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THE WATER RESOURCE SPECIALISTS

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Project No. 02-001-01

Santa Barbara County Water Agency
123 East Anapamu Street, Suite 321RMD
Santa Barbara, California 93101-2025

Attention: Mr. Robert Almy
Water Agency Manager

Subject: Hydrogeological Review of Santa Maria Valley Groundwater Basin Water Budget Models, Dated 2000, Santa Barbara County, California.

Dear Mr. Almy:

Submitted in this letter-report are the findings, conclusions, and professional opinions developed by Hopkins Groundwater Consultants, Inc. (Hopkins) as part of our hydrogeological review of the water budget model that was constructed by the Santa Barbara County Water Agency (SBCWA) to manage and protect groundwater resources in the Santa Maria Valley groundwater basin (SMVGB).

INTRODUCTION

Groundwater levels in specific areas of the SMVGB have recently approached historical high levels and have prompted many groundwater users to question the long-standing conclusion that the basin is in a state of overdraft. This study was authorized in response to concerns raised about the adequacy of the water budget model that has been used for resource management, and because of the importance of maintaining the availability and reliability of the groundwater supply for all users in the Santa Maria Valley area.

Purpose and Scope

The purpose of this study was to provide an independent review of the SBCWA's water budget model and scrutinize the SBCWA findings and conclusions. This exercise was conducted to provide another level of assurance that the current model is sufficient for the intended purpose. The project scope of work was developed through discussions with Mr. Robert Almy and Mr. Jon Ahlroth of the SBCWA. The scope of work included the following work tasks:

- Review the SBCWA 2000 water supply study and develop a thorough understanding of the findings and conclusions

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- Review data or reports used directly to develop model components
- Discuss questions that we develop during this review with SBCWA staff
- Identify potential model deficiencies and measures that could be considered to refine supply predictions and bolster the resulting conclusions
- Submit this letter report summarizing our findings, conclusions, and opinions on the status of the SMVGB and the adequacy of the water budget model for use as a planning tool.

Background

The water budget model utilized by the SBCWA is an update of the model that was developed and used for past water resource studies completed by the SBCWA in 1977, 1986, and 1994. The Santa Maria Valley water budget model (SMVWBM) was constructed using available historical hydrologic and hydrogeologic data in combination with the findings and conclusions of numerous water resource studies conducted by others. Past hydrogeological studies that compiled data and developed an understanding of the SMVGB historical conditions, and which were utilized to the development of the SMVWBM include:

1. Engineering Offices of J. B. Lippincott (1931), "Report on Water Conservation and Flood Control of the Santa Maria River in Santa Barbara and San Luis Obispo Counties," March.
2. Worts, G. F., Jr. (1951), "Geology and Ground-Water Resources of the Santa Maria Valley Area, California," U.S. Geological Survey Water Supply Paper No. 1000.
3. U.S. Bureau of Reclamation, Irrigation and Power Division (1959), "Santa Maria Project, Rules and Regulations for Operations of Project Works, May.
4. Miller and Evenson (1966), "Utilization of Groundwater in the Santa Maria Valley Area, California," U.S. Geological Survey Water Supply Paper No. 1819 A.
5. Toups Corporation (1976), "Santa Maria Valley Water Resources Study."
6. Hughes and Freckleton (1976), "Groundwater Data for the Santa Maria Valley, California." U.S. Geological Survey Open-File Report, May.
7. Hughes, J. L. (1977), Evaluation of Ground-Water Quality in the Santa Maria Valley, California," U.S. Geological Survey Water Resources Investigation 76-128, July.

Additional resources that were used for development of specific model components are cited in the references section of the SBCWA water supply reports (Jones, Lawrance, Ahlroth, MacDonald, 1977) (Naftaly, 1994).

FINDINGS

Model Review

Construction of the SMVWBM largely utilized detailed data generated from the references listed in the background section of this report. A full discussion of the development and subsequent revision of the model parameters is provided in each of the SBCWA water basin conditions reports (Jones, Lawrance, Ahlroth, MacDonald, 1977) (Naftaly, 1994). The model was constructed in 1977 using Rocky Mountain Basic computer code. In the future, the SBCWA should consider converting the model to another format that is more widely used and that would facilitate future updates and revisions. The current model includes historical conditions through the year 2000. The model simulation results generated from use of these historical data are included as Appendix A – Historical Water Budget Simulation. Simulation of future conditions has incorporated the recently revised municipal and industrial (M&I) and agricultural demand projections (SBCWA and Boyle, 2002). The model output of future basin storage changes that result from the projected demands is included as Appendix B – Future Water Budget Simulation. These approximations of basin storage include the recharge from Twitchell Reservoir operation, reduction in groundwater demand due to M&I use of SPW, and the additional recharge provided by SPW infiltration. Future basin conditions as simulated by the SMVWBM use a repeat of the historical weather conditions that occurred between 1935 and 2000.

The water budget model was constructed well before developments in computer software and hardware facilitated the proliferation of 3-dimensional groundwater flow modeling. The purpose of the model was to facilitate an accounting of water resources over the entire SMVGB and provide the basis to establish and update perennial yield estimates for planning purposes. Historical estimates of groundwater basin perennial yields have increased twice in the recent past as a result of increased recharge that is derived from operation of Twitchell Reservoir and the importation of State Project Water (SPW). Both projects were constructed to accommodate increased water demands that have resulted from expanding agricultural acreage and the growing population of the communities that overly the SMVGB.

Past studies that were conducted to evaluate the water balance within the SMVGB have estimated perennial yield values for the basin. These values represent the amount of groundwater that can be safely pumped from the basin annually (given a certain set of conditions) without adverse impacts occurring. For this value to remain constant over time we must assume that the average annual return flows from irrigation will remain constant through time along with the average annual recharge from other sources. Alternatively, estimation of the net groundwater removed annually from the basin provides a value that represents the average annual amount actually consumed from the groundwater basin. The current net perennial yield estimated by the SBCWA model is approximately 75,000 acre-feet per year (afy), while the gross perennial yield is estimated at approximately 125,000 afy. Changes in the gross perennial yield can occur over time while the net yield will remain the same until new sources of recharge are developed in the basin. Potential changes in the perennial yield of the basin will occur as agricultural and domestic irrigation practices become more efficient and less applied water returns as groundwater recharge. An increase of 10 percent in irrigation efficiency over the entire valley would reduce the gross yield by several thousand afy. This result would be because less groundwater would be extracted and less groundwater would return as recharge. The net perennial yield would remain the same as long as consumptive use (evapotranspiration) is the same and the water budget equation is balanced by reduced extractions that are equal to reduced return flows.

The model does not currently account for future reductions to basin yield that will occur as the average annual recharge of Twitchell Reservoir is decreased by siltation. The rate of lost reservoir capacity from infilling is estimated to be approximately 25 afy. At this rate, the reduced annual recharge from reservoir operation will grow to approximately 1,000 afy over a 40-year period. This factor may need to be added to the model as the significance of this number grows, however, it is not considered essential at this time.

Basin Water Levels

The SMVGB water levels have been monitored since the early 1900s. Because extensive monitoring began around 1935, the SMVWBM uses that year as a starting point. These records provide the basis from which we can derive an understanding of basin conditions and cross check model estimates of storage. These water level data show changes in basin storage that result from seasonal demand, climactic changes in average annual recharge, increased recharge from the operation of Twitchell Reservoir and importation of SPW, and changes in the distribution of pumping. The SBCWA has used key well data and specific yield estimates in arbitrary subareas/storage units (originally used by Miller and Everson, 1966) to calibrate the model and subsequently to cross check model calculations of basin storage. Appendix C – Storage Estimates From Water Level Data, provides the estimated values at specific high and low basin levels that were calculated using these physical data. Comparison of these results with the model predictions indicates that estimates from both methods correlate relatively closely under historical conditions.

Seasonal changes in basin water levels have historically oscillated in the range of 5 to 25 feet between the wet and dry seasons. Plate 1 – Hydrograph of State Well No. 10N/35W-24B01 shows that between 1940 and 1960, when this well (which is located north of the City of Betteravia) was measured several times a year, the spring water levels were typically 5 to 10 feet higher than late summer/early fall water levels. By the late 1960s, increased groundwater demands resulted in greater seasonal variations of approximately 25 feet. The significance of this observation is that basin storage estimates will be different if they are based on water levels collected in the spring versus water levels collected in the late summer or fall seasons. Current water level measurements are collected only in the spring months of March, April, or May. If historical low basin storage values (calculated from water level readings) were based on fall measurements one might conclude that basin storage is greater now during dry years (based on spring measurements) than it was during the dry years when fall readings were used. Future comparison of annual storage changes should be based on spring measurements when the basin is at its fullest. However, future studies of pumping impacts on basin conditions will likely find the fall season water levels will be most useful to understanding adverse basin conditions as they develop. Because the coastal area of the basin is the most vulnerable to impacts that could result from low water level conditions, the SBCWA should consider the merits of establishing a semiannual (or quarterly) data collection program for wells in the area west of Santa Maria.

Most of the wells monitored at the present time have a relatively short period of record or a discontinuous record that requires some interpretation to allow correlation and inferences to be made about historical basin conditions. Although water level measurements from about 20 wells extend from the late 1930s to the present, the wells were not all consistently measured with the same frequency. Some well records have data gaps that span several years and some do not include a 1943 basin high water level measurement. However, the well records that do provide these data indicate that there is a split between which year (1999 or 1943) produced higher basin groundwater levels. Wells located within approximately 2 miles of the Santa Maria River channel indicate that the 1999 recharge peak resulted in higher water levels than in 1943 and that the increased recharge from Twitchell Reservoir operations is greater than the increased demands in those areas. Wells located further south toward Orcutt and Betteravia, and west in the proximity of Guadalupe, indicate higher water levels occurred during the 1943 recharge peak. These observations reflect the increase in groundwater demand that has occurred across the basin since 1943.

