THE RESOURCES AGENCY OF CALIFORNIA

Department of Water Resources

BULLETIN No. 113

VEGETATIVE WATER USE STUDIES 1954-1960

Interim Report

AUGUST 1963

HUGO FISHER
Administrator
The Resources Agency of California

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
Department of Water Resources

State of California

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ERRATA

Bulletin No. 113, "Vegetative Water Use Studies, 1954 - 1960"

Plate 1, Agroclimatic Stations No. 4, 57, 61, 75, 93, 101:
For "Inactive - 1960" read "Active - 1960"

Plate 2, For "Evapotransperometer" read "Evapotranspirometer"

Page 58, line 10, For "Figures E and F" read "Figures A and B"

Page 66, line 21, For "Figures A and B" read "Figures E and F"

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THE RESOURCES AGENCY OF CALIFORNIA

DEPARTMENT OF WATER RESOURCES

1120 N. STREET, SACRAMENTO

June 20, 1963

Honorable Edmund G. Brown, Governor
and Members of the Legislature
of the State of California

Gentlemen:

I have the honor to transmit herewith Bulletin No. 113, "Interim Report on Vegetative Water Use Studies, 1954-1960," of the Department of Water Resources, dated May 1963. This report describes techniques and approaches which have evolved, and summarizes data on vegetative consumptive use or evapotranspiration. Interrelationships between these data are set forth, together with evapotranspiration values for some crops in Central and Northern California agricultural areas. This is a continuing study with many conclusions yet to be reached.

Data pertaining to evapotranspiration, irrigation requirements, and agricultural hydrology are basic to most water resource development studies. With the continued growth of the State, necessitating more complex and costly water development facilities, there is increasing need for more accurate water use data. Such data will enable developed surface and ground water resources to be used effectively, and will facilitate design and operation of land drainage systems.

The studies reported herein were initiated in 1954 as part of the Northeastern Counties Investigation. A continuing Vegetative Water Use Studies Program was established, and the studies were broadened, as a result of Senate Bill 434, 1959 Legislative Session. Specific authorization for these studies is set forth in Section 226(e) of the Water Code.

Sincerely yours,

William E. Warne

Director

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

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ACKNOWLEDGEMENT

The Department of Water Resources wishes to express appreciation to many organizations and individuals who have assisted the department in the Vegetative Water Use Program. Many private farm operators have provided use of their property and equipment, as well as time. The list is too numerous to completely enumerate; however, the Frick Farms at Arvin, Roland Hutchings at Pittville, and the U. S. Fish and Wildlife Service (formerly Dorris Ranch) at Alturas have been particularly helpful.

A very considerable amount of technical guidance has been given by the Irrigation Department of the University of California at Davis. The University Agricultural Extension has given assistance in the search for plot sites.

The assistance and collaboration provided by the U. S. Forest Service, the Agricultural Research Service and the Soil Conservation Service of the U. S. Department of Agriculture; the California Division of Forestry; and the Agricultural Commissioner's Office, to mention a few, are likewise gratefully acknowledged.

CHAPTER I. INTRODUCTION

This report presents data on vegetative consumptive use of water, or evapotranspiration, together with certain interrelationships with agricultural climatic factors influencing such use. The findings summarized cover the period 1954-1960, and represent a large quantity of individual measurements of evapotranspiration and related agricultural climatic data. The measurements of evapotranspiration represent scores of soil samples, neutron probe readings, and evapotranspirometer measurements of irrigated alfalfa, pasture, plums, cotton, and grass crops. Agricultural climatic or agroclimatic data are likewise summarized from a large number of measurements of evaporation from pans and atmometers. Certain other agroclimatic data, such as measurements of solar radiation and relative humidity, were collected at a few stations. These data have not been analyzed as yet, and will be reported in later publications.

Need for Vegetative Water Use Studies

Historically, irrigated agriculture has been the largest user of our developed water resources. This condition probably will continue indefinitely. The Department of Water Resources, hereinafter referred to as the department, and its predecessor agencies, have made many measurements of water deliveries for agricultural uses with regard to water right adjudication. However, for broad planning purposes the department has relied largely upon

empirical methods for estimating seasonal values of evapotranspiration or consumptive use for various crops. State Water Resources Board Bulletin No. 2, "Water Utilization and Requirements of California, 1955," has been the primary source for such estimates.

As more complex and costly water development facilities are contemplated, more accurate values for irrigation requirements and evapotranspiration will be needed. The location and sizing of reservoirs, distribution systems, and final disposal or drainage systems are dependent upon accurate estimates of at least monthly values of irrigation requirements and evapotranspiration for various kinds of vegetation. Accurate irrigation requirements and evapotranspiration values are also important in planning for the conjunctive operation of ground water reservoirs, the reclamation of salt-affected lands, and in the maintenance of a favorable salt balance within agricultural soils. Moreover, as water costs rise, more accurate knowledge of evapotranspiration rates will become of increasing importance in order to achieve greater efficiencies in irrigation practices.

Authorization

Estimates of evapotranspiration and irrigation requirements have long been a part of water development investigations, as conducted by the department and its predecessor agencies. The present program, designed to provide more accurate data on rates of evapotranspiration, was initiated in July 1954 and broadened in 1959, pursuant to Senate Bill 434, 1959 Legislative Session. Specific authorization for conducting these studies is set forth

in Section 226 (e) of the Water Code, which states that the department may "Conduct investigations of the rate of use of water for various purposes and considering various soil conditions."

Objective

The overall objective of the vegetative water use studies is to investigate and establish a means whereby the department can accurately determine long-term monthly and seasonal irrigation requirements and evapotranspiration for the principal crops grown within the various agricultural zones throughout California. To accomplish this broad objective, the vegetative water use studies are divided into three principal programs; namely, agroclimatic monitoring, evapotranspiration measurement and correlation, and irrigation requirement determination. The first two of these programs are designed to accomplish the following primary objectives: first, to collect agroclimatic data in major agricultural areas to provide a means of dividing the State into agroclimatic zones of potential water use, and for estimating evapotranspiration within those zones; and second, to test, on a statewide basis, certain procedures suggested by fundamental research by the University of California and other agencies, regarding correlation of evapotranspiration with various types of agroclimatic data. The objective of the third program is to correlate measured values of total applied water with evapotranspiration. These data will make possible the calculation of other pertinent water use information, such as irrigation efficiencies and drainage requirements. Very little has been accomplished on the third program to date.

Scope of Present Program and Report

To accomplish the foregoing objectives, it is necessary to measure evapotranspiration for various crops within the major agricultural zones of the State, and to measure various climatic, plant, and soil factors which influence evapotranspiration. To date, accurate measurements of evaporation have been made of only a few crops within certain of the major agricultural service areas of the State, because of financial and personnel limitations. Additional installations will be required to provide complete evaluation of all major agricultural zones and the principal crops grown within California.

In order to maximize the utility of the data provided by the relatively few evapotranspiration measurement stations, a correlative program has been carried on to relate evapotranspiration to evaporation indices. Theoretically, coefficients derived by comparing evapotranspiration to evaporation from pans or atmometers can be used to make reliable estimates of evapotranspiration within any agroclimatic zone where evaporation data are available. Basic research on such relationships is being conducted by the University of California as a part of the vegetative water use program.

The agroclimatic monitoring program, described fully in Chapter II, is designed to collect the basic agroclimatic data necessary to make reliable estimates of evapotranspiration within each agroclimatic zone. Chapter III discusses evapotranspiration measurements and the collection of data relative to plant conditions, soil moisture, and other factors which may affect evapotranspiration rates. The criteria, methods, and instrumentation

used in the measurements are described generally, and the data collected through 1960 are summarized. Since the initiation of this program in 1954, improvements and standardizations within the program have vastly improved the quality of the data collected, such that one hesitates to compare data collected in 1960 with earlier years of records. Consequently, judgment was exercised in summarizing certain of the earlier data.

In Chapter IV, measured evapotranspiration rates described in Chapter III are correlated with pan and atmometer evaporation data which were collected concurrently at the evapotranspiration plots. The pan and atmometer coefficients, so derived, are then applied to the agroclimatic data to estimate evapotranspiration for a few crops throughout much of the northern part of the State. While comparisons are made with the values published in Bulletin No. 2, it is not the intent of this report to imply a question as to the accuracy of previous values used by the department. Instead, this report is intended to indicate some of the problems involved in the collection and analysis of the data and, to the extent of the data collected, to show tentative values that may be used for the determination of water requirements for certain crops.

A great deal of the basic research fundamental to this study was conducted by the University of California at Davis, both prior to and since the initiation of this program. The continuing counsel and guidance provided by various members of the University of California have been of invaluable assistance in the development of these studies.

CHAPTER II. AGROCLIMATIC MONITORING PROGRAM

As stated in Chapter I, the objective of the agroclimatic monitoring program is to collect and analyze climatological data throughout the various agricultural water service areas within the State. The analyses of these data will accomplish two purposes. First, they will enable segregation and delineation of zones or areas with similar evaporation potentials. Secondly, these data will provide a basis for estimating evapotranspiration rates of various crops within those zones. This can be accomplished by utilizing coefficients which relate measured crop evapotranspiration (to be discussed in Chapter III) to agroclimatic data. The program of correlating measured evapotranspiration to various evaporative indices, such as evaporation pans and atmometers, is discussed in Chapter IV.

To date, agroclimatic stations have been established at typical locations within certain of the major inland agricultural areas in the central and northern portions of the State. The data collected and summarized in this report comprise weekly measurements of evaporation from U. S. Weather Bureau Standard Class A pans, and differences of evaporation between Livingston black and white atmometers. Measurement of solar radiation, air temperature, and humidity was made at a few locations. These data, however, are not included in this report, as research regarding their relationships to evapotranspiration and methods of analysis are still in the process of development.

As of 1960, the program included 52 stations, although a total of 112 stations have been operated for various periods of

time. Many of the original stations have been discontinued because of unfavorable site conditions or other causes. The location and status of each station are shown on Plate 1, entitled "General Locations of Agroclimatic Stations, 1954-60." A more detailed description of each of the agroclimatic stations is presented in Table A-1 of Appendix A.

Instrumentation at Agroclimatic Stations

Two types of equipment were utilized to measure evaporation potential; the Livingston spherical atmometer, and the U. S. Weather Bureau Standard Class A evaporation pan. U. S. Forest Service precipitation gages, approximately 8 inches in diameter and 10.5 inches in height, were installed at all agroclimatic stations at the same elevation above ground as prescribed for a standard U. S. Weather Bureau nonrecording rain gage. Following is a description of evaporation equipment in use and methods of installation.

Atmometers

A Livingston spherical atmometer is a specialized instrument used for measurement of evaporation. The atmometer is a hollow porous porcelain sphere 5 centimeters in diameter. In a typical assembly the sphere is mounted on a 1-gallon water supply bottle by means of a small-diameter glass tube. The sphere and connecting tube are filled with distilled water, with the lower end of the tube extending nearly to the bottom of the reservoir bottle. Thus, there is a continuous water system from the reservoir bottle to the outer surface of the porous sphere, where evaporation takes place.

Evaporation is determined by measuring the amount of water required to refill the reservoir bottle to a reference mark. A typical atmometer assembly is shown on Figure 1.

Atmometers are operated as pairs consisting of one white and one black sphere set 15 inches apart and 54 inches above ground surface. Prior to 1958, many installations had only a single pair of atmometers; however, since that time three or more pairs of atmometers have been installed at each of the stations included in the monitoring program.

Evaporation Pans

U. S. Weather Bureau Standard Class A evaporation pans were adopted in the agroclimatic program in 1957 and installed at certain of the stations. The pans were installed in accordance with the procedure prescribed in "Instructions for Climatological Observers," Circular B. Tenth Edition, Revised October 1955, U. S. Department of Commerce.

All stations included in the Agroclimatic Monitoring Program are periodically inspected to ascertain that equipment is correctly installed and properly exposed. Complete records for all stations are available in the files of the department. Typical agroclimatic station installations are shown in Figure 2.

Agroclimatic Data Analysis

Summaries of the agroclimatic data collected during the period from July 1954 through December 1960 are shown in Tables 1 and 2. Table 1 shows the means of monthly evaporation from standard

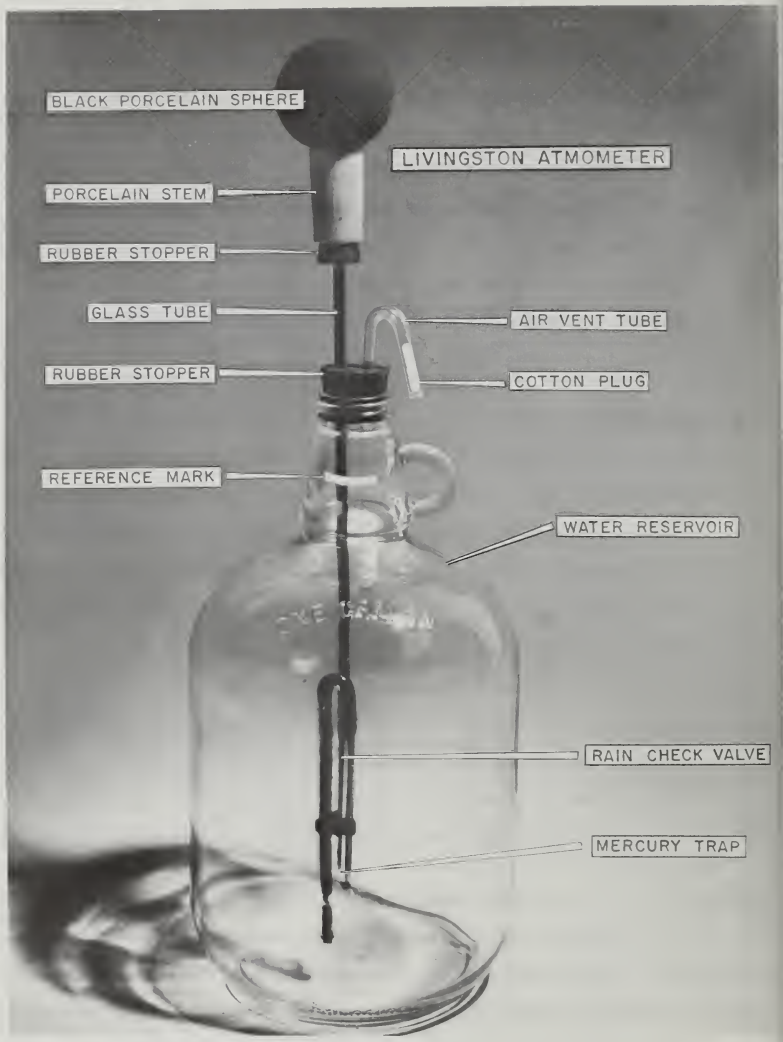


Figure 1, ATMOMETER ASSEMBLY

Station Located
in Irrigated Pasture
near Lodi

Station Located
in Dryland
Environment
near Redding

Station Located
in Non-irrigated
Alfalfa near
Adin, Modoc County

FIGURE 2. TYPICAL AGROCLIMATIC STATIONS

TABLE 1

MEAN MONTHLY EVAPORATION FROM STANDARD
U. S. WEATHER BUREAU EVAPORATION PANS

(in inches)

Environment and area	Number of Station Years	Years of Record	MONTHS Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	May Sept. Total
Pasture															
Klamath-Trinity Mt. Valleys	2	1959-60					6.95	8.76	11.06	8.44	6.18				41.39
SacramentoRiver Basin Mountain Valleys	9	1957-60	-	1.48	3.25	5.10	6.16	7.69	8.96	8.78	6.16	3.86	1.66	0.66	37.75
Sacramento River Basin Foothills	7	1957-60	1.52	2.29	3.56	5.19	6.30	9.15	10.66	9.27	6.44	5.00	2.20	1.52	41.82
Sacramento River Basin Valley Floor	12	1958-60	1.65	2.49	4.04	5.48	7.26	10.28	10.73	9.18	6.87	5.34	2.58	1.74	44.32
San Joaquin River Basin Valley Floor	11	1959-60	1.67	2.18	4.19	6.08	8.84	10.60	10.55	9.08	6.76	5.14	1.92	1.30	45.83
Tulare Lake Basin Valley Floor	6	1958-60	1.79	2.18	4.15	5.76	8.77	9.74	9.36	8.11	6.00	4.24	1.98	1.16	41.98
Lassen-Alpine Mountain Valleys	6	1957-60	--	--	--	---	6.30	8.91	10.97	9.81	6.85	4.35	--	--	42.84
Dryland															
SacramentoRiver Basin Mountain Valleys	8	1958-60	--	1.20	2.99	5.98	5.95	10.02	12.03	11.06	7.41	4.60	2.09	--	46.47
SacramentoRiver Basin Foothills	7	1958-60	1.42	2.75	4.60	6.52	8.69	13.36	15.04	12.46	10.27	7.42	3.89	2.94	59.82
SacramentoRiver Basin Valley Floor	9	1958-60	1.26	2.48	4.88	6.52	8.95	13.25	14.03	11.87	9.45	7.24	3.19	1.90	57.55

TABLE 2

MEAN MONTHLY EVAPORATION DIFFERENCE BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS

(in milliliters)

Environment and area	Number of Stations	Years of Record	MONTHS Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	May Sept. total
Pasture															
SacramentoRiver Basin Mountain Valleys	13	1955-60					463	550	600	545	417				2575
Sacramento River Basin Foothills	10	1958-60			292	453	494	572	619	562	466	375			2713
Sacramento River BasinValley Floor	13	1958-60			324	424	491	588	614	549	443	366			2585
San Joaquin River Basin Valley Floor	11	1959-60			374	460	529	569	580	543	449	366			2670
Tulare Lake Basin Valley Floor	6	1958-60				440	520	572	580	551	444	373	231		2667
Lassen-Alpine Mountain Valleys	8	1955-60					460	545	572	550	454				2581
Alfalfa															
Klamath-Trinity Mountain Valleys	3	1955						550	558	539					
Sacramento River Basin Mountain Valleys	11	1955-59					486	537	566	568	444				2601
Sacramento River Basin Valley Floor	17	1955,58-60			384	445	539	580	618	556	472	389			2765
San Joaquin River Basin Valley Floor	13	1958-60			284	470	548	571	582	548	454	379			2703
Tulare Lake Basin Valley Floor	9	1958-60			402	462	538	569	617	563	447	409			2754
Dryland															
Klamath-Trinity Mountain Valleys	15	1954-60					446	521	584	546	413				2510
Sacramento River Basin Mountain Valleys	26	1954-60					470	536	569	540	408	310			2523
Sacramento River Basin Foothills	4	1959-60			323	395	468	576	658	593	458	388			2753
Sacramento River Basin Valley Floor	17	1954-60			366	426	511	588	655	573	465	366			2792
Lassen-Alpine Mountain Valleys	7	1955-56 & 1958-59						520	582	535					
Miscellaneous															
Sacramento River Basin Valley Floor	9	1954-55, 57, & 60				403	511	581	628	567	442	351			2729

U. S. Weather Bureau pans. Table 2 indicates the mean monthly difference of evaporation between Livingston spherical black and white atmometers.

At the initiation of the program in 1954, little was known of the effects of the immediate ground cover environment on evaporation from atmometers and pans. Furthermore, little consideration had ever been given to the effects on evaporation rates of surrounding land areas or cleanliness of pans at stations having apparently similar immediate environmental conditions. In analyzing the data it became apparent that certain of these factors are extremely important.

In the initial tabulations of evaporation data, great differences were noted between adjacent stations having dissimilar environmental conditions. A tabulation on the basis of station environment shows this to be especially true for evaporation pans, as may be noted in Table 1. For example, Table 1 indicates that the May through September total of the mean monthly evaporation from pans located on dry-farmed rangelands was more than 25 percent greater than evaporation from pans situated on irrigated pasture. This difference became increasingly greater during the summer months. The higher and increasingly greater evaporation on dry-farmed rangelands resulted from the greater availability of energy in surrounding dryland areas, and the increase of advective heating that results as the drylands exhaust moisture carried over from wintertime precipitation during the summer.

An interesting fact determined from studies at the Bakersfield station was that cleanliness, or presence of algae growth, had little effect upon evaporation rates from evaporation pans. During an 18-month period starting in January 1959, three pans were maintained in the same environment and were treated in an identical manner, except that algae was permitted to grow in one pan while the other two were cleaned frequently. The difference of evaporation was small, with only 3 percent greater evaporation in the pan where algae was allowed to grow.

In an evaporation investigation carried on by A. A. Young in Southern California during the period from 1935 to 1939, inclusive, a study was conducted to determine the effect of pan color upon evaporation. He found differences varying from approximately 17 percent less to 7 percent more than from a standard U. S. Weathe Bureau pan. It is of interest to note that evaporation from a dark green colored pan was 2.5 percent greater than that from the standard U. S. Weather Bureau pan. The presence and growth of algae appear to give similar results.

The difference in evaporation between black and white atmometers, as shown in Table 2, appears to be affected less by environmental conditions than are pans. This indicates a differenc in response between pans and atmometers to various climatic conditions. This will be discussed further in Chapter IV.

Monthly evaporation data from pans and atmometers for each year and for each station are set forth in Tables A-2 and A-3, respectively, of Appendix A. The data are segregated by area and by environment.

The area designations set forth in this report are arbitrary and, in general, principally geographical subdivisions. When additional years of data become available, these area breakdowns must be reconsidered. Analysis of the records of individual stations to date indicates as much variability in evaporation between adjacent stations, within any one area, as between areas. This variability is shown in Tables 3 and 4, in which all of the stations located on irrigated pasture in 1959 and 1960 were arranged in order of decreasing evaporation rate by month. The same was done for the 1959 and 1960 dryland stations. On the basis of these data, it is concluded that no definite segregation of the stations into areas of uniform evaporation is possible.

A general pattern has been discerned with certain of the stations tending to be high and others low. There are indications that, for stations having similar environments immediately surrounding the site, adjacent dryland areas exert climatic influences and affect evaporation rates at the station site.

This factor is being given further consideration in relation to the agroclimatic stations currently in operation. Efforts are being made to standardize conditions where pan and atmometer data are collected. Insofar as possible, large, well-irrigated pastures providing nearly 100 percent ground cover are being selected as sites for agroclimatic stations. As data are obtained under similar environmental conditions, more conclusive comparisons may be made. It may be found that there are small differences in monthly evaporative rates between different agricultural areas of the State, and that the length of growing season is the most important factor affecting seasonal evapotranspiration in inland areas.

