	3510	675762
FEB		2056.21	6.764	24812	4776602	24733	4761456
MAR		1249.58	4.110	15078	2902786	15000	2887640
APR		231.97	.763	2799	538860	2720	523714
MAY		122.97	.404	1484	285655	1405	270509
JUN		56.20	.185	678	130553	599	115407
JUL		24.55	.081	296	57026	218	41880
AUG		12.85	.042	155	29839	76	14693
SEP		6.52	.021	79	15146	0	0
OCT		15.22	.050	184	35347	105	20201
NOV		110.27	.363	1331	256150	1252	241004
DEC		916.77	3.016	11062	2129674	10984	2114528
JAN	1961	320.71	1.055	3870	745011	3763	724336
FEB		1339.86	4.407	16168	3112499	16060	3091824
MAR		1152.90	3.792	13912	2678203	13804	2657529
APR		261.83	.861	3159	608241	3052	587566
MAY		141.55	.466	1708	328818	1601	308143
JUN		54.77	.180	661	127223	553	106549
JUL		16.23	.053	196	37693	88	17018
AUG		14.39	.047	174	33421	66	12747
SEP		8.90	.029	107	20675	0	0
OCT		11.65	.038	141	27074	33	6400
NOV		222.17	.731	2681	516095	2573	495420
DEC		414.29	1.363	4999	962400	4892	941725
JAN	1962	247.52	.814	2987	574982	2870	552604
FEB		2294.21	7.547	27684	5329478	27567	5307100
MAR		1194.13	3.928	14409	2773971	14293	2751593
APR		160.63	.528	1938	373153	1822	350774
MAY		68.97	.227	832	160213	716	137834
JUN		33.10	.109	399	76892	283	54513
JUL		15.13	.050	183	35145	66	12767
AUG		11.95	.039	144	27749	28	5370
SEP		9.63	.032	116	22378	0	0
OCT		341.13	1.122	4116	792445	4000	770067
NOV		124.43	.409	1502	289060	1385	266681
DEC		639.39	2.103	7715	1485301	7599	1462923

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
JAN	1963	647.94	2.131	7818	1505159	7665	1475657
FEB		1452.04	4.776	17521	3373090	17368	3343588
MAR		894.48	2.942	10794	2077893	10640	2048391
APR		1950.67	6.417	23538	4531414	23385	4501912
MAY		297.58	.979	3591	691282	3438	661780
JUN		84.03	.276	1014	195210	861	165708
JUL		39.39	.130	475	91497	322	61994
AUG		16.23	.053	196	37693	43	8190
SEP		12.70	.042	153	29502	0	0
OCT		50.10	.165	605	116375	451	86873
NOV		564.57	1.857	6812	1311493	6659	1281991
DEC		140.94	.464	1701	327394	1547	297892
JAN	1964	1117.81	3.677	13488	2596673	13403	2580164
FEB		251.11	.826	3030	583324	2944	566815
MAR		175.74	.578	2121	408250	2035	391741
APR		98.27	.323	1186	228274	1100	211765
MAY		55.68	.183	672	129339	586	112830
JUN		31.43	.103	379	73020	294	56511
JUL		13.25	.044	160	30784	74	14275
AUG		7.72	.025	93	17940	7	1431
SEP		7.11	.023	86	16509	0	0
OCT		15.75	.052	190	36599	104	20090
NOV		390.30	1.284	4710	906670	4624	890161
DEC		4395.90	14.460	53044	10211718	52958	10195209
JAN	1965	2533.19	8.333	30567	5884629	30382	5848932
FEB		450.86	1.483	5440	1047345	5255	1011648
MAR		165.16	.543	1993	383671	1808	347974
APR		1252.37	4.120	15112	2909258	14927	2873561
MAY		159.23	.524	1921	369883	1736	334186
JUN		59.73	.196	721	138761	535	103064
JUL		30.32	.100	366	70440	180	34743
AUG		20.45	.067	247	47509	61	11812
SEP		15.37	.051	185	35697	0	0
OCT		16.74	.055	202	38892	17	3195
NOV		369.93	1.217	4464	859358	4278	823661
DEC		490.16	1.612	5915	1138649	5729	1102952
JAN	1966	1642.45	5.403	19819	3815428	19707	3793832