Recent coastal water levels, measured primarily in the springtime, indicate that wells in the confined area of the basin (along the coast) have often flowed under artesian conditions when the piezometric head rose above the wellhead elevation. This occurrence results as a function the characteristic properties of a confined/semi-confined aquifer system. The combined effect of a pressure response in water levels and a small storage coefficient (orders of magnitude smaller than an unconfined aquifer) allows relatively rapid changes in aquifer conditions. Along the coast this condition is both a benefit and a concern. Without surface water recharge that occurs inland near the area of unconfinement, groundwater storage in this area is rapidly depleted and water levels can rapidly fall. The radius of influence from a well pumping in the semi-confined portion of the basin reaches a much greater distance than that of a well in the unconfined area. This explains the historical documentation of coastal water levels that have fallen well below sea level during the fall season of historically dry periods. Under this condition shallow saline groundwater can migrate downward toward the primary production zones. Migration can occur slowly across aquitards, more rapidly through sandy lenses (heterogeneities in the confining layer), and very quickly through old wells with both shallow and deep perforations or with casing damage in shallow zones. To some extent the mining of offshore storage partially mitigates the impacts of this condition, however, the planned mining of offshore groundwater is likely not a prudent or reliable strategy. Conversely, the benefit of the semi-confined aquifer condition is that during high basin water levels an offshore gradient can be quickly restored and begin to flush any near shore leakage of overlying saline water. Consistent with the inland portion of the SMVGB, the coastal portion has recovered significantly in recent years (although not to 1943 levels). This can be attributed to additional recharge from the natural changes in rainfall patterns, Twitchell releases, and likely more significantly the importation of SPW that offsets historical extractions that were located just inland of this area.

Rainfall Records During the 1935 to 2000 Study Period

Annual rainfall has been historically monitored in the SMVGB at 2 locations, Betteravia and Santa Maria. Data for these 2 stations are provided in Appendix D – Rainfall Records. The record for the Betteravia station ended in 1993. A double mass analysis comparing the rainfall records of these two stations indicates that the Santa Maria station slightly underestimates the higher rainfall events. Annual recharge to the SMVGB is proportional to the amount of rainfall that is received each year. Predictive models developed for resource planning have used rainfall records as the basis for selecting a study period/base period to be used in the development of a groundwater flow model or a water budget model. The ability to predict future changes in the basin conditions using a model is directly affected by the base period that is used. The selection of a base period or study period can be difficult but it is essential because the goal of modeling is to base conclusions on the apparent trend between the beginning and ending points. The SMVWBM has been calibrated by comparing basin storage calculated with the model to basin storage estimated using water level data from existing wells. Because sufficient well data are available back through 1935 this point was selected as the beginning of the model study period. Available rainfall records indicate that 5 of the 6 years preceding 1935 were well below the historical rainfall average. The total rainfall for the 6-year period of 1929 to 1934 was about 64.4 inches, which yields an annual average of 10.7 inches. In comparison, the 6 years prior to the end of the study period provided 111.06 inches of total rainfall and an annual average of 18.5 inches. Conclusions reached by comparing basin storage at the beginning of the study period (2.495 million acre-feet [maf] in 1935), which followed a dry spell, with basin storage ending after a wet spell (2.619 maf in 2000) may be misleading.

The adequacy of the 1935 to 2000 study period for determining the affects of severe dry cycles on basin groundwater storage is only as good as the driest conditions within that period. It is highly likely that the SMVGB is vulnerable to a longer and/or more severe drought than any recorded this century (Turner, 1996). The impacts of that type of weather pattern would be far more threatening under present and future demand conditions than at any time in the past. The 9-year period between 1936 and 1944 provided a total of 161.60 inches of rain which yields an annual average of 17.96 inches per year (in/yr). The 1992 to 2000 period yielded a total of 153.3

inches and an annual average of 17.03 in/yr. The later wet cycle was estimated to result in a total increase of 630,400 af of basin storage for an average annual recharge rate of 70,000 af/yr above the consumptive use during that period. The earlier period provided an increase in basin storage of 272,000 af for an average annual recharge surplus of just over 30,200 af/yr. Although the annual recharge supplement provided by Twitchell Reservoir more than doubles the contribution to basin storage, the peak of the later wet period (in 1999) was still estimated at 132,600 af below the 1943-peak storage volume. This simulation indicates that the basin had an average annual decline in groundwater storage of approximately 2,368 afy that occurred between the two peak periods of similar wet climatic conditions.

Model Results

As discussed in the previous sections, the 2000 version of the SMVWBM incorporates updates for sources of increased recharge and adjustments for changes in land uses. The model results now reflect these adjustments and appear to indicate that the basin perennial yield is likely only slightly exceeded by annual demands (2,000 to 3,000 afy). When the model is used to project future conditions the model simulation of future basin storage changes provides interesting results (see Appendix B). Using historical weather patterns the results indicate that the basin would be more than 400,200 af lower under 1999 conditions than under 1943 conditions, and would experience an average annual decline of 7,147 afy between these peak periods. This value is 3 times greater than the estimated historical value.

These results indicate that under the same weather conditions that have been observed over the 66 year period (1935 and 2000) the future changes in SMVGWB storage will result in higher storage volumes during the wet cycles and lower storage volumes during drought or critically dry years. These conditions reflect in combination the magnitude of increased recharge to the basin from Twithcell Reservoir operation and SWP infiltration and the higher rates of withdrawal that will be required to meet future demands. The greater amplitude of swing in groundwater storage volumes will be reflected by greater changes in basin groundwater levels. This may cause greater losses of groundwater offshore during wet periods (a small portion of the time) and conversely increase the potential for water quality impacts associated with lower water levels during the dry cycles (a greater portion of the time). The exact impact of the resulting water level changes cannot be determined at this time and will largely be controlled by future pumping patterns across the basin.

Water level data available from 1918 indicate the SMVGB groundwater levels were the highest on record. The estimated amount of groundwater in storage (above sea level) was approximately 3,135 thousand acre-feet (kaf). This value is believed to represent full groundwater basin conditions (see Appendix C). Through time groundwater demands and normal weather patterns resulted in depletion of groundwater in storage. The estimated historical volume of groundwater in storage during the peak in 1943 was 2,773 kaf or approximately 88.5 percent of the 1918 value. Enhanced recharge and future groundwater production projections result in an 8 percent increase in basin storage estimates given the 1943 climatic conditions. However, in the following years as conditions normalize, future peaks remain below historical peaks and future lows drop 6 to 8 percent below historical storage volume estimates. The result will be seen as lower water levels across the basin with a pattern that will likely be similar to the one observed most recently. Water levels within 2 miles of the Santa Maria River will likely remain higher than those further southward and westward. It is anticipated that this pattern will most likely depress water levels westward of Guadalupe to below sea level during the extended drought periods. This could induce greater water quality impacts from the shallow semi-perched zone and increase the threat of seawater intrusion. These results suggest that future increases in pumping should be directed/relocated toward the northern and eastern ends of the SMVGB.

CONCLUSIONS

Based on the findings of this study Hopkins has reached the following conclusions:

1. The SMVWBM is comprehensive in its consideration of water budget issues
2. The model simulation results of historical conditions correlate closely with storage values calculated from water level measurements
3. The model serves as an effective tool for evaluating basin storage changes by combining current water supply and demand conditions and historical weather patterns
4. The model can be easily revised to accommodate changes in specific water budget components as new data are developed over time
5. The SMVGB water budget deficit is approximately 2,000 to 3,000 afy
6. The model does not evaluate groundwater flow or solute transport within the basin
7. The model cannot predict water level variations across the basin in response to groundwater recharge or extraction
8. The model cannot simulate saltwater intrusion or groundwater degradation that could result from downward movement of perched water into the semi-confined area of the western portion of the basin
9. The model does not account for any depletion of offshore storage during basin low conditions

10. Currently the model does not include any reduction for siltation of Twitchell Reservoir

11. The anticipated increase in the seasonal and wet/dry cycle amplitudes of water level changes that will likely occur in the inland portion of the basin can likely be tolerated without any significant adverse affects

12. A greater change in the seasonal and wet/dry cycle amplitudes of water level changes in the semi-confined coastal area could result in localized water quality impacts and affect the present overlying water uses

It is our opinion that the model is a sufficient planning tool for determining the water balance of the SMVGB as a single groundwater body. The model cannot be used to identify specific impacts that would be associated with localized changes in pumping patterns. Projects that would propose to increase production or relocate production should evalutate potential impacts in a manner that is consistent with CEQA.

The SBCWA may consider the merits of constructing a groundwater flow model to assist with the finer details of basin management. Groundwater flow models are useful tools for simulating groundwater basin responses to pumping stresses. These models require considerable effort to construct in a manner that will provide accurate simulation of physical conditions. Improperly constructed or calibrated flow models can dampen the amplitude of water level fluctuation observed in key wells, miscalculate water inflow and outflow, and result in an erroneous water budget for the basin as a whole unit.

Future improvements to the accuracy of the SMVWBM may be provided with the refinement of the various parameters used for model input. Model parameters that may be improved include the following list:

1. Improving the accuracy of offshore discharge estimates perhaps by defining the near-shore aquifer geometry and including additional wells to the monitoring network for better coastal gradient control

2. Improving the accuracy of effective infiltration rates of rain water and agricultural return flows

3. Improving estimates of groundwater production through metering of well facilities

CLOSURE

This report has been prepared for the exclusive use of the Santa Barbara County Water Agency and its agents for specific application to review of the Santa Maria Valley water budget model and historical Santa Maria Valley groundwater basin conditions. The findings, conclusions, and professional opinions presented herein were prepared in accordance with the generally accepted hydrogeological resource planning practices. No other warranty, express or implied, is made.