TABLE 3

MONTHLY EVAPORATION FROM STANDARD U. S. WEATHER BUREAU
EVAPORATION PANS IN ORDER OF DECREASING MAGNITUDE FOR IRRIGATED PASTURE AND DRYLAND STATIONS
(In inches)

Environment and year	Months											
	January		February		March		April		May		June	
Irrigated Pasture												
1959	Red Bluff Cone Ranch	1.88	Lincoln Vineyard	2.62	Lincoln Vineyard	5.12	Lincoln Vineyard	6.35	El Solyo Ranch	9.52	Merced 5SE	12.03
	Lincoln Vineyard	1.72	Gold Hill Doty Flat	2.36	Red Bluff Cone Ranch	5.07	Stockton 9S	6.33	Merced 5SE	9.36	El Solyo Ranch	11.12
	Gold Hill Doty Flat	1.49	Red Bluff Cone Ranch	2.18	Lodi 3SW	4.50	Red Bluff Cone Ranch	6.23	Stockton 9S	9.16	Stockton 9S	11.05
	Penn Valley	1.36	Kingsburg 5S #2	2.14	Merced 5SE	4.49	Merced 5SE	6.03	Lincoln Vineyard	8.58	Lincoln Vineyard	10.71
	Fall River Mills 4NW	1.07	Anderson 4E	1.99	Gold Hill Doty Flat	4.25	Lodi 3SW	5.99	Kingsburg 5S #2	8.39	Lodi 3SW	10.10
			Merced 5SE	1.96	Anderson 4E	4.19	El Solyo Ranch	5.97	Lodi 3SW	8.21	Red Bluff Cone Ranch	10.10
			Lodi 3SW	1.84	Kingsburg 5S #2	4.17	Fall River Mills 4NW	5.87	Montague 3NE	8.09	Kingsburg 5S #2	9.93
			Alturas-Dorris Ranch	1.83	El Solyo Ranch	3.86	Gold Hill Doty Flat	5.80	Anderson 4E	7.26	Gold Hill Doty Flat	9.68
			El Solyo Ranch	1.73	Penn Valley	3.54	Lookout Hunt	5.63	Fall River Mills 4NW	6.99	Standish 4NW	9.31
			Fall River Mills 4NW	1.59	Alturas-Dorris Ranch	3.39	Anderson 4E	5.61	Gold Hill Doty Flat	6.93	Penn Valley	9.08
							Alturas-Dorris Ranch	5.54	Red Bluff Cone Ranch	6.91	Arvin Frick	9.06
							Kingsburg 5S #2	5.37	Standish 4NW	6.11	Anderson 4E	8.92
							Montague 3NE	5.34	Alturas-Dorris Ranch	6.09	Montague 3NE	8.74
							Penn Valley	5.25	Lookout Hunt	6.02	Alturas-Dorris Ranch	7.94
									Penn Valley	5.83	Lookout Hunt	7.71
1960	Corning 3NE	2.28	Yuba City 9W	2.88	Corning 3NE	4.61	Stockton 9S	6.40	Merced 5SE	9.59	Corning 3NE	12.57
	Lincoln Vineyard	1.99	El Solyo Ranch	2.76	Stockton 9S	4.34	El Solyo Ranch	6.17	Kerman 2ESE	9.15	Lincoln Vineyard	11.62
	Arvin Frick	1.96	Red Bluff Cone Ranch	2.76	Arvin Frick	4.30	Merced 5SE	6.10	Berenda 2N	9.06	Merced 5SE	11.29
	Stockton 9S	1.84	Gold Hill Doty Flat	2.72	Merced 5SE	4.22	Kingsburg 5S #2	6.09	El Solyo Ranch	9.02	Red Bluff Cone Ranch	10.62
	Gold Hill Doty Flat	1.83	Lincoln Vineyard	2.70	El Solyo Ranch	4.14	Lincoln Vineyard	6.05	Kingsburg 5S #2	8.81	El Solyo Ranch	10.34
	Palermo 3SW	1.80	Corning 3NE	2.69	Lincoln Vineyard	4.14	Arvin Frick	5.82	Arvin Frick	8.72	Stockton 9S	10.32
	Merced 5SE	1.76	Palermo 3SW	2.49	Kingsburg 5S #2	3.97	Gold Hill Doty Flat	5.69	Stockton 9S	8.56	Berenda 2N	10.31
	El Solyo Ranch	1.67	Thornton 2S	2.49	Fall River Mills 4NW	3.80	Thornton 2S	5.66	Corning 3NE	7.78	Newman 1SE	10.15
	Kingsburg 5S #2	1.63	Stockton 9S	2.48	Anderson 4E	3.77	Palermo 3SW	5.49	Lincoln Vineyard	7.58	Yuba City 9W	10.08
	Yuba City 9W	1.50	Elk Grove 4NW	2.32	Thornton 2S	3.75	Cedarville 2E	5.46	Palermo 3SW	7.22	Kerman 2ESE	10.05
	Red Bluff Cone Ranch	1.43	Anderson 4E	2.31	Red Bluff Cone Ranch	3.68	Standish 4NW	5.38	Thornton 2S	7.12	Arvin Frick	9.98
	Thornton 2S	1.40	Arvin Frick	2.24	Gold Hill Doty Flat	3.59	Corning 3NE	5.35	Yuba City 9W	7.06	Gold Hill Doty Flat	9.96
	Penn Valley	1.39	Cedarville 2E	2.16	Yuba City 9W	3.44	Yuba City 9W	5.20	Elk Grove 4NW	6.90	Palermo 3SW	9.72
	Elk Grove 4NW	1.34	Kingsburg 5S #2	2.15	Palermo 3SW	3.43	Red Bluff Cone Ranch	4.95	Red Bluff Cone Ranch	6.86	Kingsburg 5S #2	9.67
	Anderson 4E	0.91	Merced 5SE	2.02	Lookout Hunt	3.22	Elk Grove 4NW	4.94	Standish 4NW	6.81	Thornton 2S	9.34
			Penn Valley	1.70	Cedarville 2E	3.17	Anderson 4E	4.68	Fall River Mills 4NW	6.67	Anderson 4E	9.31
			Fall River Mills 4NW	1.51	Elk Grove 4NW	2.96	Fall River 4NW	4.65	Gold Hill Doty Flat	6.60	Elk Grove 4NW	9.15
			Alturas-Dorris Ranch	1.40	Penn Valley	2.85	Alturas-Dorris Ranch	4.53	Cedarville 2E	6.57	Cedarville 2E	9.01
			Lookout Hunt	1.08	Alturas-Dorris Ranch	2.58	Lookout Hunt	4.37	Anderson 4E	6.49	Standish 4NW	8.95
							Penn Valley	4.02	Alturas-Dorris Ranch	5.90	Montague 3NE	8.79
							Montague 3NE	3.82	Penn Valley	5.85	Lookout Hunt	8.76
									Montague 3NE	5.81	Glenburn DWR	8.69
									Lookout Hunt	5.32	Alturas-Dorris Ranch	8.00
											Penn Valley	7.87

TABLE 3 (continued)

MONTHLY EVAPORATION FROM STANDARD U. S. WEATHER BUREAU
EVAPORATION PANS IN ORDER OF DECREASING MAGNITUDE FOR IRRIGATED PASTURE AND DRYLAND STATIONS

(In inches)

Environment and year	July		August		September		October		November		December	
Irrigated Pasture												
1959	Merced 5SE	13.08	Cedarville 2E	11.35	Fall River Mills 4NW	8.99	Lincoln Vineyard	6.06	Lincoln Vineyard	3.50	Lincoln Vineyard	2.41
	Montague 3NE	12.50	Merced 5SE	10.63	Red Bluff Cone Ranch	8.32	Gold Hill Doty Flat	5.98	Gold Hill Doty Flat	3.35	Gold Hill Doty Flat	2.24
	Standish 4NW	11.96	Fall River Mills 4NW	10.07	Merced 5SE	7.98	Red Bluff Cone Ranch	5.54	Red Bluff Cone Ranch	3.34	Red Bluff Cone Ranch	2.23
	Lincoln Vineyard	11.80	Lincoln Vineyard	9.77	Cedarville 2E	7.31	Merced 5SE	5.53	Anderson 4E	2.76	El Solyo Ranch	2.10
	Cedarville 2E	11.56	Standish 4NW	9.39	El Solyo Ranch	7.17	El Solyo Ranch	5.47	Arvin Frick	2.69	Merced 5SE	1.94
	Gold Hill Doty Flat	11.32	Penn Valley	9.38	Lincoln Vineyard	6.74	Cedarville 2E	5.00	Merced 5SE	2.68	Thornton 2S	1.69
	Red Bluff Cone Ranch	10.81	El Solyo Ranch	9.01	Anderson 4E	6.62	Lodi 3SW	4.98	Cedarville 2E	2.58	Arvin Frick	1.68
	Penn Valley	10.79	Gold Hill Doty Flat	8.91	Penn Valley	6.43	Stockton 9S	4.82	El Solyo Ranch	2.53	Penn Valley	1.60
	Stockton 9S	10.70	Red Bluff Cone Ranch	8.72	Lodi 3SW	6.41	Anderson 4E	4.64	Stockton 9S	2.43	Anderson 4E	1.58
	El Solyo Ranch	10.66	Stockton 9S	8.70	Stockton 9S	6.37	Penn Valley	4.61	Fall River Mills 4NW	2.40	Stockton 9S	1.55
	Lookout Hunt	10.07	Arvin Frick	8.67	Gold Hill Doty Flat	6.37	Arvin Frick	4.49	Lodi 3SW	2.33	Kingsburg 5S #2	1.38
	Arvin Frick	9.95	Alturas-Dorris Ranch	8.65	Montague 3NE	6.30	Kingsburg 5S #2	4.31	Lookout Hunt	2.17		
	Lodi 3SW	9.84	Montague 3NE	8.56	Lookout Hunt	6.00	Lookout Hunt	4.10	Kingsburg 5S #2	2.16		
	Alturas-Dorris Ranch	9.83	Lodi 3NW	8.22	Arvin Frick	5.93	Fall River Mills 4NW	4.09	Penn Valley	1.93		
	Anderson 4E	9.54	Anderson 4E	7.72	Standish 4NW	5.91	Alturas-Dorris Ranch	3.59	Alturas-Dorris Ranch	1.72		
	Kingsburg 5S #2	9.26	Kingsburg 5S #2	7.57	Kingsburg 5S #2	5.74						
					Alturas-Dorris Ranch	5.51						
1960	Lincoln Vineyard	12.97	Lincoln Vineyard	12.16	Corning 3NE	9.02	Corning 3NE	7.55	Corning 3NE	3.90	Corning 3NE	1.93
	Corning 3NE	12.73	Corning 3NE	11.41	Merced 5SE	8.05	Newman 1SE	6.24	Lincoln Vineyard	2.66	Red Bluff Cone Ranch	1.81
	Merced 5SE	12.12	Merced 5SE	10.65	Cedarville 2E	7.76	Lincoln Vineyard	6.12	Yuba City 9W	2.45	Lincoln Vineyard	1.75
	Cedarville 2E	12.01	Cedarville 2E	10.33	Standish 4NW	7.75	Red Bluff Cone Ranch	5.70	Palermo 3SW	2.39	Yuba City 9W	1.59
	Red Bluff Cone Ranch	11.37	Berenda 2N	9.49	Lincoln Vineyard	7.21	Stockton 9S	5.66	Thornton 2S	2.15	Palermo 3SW	1.55
	Berenda 2N	10.74	Palermo 3SW	9.43	Loma Rica	7.06	Yuba City 9W	5.60	Stockton 9S	2.07	Anderson 4E	1.32
	Gold Hill Doty Flat	10.74	Glenburn DWR	9.20	Red Bluff Cone Ranch	7.05	Palermo 3SW	5.27	Gold Hill Doty Flat	2.05	Loma Rica	1.17
	Stockton 9S	10.42	Lookout Hunt	9.15	Gold Hill Doty Flat	6.63	Gold Hill Doty Flat	5.16	Red Bluff Cone Ranch	2.00	Penn Valley	1.12
	Glenburn DWR	10.40	Penn Valley	8.98	Palermo 3SW	6.62	Merced 5SE	4.95	Newman 1SE	1.98	El Solyo Ranch	1.09
	Palermo 3SW	10.31	Gold Hill Doty Flat	8.91	Newman 1SE	6.60	El Solyo Ranch	4.94	Penn Valley	1.97	Arvin Frick	1.08
	Standish 4NW	10.00	Standish 4NW	8.89	Berenda 2E	6.43	Loma Rica	4.94	Arvin Frick	1.89	Gold Hill Doty Flat	1.07
	Penn Valley	9.78	Stockton 9S	8.84	El Solyo Ranch	6.43	Cedarville 2E	4.82	Loma Rica	1.81	Stockton 9S	1.06
	Lookout Hunt	9.67	Newman 1SE	8.77	Kingsburg 5S #2	6.20	Penn Valley	4.51	El Solyo Ranch	1.79	Merced 5SE	0.98
	Montague 3NE	9.62	Anderson 4E	8.70	Stockton 9S	6.18	Berenda 2N	4.46	Elk Grove 4NW	1.75	Newman 1SE	0.95
	Anderson 4E	9.58	El Solyo Ranch	8.55	Anderson 4E	6.15	Elk Grove 4NW	4.39	Glenburn DWR	1.74	Thornton 2S	0.94
	Thornton 2S	9.50	Kingsburg 5S #2	8.36	Arvin Frick	6.13	Thornton 2S	4.38	Merced 5SE	1.69	Cedarville 2E	0.86
	Arvin Frick	9.39	Red Bluff Cone Ranch	8.36	Montague 3NE	6.07	Kerman 2ESE	4.28	Anderson 4E	1.65	Kingsburg 5S #2	0.86
	Kingsburg 5S #2	9.37	Montague 3NE	8.33	Kerman 2ESE	6.02	Arvin Frick	4.08	Kerman 2ESE	1.63	Kerman 2ESE	0.80
	Elk Grove 4NW	9.35	Alturas-Dorris Ranch	8.31	Lookout Hunt	6.00	Kingsburg 5S #2	4.04	Kingsburg 5S #2	1.62	Elk Grove 4NW	0.79
	Newman 1SE	9.25	Yuba City 9W	8.31	Penn Valley	6.00	Glenburn DWR	3.97	Cedarville 2E	1.60	Berenda 2N	0.74
	El Solyo Ranch	9.15	Arvin Frick	8.09	Thornton 2S	5.99	Anderson 4E	3.91	Berenda 2N	1.43	Lookout Hunt	0.74
	Yuba City 9S	8.84	Thornton 2S	7.96	Yuba City 9W	5.91	Alturas-Dorris Ranch	3.71	Alturas-Dorris Ranch	1.13	Alturas-Dorris Ranch	0.65
	Kerman 2ESE	8.81	Elk Grove 4NW	7.56	Alturas-Dorris Ranch	5.86	Lookout Hunt	3.71	Lookout Hunt	0.82	Glenburn DWR	0.58
	Alturas-Dorris Ranch	8.82	Kerman 2ESE	7.43	Glenburn DWR	5.85						
					Elk Grove 4NW	5.69						

TABLE 3 (continued)

MONTHLY EVAPORATION FROM STANDARD U. S. WEATHER BUREAU
EVAPORATION PANS IN ORDER OF DECREASING MAGNITUDE FOR IRRIGATED PASTURE AND DRYLAND STATIONS

(In inches)

Environment and year	January	February	March	April	May	June
Dryland						
1959	Browns Valley 3NE 1.38 Sacramento Refuge 1.35 Redding Stayer 1.24	Oroville Agric. Commission 3.00 Browns Valley 3NE 2.82 Redding Stayer 2.43 Davis Creek 4WNW 1.83 Sacramento Refuge 1.82 Adin Harper 1.25 Big Sage Reservoir 1.08	Bella Vista 4NE 5.99 Redding Stayer 5.80 Oroville Agric. Commission 5.41 Sacramento Refuge 5.34 Newville 4.84 Browns Valley 3NE 4.54 Davis Creek 4WNW 3.46 Adin Harper 3.44 Big Sage Reservoir 2.62	Bella Vista 4NE 8.02 Redding Stayer 7.94 Newville 7.72 Sacramento Refuge 7.52 Oroville Agric. Commission 7.48 Browns Valley 3NE 6.96 Big Sage Reservoir 6.29 Davis Creek 4WNW 6.24 Adin Harper 6.22 West Valley Reservoir 5.98	Newville 10.65 Redding Stayer 10.18 Oroville Agric. Commission 9.87 Sacramento Refuge 9.80 Bella Vista 4NE 9.39 Browns Valley 3NE 8.99 Adin Harper 5.77 Cedarville 2E 5.73 Big Sage Reservoir 5.69 West Valley Reservoir 5.24	Panoche Junction 16.15 Sacramento Refuge 14.25 Newville 13.99 Redding Stayer 13.79 Oroville Agric. Commission 13.41 Bella Vista 4NE 12.91 Browns Valley 3NE 12.77 West Valley Reservoir 10.22 Adin Harper 10.10 Davis Creek 4WNW 9.63 Big Sage Reservoir 9.19
1960	Browns Valley 3NE 1.47 Redding Stayer 1.42 Newville 1.42 Sacramento Refuge 1.04	Newville 2.89 Redding Stayer 2.67 Browns Valley 3NE 2.53 Sacramento Refuge 2.50 Big Sage Reservoir 1.09 Davis Creek 4WNW 1.02 Adin Harper 0.91	Panoche Junction 5.73 Newville 4.29 Bella Vista 4NE 4.28 Redding Stayer 4.21 Browns Valley 3NE 3.67 Sacramento Refuge 3.63 Davis Creek 4WNW 2.46	Browns Valley 3NE 5.61 Newville 5.50 Redding Stayer 5.46 Bella Vista 4NE 5.30 Davis Creek 4WNW 5.18 Sacramento Refuge 5.15	Sacramento Refuge 8.34 Redding Stayer 8.16 Browns Valley 3NE 7.94 Newville 7.82 Bella Vista 4NE 7.37 Eagle Lake Stone Ranch 7.26 Davis Creek 4WNW 7.12	Panoche Junction 16.15 Redding Stayer 14.93 Newville 14.34 Bella Vista 4NE 14.07 Sacramento Refuge 12.69 Browns Valley 3NE 12.11 Eagle Lake Stone Ranch 10.99 Davis Creek 4WNW 10.95

Environment and year	July	August	September	October	November	December
Dryland						
1959	Bella Vista 4NE 16.64 Redding Stayer 15.82 Newville 15.16 Oroville Agric. Commission 14.72 Browns Valley 3NE 14.35 Sacramento Refuge 13.24 Big Sage Reservoir 12.54 Adin Harper 12.40 West Valley Reservoir 12.30 Davis Creek 4WNW 10.82	Redding Stayer 12.94 Bella Vista 4NE 12.50 Newville 12.42 Oroville Agric. Commission 12.32 Browns Valley 3NE 12.11 Davis Creek 4WNW 11.91 West Valley Reservoir 11.48 Big Sage Reservoir 10.70 Sacramento Refuge 10.29 Adin Harper 10.25	Newville 10.73 Bella Vista 4NE 9.99 Redding Stayer 9.94 Oroville Agric. Commission 9.84 Browns Valley 3NE 9.09 Sacramento Refuge 8.74 Adin Harper 7.77 West Valley Reservoir 7.27 Davis Creek 4WNW 7.10 Big Sage Reservoir 6.68	Oroville Agric. Commission 8.43 Newville 8.03 Bella Vista 4NE 7.57 Browns Valley 3NE 6.99 Redding Stayer 6.77 Sacramento Refuge 6.72 West Valley Reservoir 5.15 Davis Creek 4WNW 4.87 Adin Harper 4.85 Big Sage Reservoir 3.44	Newville 5.46 Bella Vista 4NE 5.27 Redding Stayer 4.51 Sacramento Refuge 3.83 Browns Valley 3NE 3.14 West Valley Reservoir 3.00 Adin Harper 2.54 Davis Creek 4WNW 1.93 Big Sage Reservoir 1.92	Bella Vista 4NE 4.22 Newville 3.23 Redding Stayer 2.56 Browns Valley 3NE 2.21 Sacramento Refuge 2.15
1960	Panoche Junction 17.83 Bella Vista 4NE 15.98 Redding Stayer 15.95 Newville 14.70 Browns Valley 3NE 13.40 Sacramento Refuge 12.83 Davis Creek 4WNW 12.10 Eagle Lake Stone Ranch 10.40	Panoche Junction 16.60 Bella Vista 4NE 15.05 Redding Stayer 14.38 Newville 13.00 Browns Valley 3NE 12.05 Sacramento Refuge 11.76 Eagle Lake Stone Ranch 11.03 Davis Creek 4WNW 10.98	Bella Vista 4NE 12.78 Redding Stayer 10.54 Newville 10.44 Eagle Lake Stone Ranch 8.66 Sacramento Refuge 8.55 Davis Creek 4WNW 8.23	Panoche Junction 8.41 Bella Vista 4NE 8.24 Newville 7.73 Redding Stayer 7.26 Sacramento Refuge 6.48 Davis Creek 4WNW 4.55	Bella Vista 4NE 3.73 Newville 2.97 Panoche Junction 2.90 Sacramento Refuge 2.59 Redding Stayer 1.91 Davis Creek 4WNW 1.06	Bella Vista 4NE 3.92 Newville 1.89 Redding Stayer 1.46 Sacramento Refuge 1.44 Panoche Junction 1.35 Davis Creek 4WNW 0.34

TABLE 4

MONTHLY EVAPORATION DIFFERENCE BETWEEN LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
IN ORDER OF DECREASING MAGNITUDE FOR IRRIGATED PASTURE AND DRYLAND STATIONS

(In millilitres)