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
FEB		1197.54	3.939	14450	2781885	14338	2781773
MAR		557.65	1.834	6729	1295414	6617	1295302
APR		213.27	.702	2573	495420	2461	495308
MAY		67.45	.222	814	156691	702	156578
JUN		35.07	.115	423	81460	311	81348
JUL		14.33	.047	173	33294	61	33182
AUG		9.49	.031	115	22054	2	21941
SEP		10.61	.035	128	24655	16	24543
OCT		9.30	.031	112	21596	0	21484
NOV		457.26	1.504	5518	1062226	5405	1062114
DEC		1205.71	3.966	14549	2800873	14437	2800761
JAN	1967	1914.16	6.297	23098	4446612	22961	4446475
FEB		545.14	1.793	6578	1266371	6441	1266234
MAR		1237.10	4.069	14928	2873786	14791	2873649
APR		1416.20	4.659	17089	3289844	16952	3289707
MAY		238.71	.785	2880	554524	2744	554388
JUN		92.13	.303	1112	214026	975	213890
JUL		32.65	.107	394	75835	257	75698
AUG		16.00	.053	193	37168	56	37031
SEP		11.33	.037	137	26320	0	26183
OCT		22.45	.074	271	52155	134	52019
NOV		38.00	.125	459	88274	322	88138
DEC		302.61	.995	3652	702972	3515	702835
JAN	1968	1260.84	4.147	15214	2928938	15072	2928796
FEB		1027.50	3.380	12399	2386891	12256	2386748
MAR		804.10	2.645	9703	1867923	9560	1867781
APR		169.17	.556	2041	392976	1899	392833
MAY		62.81	.207	758	145900	615	145757
JUN		28.90	.095	349	67135	206	66993
JUL		12.35	.041	149	28700	7	28558
AUG		14.25	.047	172	33107	30	32964
SEP		11.80	.039	142	27411	0	27269
OCT		17.26	.057	208	40098	66	39956
NOV		55.23	.182	666	128307	524	128165
DEC		1739.90	5.723	20995	4041809	20853	4041667
JAN	1969	3928.00	12.921	47398	9124775	47319	9124696
FEB		3205.86	10.546	38684	7447231	38605	7447152

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
MAR		857.23	2.820	10344	1991342	10265	1991263
APR		235.13	.773	2837	546217	2758	546137
MAY		89.97	.296	1086	208996	1006	208917
JUN		43.30	.142	522	100586	443	100507
JUL		18.55	.061	224	43088	145	43009
AUG		9.55	.031	115	22188	36	22109
SEP		6.57	.022	79	15254	0	15175
OCT		18.66	.061	225	43350	146	43271
NOV		35.43	.117	428	82312	348	82233
DEC		1201.39	3.952	14497	2790832	14418	2790752
JAN	1970	5464.48	17.975	65938	12694039	65868	12693969
FEB		1053.25	3.465	12709	2446708	12639	2446638
MAR		488.84	1.608	5899	1135576	5829	1135506
APR		125.57	.413	1515	291692	1445	291622
MAY		53.55	.176	646	124393	576	124323
JUN		26.07	.086	315	60553	244	60483
JUL		14.08	.046	170	32717	100	32647
AUG		6.84	.022	83	15886	12	15816
SEP		5.81	.019	70	13504	0	13434
OCT		14.35	.047	173	33331	103	33261
NOV		264.07	.869	3186	613429	3116	613359
DEC		2130.81	7.009	25712	4949880	25642	4949810
JAN	1971	1676.71	5.515	20232	3895010	20117	3894894
FEB		181.14	.596	2186	420796	2070	420680
MAR		1223.84	4.026	14768	2842987	14652	2842871
APR		355.07	1.168	4284	824823	4169	824707
MAY		101.81	.335	1228	236497	1113	236381
JUN		44.50	.146	537	103374	421	103258
JUL		21.74	.072	262	50507	146	50391
AUG		11.58	.038	140	26902	24	26786
SEP		9.60	.032	116	22309	0	22193
OCT		13.17	.043	159	30589	43	30473
NOV		49.90	.164	602	115918	486	115802
DEC		474.58	1.561	5727	1102455	5611	1102339
JAN	1972	400.65	1.318	4834	930702	4774	930641
FEB		501.57	1.650	6052	1165154	5992	1165094
MAR		459.52	1.512	5545	1067460	5484	1067399