We trust this review summary is responsive to the SBCWA needs. If you have any questions or need any additional information, please give us a call.

Sincerely,

HOPKINS GROUNDWATER CONSULTANTS, INC.

Curtis J. Hopkins
Registered Geologist, RG 5695
Certified Engineering Geologist, EG 1800
Certified Hydrogeologist, HG 114

Attachment: Plate 1 – Hydrograph of State Well No. 10N/35W-24B01
Appendix A – Historical Water Budget Simulation
Appendix B – Future Water Budget Simulation
Appendix C – Storage Estimates From Water Level Data
Appendix D – Rainfall Records

Copies Provided: One (1) Reproducible
Two (2) Bound

LIST OF REFERENCES

Engineering Offices of J. B. Lippincott (1931), "Report on Water Conservation and Flood Control of the Santa Maria River in Santa Barbara and San Luis Obispo Counties," March.

Hughes and Freckleton (1976), "Groundwater Data for the Santa Maria Valley, California." U.S. Geological Survey Open-File Report, May.

Hughes, J. L. (1977), Evaluation of Ground-Water Quality in the Santa Maria Valley, California," U.S. Geological Survey Water Resources Investigation 76-128, July.

Jones, K., Lawrance, C., Ahlroth, J., MacDonald, P., (1977), "Adequacy of the Santa Maria Groundwater Basin," Santa Barbara County Water Agency Final Report, November.

Miller and Evenson (1966), "Utilization of Groundwater in the Santa Maria Valley Area, California," U.S. Geological Survey Water Supply Paper No. 1819 A.

Naftaly, M. (1994), "Santa Maria Valley Water Resources Report," Santa Barbara County Water Agency, April.

Santa Barbara County Water Agency and Boyle Engineering, (Draft, 2002), Santa Barbara County Water Supply and Demand 2002 Update, Cooperative Study, March.

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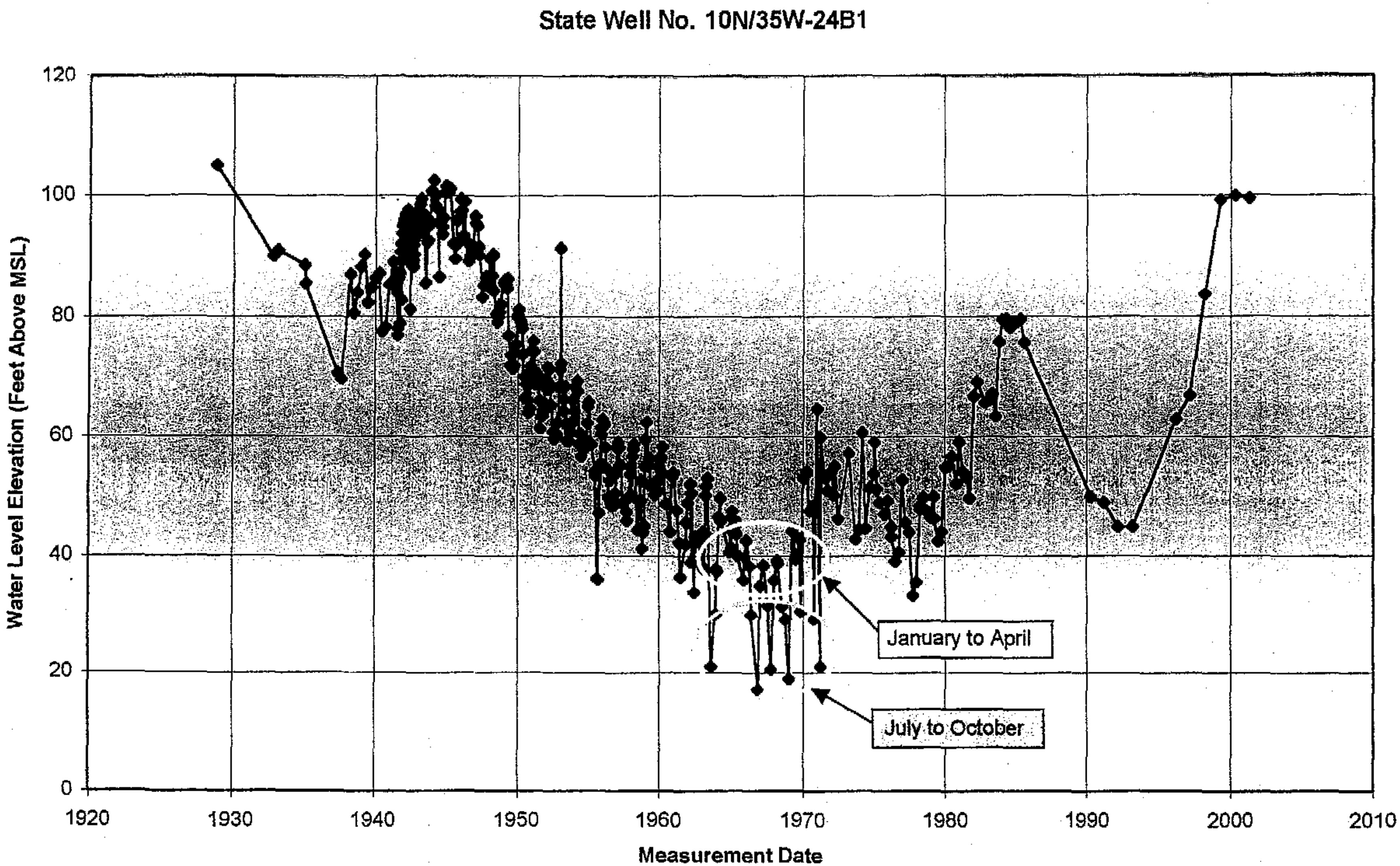
Turner, K. M. (1996), "Evaluation Reliability of Storage Schemes With Dendrohydrology and the Hurst Phenomenon," American Water Resources Association, Water Resources Bulletin, Volume 32, No. 1, February.

U.S. Bureau of Reclamation, Irrigation and Power Division (1955), "Santa Maria Project, California Definite Plan Report," Hydrology Appendix, September.

U.S. Bureau of Reclamation, Irrigation and Power Division (1959), "Santa Maria Project, Rules and Regulations for Operations of Project Works, May.

Worts, G. F., Jr. (1951), "Geology and Ground-Water Resources of the Santa Maria Valley Area, California," U.S. Geological Survey Water Supply Paper No. 1000.

PLATES



STATE WELL NO. 10N/35W-24B01
Santa Maria Valley Well Hydrograph
Santa Barbara County Water Agency
Santa Maria, California

JULY 2002
Project No. 02-001-01

HOPKINS GROUNDWATER CONSULTANTS

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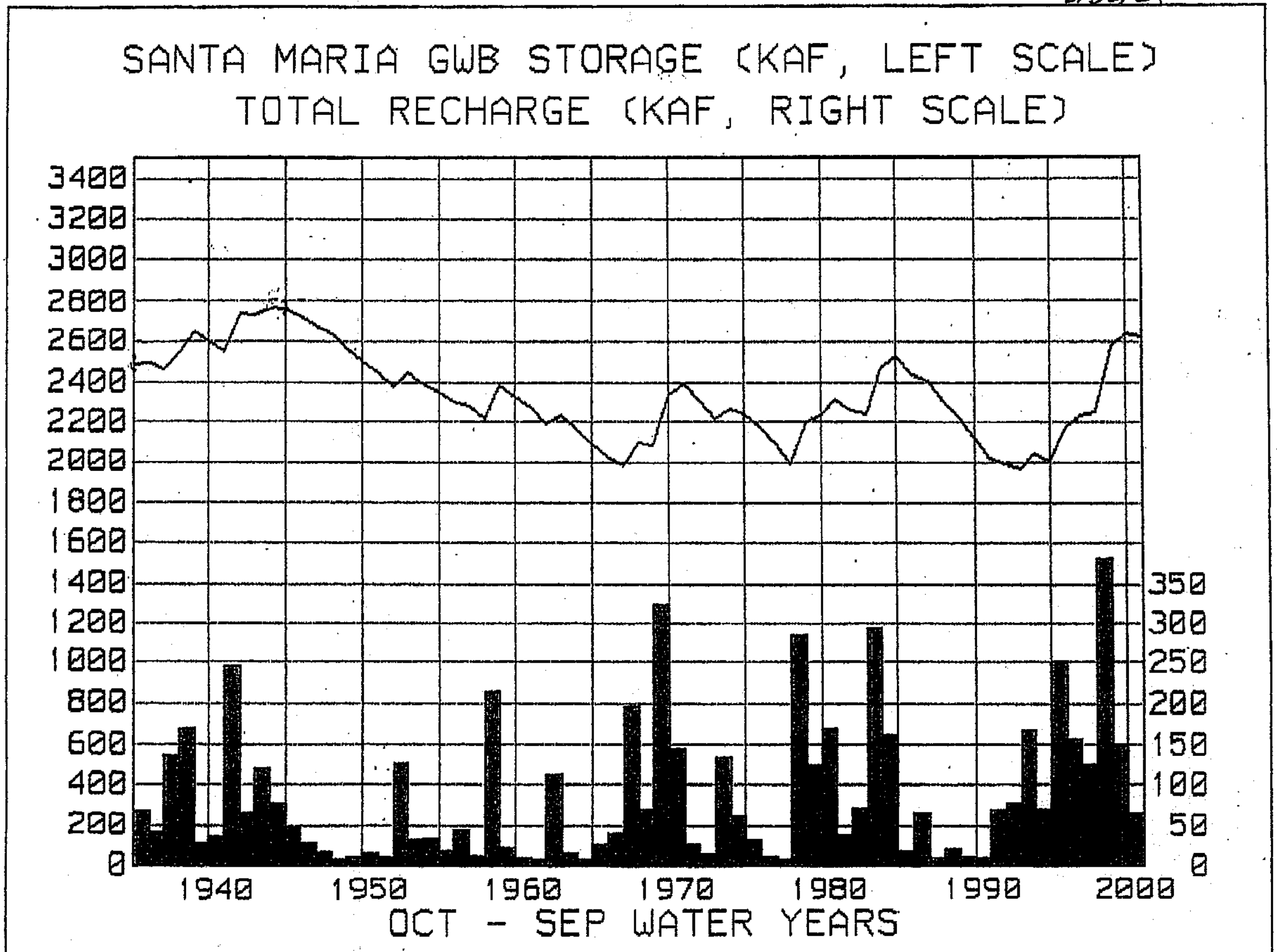
PLATE 1

APPENDIX A

HISTORICAL WATER BUDGET SIMULATION

8/30/01



"SMVHIST2" Historic scenario water budget model run...