Environment and year	Month: March		April		May		June		July		August		September		October	
Irrigated Pasture																
1959	El Solyo Ranch	427	Penn Valley	490	El Solyo Ranch	531	Red Bluff Cone		Red Bluff Cone		Cedarville 2E	572	Arvin Frick	473	Arvin Frick	413
	Kingsburg 5S #2	421	Auburn-Mt. Vernon	482	Berenda 2E	528	Ranch	641	Ranch	680	Berenda 2N	571	Berenda 2N	471	Berenda 2N	411
	Merced 5SE	415	Stockton 9S	481	Kingsburg 5S #2	517	Penn Valley	610	Likely Williams		Lockout Hunt	567	Lincoln Vineyard	459	Auburn-Mt. Vernon	402
	Lodi 3SW	402	El Solyo Ranch	476	Lincoln Vineyard	516	Berenda 2N	598	Ranch	663	Gold Hill Doty		Auburn-Mt. Vernon	457	Lodi 3SW	390
	Anderson 4E	377	Merced 5SE	475	Merced 5SE	515	El Solyo Ranch	590	Lockout Hunt	650	Flat	556	Lodi 3SW	448	Gold Hill Doty	
	Red Bluff Cone		Gold Hill Doty		Penn Valley	509	Merced 5SE	588	Altures-Dorris		Penn Valley	552	Penn Valley	448	Flat	390
	Ranch	369	Flat	471	Gold Hill Doty		Lockout Hunt	586	Ranch	643	Altures-Dorris		Red Bluff Cone		Merced 5SE	388
			Lincoln Vineyard	469	Flat		Likely Williams		Penn Valley	626	Ranch	551	Ranch	444	Penn Valley	387
			Red Bluff Cone		Auburn-Mt. Vernon	485	Ranch	584	Gold Hill Doty		Arvin Frick	548	Stockton 9S	444	Lincoln Vineyard	383
			Ranch	460	Stockton 9S	484	Lincoln Vineyard	580	Flat	625	Lincoln Vineyard	546	Gold Hill Doty		Stockton 9S	378
			Kingsburg 5S #2	455	Red Bluff Cone		Fall River Mills		Montague 3NE	624	Likely Williams		Flat	441	Red Bluff Cone	
			Lodi 3SW	454	Ranch	481	NNW	577	Berenda 2N	620	Ranch	545	Kingsburg 5S #2	431	Ranch	376
			Anderson 4E	433	Lodi 3SW	479	Gold Hill Doty		El Solyo Ranch	610	Red Bluff Cone		Merced 5SE	427	Kingsburg 5S #2	371
					Anderson 4E	466	Flat	575	Kingsburg 5S #2	604	Ranch	544	Lockout Hunt	424	El Solyo Ranch	366
					Standish NNW	460	Montague 3NE	575	Fall River Mills		Anderson 4E	540	El Solyo Ranch	419	Anderson 4E	356
					Montague 3NE	454	Arvin Frick	571	NNW	596	Merced 5SE	536	Anderson 4E	412		
							Auburn-Mt. Vernon	562	Anderson 4E	592	Stockton 9S	535	Standish NNW	412		
							Standish NNW	556	Auburn-Mt. Vernon	589	Auburn-Mt. Vernon	532	Likely Williams			
							Anderson 4E	548	Stockton 9S	587	Montague 3NE	531	Ranch	401		
							Altures-Dorris		Arvin Frick	580	Kingsburg 5S #2	529	Fall River Mills			
							Ranch	547	Lincoln Vineyard	582	El Solyo Ranch	515	NNW	374		
							Kingsburg 5S #2	544	Merced 5SE	576	Lodi 3SW	515	Montague 3NE	368		
							Cedarville 2E	539	Cedarville 2E	570	Fall River Mills					
							Stockton 9S	523	Lodi 3SW	535	NNW	503				
							Lodi 3SW	408	Standish NNW	456	Standish NNW	418				
1960	Merced 5SE	371	Thornton 2S	480	Stockton 9S	612	Arvin Frick	670	Davis Campbell	653	Stockton 9S	618	Gold Hill Doty		Davis Campbell	398
	El Solyo Ranch	362	Merced 5SE	457	Arvin Frick	570	Gold Hill Doty		Gold Hill Doty		Gold Hill Doty		Flat	515	Corning 3NE	385
	Thornton 2S	356	Gold Hill Doty		Thornton 2S	546	Flat	628	Flat	645	Flat	611	Davis Campbell	514	Gold Hill Doty	
	Berenda 2N	353	Flat	450	Berenda 2N	538	Thornton 2S	625	Arvin Frick	639	Palermo 3SW	602	Thornton 2S	495	Flat	381
	Yuba City 5W	339	Elk Grove NNW	448	Davis Campbell	532	Montague 3NE	621	Palermo 3SW	635	Davis Campbell	597	Stockton 9S	484	Palermo 3SW	378
	Elk Grove NNW	331	Stockton 9S	442	Elk Grove NNW	530	Davis Campbell	608	Montague 3NE	634	Penn Valley	596	Penn Valley	475	Penn Valley	375
	Corning 3NE	326	Berenda 2N	441	El Solyo Ranch	528	Auburn-Mt. Vernon	602	Corning 3NE	633	Arvin Frick	582	Arvin Frick	480	Arvin Frick	372
	Palermo 3SW	310	Arvin Frick	438	Merced 5SE	526	Yuba City 5W	601	Thornton 2S	614	Thornton 2S	564	Palermo 3SW	474	Thornton 2S	363
	Stockton 9S	310	El Solyo Ranch	438	Yuba City 5W	519	Gold Hill Doty		Auburn-Mt. Vernon	614	Corning 3NE	562	Corning 3NE	462	Merced 5SE	359
	Auburn-Mt. Vernon	302	Auburn-Mt. Vernon	433	Gold Hill Doty		Ranch	600	Stockton 9S	612	Lockout Hunt	561	Lockout Hunt	458	Elk Grove NNW	358
	Red Bluff Cone		Yuba City 5W	429	Flat	516	Elk Grove NNW	594	Red Bluff Cone		Montague 3NE	559	Auburn-Mt. Vernon	454	Stockton 9S	354
	Ranch	301	Kingsburg 5S #2	422	Kingsburg 5S #2	502	Palermo 3SW	594	Ranch	606	El Solyo Ranch	552	Auburn-Mt. Vernon	450	Auburn-Mt. Vernon	350
	Gold Hill Doty		Palermo 3SW	426	Palermo 3SW	499	Glenburn DWR	588	Anderson 4E	596	Glenburn DWR	550	Glenburn DWR	452	El Solyo Ranch	350
	Flat	292	Corning 3NE	417	Auburn-Mt. Vernon	492	Stockton 9S	588	El Solyo Ranch	591	El Solyo Ranch	547	Montague	452	Lincoln Vineyard	349
	Anderson 4E	284	Lincoln Vineyard	407	Kerman 2ESE	490	El Solyo Ranch	583	Yuba City 5W	591	Merced 5SE	541	Merced 5SE	442	Berenda 2N	347
	Lincoln Vineyard	283	Red Bluff Cone		Red Bluff Cone		Merced 5SE	578	Elk Grove NNW	587	Standish NNW	537	Lincoln Vineyard	440	Kerman 2ESE	343
	Penn Valley	281	Ranch	393	Ranch	487	Penn Valley	574	Glenburn DWR	584	Newman 1SE	533	Berenda 2N	436	Yuba City 5W	338
			Penn Valley	391	Corning 3NE	476	Anderson 4E	572	Lockout Hunt	584	Auburn-Mt. Vernon	532	Yuba City 5W	427	Kingsburg 5S #2	330
			Anderson 4E	357	Penn Valley	470	Corning 3NE	568	Merced 5SE	567	Yuba City 5W	530	Newman 1SE	426	Red Bluff Cone	
					Lincoln Vineyard	454	Altures-Dorris		Penn Valley	567	Kerman 2ESE	516	Altures-Dorris		Ranch	323
					Montague 3NE	450	Ranch	562	Altures-Dorris		Anderson 4E	515	Ranch	422	Newman 1SE	321
					Anderson 4E	442	Berenda 2N	558	Ranch	560	Lincoln Vineyard	512	Anderson 4E	421	Santa Rita	313
							Lincoln Vineyard	554	Lincoln Vineyard	555	Altures-Dorris		Kerman 2ESE	415	Anderson 4E	308
							Newman 1SE	543	Standish NNW	552	Ranch	501	Red Bluff Cone			
							Kerman 2ESE	536	Newman 1SE	542	Red Bluff Cone		Ranch	412		
							Kingsburg 5S #2	511	Kerman 2ESE	540	Ranch	499	Kingsburg 5S #2	395		
									Berenda 2N	511	Berenda 2N	495	Elk Grove NNW	391		
									Kingsburg 5S #2	507	Kingsburg 5S #2	494				
Dryland																
1959	Sacramento Refuge	419	Sacramento Refuge	489	Loyalton 7N	578	Sacramento Refuge	637	Redding Stayer	739	Redding Stayer	602	Oroville Agric.		Oroville Agric.	
	Redding Stayer	389	Oroville Agric.		Sacramento Refuge	539	Redding Stayer	633	Belln Vista 4NE	674	Oroville Agric.		Commission	485	Commission	425
	Oroville Agric.		Commission	471	Oroville Agric.		Loyalton 7N	612	Sacramento Refuge	662	Commission	580	Sacramento Refuge	481	Nevville	409
	Commission	386	Redding Stayer	449	Commission	516	Nevville	595	Oroville Agric.		Davis Creek 4NW	573	Nevville	470	Sacramento Refuge	405
	Nevville	383	Nevville	437	Nevville	499	Davis Creek 4NW	584	Commission	653	Nevville	573	Redding Stayer	450	Redding Stayer	390
			Bella Vista 4NE	404	Redding Stayer	491	Oroville Agric.		Nevville	632	Sacramento Refuge	559	Bella Vista 4NE	390	Bella Vista 4NE	382
			Gazelle 1NNE	388	Gazelle 1NNE	444	Commission	574	Hayfork R. J.	607	Gazelle 1NNE	541				
					Bella Vista 4NE	437	Gazelle 1NNE	556	Gazelle 1NNE	599	West Valley					
					Hayfork R. S.	428	Hayfork R. S.	537	Davis Creek 4NW	595	Reservoir	527				
							Terno	521	West Valley		Hayfork R. S.	513				
							Canby Ohm	514	Reservoir	575	Bella Vista 4NE	493				
							Bella Vista 4NE	494	Big Sage		Terno	467				
							West Valley		Reservoir	573	Canby Ohm	463				
							Reservoir	474	Terno	548	Big Sage					
							Big Sage		Canby Ohm	530	Reservoir	458				
							Reservoir	464	Loyalton 7N	479						
1960	Sacramento Refuge	353	Sacramento Refuge	434	Sacramento Refuge	518	Nevville	681	Gazelle 1NNE	758	Nevville	713	Nevville	614	Nevville	[illegible]
	Panoche Junction	315	Nevville	410	Nevville	501	Gazelle 1NNE	661	Redding Stayer	677	Gazelle 1NNE	682	Gazelle 1NNE	514	Sacramento Refuge	[illegible]
	Nevville	314	Redding Stayer	373	Gazelle 1NNE	489	Redding Stayer	632	Nevville	667	Hayfork R. J.	612	Sacramento Refuge	464	Panoche Junction	[illegible]
	Redding Stayer	281	Panoche Junction	353	Redding Stayer	470	Sacramento Refuge	623	Sacramento Refuge	623	Panoche Junction	589	Redding Stayer	461	Davis Campbell #2	[illegible]
	Bella Vista 4NE	272	Bella Vista 4NE	330	Bella Vista 4NE	436	Hayfork R. S.	596	Hayfork R. S.	589	Sacramento Refuge	570	Panoche Junction	449	Bella Vista 4NE	50
					Panoche Junction	434	Loyalton 7N	580	Loyalton 7N	586	Redding Stayer	567	Davis Campbell #2	435	Redding Stayer	[illegible]
							Bella Vista 4NE	535	Panoche Junction	513	Davis Campbell #2	537	Bella Vista 4NE	[illegible]		

CHAPTER III. EVAPOTRANSPIRATION MEASUREMENT

The objective of the evapotranspiration measurement and correlation program is to provide a more accurate basis for predicting evapotranspiration for the major crops in the various agricultural areas of the State. This is to be accomplished through measurements of evapotranspiration of various crops at several inland locations having different climatic conditions, and correlating with the evaporative demand, as measured by evaporation pans and atmometers. This chapter discusses the techniques and procedures utilized in the measurement of evapotranspiration, and changes that have occurred during the development of the study. In Chapter IV the correlation of the evapotranspiration with pan and atmometer evaporation data will be discussed and analyzed.

The principal evapotranspiration stations are located near Bakersfield in the southern San Joaquin Valley and near Alturas and Fall River Mills in mountain valleys of the Sacramento River Basin. Plate 2, entitled "General Location of Evapotranspiration Stations, 1955-1960," shows the location, type, and status of each station. More detailed information is given in Tables A-4 and A-5 of Appendix A. Measurements were made primarily on alfalfa and grass, which are grown universally throughout the State. As plant and soil moisture conditions affect evapotranspiration rates, evaluation of these factors is also an essential part of evapotranspiration measurement.

Measurement of Data Related to Evapotranspiration

Correlative pan and atmometer evaporation measurements were made at agroclimatic stations established near the evapotranspiration measuring stations. These stations are listed in Table A of Appendix A. Detailed information regarding the agroclimatic stations, and pan and atmometer data, are given in Tables A-1, A-2, and A-3 of that appendix.

At Arvin (in Kern County) the pan and atmometer data were initially collected at stations (Arvin Jewett #1 and #2) located in an irrigated alfalfa field near the evapotranspiration station, or soil moisture depletion plots. In June 1959, a new station (Arvin-Frick) was established in an irrigated grass environment. All of the soil moisture depletion plots were within 1 mile of this station.

Only atmometer data were collected at the Pittville AA plot site (in eastern Shasta County) during 1959. This agroclimatic station is identified as Pittville 1 S. Pan data were collected within an irrigated pasture site, designated as Fall River Mills 4 Nw, during 1959, and until June 1960, but due to unfavorable operational procedures at this site in 1959, the pan data were not used in this report.

In June 1960, an agroclimatic station was established at a location within an irrigated pasture 8 miles west of the Pittville AA plot. This station is identified as Glenburn DWR. Comparison of atmometer evaporation measurements at the Pittville 1 S and the Glenburn DWR stations showed that the difference in evaporation between the black and white atmometers is very close for these two locations.

At the Arvin and Glenburn sites, three sets of new atmometers were installed at the beginning of each season, and each month one pair was replaced with a new pair. At Arvin, three pans were operated, and the evaporation, which was nearly the same, was averaged.

Data on percent of ground cover were collected to determine effects of varying cover on evapotranspiration rates. The term "percent ground cover," as used in this report, refers to the percentage of ground surface covered by a canopy of living foliage as viewed looking downward from directly above the crop. During the first years, 1955-1957, few records were kept of percent ground cover. However, from 1958 through 1960 it was standard procedure to measure crop height, estimate percent ground cover, and record both.

When most of the moisture which plants can readily extract from within the root zone has been used, crop growth is slowed and evapotranspiration rates may also be correspondingly affected. To estimate available soil moisture at the test plots, samples were taken and laboratory measurements of the moisture content of the soil were made, utilizing the pressure plate membrane technique with pressures varying from 0.1 to 15 atmospheres. Tensiometers, instruments which can be used to measure availability of soil moisture for crop utilization, were installed at some plots. Calculations of available soil moisture in the root zone were based on the difference between moisture profiles determined from field measurements and moisture profiles representing the moisture level below which crops cannot readily extract moisture.

Criteria for Selection of Plots

In the selection of plots for the measurement of evapotranspiration, certain physical conditions are recognized as essential to collecting valid data. Experience over the years has emphasized the importance of certain necessary conditions. Unfortunately, the most ideal plot conditions are difficult to find, and considerable time and effort have been expended over the years selecting the most favorable sites. However, this is not to imply that evapotranspiration rates would necessarily be different under different conditions. The following criteria indicate the conditions under which good measurements of evapotranspiration representative of field conditions can be obtained. After good measurements have been obtained under these conditions, the studies should be broadened to include some of the adverse soil and other conditions which might affect evapotranspiration.

1. Measurement sites should be located 200 feet inside the edge of the irrigated field to avoid accentuated border effects.

2. Generally, the land should be of smooth topography.

3. Since the sites are located on private lands, it is necessary to have freedom of access and cooperation of the landowner or manager.

4. The soil should be deep, well drained, productive, and unaffected by salinity. The soil preferably should also be medium textured, as very fine or very coarse textures have unfavorable soil-moisture relationships. The soil profile should not be stratified to such an extent as to impede moisture flow or create sampling problems.

5. The irrigated field should be located in typical irrigated areas, not on the fringe of irrigated areas.

6. There should be an adequate supply of irrigation water. It is highly desirable that there be possibilities for controlling and measuring the amount of water applied to the test plot.

7. Except for measurements which are made by evapotranspirometers, no water table should exist within or near the root zone of the crop.

Evapotranspiration Measurement Techniques and Discussion of Development and Current Methods

The tools and techniques used in this study to measure evapotranspiration fall into two general categories. One is field plot sampling, and the other is evapotranspirometer measurements.

Field Plot Sampling - Gravimetric Method

Periodic measurement of soil moisture provides a means of determining total change of water content within a selected portion of the soil profile. Evapotranspiration may be determined from data on soil moisture change and precipitation. Soil moisture must be sampled or measured each time at or near the same location in each plot, with several locations being situated in each plot. Moreover, the moisture determinations must be made at least twice following wetting of the soil by any heavy irrigation or heavy precipitation. To obtain satisfactory results, it is necessary that sufficient time lapse be permitted following thorough wetting of the soil (usually several days) before making the first moisture

determination in a cycle of measurements. Otherwise, moisture moving out of the sampled profile would be incorrectly included as evapotranspiration in the soil moisture depletion measurement.

During the growing season, the general procedure was to sample approximately every seven days, except as modified by irrigation, harvest, or other cultural (farming) operations. During the nongrowing season, measurements were made less frequently because of the lower rates of water use.

At the initiation of the evapotranspiration measuring program in 1955, the gravimetric technique was accepted as the best method available, and was the first technique employed in the studies reported here. Moisture content of soil samples was determined by weight change resulting from moisture loss during oven drying. Soil samples were taken by means of a soil tube, in 1-foot increments of depth, from the soil surface to a depth of 7 or 9 feet. As the soil tube is difficult to handle at depth below 9 feet, sampling below that depth was attempted only in special cases where knowledge of the substratum conditions was desired.

The initial evapotranspiration measurements were made in the mountain valley areas in the northern and northeastern part of the State, and in the northern Sacramento Valley. The objectiv at that time was to determine the irrigation requirements of only those areas. Plots in the mountain valleys were located on typica irrigated parcels of land. The irrigated lands in this area exist as narrow and isolated "oases" separated by large areas of native vegetation.

From three to eight core holes were made per sampling. This number did not prove to be adequate because of inherent variability of the soils.

During analysis of data collected during the 1955 season, it was determined that observation holes should have been maintained at all plots to determine if water table conditions existed. Through observation holes on a few of the plots, and examination of soil samples taken from the lower profiles, it was found that water tables did exist on some plots where they were not expected. When a water table is present in or near the root zone, there is a probability that the crop will utilize some of this source of moisture. It is impossible to determine this amount.

The greatest problem, however, was that irrigation in some cases added too much water, and in other cases was too infrequent or too little. As previously mentioned, when too much water is applied, downward moisture movement continues for a considerable length of time. A series of field moisture measurements will include both moisture movement, or change, due to plant extraction and evaporation. If too little water is applied, the soil moisture may become critically short, and crop growth may be affected. If the soils become very dry, the evapotranspiration rate may also be affected.

For the next several seasons, work was concentrated on fewer plots, and more detailed observations were made of crop growth, presence of water tables, and other conditions. As the need for irrigation control became recognized as being critical

to obtain adequate evapotranspiration data from soil moisture depletion measurements, attempts to modify irrigation were initiated.

It was observed that weekly visits to plot sites adverseley affected the crop cover and soil conditions by trampling the crop. To overcome these undesirable effects, a portable sampling platform was built in 1956 to sample one of the plots. This was the forerunner of platforms which were used later with neutron probes.

In 1957, the water use studies were expanded to other areas of the State. Alfalfa fields were sampled in Stanislaus and Kings Counties. These plots were abandoned because data obtained from them were not considered reliable for estimating evapotranspiration because of excessive moisture movement that resulted from overirrigation at the Stanislaus County plots and unfavorable soil conditions at the plots in Kings County.

In 1958, one man was stationed in Kern County following a reconnaissance for plot sites. Plots of alfalfa, grapes, and plums were sampled. Problems of two kinds were encountered. On plots receiving lesser quantities of irrigation, the crops extracted moisture from below the zone sampled, while on plots receiving very frequent irrigations, considerable moisture movement occurred between sampling.

No further gravimetric samples were taken following the adoption of neutron scattering equipment in the spring of 1959. While complete detailed records were kept and calculations made for each of the gravimetric sampling sites, the results of these measurements are not included in this report.

Field Plot Sampling - Neutron Scattering Technique

A recently developed method to obtain the soil moisture data, referred to as the neutron scattering technique, is based upon the principle that high energy or "fast" neutrons are moderated, or "slowed down," in soils almost exclusively by hydrogen atoms contained in soil moisture. The instrument consists of a source of "fast" neutrons, a detector tube which is sensitive only to "slow" neutrons, and a slow neutron counter. Both source and detector are combined in a cylindrical probe 1.5 inches in diameter by 14 inches long. The probe is lowered into the soil through a small-diameter, cased hole to the desired depth, suspended by its electrical cable. The cable is connected to the counting device which counts pulses produced by slow neutrons returning to the detector. Since the "fast" neutron output of the source is essentially constant, the count recorded in a fixed time period may be used with a suitable calibration to determine the moisture content in the soil surrounding the probe.

The neutron scattering technique has certain advantages over the gravimetric technique. In addition to the ease of making deeper measurements, the neutron measurements take less time, repeatedly represent approximately the same soil mass, and are generally more precise than gravimetric measurements. Measurement of the same soil mass is particularly important, since soil moisture distribution and extraction patterns appear to be nonuniform. It must be noted, however, that overirrigation and resulting moisture movement remain a problem with this method. Also, for greater

accuracy, measurements of the soil surface layer, to a depth of about 1 foot, require a different calibration than the measurements at greater depth below the soil surface. Determination of a suitable calibration is under study by the department and other agencies at this time. It is believed at the present that the error of measuring the losses of water from the soil surface is not large, considering the total water use from the entire profile, in the case of deeper rooted crops.

Inherent variabilities, such as found in physical measurements of any natural phenomenon, occur in soil moisture depletion measurements. Generally, although affecting any given measurement, such variations tend to be compensating and, over a period of time, such as a year, tend to cancel out.

Two neutron scattering devices were acquired in 1958, shortly after this equipment became commercially available. The neutron equipment was used for determination of soil moisture in all field plots since early spring of 1959. The same criteria used for selection of gravimetric sampling plots were followed in establishing the plots sampled with the neutron probe.

Effort was made to keep the crop in the plot area generally typical of the normal conditions of the entire field. Light weight, portable sampling platforms with working areas of 15 to 30 square feet were fabricated in 1959 to carry the neutron scattering equipment. These also served as portable working platforms. They have been particularly advantageous in facilitating the field work and in avoiding trampling and injury to the alfalfa and grass crops

and compaction of the soils. Three types of portable sampling platforms used at Fall River Mills and Bakersfield are shown in Figure 3.

To provide neutron probe access into the soil, thin-walled aluminum tubes 20 feet in length with removable 18-inch extensions at the top were permanently installed flush with the soil surface. Stoppers were placed in the tube at the surface and immediately below the extension to exclude foreign material from the tubes. In this way, the tubes did not extend above the ground to interfere with tillage and crop cultural operations. When tillage operations damaged the upper extensions, they were simply and easily replaced. The access tube design is shown in Figure 4.

Pittville Neutron Probe Moisture Depletion Measurements. The Pittville site is located at an elevation of about 3,340 feet, in the northeastern intermountain region, at a latitude of 41 degrees. Selection of the neutron measurement site was preceded by four years of gravimetric sampling in the Fall River Valley and other mountain valleys in the northeastern area. The Pittville 1 S site was sampled using the gravimetric technique in 1956, 1957, and 1958. This prior experience indicated that the Pittville alfalfa field possessed the desirable combination of soil and irrigation conditions for a moisture depletion plot. Topographically, the site is gently sloping with small swales. There is a small ridge 600 feet north of the plot site, which is about 100 feet higher than the plot. The land at the plot site slopes 5 percent

Platform Developed in Early Stage of Program for Obtaining Soil Cores

Small, Wheeled Platform Used to Measure Soil Moisture Depletion by the Neutron Scattering Technique

Aluminum Platform Used with the Neutron Scattering Equipment

FIGURE 3. PLATFORMS USED TO MINIMIZE CROP DAMAGE AND SOIL COMPACTION

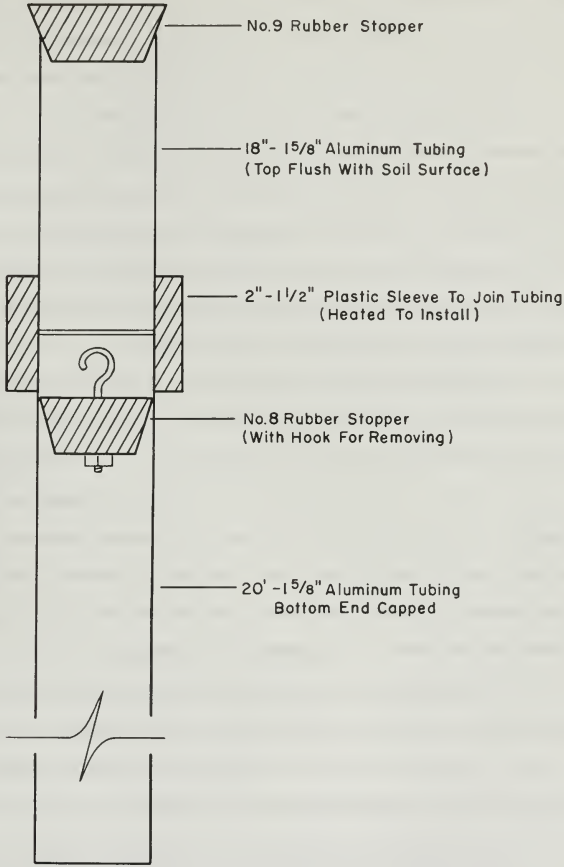


Figure 4, ACCESS TUBE DESIGN

to the south-southwest, and the 30 acres of alfalfa in the field are surrounded by small irrigated fields, dry-farmed grain, and native vegetation. Prevailing winds in the area are from the west

Initially, three rows of five access tubes were installe 75 feet apart, with the tubes spaced in the rows 15 feet apart. In September 1959, four more tubes were installed in one of the rows, and the other two rows abandoned, reducing the plot to nine tubes. This enabled the plot to be irrigated in two days, rather than the three to four days required for the sprinklers to pass over the original three rows of access tubes.

Irrigation water is applied by a portable sprinkler system, using full circle (360 degrees) rotating sprinklers. The sprinklers sometimes stuck in one position, and irrigation application, as a result, was not uniform enough to determine applied wat from pumping records. This plot was subjected to somewhat deficit irrigation, which left a dry zone generally below a depth of 8 fee For this reason, the soil moisture measurements can be used with confidence as estimate of evapotranspiration.

Neutron moisture depletion measurements were made during 1959 and 1960 at another alfalfa site 3 miles west of the Pittvill plot. Due to apparent excessive moisture movement, however, the r sults of these measurements are not included in the report.

Arvin Neutron Probe Moisture Depletion Measurements. These measurement sites are in the southern San Joaquin Valley, near the 35 degree latitude, located at an elevation of about 440 feet. The plot sites are on broad, smooth, recently formed fans

from the outwash of the Sierra Nevada Range at the southern end of the valley. The land slopes to the southwest at the plot area at about 30 feet per mile (0.6 percent).

Irrigation in the area is supplied from deep wells lifting water several hundred feet. All of the Arvin plots are located on Hesperia fine, sandy loam. This soil has no apparent clay or cemented layers. Moisture drainage is good. Noncontinuous silt layers and pockets of silt of varying thickness are found from 3 feet down to 22 feet below the surface. Plot sites were located where the least amount of silt layers are found. Surrounding the sampling areas were irrigated orchards, vineyards, alfalfa, cotton, and other crops. The irrigated area extends 20 miles to the north, 15 miles to the east, 40 miles to the south, and 60 miles to the west.

Four crops, cotton, alfalfa, plum orchard, and fescue grass, were sampled. All sites were irrigated by furrow or border methods. In order to obtain reasonably precise data, more than 20 sampling tubes were installed on the cotton and alfalfa. Six tubes each were installed on the plums and grass plots for exploratory purposes, the intent being to determine moisture extraction patterns.

The plum orchard is planted on a 24-foot square pattern. Water is applied to five or six straight furrows running in one direction. Results of the neutron probe measurements indicate that the extraction of moisture is greatest from the furrow area near the trees, intermediate from the middle furrows, and least from the soil in the tree rows. Extraction was noted to a depth of 16 feet. Depth of extraction probably depends largely on irrigation practices.

On the grass plot, the moisture was extracted primarily from the upper 2 or 3 feet. With such a large portion of the total water use from such shallow depths, the inherent uncertainty of surface neutron probe measurements assumes greater importance. It has been concluded that the neutron scattering technique is not well suited for measuring evapotranspiration of grasses due to their shallow moisture extraction patterns and frequent irrigations. Plan have been made to use evapotranspirometers on this crop.

On the alfalfa plot, ample tubes were sampled to obtain a good estimate of moisture depletion.

On the cotton plot, three sets of seven tubes each were placed at the upper, middle, and lower ends of the 440-foot furrow runs. The tubes were placed diagonally, crossing the rows, such that the tubes were located in the plant row, and in the furrow bottoms and furrow shoulders. The number of tubes was adequate to determine moisture change with good precision.

Cotton is not normally overirrigated, which is an advantag in soil moisture depletion studies, since soil moisture movement is not as much a problem in data interpretation as with most other crop Portable water meters were used to measure the water applied to the cotton. These measurements confirmed the seasonal depletion record obtained from the neutron probe measurements.

Evapotranspirometer Measurements

Evapotranspirometers, sometimes referred to as lysimeters, are instruments designed for the measurement of evapotranspiration. They can be of various shapes, sizes, and designs. Essentially,

they are devices which enable the evaluation of the moisture regime of a confined soil mass, of known dimensions, in which a crop is grown. Moisture changes of the crop-soil system are determined by periodic or continuous weighing, or by volumetric determination of water displaced, added, and/or removed from the system.