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
APR		247.47	.814	2986	574867	2926	574807
MAY		64.81	.213	782	150546	722	150485
JUN		24.50	.081	296	56914	235	56853
JUL		10.44	.034	126	24257	66	24196
AUG		5.01	.016	60	11638	0	11577
SEP		8.09	.027	98	18785	37	18725
OCT		30.06	.099	363	69825	302	69765
NOV		230.63	.759	2783	535763	2723	535703
DEC		707.52	2.327	8537	1643566	8477	1643505
JAN	1973	2988.10	9.829	36057	6941372	35942	6941257
FEB		1966.29	6.468	23727	4567697	23612	4567582
MAR		1137.16	3.741	13722	2641635	13607	2641520
APR		263.83	.868	3184	612887	3069	612772
MAY		73.61	.242	888	171003	773	170888
JUN		34.33	.113	414	79757	299	79642
JUL		16.06	.053	194	37318	79	37203
AUG		9.53	.031	115	22144	0	22028
SEP		12.13	.040	146	28186	31	28071
OCT		35.16	.116	424	81680	309	81565
NOV		2032.60	6.686	24527	4721746	24412	4721631
DEC		1805.06	5.938	21781	4193179	21666	4193064
JAN	1974	3682.77	12.114	44439	8555114	44298	8554972
FEB		1052.39	3.462	12699	2444717	12558	2444576
MAR		2771.61	9.117	33444	6438479	33303	6438337
APR		1292.87	4.253	15601	3003339	15459	3003198
MAY		125.42	.413	1513	291350	1372	291209
JUN		61.80	.203	746	143562	605	143421
JUL		41.48	.136	501	96367	359	96226
AUG		20.52	.067	248	47659	106	47518
SEP		11.70	.038	141	27179	0	27038
OCT		16.35	.054	197	37992	56	37851
NOV		39.73	.131	479	92301	338	92160
DEC		404.81	1.332	4885	940369	4744	940227
JAN	1975	714.10	2.349	8617	1658852	8497	1658733
FEB		2835.11	9.326	34210	6585976	34091	6585856
MAR		2745.48	9.031	33129	6377781	33009	6377661
APR		419.50	1.380	5062	974502	4942	974382

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
MAY		135.61	.446	1636	315030	1517	314910
JUN		41.33	.136	499	96018	379	95898
JUL		21.06	.069	254	48933	134	48813
AUG		11.24	.037	136	26108	16	25988
SEP		9.94	.033	120	23083	0	22963
OCT		53.08	.175	640	123299	521	123179
NOV		83.43	.274	1007	193816	887	193696
DEC		133.45	.439	1610	310009	1490	309889
JAN	1976	57.94	.191	699	134585	645	134531
FEB		333.39	1.097	4023	774474	3969	774420
MAR		334.45	1.100	4036	776934	3982	776880
APR		396.10	1.303	4780	920143	4726	920089
MAY		48.52	.160	585	112703	531	112649
JUN		14.27	.047	172	33142	118	33088
JUL		5.34	.018	64	12402	10	12348
AUG		9.84	.032	119	22863	65	22809
SEP		4.47	.015	54	10384	0	10330
OCT		7.07	.023	85	16426	31	16372
NOV		19.00	.063	229	44145	175	44091
DEC		18.55	.061	224	43088	170	43034
JAN	1977	44.06	.145	532	102362	524	102355
FEB		58.64	.193	708	136228	700	136220
MAR		95.13	.313	1148	220985	1140	220978
APR		34.20	.113	413	79447	405	79439
MAY		14.09	.046	170	32739	163	32732
JUN		4.23	.014	51	9827	44	9820
JUL		.62	.002	7	1436	0	1428
AUG		.67	.002	8	1568	1	1560
SEP		5.24	.017	63	12174	56	12167
OCT		11.35	.037	137	26362	129	26355
NOV		139.17	.458	1679	323285	1672	323278
DEC		1034.97	3.404	12489	2404238	12481	2404231
JAN	1978	3829.35	12.597	46208	8895622	46079	8895493
FEB		2267.64	7.459	27363	5267752	27234	5267623
MAR		1528.19	5.027	18440	3550006	18311	3549877
APR		670.17	2.204	8087	1556802	7958	1556674
MAY		140.94	.464	1701	327394	1572	327265