SANTA MARIA GW BASIN GROSS RECHARGE

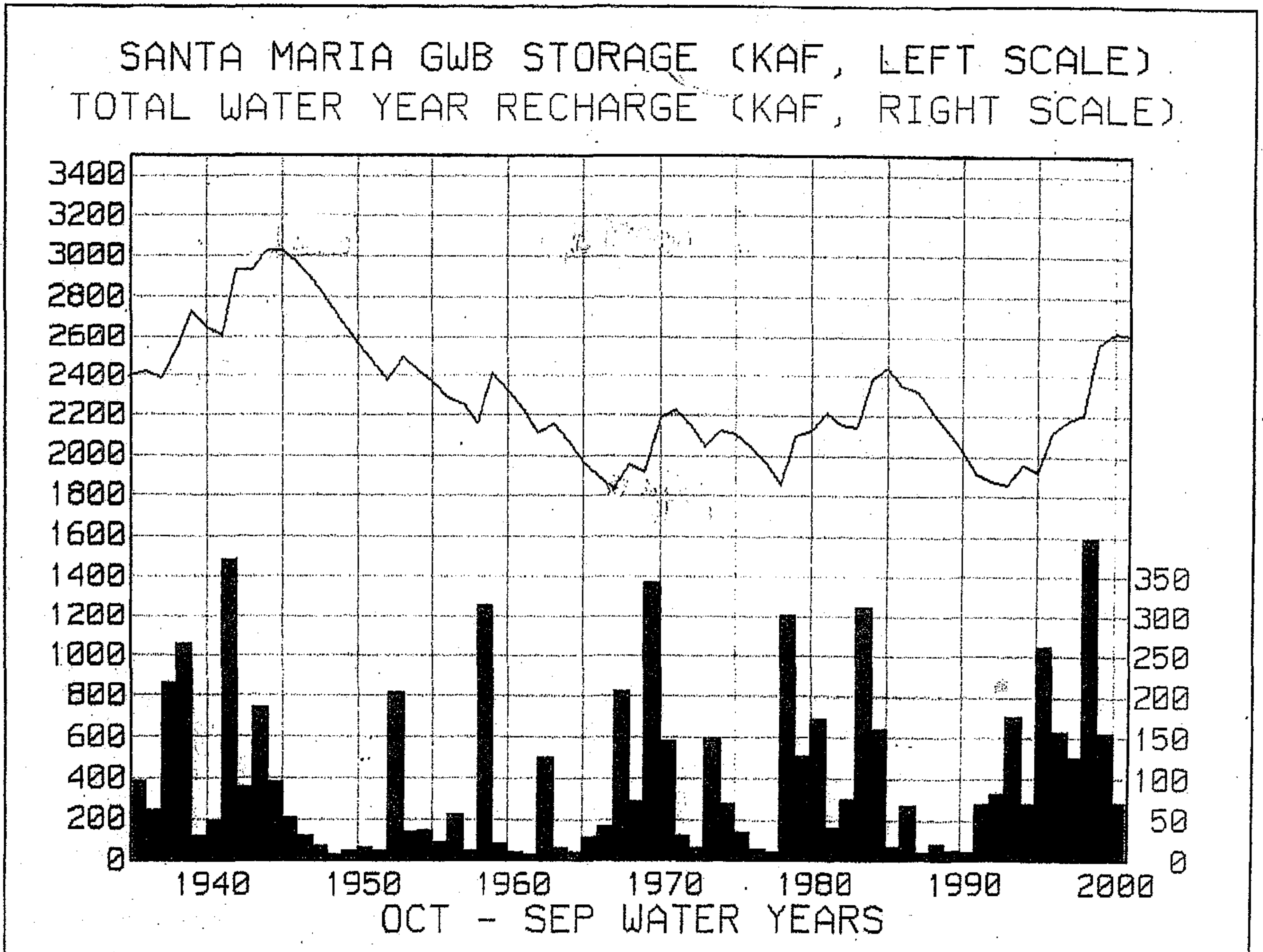
(Beginning Ground Water storage = 2.49E+6 AF); Historic net pumpage displayed..
M&I returns vary 30% to 50%; Aq returns vary w water duty (over period 1935-00)

Oct-SEP Wtr Yr.	SM-City Rainfal	Rain Infilt	UARiver Percola	Twitchl Contrib	Undr Q-in	Total Recharg	SWP Deliv	M&I C-use	Agri C-use	SubSu Q-out	Relative GWBVolum
1934-35	19.55	23921	39600	0	3550	67071	0	3276	48699	9765	2495331
1935-36	13.48	2418	36200	0	3523	42141	0	3402	57935	9816	2466319
1936-37	20.82	31640	102000	0	3668	137308	0	3528	48923	9543	2541633
1937-38	22.18	39934	127000	0	3292	170226	0	3654	48973	10260	2648973
1938-39	11.51	0	24600	0	2755	27355	0	3906	65274	11333	2595815
1939-40	14.61	5378	27700	0	3021	36099	0	4032	62044	10794	2555045
1940-41	30.75	90906	150000	0	3225	244131	0	4158	42028	10390	2742600
1941-42	16.95	11363	51500	0	2287	65150	0	4536	60584	12321	2730309
1942-43	17.22	12094	106000	0	2348	120443	0	5040	60213	12188	2773310
1943-44	14.56	5547	69886	0	2133	77566	0	5166	65881	12655	2767174
1944-45	11.31	0	44681	0	2164	46845	0	4977	69618	12588	2726837
1945-46	11.08	0	25221	0	2366	27587	0	4788	58164	12151	2679321
1946-47	9.42	0	13668	0	2603	16271	0	4788	44686	11648	2634470
1947-48	8.20	0	4375	0	2828	7203	0	4788	57221	11184	2568479
1948-49	9.17	0	7380	0	3158	10538	0	4851	56143	10522	2507501
1949-50	10.47	0	11248	0	3463	14711	0	5166	55244	9931	2451870
1950-51	8.66	0	6880	0	3741	10621	0	5166	68835	9409	2379080
1951-52	18.57	20959	102251	0	4105	127315	0	5292	47139	8751	2445212
1952-53	10.87	0	27716	0	3774	31490	0	5544	67815	9348	2393995
1953-54	12.12	0	29613	0	4030	33643	0	5607	60106	8884	2353041
1954-55	13.17	2086	11980	0	4235	18301	0	5670	53777	8523	2303372
1955-56	14.56	5876	34034	0	4483	44393	0	5859	52079	8096	2281731
1956-57	9.01	0	6714	0	4591	11305	0	5859	59401	7915	2219862
1957-58	25.86	65034	144060	0	4901	213995	0	5985	32327	7408	2388136
1958-59	7.62	0	17412	0	4059	21471	0	6426	60962	8832	2333387
1959-60	11.33	0	6604	0	4333	10937	0	6930	57170	8353	2271871
1960-61	7.11	0	2890	0	4641	7531	0	7434	69372	7833	2194763
1961-62	16.45	11399	67762	27700	5026	111887	0	8001	57083	7208	2234357
1962-63	11.30	0	9430	-19	4828	14239	0	8505	65541	7525	2167025
1963-64	7.81	0	3622	-43	5165	8744	0	9009	69207	6991	2090562
1964-65	11.71	0	19137	300	5547	24984	0	9576	67989	6412	2031569
1965-66	9.11	0	31831	1313	5842	38986	0	9956	71024	5986	1983590
1966-67	15.35	9372	166906	13346	6000	195624	0	10323	59005	5651	2104235
1967-68	8.25	0	15414	48921	5479	69814	0	10738	70520	6514	2086278
1968-69	20.84	38957	275441	3770	5569	323737	0	11139	51955	6381	2340539
1969-70	9.59	0	8200	131978	4297	144475	0	11586	74926	8414	2390088
1970-71	9.82	0	22543	-142	4050	26451	0	11492	80309	8849	2315889
1971-72	5.45	0	8925	-100	4421	13246	0	11396	91524	8203	2218012
1972-73	19.59	32734	81470	14579	4910	133693	0	11299	62687	7393	2270326
1973-74	15.21	10382	44389	1244	4648	60663	0	11256	70290	7820	2241623
1974-75	12.45	209	26846	348	4792	32195	0	11183	76806	7584	2178245
1975-76	11.97	0	7737	-31	5109	12815	0	11025	81554	7079	2091403
1976-77	8.51	0	3314	-54	5543	8803	0	10868	89771	6419	1993149
1977-78	24.46	65573	177898	34097	6000	283568	0	10842	55729	5717	2204429
1978-79	12.51	439	60972	58626	4978	125015	0	10683	74572	7285	2236904
1979-80	13.97	6149	115661	42645	4815	169270	0	10523	72722	7546	2315384
1980-81	12.81	1622	30307	551	4423	36904	0	10617	72143	8198	2261329
1981-82	14.28	7359	50985	7547	4693	70584	0	10500	68816	7746	2244851
1982-83	24.04	63778	253496	-27133	4776	294917	0	10500	50310	7610	2471348
1983-84	7.93	0	19816	137664	3643	161123	0	10750	83650	9590	2528480
1984-85	8.69	0	13793	121	3358	17272	0	10750	86636	10132	2438234
1985-86	13.43	4042	49766	8659	3809	66276	0	10750	78327	9284	2406148
1986-87	8.87	0	6992	0	3969	10961	0	11000	89542	8993	2307574
1987-88	11.91	0	14921	171	4462	19554	0	11000	82404	8132	2225592
1988-89	6.18	0	7409	28	4872	12309	0	11000	94964	7454	2124483
1989-90	5.94	0	4838	61	5378	10277	0	11250	97378	6666	2019466
1990-91	12.75	1427	53910	7465	5903	68705	0	11250	81583	5900	1989438
1991-92	14.62	9176	58095	3344	6000	76615	0	11250	78779	5691	1970333
1992-93	16.71	17944	100388	43606	6000	167938	0	11500	74289	5561	2046921
1993-94	10.91	0	63908	51	5765	69724	0	11500	90232	6095	2008818
1994-95	21.66	51239	114208	79762	5956	251165	0	11500	65736	5826	2176921
1995-96	13.37	4237	126622	19421	5115	155396	0	11750	82027	7068	2231471
1996-97	11.71	0	70716	49382	4843	124941	0	11750	86762	7502	2250398
1997-98	32.61	128416	205137	42672	4748	380973	10998	602	44803	7656	2578310
1998-99	15.07	11811	21787	114300	3108	151007	11970	-120	78126	10619	2640692
1999-00	16.64	18741	40627	2610	2797	64775	12812	-412	74762	11248	2619869
Avg&Dws	13.71	12305	55855	13163	4302	85625	0	7938	67198	8521	2378391