When used for the determination of field evapotranspiration, it is particularly important that the tanks be installed in such a manner that their presence does not modify the environment of the measured crop. Although this technique appears to be an excellent method for precise measurement of crop water use, certain factors, such as the artificial restriction of crop rooting and possible modification of soil heat transfer, have yet to be completely evaluated. Research on these factors is presently being conducted by the University of California.

The use of evapotranspirometers in the field was not common in California at the initiation of this program, although tanks had been used in the 1920's and 1930's. Because soil moisture depletion studies are not adapted to crops frequently irrigated or having high water tables, small evapotranspirometers were installed to provide a reliable measure of evapotranspiration under those conditions.

Alturas-Dorris Ranch Evapotranspirometer Measurements. In 1956, two small evapotranspirometers were installed near Alturas to measure evapotranspiration from high water table pasture. The plot site was in an irrigated meadow pasture containing high moisture favoring grasses, legumes, and broad-leafed plants found in improved

irrigated pasture mixes and in native mountain meadows. The pasture was grazed nearly continuously by cattle, and was usually short but fully covered the ground. Typical percentages of green growing leaf surfaces were as follows: In April, 40 percent, increasing to 100 percent by the end of the month; May through September, 100 percent; October, 100 percent, decreasing to 50 percent by the end of the month. Cover of green foliage varies between zero and 40 percent during the winter, depending to a large extent upon the severity of the winter. In milder winters, some green live shoots survive, while in severe winters the foliage is completely inactive, and the green color is gone.

The evapotranspirometer site was enclosed by a barbed-wire fence forming a 25- by 75-foot rectangle. Inside the fenced area the grass was mowed several times during the season to maintain approximately a 5-inch height. Two cylindrical steel evapotranspirometers, 36 inches in diameter and 30 inches deep, were installed in the soil within a fenced area, one at each end. Also, inside the plot were a hygrothermograph and evaporation pan, atmometers, phyheliometer, and a precipitation gage.

Water was supplied to the evapotranspirometers by means of a steady, small flow, at a rate calculated to exceed evapotranspiration. It took approximately one week to utilize the water from a cylindrical supply tank 5 feet deep and 18 inches in diameter. A discharge tube was attached to the evapotranspirometer 6 inches below the ground surface, and the excess water not consumed in the transpirometer spilled into a buried sump tank, where it was measured.

The numerous mechanical problems encountered during the first 2.5 years rendered the collected data of questionable validity

Therefore, these data have not been used for this report. The data collected in 1959 and 1960 are considered representative of evapotranspiration from high water table meadow pasture, and are reported herein.

Coleville Evapotranspirometer Measurements. In 1957, data on high water table meadow pasture were collected from an evapotranspirometer tank near Coleville in the Lassen-Alpine area. The measurement site was located at the eastern edge of the State, at a latitude of about 38° 30", at an elevation of 5,100 feet. The site was similar to the Alturas-Dorris Ranch site in vegetation and in irrigation methods. The field was subject to long irrigations by wild flooding. The water level at this site varied from 0-16 inches below the ground surface, and was usually about 8 inches below the ground surface. A cylindrical steel evapotranspirometer, 36 inches in diameter by 3 feet deep, was installed. Water was supplied to the evapotranspirometer from a supply tank floated on the water table surrounding the evapotranspirometer. With this system the water table inside the evapotranspirometer was kept at essentially the same level as that in the field. Moisture utilized by the plants was constantly replaced from the supply tank. The level of the supply tank was recorded on a Stevens water stage recorder. The field water table level was also measured on a separate recorder. By integration of the two charts, the rate of evapotranspiration was determined.

The topography in the area is smooth, with a 2 percent northerly slope. Data were collected at this site for one season in connection with an investigation of water use in watersheds in the eastern Sierra Nevada.

Figure 5 shows diagrammetically the functioning of the Alturas-Dorris Ranch and Coleville evapotranspirometers.

Davis Evapotranspirometer Measurements. In 1958, three small evapotranspirometers 2 feet in diameter were installed at Davis in cooperation with the Department of Irrigation of the University of California. The purpose was to determine how well thes small tanks would compare with a large 20-foot diameter tank, whic was installed by the university in 1958. Over a 10-month period, the mean evapotranspiration from the 2-foot evapotranspirometers differed less than 5 percent from the 20-foot evapotranspirometer. One reason for this favorable comparison is that both kinds of tanks were located in the same field environment having a continuous, uniform crop height and cover in and around the tanks. The data from the 2-foot evapotranspirometers are presented in thi report.

Evapotranspiration Data Summary

Summaries of evapotranspiration for measured and estimated periods are tabulated in Table 5, with corresponding measurements of pan and atmometer evaporation. Evapotranspiration for missing periods was usually estimated as the product of appropriat pan or atmometer coefficients, and pan or atmometer evaporation data collected during these periods, plus calculated increments fo surface evaporation following irrigation. Monthly evapotranspirat totals have been computed and are also presented in Table 5. A detailed tabulation of evapotranspiration and related data are presented in Tables A-6 and A-7 of Appendix A, for the approximately weekly measurement schedule. Variability of soil moisture values

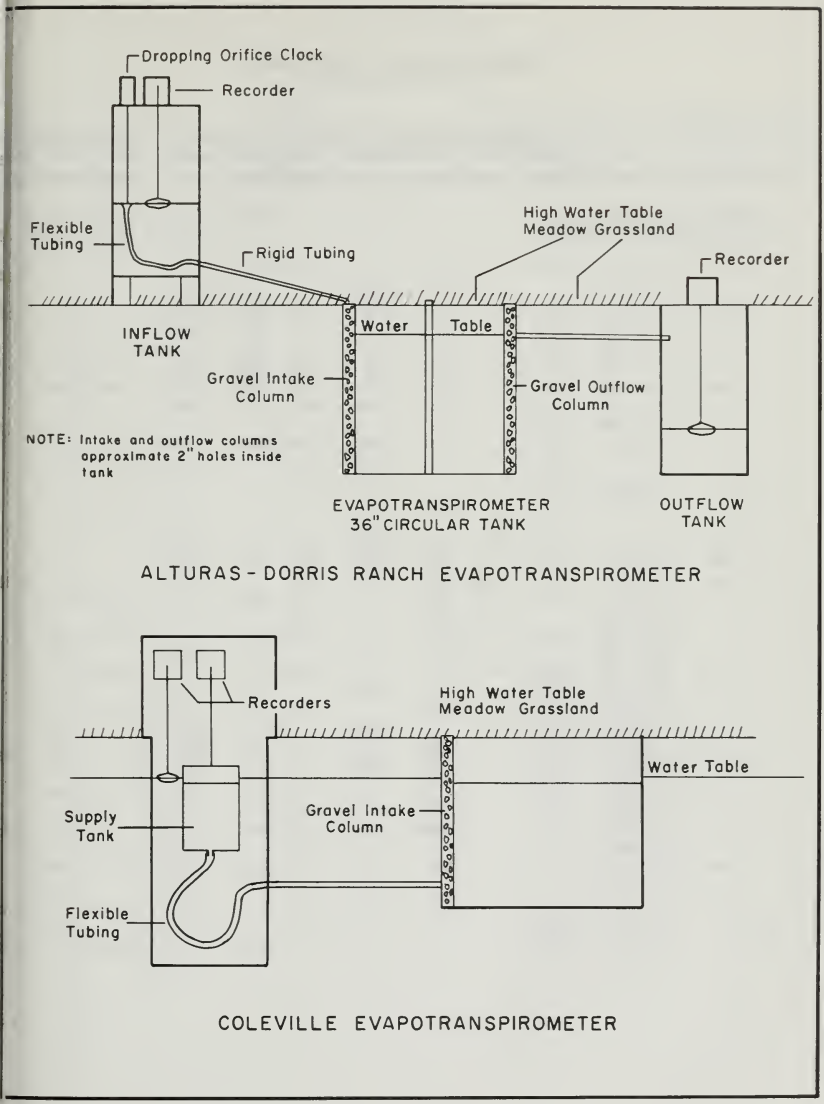


Figure 5, EVAPOTRANSPIROMETER DESIGN

TABLE 5

SUMMARY OF MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA

Year	Month	Period	Evapotranspiration: Measured	Evapotranspiration: Estimated	Evapotranspiration: Accum. totals	Evapotranspiration: Monthly est.	Pan evaporation: Each period	Pan evaporation: Accum. totals	Pan evaporation: Monthly est.	Atmometer evaporat: Each period	Atmometer evaporat: Accum. totals	Atmometer evaporat: Mon es
Sacramento River Mountain Valleys												
Pasture - Alturas - Dorrie Ranch												
1959	Apr.	4/7 - 4/30	4.03		4.03		4.35	4.35				
		3/31- 4/30				5.15			5.54			
	May	4/30- 5/31	5.99		10.02	5.99	6.09	10.44	6.09			
	June	5/31- 6/30	8.95		18.97	8.95	7.94	18.38	7.94			
		6/2 - 6/30	(8.33)							510	510	5
	July	6/30- 7/31	10.45		29.42	10.45	9.83	28.21	9.83	645	1,155	6
	Aug.	7/31- 8/31	9.04		38.46	9.04	8.65	36.86	8.65	547	1,702	5
	Sept.	8/31- 9/30	4.90		43.36	4.90	5.41	42.27	5.41			
		8/31- 9/22	(3.78)							315	2,017	
	Oct.	9/30-11/2	3.02		46.38	2.85	3.80	46.07	3.59			
TOTALS		4/7 -11/2	46.38				46.07					
		6/2 - 9/22	31.60							2,017		
1960	Apr.	4/8 - 5/1	2.33		2.33	2.99	3.50	3.50	4.53			
	May	5/1 - 5/31	4.61		6.94	4.78	5.71	9.21	5.90			
	June	5/31- 6/7		1.96	8.90		1.96					
		6/7 - 6/14	1.41		10.31		1.73	12.90		129	129	
		6/14- 6/21		1.96	12.27		1.96			116		
		6/21- 6/28	1.62		13.89		1.98	16.84		140	385	
		5/31- 6/30				6.56			8.00			
	July	6/28- 8/1	10.33		24.22		9.45	26.29		608	993	
		6/30- 7/31				9.61			8.82			
	Aug.	8/1 - 8/31	8.99		33.21		8.02	34.31		480	1,473	
		7/31- 8/31				9.31			8.31			
	Sept.	8/31- 9/30	6.01		39.22	6.01	5.91	40.22	5.91	421	1,894	4
	Oct.	9/30-10/31	3.56		42.78	3.56	3.81	44.03	3.81			
		9/30-10/3	(0.47)							43	1,934	
	Nov.	10/31-11/21		0.71	43.49		0.76					
		11/21-12/1	0.17		43.66		0.38	45.17				
		10/31-11/30				0.51			0.76			
	Dec.	12/1 -12/31	0.75		44.41		0.62	45.79				
		11/30-12/31				0.78			0.65			
TOTALS		4/8 -12/31	39.78				41.11					
		6/7 -10/3	28.83							1,821		

TABLE 5 (continued)

SUMMARY OF MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA (Continued)

Year	Month	Period	Evapotranspiration: Measured	Evapotranspiration: Estimated	Evapotranspiration: Accum. totals	Evapotranspiration: Monthly est.	Pan evaporation: Each period	Pan evaporation: Accum. totals	Pan evaporation: Monthly est.	Atmometer evaporation: Each period	Atmometer evaporation: Accum. totals	Atmometer evaporation: Monthly est.
Sacramento River Basin Valley Floor												
Pasture - Davis Campbell												
1959	Jan.	12/31- 2/2	1.42		1.42		2.03	2.03				
		12/31- 1/31				1.15						1.65
	Feb.	2/2 - 2/27	2.27		3.69		2.18	4.21				
		1/31- 2/28				2.56						2.65
	Mar.	2/27- 4/1	4.45		8.14		6.57	10.78				
		2/28- 3/31				4.31						6.32
	Apr.	4/1 - 4/16	2.51		10.65		4.26	15.04				
		4/16- 4/30		1.82	12.47		2.23	17.27				
		3/31- 4/30				4.45						7.55
	May	4/30- 5/14	2.87		15.34		4.34	21.61				
		5/14- 5/21		1.56	16.90		2.56	24.17				
		5/21- 5/28	1.06		17.96		1.91	26.08				
		4/30- 5/31				6.05						9.75
	June	5/28- 6/8		2.19	20.15		3.67	29.75				
		6/8 - 6/15	1.67		21.82		2.23	31.98				
		6/15- 6/30		4.08	25.90		5.72	37.70				
		5/31- 6/30				7.38						11.02
	July	6/30- 7/29	8.11		34.01		10.74	48.44				
		6/30- 7/31				8.74						11.15
	Aug.	7/29- 8/31	7.65		41.66		9.88	58.32				
		7/31- 8/31				7.02						9.13
	Sept.	8/31- 9/3		0.76	42.42		0.59	58.91				
		9/3 -10/2	5.63		48.05		8.23	67.14				
		8/31- 9/30				5.97						8.14
	Oct.	10/2 -11/2	4.26		52.31		6.66	73.80				
		9/30-10/31				4.56						7.11
	Nov.	11/2 -12/5	2.12		54.43		4.19	77.99				
		10/31-11/30				1.92						3.53
	Dec.	12/5 -12/31	0.88		55.31		1.68	79.67				
		11/30-12/31				(1.25)						2.65
TOTALS		12/31/58-12/31/59	44.90				64.90					
1960	Jan.	12/31- 1/30	0.84		0.84		1.48	1.48				
		12/31- 1/31				0.88						1.63
	Feb.	1/30- 2/26	1.53		2.37		2.88	4.36				
		1/31- 2/29				1.78						3.08

TABLE 5 (continued)

SUMMARY OF MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA (Continued)

Year	Month	Period	Evapotranspiration: Measured	Evapotranspiration: Estimated	Evapotranspiration: Accum. totals	Evapotranspiration: Monthly est.	Pan evaporation: Each period	Pan evaporation: Accum. totals	Pan evaporation: Monthly est.	Atmometer evaporat: Each period	Atmometer evaporat: Accum. totals	Atmometer evaporat: Mon es
1960	Mar.	2/26- 3/31	3.35		5.72		4.21	8.57				
		2/29- 3/31				3.06			3.86			
	Apr.	3/31- 4/29	4.85		10.57		5.65	14.22				
		4/18- 4/29	(1.73)							138	138	
		3/31- 4/30				5.27			6.11			
	May	4/29- 6/1	7.50		18.07		9.20	23.42				
		4/30- 5/31				7.10			8.74	570	708	
	June	6/1 - 7/1	5.87		23.94		12.02	35.44				
		5/31- 6/30				5.87			12.02	607	1,315	
	July	7/1 - 7/19	4.25		28.19		6.44	41.88		390	1,705	
TOTALS		12/31- 7/19	28.19				41.88					
		4/18- 7/19	19.35							1,705		
Lassen - Alpine Mountain Valleys												
Pasture - Coleville - 2E												
1957	May	5/27- 6/3	1.34		1.34		1.38	1.38				
	June	6/3 - 6/30	6.91		8.25		7.31	8.69				
		5/31- 6/30				7.53			7.95			
		6/10- 6/30	(5.23)							434	434	
	July	6/30- 8/1	9.12		17.37	9.12	9.33	18.02	9.33	601	1,035	6(
	Aug.	8/1 - 8/31	7.76		25.13	7.76	9.09	27.11	9.09	583	1,618	5(
	Sept.	8/31- 9/23	3.39		28.52		4.63	31.74		359	1,977	
TOTALS		5/27- 9/23	28.52				31.74					
		6/10- 9/23	25.50							1,977		
Sacramento River Basin Mountain Valleys												
Alfalfa - Fall River Mills - Plot AA												
1959	Mar.	3/17- 4/8	1.92		1.92							
		3/17- 3/31				1.26						
	Apr.	4/8 - 4/23	3.86		5.78							
		4/23- 4/30		1.34	7.12							
		3/31- 4/30				5.86						
	May	4/30- 5/6		1.33	8.45							
		5/6 - 5/28	4.24		12.69							
		4/30- 5/31				6.76						
	June	5/28- 7/2	8.48		21.17					715	715	
		5/31- 6/30				6.88						60
	July	7/2 - 7/6		1.27	22.44					86	801	
		7/6 - 7/27	6.41		28.85					463	1,264	
		7/27- 7/31		0.95	29.80					70	1,334	
		6/30- 7/31				9.04						65

TABLE 5 (continued)

SUMMARY OF MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA (Continued)

Year	Month	Period	Evapotranspiration: Measured	Evapotranspiration: Estimated	Evapotranspiration: Accum. totals	Evapotranspiration: Monthly est.	Pan evaporation: Each period	Pan evaporation: Accum. totals	Pan evaporation: Monthly est.	Atmometer evaporation: Each period	Atmometer evaporation: Accum. totals	Atmometer evaporation: Monthly est.
1959	Aug.	7/31- 8/3		0.86	30.66					59	1,393	
		8/3 - 8/14	1.81		32.47					232	1,625	
		8/14- 8/31		3.58	36.05					355	1,980	
		7/31- 8/31				6.25						646
	Sept.	8/31- 9/3		0.92	36.97					65	2,045	
		9/3 - 9/15	3.49		40.46					207	2,252	
		9/15- 9/30		2.51	42.97					209	2,461	
		8/31- 9/30				6.92						481
TOTALS		3/17- 9/30	30.21									
		5/28- 9/30	20.19							1,617		
Sacramento River Basin Mountain Valleys												
Alfalfa - Fall River Mills - Plot AA												
1960	Mar.	3/10- 4/19	3.71		3.71		5.91	5.91				
		3/10- 3/31				1.90			3.80			
	Apr.	4/19- 5/11	2.39		6.10		3.82	9.73				
		3/31- 4/30				2.83			4.65			
	May	5/11- 5/19		2.37	8.47		2.25	11.98				
		5/19- 6/3	3.31		11.78		2.91	14.89				
		4/30- 5/31				6.42			6.67			
	June	6/3 - 6/24	3.29		15.07		6.20	21.09				
		6/10- 6/24	(1.21)							275		
		6/24- 6/30		1.28	16.35		1.64	22.73		121	396	
		5/31- 6/30				5.57			8.69			588
	July	6/30- 7/25	7.85		24.20		8.61	31.34		492	888	
		7/25- 8/1		0.92	25.12		2.09	33.43		114	1,002	
		6/30- 7/31				8.40			10.40			584
	Aug.	8/1 - 8/5		1.06	26.18		1.33	34.76		80	1,082	
		8/5 - 8/26	6.30		32.48		6.41	41.17		375	1,457	
		8/26- 9/1		1.52	34.00		1.46	42.63		97	1,554	
		7/31- 8/31				8.88			9.20			550
	Sept.	9/1 - 9/28	4.55		38.55		5.41	48.04		425	1,979	
		8/31- 9/30				5.10			5.85			452
	Oct.	9/28-11/8	4.82		43.37		5.05	53.09				
		9/30-10/31				3.80			3.97			
TOTALS		3/10-11/8	36.22				44.32					
		6/10- 9/28	19.91							1,567		

TABLE 5 (continued)

SUMMARY OF MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA (Continued)

Year	Month	Period	Evapotranspiration: Measured	Evapotranspiration: Estimated	Evapotranspiration: Accum. totals	Evapotranspiration: Monthly est.	Pan evaporation: Each period	Pan evaporation: Accum. totals	Pan evaporation: Monthly est.	Atmometer evaporat: Each period	Atmometer evaporat: Accum. totals	Atmometer evaporat: Mon est
Tulare Lake Basin Valley Floor												
Alfalfa - Arwin - Plot CC												
1959	Mar.	3/13- 3/27	1.07		1.07		2.28	2.28		186	186	
		3/27- 4/3		1.06	2.13		1.35	3.63		106	292	
		- 3/31							4.53			3
	Apr.	4/3 - 4/21	2.54		4.67		4.16	7.79		293	585	
		4/21- 4/28		1.16	5.83		1.77	9.56		100	685	
		3/31- 4/30				4.49			7.00			4
	May	4/28- 5/14		2.34	8.17		3.82	13.38		244	929	
		5/14- 5/25	1.31		9.48		2.96	16.34		172	1,101	
		5/25- 6/1		1.34	10.82		2.58	18.92		123	1,224	
		4/30- 5/31				4.54			8.69			4
	June	6/1 - 6/9	2.06		12.88		2.45	21.37		148	1,372	
		6/9 - 6/15		0.93	13.81		1.81	23.18		112	1,484	
		6/15- 6/22	1.00		14.81		2.13	25.31		142	1,626	
		6/22- 6/29		1.45	16.26		2.22			132	1,758	
		5/31- 6/30				5.80			9.06			5
	July	6/29- 7/3	1.09		17.35		1.58	29.11		88	1,846	
		7/3 - 7/8		0.90	18.25		1.54	30.65		102	1,948	
		7/8 - 7/17	1.20		19.45		2.71	33.36		170	2,118	
		7/17- 7/22		1.10	20.55		1.37	34.73		84	2,202	
		7/22- 7/29	1.70		22.25		2.30	37.03		126	2,328	
		6/30- 7/31				6.34			9.95			5
	Aug.	7/29- 8/8		2.38	24.63		2.83	39.86		168	2,496	
		8/8 - 8/13	0.39		25.02		1.67	41.53		102	2,598	
		8/13- 8/27		2.56	27.58		3.50	45.03		220	2,818	
		7/31- 8/31				6.07			8.67			5
	Sept.	8/27- 9/15	3.86		31.44		3.96	48.99		312	3,130	
		9/15- 9/22		1.30	32.74		1.40	50.39		106	3,236	
		9/22-10/2	1.74		34.48		2.11	52.50		158	3,394	
		8/31- 9/30				5.27			5.93			4
	Oct.	10/2 -10/9		0.90	35.38		1.04	53.54		96	3,490	
		10/9 -10/21	1.29		36.67		1.72	55.26		172	3,662	
		10/21-11/3		1.04	37.71		1.65	56.91		135	3,797	
		9/30-10/31				3.22			4.49			4
	Nov.	11/3 - 12/2	2.52		40.23		2.49	59.40				
		10/31-11/30				2.76			2.69			
	Dec.	12/2 - 1/5	2.01		42.24		1.76	61.16				
		11/30-12/31				1.87			1.68			
TOTALS		3/13- 1/5	23.78				34.28					
		3/13-10/21	19.25							2,069		

TABLE 5 (continued)

SUMMARY OF MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA (Continued)

Year	Month	Period	Evapotranspiration: Measured	Evapotranspiration: Estimated	Evapotranspiration: Accum. totals	Evapotranspiration: Monthly est.	Pan evaporation: Each period	Pan evaporation: Accum. totals	Pan evaporation: Monthly est.	Atmometer evaporation: Each period	Atmometer evaporation: Accum. totals	Atmometer evaporation: Monthly est.
1960	May	5/12- 5/31	2.98		2.98		5.58	5.58		354	354	
	June	5/31- 6/24		6.69	9.67		8.24	13.82		541	895	
		6/24- 7/1	1.01		10.68		1.93	15.75		138	1,033	
		5/31- 6/30				7.67			9.98			670
	July	7/1 - 7/8		1.44	12.12		2.27	18.02		151	1,184	
		7/8 - 8/1	4.56		16.68		7.13	25.15		488	1,672	
		6/30- 7/31				6.00			9.39			639
	Aug.	8/1 - 8/10		1.36	18.04		2.53	27.68		180	1,852	
		8/10- 9/1	5.27		23.31		5.56	33.24		402	2,254	
		7/31- 8/31				6.63			8.09			582
	Sept.	9/1 - 9/16		1.67	24.98		3.19	36.43		251	2,505	
		9/16- 9/22	1.58		26.56		1.19	37.62		98	2,603	
		9/22- 9/29		0.72	27.28		1.44	39.06		108	2,711	
		8/31- 9/30				4.10			6.13			480
	Oct.	9/29-10/27	2.42		29.70		3.85	42.91		341	2,052	
		9/30-10/31				2.59			4.08			372
	Nov.	10/27-11/18	0.87		30.57		1.60	44.51		179	3,231	
TOTALS		5/12-11/18	18.69				26.84			2,000		
Tulare Lake Basin Valley Floor												
Cotton - Arvin - Plot CD												
1959	May	4/30- 5/8		0.13	0.13		1.68	1.68		117	117	
		5/8 - 5/21	0.32		0.45		3.88	5.56		217	334	
		5/21- 6/3		1.54	1.99		3.76	9.32		210	544	
		4/30- 5/31				1.58			8.69			498
	June	6/3 - 6/16	1.88		3.87		4.19	13.51		252	796	
		6/16- 6/23		2.51	6.38		2.16	15.67		153	949	
		6/23- 6/30	2.67		9.05		2.11	17.78		126	1,075	
		5/31- 6/30				7.47			9.06			571
	July	6/30- 7/7	2.41		11.46		2.43	20.21		138	1,213	
		7/7 - 7/15		2.79	14.25		2.56	22.77		159	1,372	
		7/15- 7/28	4.55		18.80		4.02	26.79		236	1,608	
		6/30- 7/31				10.67			9.95			582
	Aug.	7/28- 8/4	2.31		21.11		2.23	29.02		126	1,734	
		8/4 - 8/11		1.86	22.97		2.15	31.17		131	1,865	
		8/11- 8/18	1.38		24.35		1.91	33.08		125	1,990	
		8/18- 8/25		1.50	25.85		1.63	34.71		106	2,096	
		8/25- 9/2	2.22		28.07		2.23	36.94		146	2,242	
		7/31- 8/31				7.76			8.67			548
	Sept.	9/2 - 9/24	3.85		31.92		4.18	41.12		338	2,580	
		8/31- 9/30				5.10			5.93			473

TABLE 5 (continued)

SUMMARY OF MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA (Continued)

Year	Month	Period	Evapotranspiration: Measured	Estimated	Accum. totals	Monthly est.	Pan evaporation: Each period	Accum. totals	Monthly est.	Atmometer evaporati: Each period	Accum. totals	Monthl est.
1959	Oct.	9/24-10/19	3.68		35.60		4.21	45.33		372	2,952	
	Defoliated											
		10/19-11/4	0.36		35.96		2.01	47.34		163	3,115	
		9/30-10/31				2.95			4.49			41
	Nov.	11/4 -12/17	0.33		36.29		3.21	50.55				
		10/31-11/30				0.19			2.69			
TOTALS		5/8 -12/17	25.96				36.61					
		5/8 -11/4	25.63							2,239		
Tulare Lake Basin Valley Floor												
Cotton - Arvin - Plot CF												
1960	Mar.	3/18- 3/23		0.50	0.50		0.85	0.85				
	Planted	4/6										
	Apr.	3/23- 5/6	1.46		1.96		8.40	9.25		634	634	
		3/31- 4/30				0.83			5.82			43
	May	5/6 - 6/9	0.37		2.33		10.39	19.64		666	1,300	
		4/30- 5/31				0.31			8.72			57
	June	6/9 - 6/15	0.84		3.17		2.03	21.67		131	1,431	
		6/15- 6/20		1.81	4.98		1.82	23.49		124	1,555	
		6/20- 6/30	2.41		7.39		3.20	26.69		226	1,781	
		5/31- 6/30				5.31			9.98			67
	July	6/30- 7/7	1.94		9.33		2.13	28.82		138	1,919	
		7/7 - 7/15		2.63	11.96		2.54	31.36		179	2,098	
		7/15- 7/28	4.15		16.11		3.59	34.95		249	2,347	
		6/30- 7/31				10.14			9.39			63
	Aug.	7/28- 8/9		4.25	20.36		3.44	38.39		234	2,581	
		8/9 - 8/19	3.28		23.64		2.62	41.01		198	2,779	
		8/19- 8/23		1.43	25.07		1.34	42.35		86	2,865	
		8/23- 8/31	1.29		26.36		1.71	44.06		127	2,992	
		7/31- 8/31				8.87			8.09			58
	Sept.	8/31- 9/21	4.35		30.71		4.61	48.67		346	3,338	
		8/31- 9/30				5.04			6.13			48
	Oct.	9/21-10/14	1.79		32.50		3.96	52.63		318	3,656	
	Defoliated	-10/19										
		9/30-10/31				1.03			4.08			37
	Nov.	10/14-11/22	0.94		33.44		3.45	56.08		365	4,021	
		10/31-11/22				1.02			1.89			2
TOTALS		3/23-11/22	22.82				46.09			3,398		

obtained during any one period of depletion is expressed in Table A-6 under the heading "Twice the Standard Error."