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
JUN		47.40	.156	572	110111	443	109982
JUL		21.61	.071	261	50207	132	50078
AUG		10.68	.035	129	24819	0	24690
SEP		19.67	.065	237	45686	108	45557
OCT		13.19	.043	159	30649	30	30520
NOV		16.18	.053	195	37579	66	37450
DEC		26.42	.087	319	61372	190	61243
JAN	1979	571.03	1.878	6890	1326512	6827	1326449
FEB		1612.75	5.305	19461	3746431	19397	3746368
MAR		813.35	2.676	9815	1889430	9751	1889366
APR		240.90	.792	2907	559613	2844	559549
MAY		172.61	.568	2083	400981	2020	400918
JUN		38.87	.128	469	90288	406	90224
JUL		16.16	.053	195	37543	132	37480
AUG		5.24	.017	63	12177	0	12114
SEP		6.50	.021	78	15100	15	15036
OCT		69.36	.228	837	161134	774	161071
NOV		417.23	1.372	5035	969236	4971	969173
DEC		620.13	2.040	7483	1440565	7420	1440501
JAN	1980	2479.03	8.155	29914	5758812	29819	5758716
FEB		2239.57	7.367	27024	5202542	26929	5202447
MAR		867.55	2.854	10468	2015322	10373	2015227
APR		315.97	1.039	3813	733993	3718	733898
MAY		102.03	.336	1231	237022	1136	236927
JUN		45.60	.150	550	105929	455	105834
JUL		22.06	.073	266	51256	171	51161
AUG		9.62	.032	116	22338	21	22243
SEP		7.89	.026	95	18321	0	18226
OCT		14.26	.047	172	33129	77	33034
NOV		17.03	.056	206	39569	110	39473
DEC		171.55	.564	2070	398508	1975	398413
JAN	1981	1272.45	4.186	15354	2955915	15316	2955877
FEB		633.79	2.085	7648	1472289	7610	1472251
MAR		543.45	1.788	6558	1262442	6520	1262404
APR		166.57	.548	2010	386936	1972	386898
MAY		57.71	.190	696	134060	658	134022
JUN		18.30	.060	221	42503	183	42465

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
JUL		5.68	.019	69	13196	30	13158
AUG		3.16	.010	38	7344	0	7306
SEP		5.08	.017	61	11809	23	11770
OCT		67.39	.222	813	156556	775	156518
NOV		1517.67	4.992	18313	3525552	18275	3525514
DEC		2717.29	8.938	32789	6312287	32751	6312249
JAN	1982	1538.71	5.062	18567	3574435	18404	3574272
FEB		1844.68	6.068	22259	4285203	22096	4285040
MAR		1484.71	4.884	17916	3448992	17753	3448829
APR		2516.77	8.279	30369	5846469	30206	5846306
MAY		168.16	.553	2029	390640	1866	390477
JUN		55.93	.184	675	129934	512	129770
JUL		25.81	.085	311	59949	148	59785
AUG		13.52	.044	163	31398	0	31235
SEP		13.90	.046	168	32290	5	32127
OCT		51.84	.171	626	120422	462	120259
NOV		641.80	2.111	7744	1490906	7581	1490743
DEC		2232.68	7.344	26941	5186527	26778	5186364
JAN	1983	2609.77	8.585	31491	6062526	31229	6062263
FEB		3304.04	10.869	39869	7675301	39606	7675038
MAR		4280.00	14.079	51646	9942474	51383	9942211
APR		2018.67	6.640	24359	4689379	24096	4689116
MAY		499.32	1.643	6025	1159930	5762	1159668
JUN		97.83	.322	1181	227268	918	227005
JUL		46.74	.154	564	108582	301	108319
AUG		26.81	.088	323	62272	61	62009
SEP		25.17	.083	304	58462	41	58200
OCT		21.77	.072	263	50582	0	50319
NOV		1594.50	5.245	19240	3704036	18978	3703773
DEC		3520.74	11.581	42484	8178711	42221	8178449
JAN	1984	545.00	1.793	6576	1266039	6489	1265952
FEB		716.46	2.357	8645	1664352	8558	1664265
MAR		528.61	1.739	6379	1227972	6291	1227885
APR		244.47	.804	2950	567898	2863	567811
MAY		98.94	.325	1194	229828	1106	229741
JUN		45.60	.150	550	105929	463	105842
JUL		17.77	.058	214	41290	127	41202

Table A-1 (continued)

Month	Year	Navarro R. discharge	Unit runoff	Estimated Caspar Creek discharge		Available diversion	
		cfs	cfs/mi2	gpm	ft3/day	gpm	ft3/day
AUG		9.87	.032	119	22938	32	22850
SEP		7.24	.024	87	16826	0	16739
OCT		22.12	.073	267	51383	180	51296
NOV		1036.53	3.410	12508	2407875	12420	2407788
DEC		436.16	1.435	5263	1013206	5176	1013119
JAN	1985	148.03	.487	1786	343880	1727	343821
FEB		705.43	2.320	8512	1638716	8453	1638657
MAR		586.35	1.929	7075	1362107	7016	1362047
APR		203.77	.670	2459	473352	2399	473292
MAY		54.03	.178	652	125517	592	125458
JUN		22.73	.075	274	52810	215	52750
JUL		7.00	.023	85	16269	25	16209
AUG		4.94	.016	60	11465	0	11406
SEP		9.75	.032	118	22642	58	22582