SBCWA: 8/30/01

APPENDIX B

FUTURE WATER BUDGET SIMULATION



"SMYNOW4" 3/9/02

(Beginning Ground Water storage = 2.4E+6 AF); Scenario net pumpage displayed..
M&I returns set at 50%: Ag returns set at 30%; Ag water duty varies with rainfall..

Oct-SEP Wtr Yr.	SM-City Rainfal	Rain Infilt	UARiver Percola	Twitchl Contrib	Undr Q-in	Total Recharg	SWP Deliv	M&I C-use	Agri C-use	SubSu Q-out	Relative GWBVolum
1934-35	19.55	46320	42400	3260	4000	95980	17250	-4093	70195	8938	2420940
1935-36	13.48	6431	38202	12861	3895	61389	17250	-4093	88698	9126	2388597
1936-37	20.82	55972	102800	51633	4057	214462	14663	-1505	66633	8836	2529096
1937-38	22.18	66309	127650	67291	3355	264605	17250	-4093	62887	10138	2724769
1938-39	11.51	0	26280	1009	2376	29665	17250	-4093	96678	12129	2649721
1939-40	14.61	13123	29600	1807	2751	47282	17250	-4093	84949	11341	2604806
1940-41	30.75	131446	150700	86084	2976	371206	17250	-4093	40396	10884	2928826
1941-42	16.95	26982	53500	5811	1356	87649	17250	-4093	77733	14430	2928405
1942-43	17.22	28610	107600	48805	1358	186373	17250	-4093	76932	14425	3027514
1943-44	14.56	12827	72049	8429	862	94168	17250	-4093	85110	15627	3025038
1944-45	11.31	0	46383	3131	875	50389	17250	-4093	97447	15596	2966476
1945-46	11.08	0	26837	862	1168	28867	17250	-4093	98299	14880	2886256
1946-47	9.42	0	15044	368	1569	16981	15698	-2540	103932	13930	2787915
1947-48	8.20	0	5578	60	2060	7698	12938	220	107766	12816	2674812
1948-49	9.17	0	8888	54	2626	11568	11040	2117	104732	11601	2567930
1949-50	10.47	0	12670	203	3160	16033	13973	-815	100451	10517	2473811
1950-51	8.66	0	8148	148	3631	11927	17250	-4093	106341	9613	2373877
1951-52	18.57	38871	104333	56091	4131	203426	17250	-4093	72993	8706	2499697
1952-53	10.87	0	29165	1148	3502	33815	17250	-4093	99055	9857	2428693
1953-54	12.12	0	31312	1014	3857	36183	17250	-4093	93854	9197	2365917
1954-55	13.17	4595	13662	115	4170	22542	10695	2462	89780	8635	2287582
1955-56	14.56	12827	35919	2524	4562	55832	17250	-4093	85110	7964	2254434
1956-57	9.01	0	7945	31	4728	12704	17250	-4093	105240	7689	2158302
1957-58	25.86	94279	145344	68468	5208	313300	17250	-4093	53027	6924	2415744
1958-59	7.62	0	16013	280	3921	20214	17250	-4093	109534	9079	2321438
1959-60	11.33	0	6324	45	4393	10762	10868	2290	97372	8250	2224289
1960-61	7.11	0	2375	0	4879	7254	12420	737	111065	7444	2112297
1961-62	16.45	24021	68854	27700	5439	126013	16905	-3748	79232	6574	2156252
1962-63	11.30	0	10611	-19	5219	15811	17250	-4093	97485	6908	2071763
1963-64	7.81	0	4566	-43	5641	10164	16560	-3403	108958	6275	1970098
1964-65	11.71	0	20296	300	6000	26596	15180	-2023	95868	5559	1897289
1965-66	9.11	0	32811	1313	6000	40124	17250	-4093	104923	5078	1831505
1966-67	15.35	17506	167625	13346	6000	204477	17250	-4093	82605	4665	1952805
1967-68	8.25	0	16254	48921	6000	71175	17250	-4093	107612	5443	1915019
1968-69	20.84	56124	275544	3770	6000	341438	17250	-4093	66578	5193	2188780
1969-70	9.59	0	8939	131978	5056	145973	17250	-4093	103382	7161	2228303
1970-71	9.82	0	23606	-142	4858	28322	17250	-4093	102631	7476	2150611
1971-72	5.45	0	9630	-100	5247	14777	16043	-2885	115927	6864	2045482
1972-73	19.59	46624	82052	14579	5773	149027	17250	-4093	70082	6085	2122436
1973-74	15.21	16677	45776	1244	5388	69085	17250	-4093	83043	6650	2105920
1974-75	12.45	331	27789	348	5470	33938	17250	-4093	92457	6526	2044967
1975-76	11.97	0	8544	-31	5775	14288	17250	-4093	94676	6081	1962591
1976-77	8.51	0	4098	-54	6000	10044	4140	9017	106808	5508	1851302
1977-78	24.46	83638	178122	34097	6000	301857	17250	-4093	56735	4787	2095730
1978-79	12.51	686	61446	58626	5521	126279	17250	-4093	92221	6451	2127431
1979-80	13.97	9333	115484	42645	5363	172825	17250	-4093	87041	6688	2210620
1980-81	12.81	2463	30309	551	4947	38270	17250	-4093	91082	7334	2154566
1981-82	14.28	11169	51245	7547	5227	75188	17250	-4093	86019	6895	2140934
1982-83	24.04	80446	253519	-27133	5295	312128	17250	-4093	57858	6790	2392506
1983-84	7.93	0	19487	137664	4037	161188	17250	-4093	108592	8871	2440325
1984-85	8.69	0	13639	121	3798	17558	17250	-4093	106247	9303	2346426
1985-86	13.43	6135	49561	8659	4268	68623	17250	-4093	88870	8465	2321806
1986-87	8.87	0	6309	0	4391	10700	17250	-4093	105682	8253	2222663
1987-88	11.91	0	14707	171	4887	19765	5175	7982	94981	7431	2132034
1988-89	6.18	0	7099	28	5340	12467	13973	-815	113809	6723	2024784
1989-90	5.94	0	5205	61	5876	11142	5865	7292	114509	5938	1908187
1990-91	12.75	2107	53848	7465	6000	69420	4140	9017	91305	5148	1872138
1991-92	14.62	13183	58122	3344	6000	80649	7245	5912	84917	4917	1857040
1992-93	16.71	25561	100398	43606	6000	175565	17250	-4093	78450	4823	1953425
1993-94	10.91	0	64006	51	6000	70057	13283	-125	98913	5447	1919248
1994-95	21.66	62357	114189	79762	6000	262308	17250	-4093	64311	5220	2116117
1995-96	13.37	5779	126677	19421	5419	157297	13455	-298	89078	6603	2178031
1996-97	11.71	0	70798	49382	5110	125290	17250	-4093	95868	7077	2204468
1997-98	32.61	145583	205135	42672	4978	398368	17250	-4093	35701	7285	2563943
1998-99	15.07	15848	21943	114300	3180	155271	15180	-2023	83484	10478	2627276
1999-00	16.64	25146	40641	2610	2864	71261	17250	-4093	78660	11111	2612858
Avg&Dws	13.71	18020	56600	19550	4421	98591	15541	-2384	89436	8313	2302195

"SMV NOW 4" 3/9/02

APPENDIX C

STORAGE ESTIMATES FROM WATER LEVEL DATA

GROUND WATER STORAGE IN EIGHT STORAGE UNITS IN SANTA MARIA VALLEY

Storage Unit area is Approx 25000 Acres. Storage multiplyer = 0.410 Calculated SpYld = 14.23%