The effects of percent ground cover and, possibly, of stage of crop maturity and available soil moisture, are illustrated in Plate 3, which compares accumulated evapotranspiration of different crops. These measurements were made in the Arvin area under similar climatic conditions and on the same soil series. Differences in percent ground cover and possibly crop maturity and available soil moisture cause differences in slopes of the curves shown in Plate 3. Defoliation caused the abrupt changes in evapotranspiration rates reflected in the curves on cotton and plums. Alfalfa remains green at this location throughout the year, and shows little seasonal slope changes. It is of interest to note the much higher July and August rates of evapotranspiration by cotton, as compared to alfalfa and plums in both 1959 and 1960. A complete explanation for this cannot be presented; however, certain of the factors affecting evapotranspiration are discussed in the following chapter.

CHAPTER IV. CORRELATION OF EVAPOTRANSPIRATION DATA WITH AGROCLIMATIC DATA

To attempt concurrently to measure evapotranspiration of the many species of irrigated crops presently grown in California is impractical because of financial and manpower requirements. Likewise impractical is the measurement of evapotranspiration of a single crop at more than a few locations.

The most promising approach at this time appears to be to determine the important and measurable parameters affecting evapotranspiration rates, and to correlate actual measurements of evapotranspiration with those parameters. Three important parameters which appear independently to affect evapotranspiration are climate, plant conditions, including physiological factors, and soil moisture availability. Differences in the physical and chemical properties of soils and soil fertility are not considered to directly affect evapotranspiration, even though they may have indirect effects.

This chapter discusses the relationship of each of those parameters of evapotranspiration, and summarizes the analysis of data collected through 1960. In this regard, basic research on factors affecting evapotranspiration is being conducted by the University of California, as an integral part of the Vegetative Water Use Program. The Agricultural Research Service is also conducting basic research in this field. The results of these research programs have affected, and shall continue to influence, the course of these studies.

Evapotranspiration and Climatic Data

Climate in the evapotranspiration process can be though of as a combination of evaporative elements, such as air temperature, wind, dryness of the air, and solar radiation. Other factors of climate, such as length of daylight, may be indirectly related to evaporation.

The energy sources for the evapotranspiration processes are derived principally from direct solar radiation and advection or exchangeable heat from the air. The evaporative demand of the atmosphere is largely a function of those two elements. However, not all of the solar radiation that falls directly on the plant or ground surface is used in evapotranspiration. A portion is re flected back into the atmosphere, a portion is utilized in heatin the air, a portion is absorbed in heating the soil, and the balan is utilized in evapotranspiration and plant growth. It is likewi probable that the energy available from advection is not all utilized, depending upon many factors, such as vapor pressure defici and extent of wind movement. Under certain conditions, it has be demonstrated that advective cooling, as well as advecting heating may occur.

As the moisture content of the air increases through evaporation and/or transpiration, the moisture gradient (vapor pressure gradient) between an air mass and an evaporating surface becomes less steep and retards further moisture transfer. Under field conditions, the air mass near the ground is far from stable Air movements act to mix moisture-saturated air near the evaporat

surface with drier air from above. Wind speeds and surface roughness influence the relative turbulence of the air, moving the moisture away from the evaporating surface and bringing in drier air to further the evaporation process. Thus, it is apparent that the evaporative demand of the atmosphere is determined by the interaction of several climatic elements.

Progress is being made in determining the relationships between the aforementioned climatic factors to arrive at a quantitative approach to estimating evapotranspiration.

Evapotranspiration and Plant Conditions

The term "evapotranspiration" implies the sum of evaporation plus transpiration. In the case of plants that are actively growing and well supplied with moisture, transpiration is related and responsive to climatic conditions. Evaporation from soils, however, is related more closely to, and limited by, the moisture content of the exposed soil surface than to climatic conditions. In most irrigated areas in California, rain is sparse during the growing season and, except for areas of high water tables, soil surfaces soon dry through evaporation following irrigation. As a result, under California irrigation conditions, transpiration is usually the larger of the two components comprising evapotranspiration.

The primary plant parameter affecting evapotranspiration rate appears to be the percent of ground cover. This is an important consideration when determining evapotranspiration for annual field crops, such as sugar beets and cotton, and for other

crops having variable ground cover percentages, such as alfalfa, which is cut frequently.

Crops having rapid growth rates and vigor tend to provid greater ground cover more rapidly than a slow-growing crop, even of the same species. Thus, differences in growth rate may affect evapotranspiration rates through the direct mechanism of percent of ground cover, although other physiological factors, such as stage of maturity or growth, may also affect evapotranspiration.

Evapotranspiration and Soil Moisture

Research findings relative to the effect of variations of available soil moisture upon evapotranspiration and plant growt are varied.

The amount of soil moisture available above the permaner wilting point does not seem to affect the evapotranspiration rate of crops, according to many research reports. Other research has indicated that maximum growth rates are obtained only under conditions of high moisture availability, and that growth rates and yields are retarded as soil moisture availability decreases. Thes concepts differ from other research investigations which have indicated a close relationship between evapotranspiration and plant growth. These concepts are of particular importance in considerir if evapotranspiration rates are affected by low soil moisture leve which appear to affect growth rates, such as occur when irrigatior is deliberately withheld from grapes and cotton to change their fruiting characteristics.

Besides intentional withholding of irrigation, there are also occasions of drought due to insufficient irrigation water

supplies. Due to the foregoing reasons, crops are frequently subjected to drought for periods of time varying from a few hours up to several weeks.

Therefore, in the studies reported here, an evaluation was made of the effect of available moisture upon evapotranspiration.

Available moisture was determined for the principal root zone for each crop from selected neutron probe soil moisture data. In the case of the alfalfa, a perennial crop, a single zone from 0-12 feet was used for the entire study. For cotton, an annual crop, the zone was increased from the 0-1-foot depth to the 0-11-foot depth as the crop grew and the root system developed and expanded. The results of the evaluations are discussed further under the sections on crop coefficients.

Other Factors Affecting Evapotranspiration

Soil fertility and other physical factors of the soil, such as texture, structure, salinity, and even color, affect the growth rate of a crop. Soil properties, such as texture, structure, and salinity may also affect, to some degree, moisture movement and utilization. These factors have an undetermined, and probably much lesser, effect on evapotranspiration than drought, climate, and plant conditions.

Determination of Coefficients

Results of various research projects have indicated that the processes of evapotranspiration and evaporation are both responsive to the same factors. As will be discussed in ensuing

paragraphs, a definite relationship exists between evapotranspiration and rates of evaporation from pans or atmometers. This relationship is considered fundamental to estimating evapotranspiration for other crops and in other agricultural areas throughout the State.

The ratio of evapotranspiration (ET) to evaporation from an evaporation pan (Ep) is referred to as a "pan coefficient" (ET/Ep); in like manner, the ratio of evapotranspiration to net atmometer evaporation, or the difference of evaporation from a black and white Livingston Spherical Atmometer (Eb-w), is referred to as the "atmometer coefficient" (ET/eb-w).

Pan and/or atmometer coefficients for individual evapotranspiration measurement periods for the various plots sampled are shown in Appendix A in Tables A-6 and A-7. A casual examination of these individual periods reveals wide variations which would appear to discount the validity of such comparisons. However, a more detailed analysis of the data indicates that certain relationships do exist, and upon such relationships tentative values can be established. Certain variations of the pan and atmometer coefficients from time to time are caused by plants responding differently to evaporation influences than do pans and atmometers. Likewise, variations in the coefficients were due also to individual differences in the response of atmometers or pans to these climatic influences.

Analysis of data for each individual crop and the conclusions drawn therefrom are discussed in the following paragraphs

Grass and Pasture Coefficients

Pan and atmometer coefficients have been determined using data from grass and grass-pasture evapotranspirometer tanks located in the Sacramento River Basin mountain valleys, in the Lassen-Alpine mountain area, and in the Sacramento Valley floor (Alturas, Coleville, and Davis).

Graphs of coefficients and percent of ground cover for pasture and grass, plotted against time, are presented in Figures A through E of Plate 4, entitled "Variation of Pan and Atmometer Coefficients for Individual Periods of Measurements." Percent of ground cover is relatively constant for those crops, and wide variations of the coefficients occur less than with alfalfa and cotton. During the growing period, the grass was at nearly 100 percent ground cover in all of the evapotranspirometer tanks, as mowings did not clip the foliage short enough to cause large reductions in ground cover. While the ground was always sod-covered, the colder climate at the mountain sites caused dormancy to some degree during late fall, winter, and early spring. Approximate ground cover percentages indicated on Figures A, B, and E of Plate 4 are for the green and actively growing fraction of the foliage. At Davis, the climate is not cold enough to force the grass completely into winter dormancy. Occasionally at the Davis site, however, small areas of ground surface were exposed throughout the year, as indicated on Plate 4, Figures C and D.

High water table conditions, typical of the predominant irrigation practice in the mountain valleys, were maintained in the Alturas and Coleville tanks. There was, therefore, no

moisture shortage at these sites. The evapotranspirometer tanks and ryegrass field at Davis were frequently irrigated, and it is probable that soil moisture was not limiting there. Availability of soil moisture is assumed to have had little effect on evapotranspiration rates and coefficients at any of the three sites.

Seasonal accumulated evapotranspiration plotted against accumulated pan evaporation and, except for Davis, accumulated atmometer evaporation are shown on Plate 5, entitled "Comparison of Pan and Atmometer Coefficients for Cotton, Alfalfa, and Grass," Figures E and F. Each curve is for an individual year, and has separate zero lines for plotting evapotranspiration. Evaporation from pans or atmometers was plotted using the date of June 30 as the common point on all curves. Coefficients for the period of record for both years were consistently similar for Alturas for both pan and atmometer. The pan coefficient for the period of record at Davis was likewise similar.

Coefficients from three seasons of record in the mountain areas, combining Alturas and Coleville, are compared with coefficients from Davis in Table 6. Coefficients are shown for both the growing seasons assumed in Bulletin No. 2 and for the longer period for which data were obtained. The reason for the differences between the valley and mountain coefficients has not been ascertained.

Alfalfa Coefficients

Pan and atmometer coefficients have been determined from an alfalfa plot located near Pittville in the Sacramento River Basin mountain valleys, and from an alfalfa plot near Arvin in the Tulare Lake Basin Valley floor at the southern end of the Central Valley

TABLE 6

PAN AND ATMOMETER COEFFICIENTS FOR PASTURE AND GRASS

Month	Pan Coefficients				Atmometer Coefficients			
	Sacramento River Basin Valley Floor (Davis Campbell 1959 & 1960)		Mountain Valleys 1/ (Alturas Dorris Ranch 1959 & 1960 Coleville 1957)		Sacramento River Basin Valley Floor (Davis Campbell 1959 & 1960)		Mountain Valleys 1/ (Alturas Dorris Ranch 1959 & 1960 Coleville 1957)	
	No. Days of Record	ET/Ep*	No. Days of Record	ET/Ep	No. Days of Record	ET/Eb-w*	No. Days of Record	ET/Eb-w
January	63	0.64	--	--	--	--	--	--
February	52	0.75	--	--	--	--	--	--
March	67	0.72	--	--	--	--	--	--
April	44	0.74	46	0.81	11	0.0125	--	--
May	54	0.74	65	0.90	33	0.0132	--	--
June	7	0.75	74	1.00	--	--	62	0.0137
July	47	0.72	96	1.04	47	0.0127	96	0.0161
August	33	0.77	92	1.00	--	--	92	0.0160
September	29	0.68	83	0.90	29	0.0108	75	0.0120
October	31	0.64	64	0.87	31	0.0100	3	0.0109
November	33	0.51	10	0.45	10	0.0060	--	--
December	26	0.52	30	1.21	--	--	--	--
Average Coefficient for Growing Season 2/	245	0.72 a/	410	0.98 b/	151	0.0120 a/	325	0.0148 b/
Period of Record	486	0.71	560	0.96	161	0.0117	328	0.0148

1/ Mountain Valleys = Sacramento River Basin Mountain Valleys and Lassen-Alpine Mountain Valleys.
2/ For growing season periods used in Bulletin No. 2.
a/ April-October
b/ May-September
* ET/Ep = Pan Coefficient, ET/Eb-w = Atmometer Coefficient

One of the most notable details of the alfalfa coefficients determined from both areas is the variation associated with percentage of ground cover. It is important to point out that the method of collecting data on percentage of ground cover was subjective, being based upon personal judgment, and that estimates by individual observers differ by perhaps 5 to 15 percent. There is, however, general agreement that following mowing the ground cover is usually reduced to 5 to 10 percent, and that grour cover usually approaches 100 percent cover prior to mowing. Although there are exceptions due to possible experimental error and other factors, the coefficients are smaller when the ground cover is low following mowing, and become larger as the ground cover increases. Plate 4, Figures F, G, H, and I, illustrate these relationships between coefficients and percent of ground cover, plotted against time.

A more direct comparison of pan and atmometer coefficien with percent of ground cover is shown in Plate 6, entitled "Relationship Between Pan and Atmometer Coefficients for Alfalfa and Ground Cover." Figure A shows atmometer coefficients, and Figure shows pan coefficients. The data for both figures were the same utilized in Plate 4. As indicated in Plate 6, the Pittville coefficients appear to be higher than the Arvin coefficients. Two linear regression lines have been fitted to the data. However, it may be that additional data will indicate a somewhat curvilinear relation. It seems reasonable to assume that coefficients at 100 percent of ground cover would not be proportionally higher than coefficients at 80 percent of ground cover, which, for practical purposes, also provide nearly complete shade, except near noonday.

Since the soil at both plot sites was deep, and alfalfa is a perennial crop, moisture in the 0-12-foot zone was used to estimate available soil moisture.

The lowest moistures occurred at the Pittville plot, where on several occasions the available moisture was reduced to less than 2 inches in the 12 feet, or less than 0.2 inch of moisture per foot of soil, on the average. When this condition occurred, the upper portion of the profile was usually relatively drier than the deeper soil. On several of these occasions, crop growth at the Pittville plot was slow, and considerable flower blooms and dark blue-green leaf color associated with moisture deficiency appeared. As indicated on Figures F and G of Plate 4, low available soil moisture may account for some of the smaller coefficients noted prior to mowing. The Arvin plot, in contrast, was very well supplied with soil moisture. As shown on Figures H and I, the available moisture at Arvin ranged above 1 and up to 2 inches per foot during the measurement periods.

If evapotranspiration were reduced by low available soil moisture, the pan and atmometer coefficients would be smaller. This does not appear to be the case for the Pittville plot, although several of the coefficients just prior to mowing are smaller than would be expected, considering the percent of ground cover. Overall, the pan and atmometer coefficients of the Pittville data are as high, if not higher, than the Arvin coefficients, regardless of the lower soil moistures at Pittville.

Since coefficients from the Pittville and Arvin plots show monthly variations reflecting mowing schedules, farm practices,

and, perhaps, effects of plant growth environments, it is deemed best to compare seasonal rather than monthly coefficients.

Seasonal coefficients have been determined for periods when evapotranspiration measurements were made using data shown in Table 5, and are summarized here as follows:

Seasonal Alfalfa Coefficients Determined
From Measured Periods Only

	Pan Coefficient		Atmometer Coefficient	
	1959	1960	1959	1960
Pittville	nr	0.82	0.0125	0.0127
Arvin	0.69	0.70	0.0093	0.0093

In order to take into account the possibility that the sampling periods could be biased and not representative of ground cover conditions, and also to include estimated evaporation incre ments following irrigations, estimates of evapotranspiration were made for the irrigation periods. These estimates fill in the misi records. Seasonal coefficients determined from these data are su- marized as follows:

Seasonal Alfalfa Coefficients,
Including Estimated Data

	Pan Coefficient		Atmometer Coefficient	
	1959	1960	1959	1960
Pittville	nr	0.82	0.0123	0.0125
Arvin	0.69	0.69	0.0099	0.0095

The close similarity between the coefficients determine from the measured periods as compared with the total seasonal period of record, including estimated periods, indicates that the

measured periods are not biased, and the seasonal coefficients appear to be reasonable. Curves of seasonal accumulated evapotranspiration versus evaporation are shown on Plate 5, Figures C and D. As noted previously, each curve on Plate 5 is plotted for an individual year, with separate zero lines for indication of evapotranspiration. Evaporation from pan and atmometers was plotted, using the date of June 30 as the common point on all curves.

The pan and atmometer coefficients derived after combining the two years of record at the Pittville AA plot are shown in Table 7, and are compared with coefficients derived in the same manner at the Arvin CC plot. For purposes of comparison, average coefficients were determined not only for the period of record, but also for the growing season, as shown in Bulletin No. 2.

By any method of determining seasonal coefficients, the Pittville pan coefficient is approximately 17 percent higher than the Arvin coefficient, and the Pittville atmometer coefficient is approximately 27 percent higher than the Arvin coefficient. Whether the difference is due primarily to basic climatic differences between the two areas, which affect different plant and evaporation response, or due to experimental error, is not known at this time.

Cotton Coefficients

Pan and atmometer coefficients for cotton for each period of measurement during 1959 and 1960 are shown in Figures J and K of Plate 4. Also shown are estimates of the percent of ground cover, available moisture, and other factors affecting plant growth and water use. There is a rather close agreement between the two years

TABLE 7

PAN AND ATMOMETER COEFFICIENTS FOR ALFALFA

Month	Pan Coefficients				Atmometer Coefficients			
	Tulare Lake Basin Valley Floor (Arvin (CC) 1959 & 1960)		Sacramento River Basin Mountain Valleys (Pittville (AA) 1960 only)		Tulare Lake Basin Valley Floor (Arvin (CC) 1959 & 1960)		Sacramento River Basin Mountain Valleys (Pittville (AA) 1959 & 1960)	
	No. Days of Record	ET/Ep*	No. Days of Record	ET/Ep	No. Days of Record	ET/Eb-w*	No. Days of Record	ET/Eb-w
January	--	--	--	--	--	--	--	--
February	--	--	--	--	--	--	--	--
March	18	0.53	21	0.63	18	0.0065	--	--
April	30	0.64	30	0.61	30	0.0095	--	--
May	51	0.52	31	0.96	51	0.0088	19	0.0108
June	60	0.71	30	0.64	60	0.0109	60	0.0104
July	62	0.64	31	0.81	62	0.0101	62	0.0140
August	62	0.76	31	0.97	62	0.0112	62	0.0127
September	60	0.78	30	0.87	60	0.0098	60	0.0129
October	62	0.68	31	0.96	62	0.0074	--	--
November	47	0.88	8	0.89	17	0.0046	--	--
December	31	1.11	--	--	--	--	--	--
Average Coefficient for Growing Season 1/	295	0.68 a/	153	0.84 b/	387	0.0099 a/	263	0.0124 b/
Period of Record	483	0.69	243	0.82	422	0.0097	--	--

1/ For growing season periods used in Bulletin No. 2.
a/ April-October
b/ May-September
* ET/Ep = Pan Coefficient, ET/Eb-w = Atmometer Coefficient

in regard to the general pattern of plant growth and the relationships of the coefficient with the various factors affecting water use. The soil moisture observations are believed to be of reliable quality, particularly for the 1960 data, where a dry soil zone was maintained at depth below the root zone, assuring that no deep percolation of irrigation water occurred.

Coefficients for individual period of measurements show a pattern of progressive increase from the low early season value to a peak in July, and then a progressive decrease to the year's end. The differences in coefficients during the early season emphasized the direct relationship between the evapotranspiration and percent of ground cover. The decreasing pattern of coefficients after July reflects the integrated effect of decreasing ground cover, physiological aging of the plants, and availability of soil moisture.

It is of interest that, although ground cover on these plots reached 80 and 95 percent, the maximum coefficients were reached at a ground cover of about 60 percent. This corresponds in time to the boll setting. It is believed that physiological factors may have had an influence on the transpiration rate at this stage of plant development. Physiological factors are believed to have caused similar effects in other crops. With small grains, for example, peak water use rates are reported to occur at the heading stage.

Late-season use of water by cotton is dependent to some extent upon the amount of moisture available prior to natural or

induced defoliation. The plants will generally use all available moisture within the root zone. The amount of use is a function of the amount of moisture available. This is to say that the availability of soil moisture is often the limiting factor in the late-season evapotranspiration. This also may account, in part, for the August-September coefficients being lower than the July coefficient.

Early- or late-season precipitation, although a part of evapotranspiration and reflected in the pan and atmometer coefficients, is, quite often, not a beneficial source of moisture to the plants. Early-season precipitation is evaporated from the soil surface with little gainful effect upon plant growth. Late-season precipitation is either evaporated from the soil or vegetative surface, and/or transpired by the plant without contributing substantially to the plant cultural requirements. Thus, pan and atmometer coefficients for early and late season must be applied with caution and only after a thorough evaluation of rainfall amount, frequency and pattern, as well as knowledge of the late-season availability of soil moisture.

Based on the information summarized in Table 5, monthly pan and atmometer coefficients for the two years of record have been determined, and are shown on Figures A and B on Plate 5. There is, in general, rather close agreement between the monthly pan or atmometer coefficients for both 1959 and 1960. There are also several indications that evapotranspiration for cotton sometimes exceeds evaporation from pans. The July pan coefficients for 1959 and 1960 were respectively 1.07 and 1.08, which indicates that evapotranspiration exceeds evaporation from the free-water

surface. It is believed that the crop surface roughness may, through greater air mixing, be one of the influencing factors.