GUADALUPE STORAGE UNIT	1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN:									
10N/36W-12P1	67	31	42	25	27	27	30	27	11.0%	5.0%
10N/35W-18F2	77	39	51	25	35	27	40	32	14.0%	5.0%
11N/35W-20E1	77	44	49	19	37	30	42	29	18.2%	10.0%
11N/35W-28M1	95	57	66	26	45	18	52	32	13.0%	5.0%
11N/35W-33G1	100	53	73	30	50	40	60	40	9.4%	10.0%
10N/35W-9F1	100	55	74	32	50	29	55	39	12.0%	10.0%
10N/35W-21B1	110	58	86	42	60	49	59	50	11.5%	5.0%
10N/35W-23M2	126	75	85	30	51	40	70	57	12.5%	5.0%
10N/35W-14P1	125	74	90	58	53	53	65	50	12.5%	5.0%
10N/35W-11E4	115	65	87	23	50	47	62	46	13.7%	5.0%
11N/35W-35A1	125	70	91	35	61	35	83	35	14.9%	10.0%
10N/35W-12M1	130	74	100	35	67	38	64	40	16.7%	10.0%
10N/35W-24B1	133	80	101	37	59	47	79	49	17.7%	5.0%
10N/34W-6N1	140	77	103	35	70	32	87	43	18.1%	10.0%
Est. storage above MSL at periods..KAF	235.0	163.9	190.5	119.3	150.8	124.9	164.9	130.7	Total % =	100.0%

Storage Unit area is Approx 6100 Acres. Mult. factor = 1.000 Calculated SpYld = 11.26%

BETTERAVIA STORAGE UNIT	1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN:									
10N/35W-24Q1	114	82	103	40	40	40	72	49	12.0%	24.0%
10N/35W-35J2	117	84	102	50	70	60	91	50	10.0%	24.0%
9N/34W-6C1	125	95	109	40	60	47	70	48	11.0%	13.0%
9N/34W-6K2	128	93	110	61	70	66	82	76	11.0%	13.0%
10N/34W-31L2	123	90	108	45	56	45	75	59	12.0%	13.0%
10N/34W-31D1	121	87	107	45	56	45	74	50	12.0%	13.0%
Est. storage above MSL at periods..KAF	82	60	73	32	39	34	53	37	Total % =	100.0%

Storage Unit area is Approx 10500 Acres. Mult. factor = 1.000 Calculated SpYld = 13.60%

NIPOMO STORAGE UNIT	1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN:									
South Border	116	66	83	34	58	39	73	39	11.3%	50.0%
North Boundry	150	100	113	66	72	68	81	66	15.9%	50.0%
Est. storage above MSL at periods..KAF	250	179	200	131	151	136	167	134	Total % =	100.0%

Storage Unit area is Approx 16200 Acres. Mult. factor = 1.000 Calculated SpYld = 15.75%

ORCUTT STORAGE UNIT	1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN:									
10N/34W-34G1	160	104	117	60	70	60	80	60	17.0%	7.0%
10N/34W-34G2	160	105	118	60	70	60	80	60	17.0%	7.0%
10N/34W-26H2	175	115	125	49	79	58	100	58	16.3%	10.0%
10N/34W-26P1	170	112	120	50	75	65	90	60	16.3%	7.0%
9N/34W-3N1	165	106	115	70	73	70	80	70	15.9%	10.0%
9N/34W-3F1	166	106	112	40	65	20	78	50	15.9%	7.0%
9N/34W-3A2	167	106	112	49	68	49	82	52	15.9%	10.0%
9N/34W-8H1	160	106	112	70	71	71	85	84	13.7%	10.0%
9N/34W-9R1	169	112	112	60	80	60	93	70	16.7%	5.0%
9N/34W-15Q1	175	120	125	71	95	61	107	70	12.6%	10.0%
9N/34W-10M2	170	110	110	58	78	58	90	67	16.0%	5.0%
9N/34W-14H1	175	110	125	78	106	72	115	64	17.0%	7.0%
9N/34W-14D1	172	120	126	70	93	59	105	54	17.0%	5.0%
Est. storage above MSL at periods..KAF	428	280	300	154	199	151	231	161	Total % =	100.0%

Storage Unit area is Approx 17400 Acres. Mult. factor = 1.000 Calculated SpYld = 19.19%

SANTA MARIA STORAGE UNIT	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN: 1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
10N/34W-13J1	175	120	150	102	168	117	173	65	18.0%	4.0%
10N/34W-13C1	172	115	148	93	160	95	160	80	18.0%	4.0%
10N/34W-13G1	173	118	150	98	161	100	153	86	18.0%	4.0%
10N/34W-14E5	166	92	129	44	104	43	123	53	20.3%	12.0%
10N/34W-4R1	158	95	120	40	92	52	121	48	21.3%	12.0%
10N/34W-2R1	180	120	160	98	168	100	175	100	17.0%	5.0%
10N/34W-20H3	148	101	110	44	78	54	94	54	19.8%	5.0%
10N/34W-23H1	173	110	141	65	112	72	120	68	18.5%	12.0%
10N/34W-24K3	180	125	155	92	132	79	128	75	16.2%	5.0%
10N/34W-8E4	144	83	109	36	74	35	96	35	18.0%	5.0%
10N/34W-5E1	145	82	106	36	74	35	99	36	21.0%	5.0%
10N/34W-5P1	148	85	110	37	78	36	101	36	21.0%	12.0%
10N/34W-16R1	160	90	118	40	90	40	100	40	20.0%	5.0%
10N/34W-18C1	139	82	105	37	70	38	75	35	16.0%	5.0%
10N/34W-17H1	152	88	109	39	80	40	87	40	18.0%	5.0%
Est. storage above MSL at periods..KAF	535	327	420	180	344	190	392	180	Total % =	100.0%

Storage Unit area is Approx 5500 Acres. Mult. factor = 1.000 Calculated SpYld = 15.57%

FUGLER POINT STORAGE UNIT	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN: 1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
10N/33W-20L1	250	185	236	137	220	140	222	140	15.8%	10.0%
10N/33W-20H1	260	200	240	180	245	180	244	155	15.8%	10.0%
10N/33W-16N2	270	230	260	218	262	200	260	165	17.0%	10.0%
10N/33W-27K2	320	283	292	220	300	233	298	220	16.3%	5.0%
10N/33W-18G1	215	160	205	143	209	143	209	139	14.9%	10.0%
10N/33W-21P1	275	225	260	200	260	200	268	169	15.7%	10.0%
10N/33W-27G1	320	288	310	220	307	221	308	207	16.3%	5.0%
10N/33W-28A1	295	252	292	225	289	217	291	202	14.6%	10.0%
10N/33W-19B1	210	160	201	102	201	100	204	90	15.9%	10.0%
10N/33W-35C1	335	297	333	276	328	273	320	256	12.7%	10.0%
10N/33W-7M1	195	134	170	123	175	110	193	110	17.0%	10.0%
Est. storage above MSL at periods..KAF	223	181	212	154	212	151	214	138	Total % =	100.0%

Storage Unit area is Approx 22000 Acres. Mult. factor = 1.000 Calculated SpYld = 12.90%

BRADLEY CYN. STORAGE UNIT	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN: 1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
10N/33W-29F1	185	165	180	100	161	102	175	110	16.6%	10.0%
9N/33W-28M1	640	636	640	633	635	634	639	640	14.0%	10.0%
10N/33W-30G1	183	150	180	96	135	102	145	83	13.6%	10.0%
10N/33W-30R1	183	150	180	96	133	103	155	93	13.6%	10.0%
10N/33W-33H1	230	185	225	143	178	148	200	148	13.2%	10.0%
9N/32W-19A1	390	378	388	360	375	359	370	348	12.0%	10.0%
9N/32W-20E1	396	388	395	386	391	379	383	373	12.0%	10.0%
9N/33W-24L1	378	355	375	340	340	335	331	330	14.0%	10.0%
9N/32W-32K1	680	667	678	663	665	664	678	670	10.0%	10.0%
9N/32W-33M1	691	684	690	681	684	680	689	686	10.0%	10.0%
Est. storage above MSL at periods..KAF	1067	1008	1059	928	990	931	1010	923	Total % =	100.0%

Storage Unit area is Approx 4300 Acres. Mult. factor = 1.000 Calculated SpYld = 17.31%

SISQUOC STORAGE UNIT	1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	SPCIFC YIELDS	AREA DISTRIB
	MEASURED AND ESTIMATED WATER LEVELS (ft MSL) IN:									
9N/32W-7N1	386	335	385	300	360	290	366	278	17.0%	10.0%
9N/33W-2H9	341	310	340	267	322	250	327	252	16.7%	10.0%
10N/33W-36A1	366	355	365	347	353	348	350	334	16.0%	6.0%
9N/32W-6D1	371	335	370	320	369	320	362	312	12.0%	7.0%
9N/32W-7A1	394	355	392	336	385	330	375	313	12.0%	7.0%
9N/33W-12C1	355	325	353	260	327	262	330	240	13.0%	10.0%
9N/32W-7Q1	397	361	395	330	387	328	380	290	20.0%	5.0%
9N/32W-8N1	403	380	400	360	396	338	385	320	20.0%	5.0%
9N/32W-17G1	438	390	433	380	421	380	412	370	20.0%	10.0%
9N/32W-16L1	458	415	455	435	448	400	440	387	20.0%	10.0%
9N/32W-22D1	486	475	485	460	473	450	480	458	20.0%	10.0%
9N/32W-23K1	526	520	525	510	523	515	522	508	20:0%	10.0%
Est. storage above MSL at periods..KAF	314	291	312	277	304	270	302	263	Total % =	100.0%

TOTAL BASIN	1918	1936-7	1943-4	1966-7	1970-1	1977-8	1984	1991	OVERALL AVERAGE (acft/ft)	SpYld(%)
Est. storage above MSL at periods..KAF	3135	2490	2767	1975	2389	1988	2535	1967	13902	12.99%
CHANGE IN STORAGE, KAF		-645	277	-792	414	-401	547	-568		

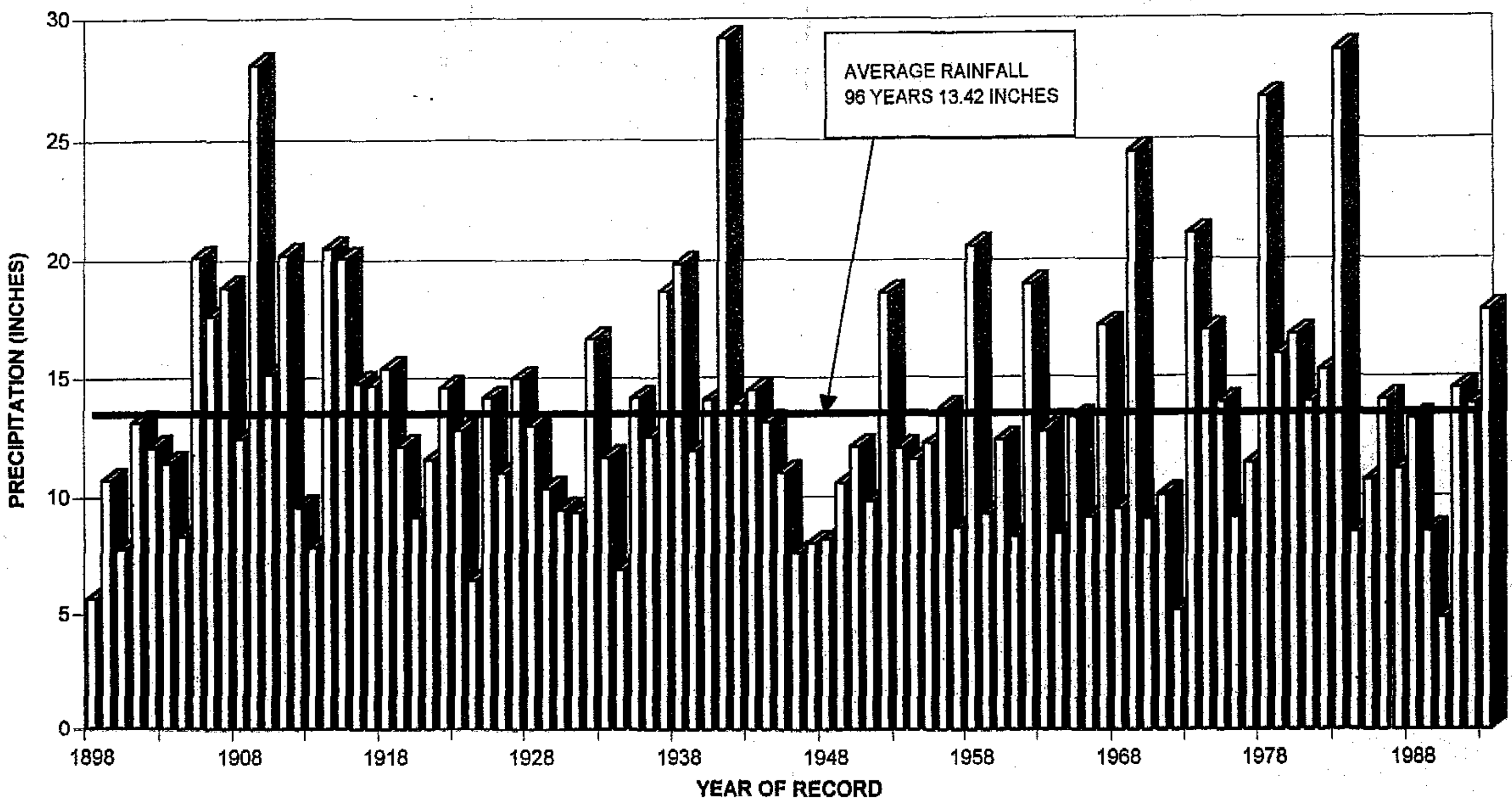
*SMVSTR2

THIS PROGRAM SAVED AS ~~'SMVSTOR'~~; LOWER RIGHT CORNER IS N160.

APPENDIX D

RAINFALL RECORDS

UNION SUGAR BEET COMPANY
RAINFALL STATION No. 387



UNION SUGAR BEET COMPANY STATION NO. 387

Santa Maria Valley Precipitaion Data

Santa Barbara County Water Agency

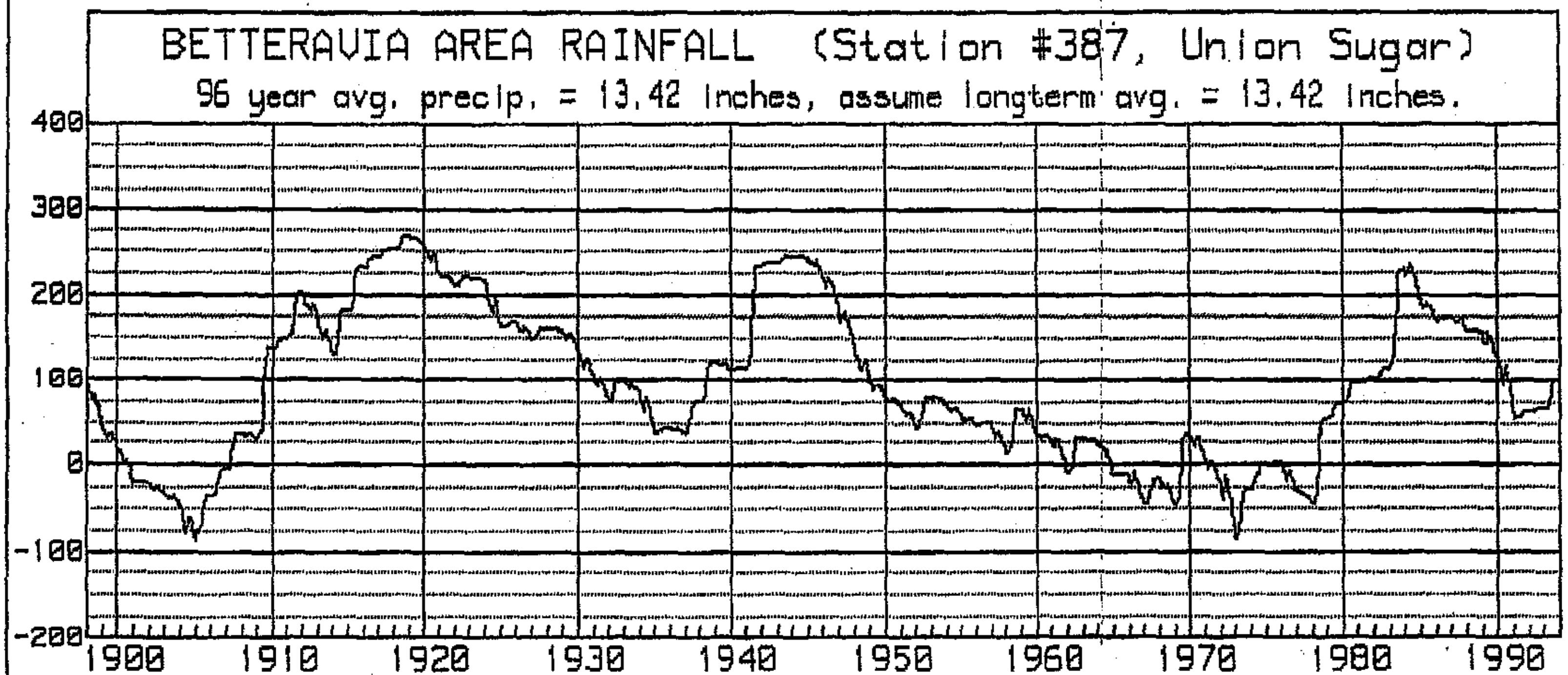
Santa Maria, California

JULY 2002
Project No. 02-001-01

GROUNDWATER CONSULTANTS

PLATE D1

UNION SUGAR CO. STATION # 387			
YEAR	RAINFALL (inches)	YEAR	RAINFALL (inches)
1898	5.66	1946	7.6
1899	10.7	1947	8
1900	7.78	1948	8.16
1901	13.11	1949	10.55
1902	12.07	1950	12.07
1903	11.42	1951	9.79
1904	8.31	1952	18.58
1905	20.11	1953	12.02
1906	17.63	1954	11.55
1907	18.84	1955	12.2
1908	12.44	1956	13.67
1909	28.09	1957	8.63
1910	15.16	1958	20.57
1911	20.2	1959	9.26
1912	9.55	1960	12.35
1913	7.85	1961	8.29
1914	20.46	1962	18.95
1915	20.05	1963	12.73
1916	14.79	1964	8.38
1917	14.68	1965	13.27
1918	15.41	1966	9.09
1919	12.09	1967	17.19
1920	9.11	1968	9.46
1921	11.55	1969	24.45
1922	14.57	1970	9.05
1923	12.76	1971	10.04
1924	6.45	1972	5.13
1925	14.13	1973	21.06
1926	11.01	1974	16.96
1927	14.97	1975	13.91
1928	12.97	1976	9.1
1929	10.34	1977	11.36
1930	9.43	1978	26.71
1931	9.32	1979	15.96
1932	16.633	1980	16.78
1933	11.62	1981	13.93
1934	6.88	1982	15.28
1935	14.14	1983	28.62
1936	12.51	1984	8.43
1937	18.65	1985	10.68
1938	19.824	1986	14.01
1939	11.91	1987	11.13
1940	14.05	1988	13.21
1941	29.16	1989	8.48
1942	13.9	1990	4.81
1943	14.45	1991	14.47
1944	13.09	1992	13.82
1945	10.99	1993	17.81
		Total	1,288.367
		Average	13.420