Average monthly pan and atmometer coefficients for cotton for the two years of record are presented in Table 8. For purposes of comparing with Bulletin 2 estimates, an average coefficient for the Tulare Lake Basin Valley Floor Hydrographic Units was determined for the growing season used in Bulletin 2. For the period from May through October, the active growing season, the average pan coefficient is 0.68, and the atmometer coefficient is 0.0098. The monthly coefficients for the period from June through September are considered to be primarily the effect of climatic evaporative demand and crop conditions, and are not subject to the influence of early-or late-season nonbeneficial uses.

Application of Coefficients and Evaporation Data to Estimation of Evapotranspiration

Using the average pan or atmometer evaporation observed in each area, as shown in Tables 2 and 3 in Chapter II, and applying the appropriate pan or atmometer coefficients as described in Tables 6, 7, and 8, estimates of monthly consumptive use values were made for several crops. These monthly estimates are summarized in Table 9, and are compared with values utilized in Bulletin 2, "Water Utilization and Requirements in California," published by the department in 1955. To make the comparison with Bulletin 2 values valid, the growing seasons used in Bulletin 2 were used in all calculations for Tables 6 through 9. In general, the estimates based upon the pan and atmometer coefficients are approximately equal to or greater than the Bulletin 2 values. This is also true where measured values of consumptive use are available. This, in

TABLE 8

PAN AND ATMOMETER COEFFICIENTS FOR COTTON

Month	Pan Coefficients: Tulare Lake Basin Valley Floor (Arvin (CD) 1959 Arvin (CF) 1960)		Atmometer Coefficients: Tulare Lake Basin Valley Flo (Arvin (CD) 1959 Arvin (CF) 1960)	
	No. Days of Record	ET/Ep*	No. Days of Record	ET/Eb-w*
January	--	--	--	--
February	--	--	--	--
March	8	0.75	--	--
April	30	0.14	30	0.0019
May	62	0.11	62	0.0018
June	60	0.67	60	0.0103
July	62	1.08	62	0.0170
August	62	0.99	62	0.0147
September	60	0.84	60	0.0106
October	62	0.46	62	0.0051
November	60	0.26	60	0.0023
December	62	0.15	--	--
Average Coefficient for Growing Season 1/	398	0.68 a/	398	0.0098 a/
Period of Record	--	--	--	--

1/ For growing season periods used in Bulletin No. 2, Tulare Lake Basin Valley Fo hydrographic units.

a/ April-October

* ET/Ep = Pan Coefficient, ET/Eb-w = Atmometer Coefficient

COMPARISON OF SEASONAL CONSUMPTIVE USE
OF ALFALFA, PASTURE, AND COTTON
BASED ON BULLETIN NO. 2 GROWING SEASON

(in inches)

Area	Alfalfa				Pasture-Grass				Cotton			
	Based on Pan Data	Based on Atmometer Data	Bull. #2	Measurement	Based on Pan Data	Based on Atmometer Data	Bull. #2	Measurement	Based on Pan Data	Based on Atmometer Data	Bull. #2	Measurement
Klamath-Trinity Mountain Valleys	34.77	32.66	27.41	--	40.56	38.98	27.41	--	--	--	--	--
Sacramento River Basin Mountain Valleys	31.71	31.93	25.15	35.11	37.00	38.11	25.15	37.79	--	--	--	--
Sacramento River Basin Foothills	28.44* 35.13**	27.94 33.64	29.65 29.65	-- --	29.69* 40.98**	30.66* 40.15**	29.65 29.65	-- --	-- --	-- --	-- --	-- --
Sacramento River Basin Valley Floor	37.50	34.40	36.48	--	39.70	39.96	36.48	45.11	--	--	--	--
San Joaquin River Basin Valley Floor	38.79	34.61	35.84	--	41.08	40.19	35.84	--	36.49	31.28	23.43	--
Tulare Lake Basin Valley Floor	35.35	34.45	37.14	35.87	37.42	40.03	37.14	--	33.43	32.24	28.78	33.94
Lassen-Alpine Mountain Valleys	35.98	32.00	27.24	--	41.98	38.20	27.24	--	--	--	--	--

* Calculated using valley coefficient.
** Calculated using mountain coefficient.

itself, does not prove that the estimates based upon pan and atmometer coefficients are more accurate. Additional supporting data shall be required to confirm this possibility.

Examination of the data in Table 9 indicates that estimates of consumptive use can be made with equal confidence, on the basis of either pan or atmometer data. It should be emphasized also that the consumptive use values must be determined for the actual period of active plant growth. The actual growing season for most crops in the various areas of the State still remains to be determined. Furthermore, a careful analysis of precipitation pattern, frequency, and amounts must be made for both growing and nongrowing seasons, to determine the effectiveness of this moisture source toward meeting the water demand of the various crops.

CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents a concise summary of the vegetative water use studies, the conclusions drawn therefrom, and recommendations with regard to the future lines of study.

Summary

Precise knowledge of the total seasonal as well as the distribution pattern of water use throughout the year is basic to the planning, design, and operation of comprehensive water development projects. In developing this essential knowledge, the department has been engaged in studies directed toward determination of evapotranspiration. During the period from 1954 to 1960, these studies were limited to certain geographic regions of northern and central California.

Accurate measurement of evapotranspiration is so complex and costly that practical considerations limit collection of these data to relatively few locations. Recent research work by various groups throughout the world has pointed out certain fundamental relationships between the evapotranspiration process and climatic factors. Transpiring crops respond to the same energy sources as evaporation devices. The response of crops, however, is modified by physical and physiological characteristics. Under any given climatic condition, factors such as availability of soil moisture, percent of vegetative ground cover, and physiological development control the rate of evapotranspiration.

The approach taken in these studies has been to study at a few locations the relationship between measured evapotranspiration, under specified crop conditions, and certain climatic indices. Concurrently with the measurement and correlation of evapotranspiration and climatic factors, a network of agroclimatic stations was established and observed throughout the several major inland agricultural areas in northern and central California Having determined evaporation at these stations, estimates of evapotranspiration can be extrapolated into these areas by using the relationship between evapotranspiration and evaporation data measured at the key evapotranspiration stations.

In the early years of these studies, available knowledge on climatic station environmental requirements was very meager. However, as data were collected and analyzed, the importance of certain environmental effects became apparent. Stations were relocated to sites where they were surrounded by an extensive area of vigorous, low-growing vegetation at full ground cover. Large, well-managed pastures best meet these requirements. At such sites, the confounding effects of microenvironment differences are minimized.

The techniques used for the determination of evapotranspiration were the best available methods for the task, at the time they were employed However, as the study progressed, techniques were modified to take advantage of new and better tools as they became available. The initial soil moisture measurements to determine evapotranspiration were made by the

gravimetric technique. The development and refinement of the neutron scattering technique offered promise of a far superior method of making soil moisture determinations. For this reason, this new equipment was adopted shortly after it became commercially available.

Small evapotranspirometer tanks of various designs were installed and used where high-water table conditions prohibited the use of soil moisture depletion techniques, and were later installed on sites where no high water tables existed. The success of these devices has encouraged the extension of this method to other close growing crops.

Estimates of evapotranspiration were made for all areas studied, using pan and atmometer coefficients and evaporation data collected as part of the agroclimatic program. These estimates were compared to Bulletin 2 consumptive use values, using the Bulletin 2 growing seasons. In many cases, the estimates obtained by using the evaporation correlation technique were higher than were the Bulletin 2 values.

Data collected at the evapotranspiration field plots indicate that the actual periods of active growth are considerably longer than those assumed in the determination of Bulletin 2 values. On a yearly basis, the estimates shown in this report may show even a greater variance with Bulletin 2 values.

As the estimated values presented in this report are based upon only two years of record, they should be used with considerable caution. However, the evaporation correlation

technique appears to promise a reasonable means of estimating, with precision heretofore unknown, evapotranspiration rates fo crops in the various geographic areas of California.

Conclusions

1. Correlation of evaporation with evapotranspirati appears to promise a reasonable means of estimating evapotranspiration within the various agricultural area of the State.

2. Reasonable estimates may be obtained by using either pan, or atmometer coefficients.

3. Pan and atmometer coefficients are strongly influenced by percent of ground cover, particularly for ground cover percentage less than (60%) sixty percent.

4. Estimated values presented in this report are based upon only two years of record, and so should be used with considerable judgment.

5. On the basis of the agroclimatic data collected, no definite segregation of the State into areas of uniform evaporation is possible at present. Inland areas appear to ha more uniform evaporation rates than expected, although effect of microenvironment cause large differences of evaporation between individual measurement sites.

6. It may be found that the length of growing seaso is the most important factor affecting seasonal evapotranspiration in inland areas.

Recommendations

On the basis of the collection and analysis of the data on vegetative water use, as presented in this report, and on the conclusions drawn therefrom, it is recommended that:

1. The evapotranspiration studies at the present sites be continued until sufficient data can be collected to provide reasonable estimates of evapotranspiration under the range of climatic conditions which can occur at these locations.

2. Additional sites for evapotranspiration measurements be established in locations having different climatic conditions than those now being measured to determine variability of evapotranspiration coefficients (i.e., Delta area, coastal areas, and desert areas).

3. The scope of the present program be expanded to include measurements of applied water under different irrigation practices and lengths of growing seasons for major crops within the various agricultural zones of the State. This would provide the basic information needed to determine irrigation efficiencies, drainage requirements, and, with the unit evapotranspiration values, to determine total irrigation water requirements.

APPENDIX A

Supplemental Agroclimatic and Evapotranspiration Data

TABLE OF CONTENTS

TABLE A-1

AGROCLIMATIC STATIONS,
LOCATION AND GENERAL INFORMATION

Area, environment, and station name	Location: MDB&M			County	Description	Elevation, in feet	Observer[2]	Evaporation equipment: Pan	Evaporation equipment: Atmometers	Irrigation method
KLAMATH, TRINITY MOUNTAIN VALLEYS					NORTH COASTAL					
Pasture										
Montague 3NE	T45N	R6W	13B1	Siskiyou	3 mi. NE of Montague	2600	DWR	x	x	Surface
Alfalfa										
Callahan Towne Ranch	T41N	R9W	24K1	Siskiyou	5 mi. N of Callahan	2891	DWR	-	x	Surface
Gazelle 3NNW	T43N	R6W	21H1	Siskiyou	3 mi. NNW of Gazelle	2720	DWR	-	x	Sprinkler
Grenada 6E	T44N	R5W	34B1	Siskiyou	6 mi. E of Grenada	2640	DWR	-	x	Surface
Dryland										
Fort Jones R. S.	T43N	R9W	2C1	Siskiyou	Town of Fort Jones	2720	USFS	x	x	--
Gazelle 1NNE	T43N	R6W	35E1	Siskiyou	1 mi. NNE of Gazelle	2720	DWR	-	x	--
Hayfork R. S.	T31N	R12W	12R1	Trinity	1 mi. E of Hayfork	2346	USFS	-	x	--
Macdoel F. S.	T46N	R1W	17C1	Siskiyou	Town of Macdoel	2718	CDF	-	x	--
Yreka 1NE	T45N	R7W	23M1	Siskiyou	1 mi. NE of Yreka	2625	DWR	x	x	--
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS					CENTRAL VALLEY					
Pasture										
Alturas Dorris Ranch	T42N	R13E	19L1	Modoc	2 mi. SE of Alturas	4450	DWR	x	x	Surface
Fall River Mills 4NW	T37N	R4E	10N1	Shasta	4 mi. NW of Fall River Mills	3500	DWR	x	x	Sprinkler
Glenburn DWR	T37N	R4E	10J1	Shasta	½ mi. SSE of Glenburn	3500	DWR	x	x	Surface
Hat Creek 3N	T34N	R4E	11D1	Shasta	3 mi. N of Hat Creek	3350	DWR	-	x	Surface
Likely Williams Ranch	T40N,	R13E	31E1	Modoc	3 mi. W of Likely	4400	DWR	-	x	Surface
Lookout Hunt	T39N	R7E	35P1	Lassen	3 mi. S of Lookout	4200	DWR	x	x	Surface

TABLE A-1 (continued)

AGROCLIMATIC STATIONS,
LOCATION AND GENERAL INFORMATION

Area, environment, and station name	Location: MDB&M			County	Description	Elevation, in feet	Observer[a]	Evaporation equipment: Pan	Atmometers	Irrigation method
CENTRAL VALLEY (continued)										
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)										
Alfalfa										
Bieber 4E	T38N	R8E	17K1	Lassen	4 mi. E of Bieber	4200	DWR	-	x	Sprinkler
Canby 11SW	T41N	R8E	27C1	Modoc	11 mi. SW of Canby	4500	DWR	x	x	Surface
Hat Creek 3SE	T33N	R4E	1K1	Shasta	3 mi. SE of Hat Creek	3660	DWR	-	x	Surface
Lookout 1S	T39N	R7E	26D1	Lassen	1 mi. S of Lookout	4200	DWR	x	x	Surface
McArthur 2E	T37N	R5E	11Q1	Shasta	2 mi. E of McArthur	3325	DWR	x	x	Surface
Pittville 1S	T37N	R5E	13R1	Shasta	1 mi. S of Pittville	3300	DWR	x	x	Sprinkler
Dryland										
Adin Harper	T39N	R9E	10Q1	Modoc	2 mi. NE of Adin	4200	DWR	x	x	--
Alturas Park Avenue	T42N	R13E	14B1	Modoc	Town of Alturas	4440	DWR	-	x	--
Bieber S.C.S.	T38N	R7E	23D1	Lassen	Town of Bieber	4169	USDA	-	x	--
Big Sage Reservoir	T43N	R11E	11C1	Modoc	South side of reservoir	4400	DWR	x	x	--
Canby Ohm	T42N	R9E	35R1	Modoc	1 mi. W of Canby	4310	DWR	-	x	--
Canby R. S.	T42N	R10E	30N1	Modoc	Town of Canby	4310	USFS	-	x	--
Davis Creek 4WNW	T45N	R13E	22R1	Modoc	4 mi. WNW of Davis Creek	5000	DWR	x	x	--
Fall River Mills Intake	T37N	R4E	25M1	Shasta	1 mi. NW of Fall River Mills	3325	PG&E	-	x	--
Fall River Mills R.S.	T37N	R5E	30Q1	Shasta	Town of Fall River Mills	3325	USFS	-	x	--
Likely 4N	T40N	R13E	30H1	Modoc	4 mi. N of Likely	4400	DWR	-	x	--
Loyalton 5W	T22N	R15E	6Q1	Sierra	5 mi. W of Loyalton	4880	DWR	-	x	--
Loyalton 7N	T22N	R15E	11G1	Plumas	7 mi. N of Loyalton	4880	DWR	-	x	--
Mt. Shasta City W.B.	T32N	R4W	16H1	Siskiyou	Town of Mt. Shasta	3554	USFS	-	x	--
Quincy R.S.	T24N	R9E	14P1	Plumas	Town of Quincy	3442	USFS	-	x	--
West Valley Reservoir	T39N	R14E	19Q1	Modoc	7 mi. E of Likely	5500	DWR	x	x	--
Miscellaneous										
Adin R.S.	T39N	R9E	28D1	Modoc	Town of Adin	4200	USFS	-	x	--

TABLE A-1 (continued)

AGROCLIMATIC STATIONS,
LOCATION AND GENERAL INFORMATION

Area, environment, and station name	Location: MDB&M			County	Description	Elevation in feet	Observer[a]	Evaporation equipment: Pan	Evaporation equipment: Atmometers	Irrigation method
SACRAMENTO RIVER BASIN FOOTHILLS					CENTRAL VALLEY (continued)					
Pasture										
Auburn Mt. Vernon	T13N	R7E	25E1	Placer	7 mi. NW of Auburn	1085	DWR	-	x	Sprinkler
Gold Hill Doty Flat	T12N	R7E	12D1	Placer	2 mi. NW of Newcastle	730	DWR	x	x	Surface
Loma Rica	T17N	R5E	34J1	Yuba	3½ mi. NE of Browns Valley	439	DWR	x	x	Surface
Penn Valley	T16N	R7E	28H1	Nevada	6 mi. E of Smartville	1388	DWR	x	x	Surface
Dryland										
Bella Vista 4NE	T33N	R3W	27E1	Shasta	4 mi. NE of Bella Vista	960	CDF	x	x	Surface
Browns Valley 3NE	T16N	R5E	12H1	Yuba	3 mi. NE of Browns Valley	388	DWR	x	-	--
Newville	T22N	R6W	2E1	Glenn	1 mi. E of Newville	650	DWR	x	x	--
SACRAMENTO RIVER BASIN VALLEY FLOOR										
SACRAMENTO RIVER BASIN VALLEY FLOOR										
Pasture										
Anderson 4E	T30N	R3W	17F1	Shasta	4 mi. E of Anderson	390	DWR	x	x	Surface
Corning 3NE	T24N	R3W	12L1	Tehama	3 mi. NE of Corning	240	DWR	x	x	Surface
Davis Campbell #1	T8N	R2E	17K1	Yolo	Univ. of Calif. farm	50	DWR	-	x	Surface
Elk Grove 4NW	T7N	R5E	28E1	Sacramento	4 mi. NW of Elk Grove	23	DWR	x	x	Surface
Lincoln Vineyard	T13N	R6E	26G1	Placer	5 mi. N of Lincoln	270	DWR	x	x	Surface
Palermo 3SW	T18N	R4E	19D1	Butte	3 mi. SW of Palermo	169	DWR	x	x	Surface
Red Bluff Cone Ranch	T27N	R2W	30D1	Tehama	5 mi. E of Red Bluff	275	DWR	x	x	Surface
Yuba City 9W	T15N	R2E	21R1	Sutter	9 mi. W of Yuba City	42	DWR	x	x	Surface
Alfalfa										
Anderson 2E	T30N	R3W	18G1	Shasta	2 mi. E of Anderson	390	DWR	-	x	Surface
Anderson 3E	T30N	R3W	17M1	Shasta	3½ mi. E of Anderson	390	DWR	-	x	Surface
Arbuckle 1S	T13N	R2W	11E1	Colusa	1 mi. S of Arbuckle	191	DWR	-	x	Sprinkler
Corning Jobe	T24N	R3W	20D1	Tehama	2 mi. W of Corning	307	DWR	-	x	Surface

TABLE A-1 (continued)

AGROCLIMATIC STATIONS,
LOCATION AND GENERAL INFORMATION

Area, environment, and station name	Location: MDB&M			Location: County	Location: Description	Elevation, in feet	Observer[a]	Evaporation equipment: Pan	Evaporation equipment: Atmometers	Irrigation method
CENTRAL VALLEY (continued)										
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)										
Alfalfa (continued)										
Hamilton City	T22N	R1E	20N1	Glenn	1 mi. N of Hamilton City	150	DWR	-	x	Surface
Red Bluff 3E	T27N	R3W	23J1	Tehama	3 mi. E of Red Bluff	270	DWR	x	x	Surface
Rocklin Igarashi	T11N	R7E	29C1	Placer	1 mi. SE of Rocklin	310	DWR	-	x	Sprinkler
Vina Beck	T24N	R2W	23Q1	Tehama	2 mi. S of Vina	188	DWR	-	x	Surface
Yuba City	T15N	R2E	22D1	Sutter	9 mi. W of Yuba City	46	DWR	-	x	Surface
Dryland										
Davis Campbell #2	T8N	R2E	17K1	Yolo	Univ. of Calif. farm	50	DWR	-	x	--
Mills Orchard	T22N	R3W	26F1	Glenn	2 mi. W of Hamilton City	175	DWR	-	x	--
Oroville Agric. Comm.	T19N	R4E	6N1	Butte	1 mi. NW of Oroville	270	DWR	x	x	--
Redding 6SE	T31N	R4W	15Q1	Shasta	6 mi. SE of Redding	515	DWR	-	x	--
Redding Stayer	T31N	R4W	15K1	Shasta	6 mi. SE of Redding	510	DWR	x	x	--
Sacramento Refuge	T18N	R3W	10F1	Glenn	6 mi. S of Willows	96	DWR	x	x	--
Miscellaneous										
Corning 3NW	T24N	R3W	8K1	Tehama	3 mi. NW of Corning	307	DWR	-	x	--
Live Oak 3SE	T16N	R3E	10R1	Yuba	3 mi. SE of Live Oak	70	DWR	-	x	Surface
Pennington 3NW	T17N	R1E	15K1	Butte	3 mi. NW of Pennington	60	DWR	x	x	Marsh
Redding A.P.	T31N	R4W	27K1	Shasta	7 mi. SE of Redding	500	CAA	-	x	Sprinkler
Redding R.S.	T31N	R5W	10D1	Shasta	Town of Redding	500	CDF	-	x	Sprinkler
Richvale 1E	T19N	R2E	23D1	Butte	1 mi. E of Richvale	105	DWR	-	x	--
SAN JOAQUIN RIVER BASIN VALLEY FLOOR										
Pasture										
Berenda 2N	T10S	R17E	8P1	Madera	2 mi. N of Berenda	270	DWR	x	x	Surface
El Solyo Ranch	T4S	R7E	5J1	Stanislaus	4 mi. SE of Vernalis	35	DWR	x	x	Surface

TABLE A-1 (continued)

AGROCLIMATIC STATIONS,
LOCATION AND GENERAL INFORMATION

Area, environment, and station name	Location: MDB&M			County	Description	Elevation, in feet	Observer[a]	Evaporation equipment: Pan	Evaporation equipment: Atmometers	Irrigation method
CENTRAL VALLEY (continued)										
SAN JOAQUIN RIVER BASIN VALLEY FLOOR (continued)										
Pasture (continued)										
Lodi 3SW	T3N	R6E	27B1	San Joaquin	3 mi. SW of Lodi	29	DWR	x	x	Surface
Merced 5SE	T8S	R15E	6E1	Merced	5 mi. SE of Merced	198	DWR	x	x	Surface
Newman 1SE	T7S	R9E	29B1	Merced	1 mi. SE of Newman	87	DWR	x	x	Surface
Stockton 9S	T1S	R7E	19H1	San Joaquin	9 mi. S of Stockton	27	DWR	x	x	Surface
Thornton 2S	T4N	R5E	15H1	San Joaquin	2 mi. S of Thornton	7	DWR	x	x	Surface
Alfalfa										
Atwater 1N	T7S	R12E	35P1	Merced	1 mi. N of Atwater	150	DWR	-	x	Sprinkler
Ceres 3E	T4S	R10E	7J1	Stanislaus	3 mi. E of Ceres	104	DWR	x	x	Surface
Lodi 3S	T3N	R7E	30Q1	San Joaquin	3 mi. S of Lodi	41	DWR	x	x	Surface
Los Banos 3S	T10S	R10E	33P1	Merced	3 mi. S of Los Banos	161	USDA	-	x	Surface
Los Banos 8SE	T11S	R11E	19K1	Merced	8 mi. SE of Los Banos	140	USDA	-	x	Surface
Stockton 8S	T1S	R7E	39E1	San Joaquin	8 mi. S of Stockton	25	DWR	-	x	Surface
Vernalis 3SE	T4S	R7E	5J1	Stanislaus	3 mi. SE of Vernalis	69	DWR	x	x	Surface
Miscellaneous										
Los Banos Equipment Yard	T10S	R10E	32K1	Merced	6 mi. SW of Los Banos	160	USBR	x	x	--
Twitchell Island	T3N	R3E	16K1	Sacramento	6 mi. SE of Rio Vista	10	DWR	x	-	--
TULARE LAKE BASIN VALLEY FLOOR										
Pasture										
Arvin Frick	T31S	R29E	16F1	Kern	4 mi. NW of Arvin	437	DWR	x	x	Surface
Kerman 2ESE	T14S	R18E	17H1	Fresno	2 mi. ESE of Kerman	225	DWR	x	x	Surface
Kingsburg 5S #2	T17S	R22E	16H1	Kings	5 mi. SW of Kingsburg	277	DWR	x	x	Surface
Alfalfa										
Arvin Jewett #1	T31S	R29E	16H1	Kern	2½ mi. NW of Arvin	448	DWR	x	x	Surface
Arvin Jewett #2	T31S	R29E	16G1	Kern	2⅔ mi. NW of Arvin	440	DWR	x	x	Surface
Fresno Kearney Park	T14S	R19E	19K1	Fresno	2 mi. SW of Kearney Park	238	DWR	-	x	Surface
Kingsburg 5S #1	T17S	R22#	15N1	Kings	5 mi. SW of Kingsburg	276	DWR	x	-	Surface
Mendota Murietta Ranch	R15S	R14E	4N1	Fresno	6 mi. SW of Mendota	253	MFC	-	x	Surface
Shafter 2NW	T27S	R25E	32J1	Kern	2 mi. NW of Shafter	353	DWR	x	x	Surface

TABLE A-1 (continued)