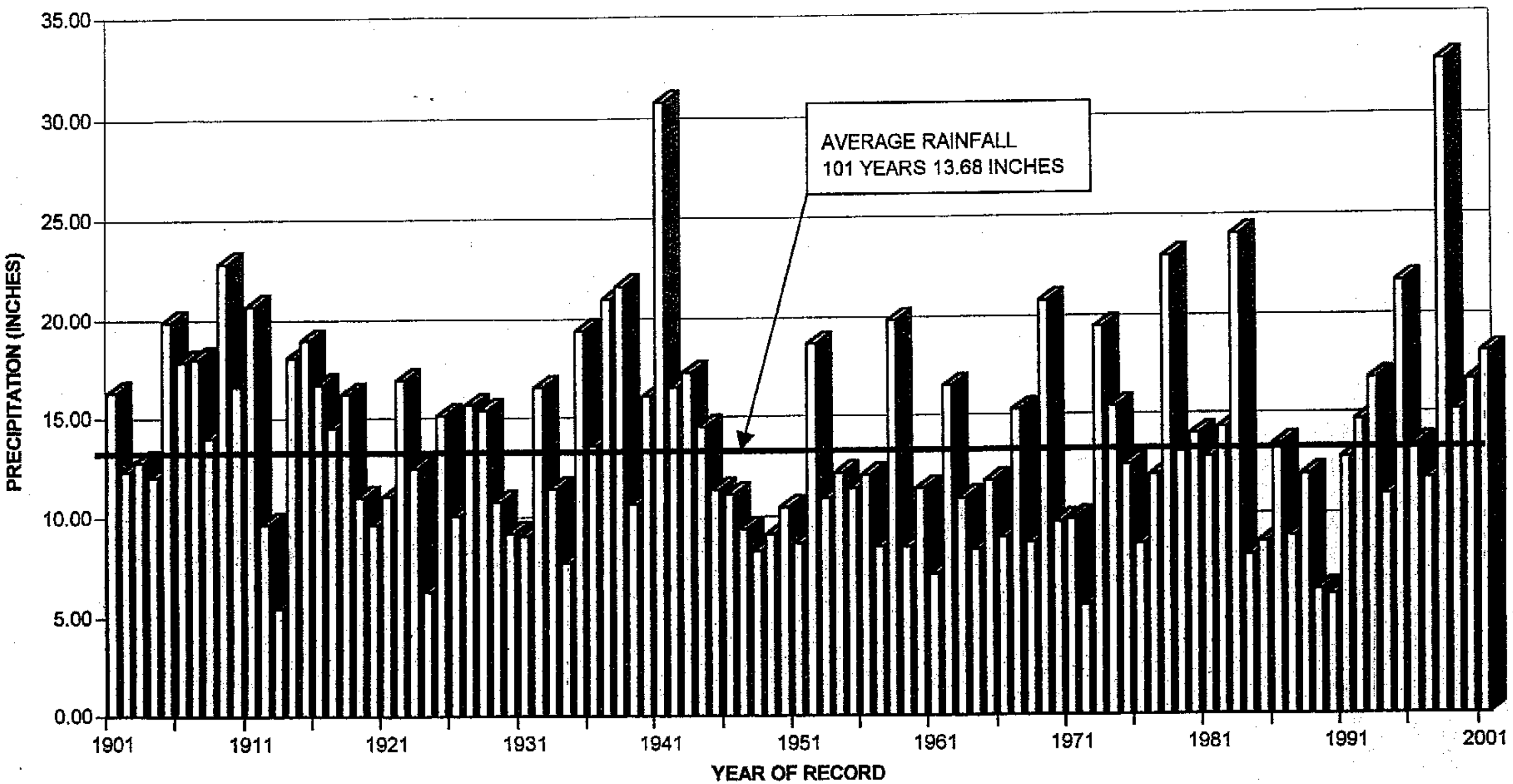


DEVIATION FROM MEAN IN %; TIME SCALE = SEP-AUG WATER YEARS.

7/10/99

HOPKINS GROUNDWATER CONSULTANTS

SANTA MARIA CITY
RAINFALL STATION No. 380



SANTA MARIA CITY RAINFALL STATION NO. 380

Santa Maria Valley Precipitaion Data

Santa Barbara County Water Agency

Santa Maria, California

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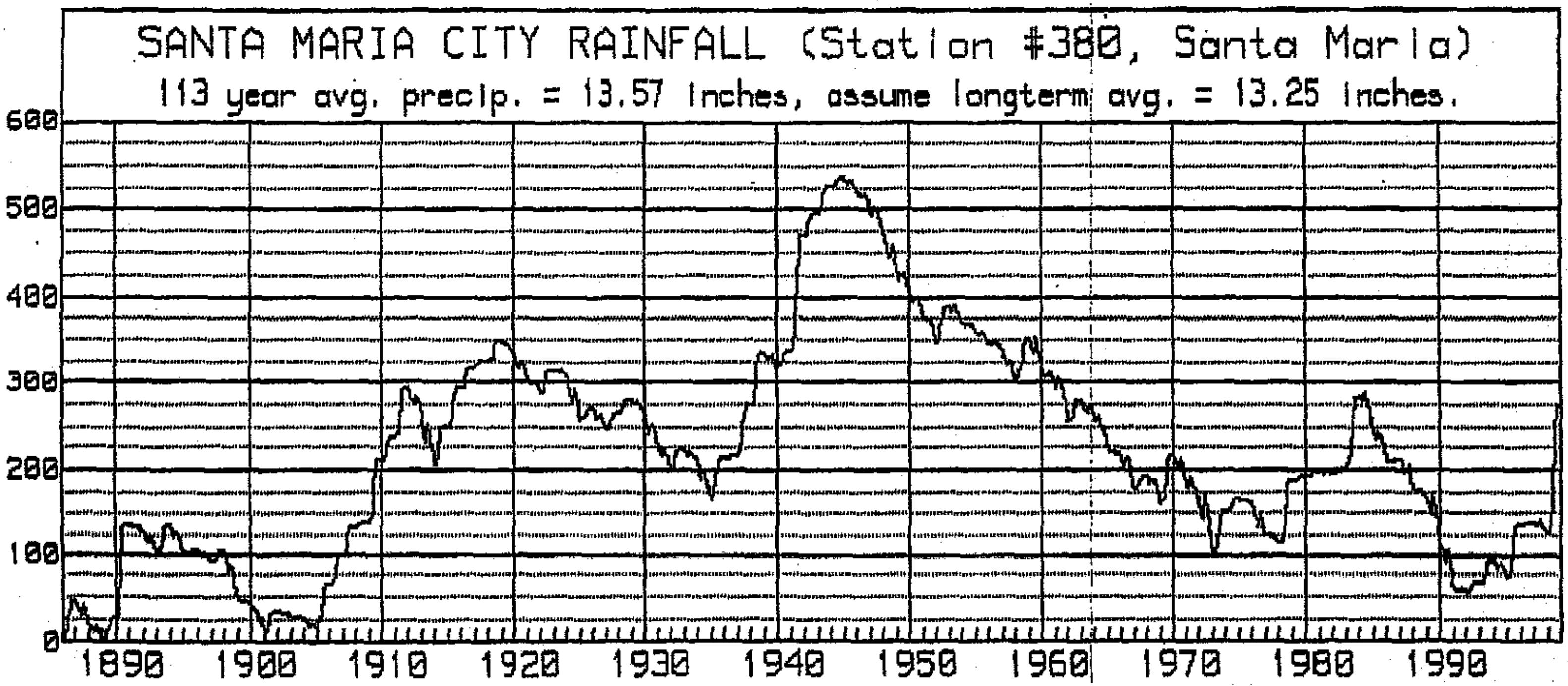
PLATE D2

JULY 2002
Project No. 02-001-01

HOPKINS
GROUNDWATER CONSULTANTS



DEVIATION FROM MEAN IN %; TIME SCALE = SEP-AUG WATER YEARS.

7/9/99

HOPKINS
GROUNDWATER
CONSULTANTS

SANTA MARIA CITY STATION NO. 380					
YEAR	RAINFALL (inches)	YEAR	RAINFALL (inches)	YEAR	RAINFALL (inches)
1901	16.28	1944	14.46	1987	8.87
1902	12.32	1945	11.31	1988	11.91
1903	12.79	1946	11.08	1989	6.18
1904	12.04	1947	9.36	1990	5.94
1905	19.91	1948	8.26	1991	12.75
1906	17.85	1949	9.09	1992	14.62
1907	18.01	1950	10.43	1993	16.71
1908	13.96	1951	8.63	1994	10.91
1909	22.81	1952	18.64	1995	21.66
1910	16.58	1953	10.86	1996	13.37
1911	20.69	1954	12.13	1997	11.71
1912	9.63	1955	11.34	1998	32.61
1913	5.48	1956	12.01	1999	15.07
1914	18.06	1957	8.46	2000	16.64
1915	18.93	1958	19.84	2001	18.02
1916	16.66	1959	8.41	Total	1,381.25
1917	14.48	1960	11.33	Average	13.68
1918	16.19	1961	7.09		
1919	10.99	1962	16.47		
1920	9.60	1963	10.84		
1921	11.04	1964	8.27		
1922	16.88	1965	11.71		
1923	12.44	1966	8.89		
1924	6.29	1967	15.21		
1925	15.07	1968	8.61		
1926	10.05	1969	20.78		
1927	15.61	1970	9.65		
1928	15.34	1971	9.78		
1929	10.74	1972	5.49		
1930	9.19	1973	19.43		
1931	9.04	1974	15.37		
1932	16.50	1975	12.45		
1933	11.40	1976	8.5		
1934	7.69	1977	11.94		
1935	19.39	1978	22.95		
1936	13.51	1979	13.08		
1937	20.96	1980	13.97		
1938	21.59	1981	12.81		
1939	10.60	1982	14.28		
1940	16.00	1983	24.04		
1941	30.76	1984	7.93		
1942	16.48	1985	8.6		
1943	17.24	1986	13.43		