AGROCLIMATIC STATIONS,
LOCATION AND GENERAL INFORMATION

Area, environment, and station name	Location: MDB&M			County	Description	Elevation, in feet	Observer a/	Evaporation equipment: Pan	Evaporation equipment: Atmometers	Irrigation method
					CENTRAL VALLEY (continued)					
TULARE LAKE BASIN VALLEY FLOOR (continued)										
Dryland										
Panoche Junction	T16S	R14E	16P1	Fresno	15 mi. SSW of Mendota	500	DWR	x	x	--
					LAHONTAN					
LASSEN-ALPINE MOUNTAIN VALLEYS										
Pasture										
Cedarville 2E	T42N	R16E	10B1	Modoc	2 mi. E of Cedarville	4670	DWR	x	x	Subsurface
Coleville 2W	T8N	R22E	3K1	Mono	2 mi. W of Coleville	5120	DWR	x	x	Subsurface
Standish 4NW	T29N	R13E	11N1	Lassen	4 mi. NW of Standish	4100	DWR	x	x	Subsurface
Alfalfa										
Cedarville 1E	T42N	R16E	4P1	Modoc	1 mi. E of Cedarville	4670	DWR	-	x	Sprinkler
Standish 1NW	T29N	R14E	18R1	Lassen	1 mi. NW of Standish	4060	DWR	-	x	Surface
Dryland										
Bridgeport DWR	T5N	R25E	33D1	Mono	Town of Bridgeport	6465	DWR	-	x	--
Eagle Lake Stone Ranch	T32N	R12E	5N1	Shasta	22 mi. NW of Susanville	5120	DWR	x	-	--
Cedarville Chevron	T42N	R16E	5Q1	Modoc	Town of Cedarville	4670	DWR	-	x	--
Leavitt Lake	T29N	R13E	16N1	Lassen	10 mi. SE of Susanville	4112	PC	-	x	--
Madeline 3SW	T37N	R13E	19Q1	Lassen	3 mi. SW of Madeline	5400	DFG	-	x	--
Termo	T35N	R13E	25M1	Lassen	Town of Termo	5290	DWR	-	x	--
Woodfords	T11W	R20E	35D1	Alpine	Town of Woodfords	5526	DWR	-	x	--
Miscellaneous										
Tahoe	T15N	R17E	7R1	Placer	1 mi. S of Truckee Dam	5818	DWR	-	x	--

a/ CAA - Civil Aeronautics Administration
CDF - California Division of Forestry
CSR - City of Santa Rosa
DFG - California Department of Fish and Game
DWR - California Department of Water Resources
MFC - Murietta Farms Company
PC - Private Cooperator
PG&E - Pacific Gas and Electric Company
UC - University of California
USBR - United States Bureau of Reclamation
USDA - United States Department of Agriculture
USFS - United States Forestry Service

TABLE A-2

MONTHLY EVAPORATION FROM STANDARD
U. S. WEATHER BUREAU EVAPORATION PANS
(in inches)

Area, environment, and station name	Year of record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	May-Sept. total
						NORTH COASTAL								
KLAMATH, TRINITY MOUNTAIN VALLEYS														
Pasture														
Montague 3NE	1959				5.34	8.09	8.74	12.50	8.56	6.30				44.19
Montague 3NE	1960				3.82	5.81	8.79	9.62	8.33	6.07				38.62
Dryland														
Fort Jones R. S.	1955					5.46	10.10	10.89	10.38	3.79				40.62
Yreka 1NE	1955					4.71	11.13	11.23	12.36	6.18	2.35			45.61
						CENTRAL VALLEY								
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS														
Pasture														
Alturas Dorris Ranch	1957						7.16	6.72	7.69	5.73				
Alturas Dorris Ranch	1958						5.56	7.23	8.39	5.26				
Alturas Dorris Ranch	1959		1.83	3.39	5.54	6.09	7.94	9.83	8.65	5.51	3.99	1.72		38.02
Alturas Dorris Ranch	1960		1.40	2.58	4.53	5.90	8.00	8.82	8.31	5.86	3.71	1.13	0.35	36.89
Fall River Mills 4NW	1959	1.07	1.59		5.87	6.99			10.07	8.99	4.09	2.40		
Fall River Mills 4NW	1960		1.51	3.80	4.65	6.67								
Glenburn DWR	1960						8.69	10.40	9.20	5.35	3.97	1.74	0.58	
Lookout Hunt	1959				5.63	6.02	7.71	10.07		6.11	4.10	2.17		
Lookout Hunt	1960		1.08	3.22	4.37	5.32	8.76	9.67	9.15	6.00	3.71	0.82	0.74	38.90
	Mean		1.48	3.25	5.10	6.16	7.69	8.96	8.78	6.16	3.86	1.66	0.66	
Alfalfa														
Canby 11SW	1958								7.03	5.58				
Canby 11SW	1959					5.16	7.54	11.39	9.38	7.32	4.13	1.81		41.29
Lookout 1S	1959	1.46	1.89	3.78										
McArthur 2E	1956							9.53	7.75	6.07				
Pittville 1S	1956							9.55	7.80	4.20				
Pittville 1S	1957					4.82	8.51	6.39	8.49	6.08				34.75
Pittville 1S	1958						6.05	7.79	8.49	3.03				
	Mean						7.37	9.03	8.16	5.56				

TABLE A-2 (continued)

MONTHLY EVAPORATION FROM STANDARD
U. S. WEATHER BUREAU EVAPORATION PANS

(in inches)

Area, environment, and station name	Year of: record	Months: Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	May-Sept. total
CENTRAL VALLEY (continued)														
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)														
Dryland														
Adin Harper	1959		1.25	3.44	6.22	5.77	10.10	12.40	10.25	7.77	4.85	2.54		46.29
Adin Harper	1960		0.91											
Big Sage Reservoir	1959		1.08	2.62	6.29	5.69	9.19	12.54	10.70	6.68	3.44	1.92		44.80
Big Sage Reservoir	1960		1.09											
Davis Creek 4.NW	1959		1.83	3.46	6.24		9.63	10.82	11.91	7.10	4.87	1.93		
Davis Creek 4.NW	1960		1.02	2.46	5.18	7.12	10.95	12.10	10.98	8.23	4.55	1.06	0.34	49.38
West Valley Reservoir	1958										4.74			
West Valley Reservoir	1959				5.98	5.24	10.22	12.30	11.48	7.27	5.15	3.00		46.51
	Mean		1.20	2.99	5.98	5.95	10.02	12.03	11.06	7.41	4.60	2.09		
SACRAMENTO RIVER BASIN FOOTHILLS														
Pasture														
Gold Hill Doty Flat	1958											2.52	1.92	
Gold Hill Doty Flat	1959	1.49	2.36	4.25	5.80	6.93	9.[illegible]8	11.32	8.91	6.37	5.98	3.35	2.24	43.21
Gold Hill Doty Flat	1960	1.83	2.72	3.39	5.49	6.70	9.9	10.74	8.91	5.63	5.10	2.09	1.07	42.84
Loma Rica	1960									7.00	4.94	1.81	1.17	
Penn Valley	1958								10.19	5.14	4.30	1.77	1.51	
Penn Valley	1959	1.36		3.34	5.25	5.83	9.08	10.79	9.38	5.43	4.41	1.93	1.60	41.51
Penn Valley	1960	1.39	1.70	2.85	4.02	5.85	7.87	9.73	8.98	6.00	4.51	1.97	1.12	38.48
	Mean	1.52	2.29	3.56	5.19	6.30	9.15	10.66	9.27	6.44	5.00	2.20	1.52	
Dryland														
Bella Vista 4NE	1959			5.99	8.02	9.39	12.91	1[illegible].4	12.50	9.99	7.57	5.27	4.22	61.43
Bella Vista 4NE	1960			4.23	5.30	7.37	14.07	15.98	15.05	12.78	8.24	3.73	3.92	65.25
Browns Valley 3NE	1958								10.13	8.59	5.94	2.81	2.17	
Browns Valley 3NE	1959	1.38	2.32	4.54	6.96	8.99	12.77	14.35	12.11	9.09	5.99	3.14	2.21	57.31
Browns Valley 3NE	1960	1.47	2.53	3.27	5.61	7.94	12.11	13.40	12.05					
Newville	1959			4.84	7.72	10.65	13.99	15.16	12.42	10.73	8.03	5.46	3.23	62.95
Newville	1960	1.42	2.89	4.29	5.50	7.82	14.34	14.70	13.00	10.44	7.73	2.97	1.89	60.30
	Mean	1.42	2.75	4.60	6.52	8.69	13.36	15.04	12.46	10.27	7.42	3.89	2.94	

TABLE A-2 (continued)

MONTHLY EVAPORATION FROM STANDARD
U. S. WEATHER BUREAU EVAPORATION PANS

(in inches)

Area, environment, and station name	Year of record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	May-Sept. total
CENTRAL VALLEY (continued)														
SACRAMENTO RIVER BASIN VALLEY FLOOR														
Pasture														
Anderson 4E	1958								8.09	6.23	4.01	1.65		
Anderson 4E	1959		1.99	4.19	5.61	7.26	8.92	9.54	7.72	6.62	4.64	2.76	1.58	40.06
Anderson 4E	1960	0.91	2.31	3.77	4.68	6.49	9.31	9.58	8.70	6.15	3.91	1.65	1.32	40.23
Corning 3NE	1960	2.28	2.69	4.61	5.35	7.78	12.57	12.73	11.41	9.02	7.55	3.90	1.93	53.51
Elk Grove 4NW	1960	1.34	2.32	2.96.	4.94	6.90	9.15	9.35	7.56	5.69	4.39	1.75	0.79	38.65
Lincoln Vineyard	1958								8.79	6.88	5.31	2.86	2.15	
Lincoln Vineyard	1959	1.72	2.62	5.12	6.35	8.58	10.71	11.80	9.77	6.74	6.06	3.50	2.41	47.60
Lincoln Vineyard	1960	1.99	2.70	4.14	6.05	7.58	11.62	12.97	12.16	7.21	6.12	2.66	1.75	51.54
Palermo 3SW	1960	1.80	2.49	3.43	5.49	7.22	9.72	10.31	9.43	6.62	5.27	2.39	1.55	43.30
Red Bluff Cone Ranch	1959	1.88	2.18	5.07	6.23	6.91	10.10	10.81	8.72	8.32	5.54	3.34	2.23	44.86
Red Bluff Cone Ranch	1960	1.43	2.76	3.68	4.95	6.86	10.62	11.37	8.36	7.05	5.70	2.00	1.81	44.26
Yuba City 9W	1960	1.50	2.88	3.44	5.20	7.06	10.08	8.84	8.31	5.91	5.60	2.45	1.59	40.20
	Mean	1.65	2.49	4.04	5.48	7.26	10.28	10.73	9.18	6.87	5.34	2.58	1.74	
Alfalfa														
Red Bluff 3E	1958							7.06	8.48	6.49	5.10	2.11		
Dryland														
Oroville Agriculture Commission	1958										7.86	3.66		
Oroville Agriculture Commission	1959		3.00	5.41	7.48	9.87	13.41	14.72	12.32	9.84	8.43			60.16
Redding Stayer	1958									10.39	7.28	2.67		
Redding Stayer	1959	1.24	2.43	5.80	7.94	10.18	13.79	15.82	12.94	9.94	6.77	4.51	2.56	62.67
Redding Stayer	1960	1.42	2.67	4.21	5.46	8.16	14.93	15.95	14.38	10.54	7.26	1.91	1.46	63.96
Sacramento Refuge	1957								10.27	7.72				
Sacramento Refuge	1958				5.57	7.33	10.46	11.62	11.11	9.88	7.16	3.18		50.40
Sacramento Refuge	1959	1.35	1.82	5.34	7.52	9.80	14.25	13.24	10.29	8.74	6.72	3.83	2.15	56.32
Sacramento Refuge	1960	1.04	2.50	3.63	5.15	8.34	12.69	12.83	11.76	8.55	6.48	2.59	1.44	54.17
	Mean	1.26	2.48	4.88	6.52	8.95	13.25	14.03	11.87	9.45	7.24	3.19	1.90	
Miscellaneous														
Pennington 3NW	1960								5.82	3.62	3.91	1.90	1.22	

TABLE A-2 (continued)

MONTHLY EVAPORATION FROM STANDARD
U. S. WEATHER BUREAU EVAPORATION PANS
(in inches)

Area, environment, and station name	Year of record	Months												May-Sept. total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
CENTRAL VALLEY (continued)														
SAN JOAQUIN RIVER BASIN VALLEY FLOOR														
Pasture														
Berenda 2N	1960					9.06	10.31	10.74	9.49	6.43	4.46	1.43	0.74	46.03
El Solyo Ranch	1959		1.73	3.86	5.97	9.52	11.12	10.66	9.01	7.17	5.47	2.53	2.10	47.48
El Solyo Ranch	1960	1.67	2.76	4.14	6.17	9.02	10.34	9.15	8.55	6.43	4.94	1.79	1.09	43.49
Lodi 3SW	1959		1.84	4.50	5.99	8.21	10.10	9.84	8.22	6.41	4.98	2.33		42.78
Merced 5SE	1959		1.96	4.49	6.03	9.36	12.03	13.08	10.63	7.98	5.53	2.68	1.94	53.08
Merced 5SE	1960	1.76	2.02	4.22	6.10	9.59	11.29	12.12	10.65	8.05	4.95	1.69	0.98	51.70
Newman 1SE	1960						10.15	9.25	8.77	6.60	6.24	1.98	0.95	
Stockton 9S	1959				6.33	9.16	11.05	10.70	8.70	6.37	4.82	2.43	1.55	45.98
Stockton 9S	1960	1.84	2.48	4.34	6.40	8.56	10.32	10.42	8.84	6.18	5.66	2.07	1.06	44.32
Thornton 2S	1959												1.69	
Thornton 2S	1960	1.40	2.49	3.75	5.66	7.12	9.34	9.50	7.96	5.99	4.38	2.15	0.94	39.91
	Mean	1.67	2.18	4.19	6.08	8.84	10.60	10.55	9.08	6.76	5.14	1.92	1.30	
Alfalfa														
Ceres 3E	1957								6.50	5.89	3.14	1.77		
Ceres 3E	1958				6.83	6.22	8.57	8.60		6.71	3.79	2.35	1.23	37.19
Ceres 3E	1959		1.55	4.35	6.85	8.51	9.61	10.00	8.05	6.05	5.73	2.52	1.82	42.22
Ceres 3E	1960	1.78	2.35	3.64	6.52	8.38	8.77	8.93	6.30	4.92	4.03	1.37	0.91	37.30
Lodi 3S	1958										3.97	2.45	1.59	
Vernalis 3SE	1958					7.48	7.44	9.94	5.94	6.46	4.05	2.76	1.62	37.26
	Mean				6.73	7.65	8.60	9.37	6.78	6.01	4.22	2.20	1.43	
Miscellaneous														
Los Banos Equipment Yard	1959				9.00	12.27	16.11	15.61	12.59	9.79	6.68	3.08	1.96	66.37
Los Banos Equipment Yard	1960	1.16	2.16	4.78	7.96	11.99	16.47	16.29	14.04	9.75	5.22	1.90	0.84	68.54
Twitchell Island	1959										6.03	2.95	2.04	
Twitchell Island	1960	1.59	3.08	4.24	6.19	8.36	12.38	11.57	11.16	8.17	5.70	1.96	1.28	51.64

TABLE A-2 (continued)

MONTHLY EVAPORATION FROM STANDARD
U. S. WEATHER BUREAU EVAPORATION PANS

(in inches)

Area, environment, and station name	Year of record	Months: Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	May-Sept. total
CENTRAL VALLEY (continued)														
TULARE LAKE BASIN VALLEY FLOOR														
Pasture														
Arvin Frick	1959						9.06	9.95	8.67	5.93	4.49	2.69	1.68	
Arvin Frick	1960	1.96	2.24	4.30	5.82	8.72	9.98	9.39	8.09	6.13	4.08	1.89	1.08	42.31
Kerman 2ESE	1960					9.15	10.05	8.81	7.43	6.02	4.28	1.63	0.80	41.46
Kingsburg 5S No. 2	1958								8.56		4.25	1.88		
Kingsburg 5S No. 2	1959		2.14	4.17	5.37	8.39	9.93	9.26	7.57	5.74	4.31	2.16	1.38	40.89
Kingsburg 5S No. 2	1960	1.63	2.15	3.97	6.09	8.81	9.67	9.37	8.36	6.20	4.04	1.62	0.86	42.41
	Mean	1.79	2.18	4.15	5.76	8.77	9.74	9.36	8.11	6.00	4.24	1.98	1.16	
Alfalfa														
Arvin Jewett No. 1	1958					6.44	8.59	9.45	9.83	4.24	5.10			38.55
Arvin Jewett No. 2	1958											2.31	1.68	
Arvin Jewett No. 2	1959	1.84	2.51	4.53	7.00	8.69								
Kingsburg 5S No. 1	1957								5.06	4.60	2.48	1.21	0.78	
Shafter 2NW	1958								8.88	5.94	4.25	2.25		
	Mean								7.92	4.93	3.94	1.92		
Dryland														
Panoche Junction	1960			5.73			16.15	17.83	16.60		8.41	2.90	1.35	
LAHONTAN														
LASSEN, ALPINE MOUNTAIN VALLEYS														
Pasture														
Cedarville 2E	1958									5.93	4.14			
Cedarville 2E	1959					5.73		11.56	11.35	7.31	5.00	2.58		
Cedarville 2E	1960		2.16	3.17	5.46	6.57	9.01	12.01	10.33	7.76	4.82	1.60	0.86	45.68
Colcville 2W	1957						8.38	9.33	9.09	6.45	3.44			
Standish 4NW	1959					6.11	9.31	11.96	9.39	5.91				42.68
Standish 4NW	1960				5.38	6.81	8.95	10.00	8.89	7.75				42.40
	Mean					6.30	8.91	10.97	9.81	6.85	4.35			
Dryland														
Eagle Lake Stone Ranch	1960					7.26	10.99	10.40	11.03	8.66				48.34

TABLE A-3

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
(in milliliters)

Area, environment, and station name	Year of record	Months											May-September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
NORTH COASTAL														
KLAMATH, TRINITY MOUNTAIN VALLEYS														
Pasture														
Montague 3NE	1959					454	575	624	531	368				2,552
Montague 3NE	1960					450	621	634	559	452				2,716
Alfalfa														
Calahan Towne Ranch	1955						590	582	560					
Gazelle 3NNW	1955						528	507	510					
Grenada 6E	1955					392	533	584	547					
	Mean						550	558	539					
Dryland														
Fort Jones R. S.	1954							618	427	371				
Fort Jones R. S.	1955					320	525	566	528					
Gazalle 1NNE	1958					530	486	569	507	438				2,530
Gazalle 1NNE	1959				388	444	556	599	541	370				2,510
Gazalle 1NNE	1960					489	661	758	682	534				3,124
Hayfork R. S.	1954								466	350				
Hayfork R. S.	1955				226	462	486	493	473					
Hayfork R. S.	1956						513	630	611	416				
Hayfork R. S.	1957					432	566	582	567	466				2,613
Hayfork R. S.	1958					464	369	416	519	421				2,138
Hayfork R. S.	1959					428	537	607	513	398				2,483
Hayfork R. S.	1960						598	589	612					
Macdoel F. S.	1955							607	683					
Yreka 1NE	1954						398	560	491					
Yreka 1NE	1955						556	579	576	363				
	Mean					446	521	584	546	413				
CENTRAL VALLEY														
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS														
Pasture														
Alturas Dorris Ranch	1956								599					
Alturas Dorris Ranch	1957					380	544	607	538	387				2,456
Alturas Dorris Ranch	1958					476	471	535	501					
Alturas Dorris Ranch	1959						547	643	551					
Alturas Dorris Ranch	1960						562	560	501	422				

TABLE A-3 (continued)

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS

(in milliliters)

Area, environment, and station name	Year of record	Months												May - September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
CENTRAL VALLEY (continued)														
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)														
Pasture (continued)														
Fall River Mills 4NW	1958									384	386			
Fall River Mills 4NW	1959						577	596	503	374				
Glenburn DWR	1960						588	584	550	452				
Hatcreek 3N	1955					488	538	623	589	451				2,689
Likely Williams Ranch	1958					510	505	556	535					
Likely Williams Ranch	1959						584	663	545	401				
Lookout Hunt	1959						586	650	567	424				
Lookout Hunt	1960							584	561	458				
	Mean					463	550	600	545	417				
Alfalfa														
Bieber 4E	1956						576	666	586					
Canby 11SW	1958								477	385				
Canby 11SW	1959						523			387				
Hat Creek 3SE	1958						410	372	535					
Lookout 1S	1958					547	520	460	590					
McArthur 2E	1955								619	519				
McArthur 2E	1956					428	563	591	540	448				2,570
Pittville 1S	1956								535	428				
Pittville 1S	1957					484	626	634	549	457				2,750
Pittville 1S	1958						474	579	602	450				
Pittville 1S	1959						606	659	646	481				
	Mean					486	537	566	568	444				
Dryland														
Adin Harper	1958								536	402				
Adin Harper	1959									364				
Alturas Park Avenue	1955					423	474	571	538	380	288			2,386
Bieber S.C.S.	1955						598	633	633					
Big Sage Reservoir	1958									366				
Big Sage Reservoir	1959						464	573	458	360				
Canby Ohm	1958						499	571	546	450				
Canby Ohm	1959						514	530	463	357				
Canby R. S.	1955					432	546	575	569					
Davis Creek 4WNW	1958									411				

TABLE A-3 (continued)

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
(in milliliters)

Area, environment, and station name	Year of record	Months											May - September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
CENTRAL VALLEY (continued)														
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)														
Dryland (continued)														
Davis Creek 4WNW	1958						584	595	573	379				
Fall River Mills Intake	1956						512	575	497	512				
Fall River Mills Intake	1957					408	581							
Fall River Mills R. S.	1955						534	594	628	479	342			
Fall River Mills R. S.	1956						536	612	578	464				
Fall River Mills R. S.	1957					493	554	508	513	418				2,486
Likely 4N	1954							601	543	461				
Loyalton 5W	1954							616	519					
Loyalton 7N	1958					484	497	555	543					
Loyalton 7N	1959					578	612	479						
Loyalton 7N	1960						580	536						
Mt. Shasta City W.B.	1955						547	585	580	387	301			
Quincy R. S.	1954							560	507	469				
Quincy R. S.	1955							528	502	370				
West Valley Reservoir	1958									328				
West Valley Reservoir	1959						474	575	527	396				
	Mean					470	536	569	540	408	310			
Miscellaneous Lands														
Adin R. S.	1955					425	554	640	589	478	300			2,686
SACRAMENTO RIVER BASIN FOOTHILLS														
Pasture														
Auburn Mt. Vernon	1958						503	628	554	463	397			
Auburn Mt. Vernon	1959				482	485	562	589	532	457	402			2,625
Auburn Mt. Vernon	1960			302	433	492	602	614	532	454	350			2,694
Gold Hill Doty Flat	1958						544	642	575	466	391			
Gold Hill Doty Flat	1959				471	491	575	625	556	441	390			2,688
Gold Hill Doty Flat	1960			292	450	516	628	645	611	515	381			2,915
Loma Rica	1960										315			
Penn Valley	1958						547	634	562	466	360			
Penn Valley	1959				490	509	610	626	552	448	387			2,745
Penn Valley	1960			281	391	470	574	567	586	484	375			2,681
	Mean			292	453	494	572	619	562	466	375			

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
(in milliliters)

Area, environment, and station name	Year of record	Months												May - September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
CENTRAL VALLEY (continued)														
SACRAMENTO RIVER BASIN FOOTHILLS (continued)														
Dryland														
Bella Vista 4NE	1959				404	437	494	674	493	393	343			2,491
Bella Vista 4NE	1960			272	330	436	535			353	350			
Newville	1959			383	437	499	595	632	573	470	409			2,769
Newville	1960			314	410	501	681	667	713	614	451			3,176
	Mean			323	395	468	576	658	593	458	388			
SACRAMENTO RIVER BASIN VALLEY FLOOR														
Pasture														
Anderson 4E	1958							602	563	483	385			
Anderson 4E	1959			377	433	466	548	592	540	412	356			2,558
Anderson 4E	1960			284	357	442	572	598	515	421	308			2,548
Corning 3NE	1960			326	417	476	568	633	562	462	385			2,701
Davis Campbell #1	1960					532	608	653	597	514	398			2,904
Elk Grove 4NW	1960			331	448	530	594	587	550	391	358			2,652
Lincoln Vineyard	1958						599	662	579	493	425			
Lincoln Vineyard	1959				469	516	580	582	546	459	383			2,683
Lincoln Vineyard	1960			283	407	454	554	555	512	440	349			2,515
Palermo 3SW	1960			310	426	499	594	635	602	474	378			2,804
Red Bluff Cone Ranch	1959			369	460	481	641	680	544	444	376			2,790
Red Bluff Cone Ranch	1960			301	393	487	600	606	499	412	323			2,604
Yuba City 9W	1960			339	429	519	601	591	530	427	337			2,668
	Mean			324	424	491	588	614	549	443	366			
Alfalfa														
Anderson 3E	1955					584	513	623	572	504	352			2,796
Anderson 2E	1958				406	552	542	602	563	483	385			2,742
Arbuckle 1S	1958				489	561	552	601	557	483	452			2,754
Arbuckle 1S	1959			404	450	497	589	609	508	416	357			2,619
Arbuckle 1S	1960			330	392	504	555	559	516	430	334			2,564
Corning Jobe	1958				430	561	572	644	611	481	454			2,869
Corning Jobe	1959				463	524	604	660	573	456	381			2,817
Hamilton City	1955					609	649	680	618	531	423			3,087
Red Bluff 3E	1958				445	532	567	578	526	521	342			2,724
Rocklin Igarashi	1958						558	612	552	487	417			

TABLE A-3 (continued)

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
(in milliliters)

Area, environment, and station name	Year of record	Months												May - September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
CENTRAL VALLEY (continued)														
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)														
Alfalfa (continued)														
Rocklin Igarashi	1959				472	531	563	628	565	442	369			2,729
Rocklin Igarashi	1960			327	436	504	606	584	529	448	346			2,671
Vina Beck	1958				449	546	615	644	581	445	419			2,831
Vina Beck	1959			440	446	507	579	612	552	457	379			2,707
Vina Beck	1960				448	530	615	592	498					
Yuba City	1958				416	535	559	648	576	521	426			2,839
Yuba City	1959			417	488	545	619	634	551	451	390			2,800
	Mean			384	445	539	580	618	556	472	389			
Dryland														
Davis Campbell #2	1960								537	435	351			
Mills Orchard	1954									459	373			
Mills Orchard	1955				327	555	547	601	570	469	362			2,740
Oroville Agri. Comm.	1959			386	471	516	574	653	580	485	425			2,808
Redding 6SE	1955					570	607	685	647	492	395			3,001
Redding 6SE	1956					452	559	611	516	412				2,550
Redding 6SE	1957					461	625	595	485	379	252			
Redding 6SE	1958					500	506	590	550					
Redding Stayer	1958									500	397			
Redding Stayer	1959			389	449	491	633	739	602	456	396			2,921
Redding Stayer	1960			281	373	470	632	677	567	463	316			2,809
Sacramento Refuge	1955						448	641	614	529	421			
Sacramento Refuge	1956				407	503	613	690	609	481	336			2,896
Sacramento Refuge	1957					533	638	681	618	486	330			2,956
Sacramento Refuge	1958				458	538	589	659	573	457	357			2,816
Sacramento Refuge	1959			419	489	539	637	662	559	481	405			2,878
Sacramento Refuge	1960			353	434	518	623	623	570	464	371			2,798
	Mean			366	426	511	588	655	573	465	366			
Miscellaneous Lands														
Corning 3NW	1954								546	525	414			
Live Oak 3SE	1954							540	478	421	338			
Pennington 3NW	1960								526	435	325	162		
Redding A. P.	1957					427	474		554	324	275			

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
(in milliliters)

Area, environment, and station name	Year of record	Months												May-September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
CENTRAL VALLEY (continued)														
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)														
Miscellaneous Lands (continued)														
Richvale 1E	1957								668	428	314			
Richvale 1E	1958				446	549	603	655	579	441	349			2,827
Richvale 1E	1959			355	473	533	613	703	573	451	390			2,873
Richvale 1E	1960			309	425	516	639	636	612	474	370	179		2,877
	Mean				403	511	581	628	567	442	351			
SAN JOAQUIN RIVER BASIN VALLEY FLOOR														
Pasture														
Berenda 2N	1959					528	598	620	571	471	413			2,788
Berenda 2N	1960			353	441	538	558	511	495	436	347			2,538
El Solyo Ranch	1959			427	476	531	590	610	515	419	366			2,665
El Solyo Ranch	1960			362	438	528	583	591	547	452	350			2,701
Lodi 3SW	1959			402	454	479	486	535	515	448	390			2,463
Merced 5SE	1959			415	475	515	588	576	536	427	388			2,642
Merced 5SE	1960			371	457	526	578	567	541	442	359			2,654
Newman 1SE	1960						543	542	533	426	321			
Stockton 9S	1959				481	484	523	587	535	444	378			2,573
Stockton 9S	1960			310	442	612	588	612	618	484	354			2,914
Thornton 2S	1960			356	480	546	625	631	564	495	363			2,861
	Mean			374	460	529	569	580	543	449	366			
Alfalfa														
Atwater 1N	1958					584	598	608	566	475	359			2,831
Atwater 1N	1959			372	471	541	591	606	557	452	395			2,747
Atwater 1N	1960			345	412	541	553	479	519	435	354			2,527
Ceres 3E	1958				529	559	542	592	583	434	414			2,710
Ceres 3E	1959			400	460	520	573	549	513	379	335			2,534
Ceres 3E	1960			373	445	569	600	577	554	501	402			2,801
Lodi 3S	1958							564	573	459	388			
Lodi 3S	1959			417	472	503	478	572	522	467	419			2,542
Los Banos 3S	1958				539	565	631							
Los Banos 8SE	1958							638	552	449	412			
Stockton 8S	1958							614	578	482	356			

TABLE A-3 (continued)

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
(in milliliters)

Area, environment, and station name	Year of record	Months											May - September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
CENTRAL VALLEY (continued)														
SAN JOAQUIN RIVER BASIN VALLEY FLOOR (continued)														
Alfalfa (continued)														
Stockton 8S	1959			400	435	514	577	606	524	435	362			2,656
Vernalis 3SE	1958					581	567	576	532	476	359			2,732
	Mean			284	470	548	571	582	548	454	379			
Miscellaneous Lands														
Los Banos Equip. Yard	1959				455	468	533	561	421	394	283			2,377
Los Banos Equip. Yard	1960			289	388	496	460	447	476	432	356			2,311
TULARE LAKE BASIN VALLEY FLOOR														
Pasture														
Arvin Frick	1959						571	582	548	473	413	293		
Arvin Frick	1960				438	570	670	639	582	480	372	223		2,941
Kerman 2ESE	1960					490	536	540	516	415	343	176		2,497
Kingsburg 5S #2	1958						599	611	638	469	407			
Kingsburg 5S #2	1959			421	455	517	544	604	529	431	371			2,625
Kingsburg 5S #2	1960				427	502	511	507	494	395	330			2,409
	Mean				440	520	572	580	551	444	373	231		
Alfalfa														
Arvin Jewett #1	1958					555	571	610	551	460	378			2,747
Arvin Jewett #2	1959			390	473	498								
Fresno Kearney Park	1958					588	586	664	540	400	408			2,778
Fresno Kearney Park	1959				432	494	605	600	551	421	365			2,671
Fresno Kearney Park	1960			406	424									
Mendota Murietta Ranch	1958				516	534	587	643	541	434	511			2,739
Mendota Murietta Ranch	1959				473	561	595	590	561	456	420			2,763
Mendota Murietta Ranch	1960			410	452				593	502	371			
Shafter 2NW	1958							596	605	456	407			
	Mean			402	462	538	589	617	563	447	409			
Dryland														

TABLE A-3 (continued)

MONTHLY EVAPORATION DIFFERENCES BETWEEN
LIVINGSTON SPHERICAL BLACK AND WHITE ATMOMETERS
(in milliliters)

Area, environment, and station name	Year of record	Months												May - September total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
						LAHONTAN								
LASSEN, ALPINE MOUNTAIN VALLEYS														
Pasture														
Cedarville 2E	1958								472					
Cedarville 2E	1959						539	570	572					
Coleville 2W	1955								584	407				
Coleville 2W	1956							653	654	539				
Coleville 2W	1957							609	588	467				
Coleville 2W	1958						540	590	572	446				
Standish 4NW	1959					460	556	456	418	412				2,302
Standish 4NW	1960							552	537					
	Mean					460	545	572	550	454				2,581
Alfalfa														
Cedarville 1E	1958					484	467	550	475	378				2,354
Standish 1NW	1958					550	520	461	527	412				2,470
Dryland														
Bridgeport DWR	1956							569	565					
Cedarville Chevron	1955						496	626	591					
Leavitt Lake	1955						507	612	590					
Madeline 3SW	1955						502	553	535	372				
Madeline 3SW	1958								474					
Termo	1959						521	548	467					
Woodfords	1956						574	584	523					
	Mean						520	582	535					
Miscellaneous Lands														
Tahoe	1956						538	495	449	320				

TABLE A-4

LOCATION OF EVAPOTRANSPIRATION
MEASURING STATIONS

Area and station name	Crop	Location				
		MDB&M			County	Description
NORTH COASTAL						
KLAMATH-TRINITY MOUNTAIN VALLEYS						
Gazelle Dougherty #1	Alfalfa	T43N	R6W	22N1	Siskiyou	C. C. Dougherty Ranch, 3-1/2 mi. NW of Gazelle
Gazelle Dougherty #2	Alfalfa	T43N	R6W	22N2	Siskiyou	C. C. Dougherty Ranch, 3-1/2 mi. NW of Gazelle
Gazelle Dougherty #3	Alfalfa	T43N	R6W	21J1	Siskiyou	C. C. Dougherty Ranch, 3-1/2 mi. NW of Gazelle
CENTRAL VALLEY						
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS						
Alturas Dorris Ranch	Pasture	T42N	R13E	19L1	Modoc	Dorris Ranch, 2 mi. SE of Alturas
Bieber 3E	Alfalfa	T38N	R8E	18D1	Lassen	Earl Leonard Ranch, 3 mi. E of Bieber
Bieber Leonard	Alfalfa	T38N	R8E	17R1	Lassen	Francis Leonard, 4 mi. E of Bieber
Canby Bushey	Alfalfa	T42N	R9E	8R1	Modoc	R. Bushey Ranch, 5 mi. SW of Canby
Hat Creek Kern	Alfalfa	T34N	R4E	11L1	Shasta	B. S. Kern Ranch, 4 mi. N of Hat Creek
Hat Creek Opdyke	Alfalfa	T34N	R4E	15E1	Shasta	P. Opdyke Ranch, 2 mi. NW of Hat Creek
McArthur Albaugh #1	Alfalfa	T37N	R5E	11Q1	Shasta	C. A. Albaugh Ranch, 1 mi. W of Pittville
McArthur Albaugh #2	Alfalfa	T37N	R5E	11Q2	Shasta	C. A. Albaugh Ranch, 1 mi. W of Pittville
McArthur 1 NE	Alfalfa	T37N	R5E	9R1	Shasta	J. McArthur Ranch, 1/2 mi. NE of McArthur
Pittville 1S	Alfalfa	T37N	R5E	13A1	Shasta	L. Owens Ranch, 1 mi. S of Pittville
Pittville (AA)	Alfalfa	T37N	R5E	13R2	Shasta	L. Owens Ranch, 1 mi. S of Pittville
McArthur (AB)	Alfalfa	T37N	R5E	16R1	Shasta	J. McArthur Ranch, 1 mi. SE of McArthur
SACRAMENTO RIVER BASIN VALLEY FLOOR						
Davis Campbell	Ryegrass	T8N	R2E	17L1	Yolo	Campbell Tract, Univ. of Calif. at Davis
Anderson 2N	Alfalfa	T30N	R4W	10A1	Shasta	Floyd Leonard Ranch, 2 mi. N of Anderson
Anderson 3E	Alfalfa	T30N	R3W	8G1	Shasta	R. Haller Ranch, 3 mi. E of Anderson
Anderson Trisdale	Alfalfa	T30N	R3W	8B1	Shasta	J. H. Trisdale Ranch, 4 mi. E of Anderson
Mills Orchard	Alfalfa	T22N	R2W	30K1	Glenn	Mills Orchard Co., 2 mi. W of Hamilton C.
Redding 6SE	Alfalfa	T31N	R4W	15G1	Shasta	L. A. Stayer Ranch, 6 mi. SE of Redding

TABLE A-4 (Continuing)

LOCATION OF EVAPOTRANSPIRATION
MEASURING STATIONS

Area and station name	Crop	Location				
		MDB&M			County	Description
CENTRAL VALLEY (continued)						
TULARE LAKE BASIN VALLEY FLOOR						
Arvin (CE)	Grass	T31S	R29E	16F1	Kern	Howard Frick Ranch, 2-1/2 mi. NW of Arvin
Arvin Jewett	Alfalfa	T31S	R29E	16H1	Kern	H. S. Jewett Ranch, 4 mi. NW of Arvin
Arvin Jewett #2	Alfalfa	T31S	R29E	16H2	Kern	H. S. Jewett Ranch, 4 mi. NW of Arvin
Arvin Jewett #3	Alfalfa	T31S	R29E	16H3	Kern	H. S. Jewett Ranch, 4 mi. NW of Arvin
Arvin (CC)	Alfalfa	T31S	R29E	16F2	Kern	Howard Frick Ranch, 2-3/4 mi. NW of Arvin
Arvin (CB)	Plums	T31S	R29E	10N1	Kern	DiGiorgio Farms, 4 mi. NW of Arvin
Arvin (CD)	Cotton	T31S	R29E	9N1	Kern	Howard Frick Ranch, 3 mi. NW of Arvin
Arvin (CF)	Cotton	T31S	R29E	16D1	Kern	Howard Frick Ranch, 3 mi. NW of Arvin
LAHONTAN						
LASSEN-ALPINE MOUNTAIN VALLEYS						
Coleville 2W	Pasture	T8N	R22E	3K1	Mono	F. Spring Ranch, 2 mi. W of Coleville
Leavitt Lake	Alfalfa	T29N	R13E	16N1	Lassen	P. Milton Ranch, 10 mi. SE of Susanville

TABLE A-5

GENERAL INFORMATION RELATIVE TO EVAPOTRANSPIRATION MEASURING STATIONS

Area, crop, and station name	Year of measurement	Soil profile characteristics	Moisture measurement techniques	Method of irrigation	Dates of irrigation	Dates of cutting or harvesting	Approximate growing season	Elevation	Correlative agroclimatic station
NORTH COASTAL									
KLAMATH-TRINITY MOUNTAIN VALLEYS									
ALFALFA									
Gazelle Dougherty #1	1955	Sandy loam 0-7 feet.	Three gravimetric sampling stations. Total sampling depth, 7 feet.	Sprinkler	Apr. 6 May 19 June 28 July 5 Aug. 16, 29	June 12 July 31 Sept. 26	May 1 - Sept. 20	2,720	Gazelle 3NNW
Gazelle Dougherty #2	1955	Sandy loam 0-7 feet.	Three gravimetric sampling stations. Total sampling depth, 7 feet.	Sprinkler	Apr. 6 May 17 June 27 July 4 Aug. 14, 28	June 12 July 30 Sept. 26	May 1 - Sept. 20	2,720	Gazelle 3NNW
Gazelle Dougherty #3	1955	Sandy loam 0-7 feet.	Three gravimetric sampling stations. Total sampling depth, 7 feet.	Sprinkler	Apr. 6 May 18 June 27 July 4 Aug. 14, 28	June 12 July 31 Sept. 26	May 1 - Sept. 20	2,720	Gazelle 3NNW
CENTRAL VALLEY									
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS									
PASTURE									
Alturas Dorris Ranch	1959 1960	Undisturbed clay loam throughout.	Inflow-outflow evapotranspirometer.	Continuous surface application high water table level maintained.	Continuous		May 15 - Sept. 15	4,450	Alturas Dorris Ranch
ALFALFA									
Bieber 3E	1955	Fine sandy loam overlying relatively impervious consolidated material at 3½ feet.	Four gravimetric sampling stations. Total sampling depth, 3½ feet.	Sprinkler	July 1 Aug. 29	July 8 Aug. 17	May 15 - Sept. 15	4,200	Bieber S.C.S.

TABLE A-5 (continued)

GENERAL INFORMATION RELATIVE TO EVAPOTRANSPIRATION MEASURING STATIONS

Area, crop, and station name	Year of measurement	Soil profile characteristics	Moisture measurement techniques	Method of irrigation	Dates of irrigation	Dates of cutting or harvesting	Approximate growing season	Elevation	Correlative agroclimatic station
CENTRAL VALLEY (continued)									
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)									
ALFALFA (continued)									
Bieber Leonard	1956	Sandy loam 0-18". Partially cemented sandy loam 18-36". Loamy sand 36-68". Diatomaceous earth below 68".	Sixteen gravimetric sampling stations. Total sampling depth, 7 feet.	Sprinkler	July 3, 19 Aug. 27	July 1 Aug. 18	May 15 - Sept. 15	4,200	Bieber 4E
Canby Bushey	1955	Clay loam 0-8 feet.	Three gravimetric sampling stations. Total sampling depth, 8 feet.	Wild flooding	July 15 Aug. 21 Sept. 26	July 8 Sept. 2	May 15 - Sept. 15	4,300 (est.)	Canby R.S.
Hat Creek Kern	1955	Sandy loam underlain by coarse sand at four feet.	One gravimetric sampling station. Total sampling depth, 6 feet.	Border irrigation. Length of run, 1,000 feet.	May 18 June 9, 28 July 18 Aug. 8, 21 Aug. 29 Sept. 18	July 5 Sept. 1	May 1 - Sept. 30	3,350 (est.)	Hat Creek 3N
Hat Creek Opdyke	1955	Fine sandy loam underlain by sand and gravel at 4 feet. Water table at 6 feet.	One gravimetric sampling station. Total sampling depth, 4 feet.	Border irrigation. Length of run, 500 feet.	May 24 June 8 July 5, 24 Aug. 14 Sept. 6	July 6 Aug. 29	May 1 - Sept. 30	3,350 (est.)	Hat Creek 3N
McArthur Albaugh #1	1955	Sandy loam 0-13' underlain by coarse sand.	Two gravimetric sampling stations. Total sampling depth, 7 feet.	Wild flooding.	May 11 June 2, 28 July 17 Aug. 19 Oct. 2	June 16 Aug. 6 Sept. 13	April 15 - Oct. 15	3,325	McArthur 2E
McArthur Albaugh #1	1956	Sandy loam 0-13 feet underlain by coarse sand.	Sixteen gravimetric sampling stations. Total sampling depth, 9 feet.	Wild flooding.	April 27 June 21 July 17 Aug. 13 Sept. 13	June 7 July 23 Sept. 4	April 1 - Sept. 30	3,325	McArthur 2E
McArthur Albaugh #2	1956	Sandy loam 0-9' underlain by clay.	Twelve gravimetric sampling stations. Total sampling depth, 9 feet.	Wild flooding.	April 27 June 21 July 17 Aug. 13 Sept. 13	Oct. 3	April 1 - Sept. 30	3,325	McArthur 2E

TABLE A-5 (continued)

GENERAL INFORMATION RELATIVE TO EVAPOTRANSPIRATION MEASURING STATIONS

Area, crop, and station name	Year of measurement	Soil profile characteristics	Moisture measurement techniques	Method of irrigation	Dates of irrigation	Dates of cutting or harvesting	Approximate growing season	Elevation	Correlative agroclimatic station
CENTRAL VALLEY (continued)									
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)									
ALFALFA (continued)									
McArthur 1NE	1955	Sandy loam 0-3' underlain by sand.	One gravimetric sampling station. Total sampling depth, 4 feet.	Border irrigation. Length of run, 1,200 feet.	May 21 June 15 July 19 Aug. 2, 14, 24	June 7 July 25 Sept. 5	April 1 - Sept. 30	3,350	McArthur 2E
Pittville 1S	1956	Sandy loam underlain by coarse sand at 18'. Water table at 19'.	Eight gravimetric sampling stations. Total sampling depth, 9 feet.	Sprinkler	May 16 June 29 July 20 Aug. 14 Sept. 5	June 16 July 27 Sept. 12	April 1 - Sept. 30	3,300	McArthur 2E
Pittville 1S	1957	Sandy loam underlain by coarse sand at 18'. Water table at 19'.	Eight gravimetric sampling stations. Total sampling depth, 9 feet.	Sprinkler	May 14 June 25 Aug. 16, 27 Sept. 5	June 7 Aug. 5 Sept. 17	April 15 - Oct. 15	3,300	Pittville 1S
Pittville 1S	1958	Sandy loam underlain by coarse sand at 18'. Water table at 19'.	Five gravimetric sampling stations. Total sampling depth, 9 feet.	Sprinkler	May 23 July 19 Aug. 29	June 19 Aug. 4 Sept. 25	April 15 - Oct. 15	3,300	Pittville 1S
Pittville (AA)	1959	Sandy loam underlain by coarse sand at 18'. Dense clay at 20'.	Neutron scattering.	Sprinkler	Shown in Table 8	June 15 Aug. 1 Sept. 23	April 15 - Oct. 15	3,300	Pittville 1S
Pittville (AA)	1960	Sandy loam underlain by coarse sand at 18'. Dense clay at 20'.	Neutron scattering.	Sprinkler	Shown in Table 8	June 10 July 18 Sept. 15	April 15 - Oct. 15	3,300	Olenburn DWR
McArthur (AB)	1959	Stratified loam and clay loam 0-20 feet.	Neutron scattering.	Sprinkler	Shown in Table 8	May 25 July 10 Aug. 13 Sept. 25	April 15 - Oct. 15	3,350	Pittville 1S
McArthur (AB)	1960	Stratified loam and clay loam 0-20 feet.	Neutron scattering.	Sprinkler	Shown in Table 8	June 1 July 5 Aug. 17 Sept. 30	April 15 - Oct. 15	3,350	Olenburn DWR

TABLE A-5 (continued)

GENERAL INFORMATION RELATIVE TO EVAPOTRANSPIRATION MEASURING STATIONS

Area, crop, and station name	Year of measurement	Soil profile characteristics	Moisture measurement techniques	Method of irrigation	Dates of irrigation	Dates of cutting or harvesting	Approximate growing season	Elevation	Correlative agroclimatic station
			CENTRAL VALLEY (continued)						
SACRAMENTO RIVER BASIN VALLEY FLOOR									
RYEGRASS									
Davis Campbell	1958	Disturbed Yolo loam. Uniform throughout.	Weighing type evapotranspirometers.	Sprinkler	Sept. 12, 27 Oct. 30	Sept. 16 Oct. 29 Dec. 2	Mar. 1 - Oct. 31	50	Davis-Campbell, #1
Davis Campbell	1959	Disturbed Yolo loam. Uniform throughout.	Weighing type evapotranspirometers.	Sprinkler	Apr. 27-29 May 19-22 June 5-7, 19-20, 28-29 July 11-13 21-23 July 31-Aug. 1 Aug. 11-12, 21-22 Sept. 1-2, 13-14 Oct. 4-5, 31-Nov. 1 Nov. 6-7	Mar. 17 Apr. 20 May 6, 15 June 5, 16, 24 July 6, 16, 27 Aug. 10, 17, 26, 31 Sept. 11, 23 Oct. 14 Nov. 6 Dec. 1	Mar. 1 - Oct. 31	50	Davis-Campbell, #1
Davis Campbell	1960	Disturbed Yolo loam. Uniform throughout.	Weighing type evapotranspirometers.	Sprinkler	April 12, 18, 29 May 9 June 3, 12, 19, 20, 28, 29, 30 July 11, 17	Mar. 31 April 8, 15 May 4, 16, 31 June 10, 17, 27 July 6, 13	Mar. 1 - Oct. 31	50	Davis-Campbell, #1
ALFALFA									
Anderson 2N	1955	Sandy loam underlain by loamy sand at 5'. Sand and cobble at 8-10 feet.	One gravimetric sampling station. Total sampling depth, 7 feet.	Sprinkler	May 25 June 4, 14 July 12 Aug. 9, 20 Aug. 28	May 19 July 31 Sept. 8 Oct. 21	April 1 - Nov. 1	390 (est.)	Anderson 3E
Anderson 3E	1955	Sandy loam 0-5 feet.	One gravimetric sampling station. Total sampling depth, 7 feet.	Border irrigation. Length of run, 400 feet.	May 27 July 5 Sept. 22	May 17 June 20 Aug. 3 Sept. 6	March 15 - Nov. 1	390 (est.)	Anderson 3F

TABLE A-5 (continued)

GENERAL INFORMATION RELATIVE TO EVAPOTRANSPIRATION MEASURING STATIONS

Area, crop, and station name	Year of measurement	Soil profile characteristics	Moisture measurement techniques	Method of irrigation	Dates of irrigation	Dates of cutting or harvesting	Approximate growing season	Elevation	Correlative agroclimatic station
				CENTRAL VALLEY (continued)					
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)									
ALFALFA (continued)									
Anderson Trisdale	1955	Sandy clay loam 0-10 feet.	One gravimetric sampling station. Total sampling depth, 7 feet.	Border irrigation. Length of run, 600 feet.	May 31 July 10 Aug. 4 Oct. 9	May 16 June 20 July 28 Sept. 25	April 1 - Nov. 1	390 (est.)	Anderson 3E
Mills Orchard	1955	Silty clay loam underlain by fine sandy loam at 5½ feet.	One gravimetric sampling station. Total sampling depth, 7 feet.	Border irrigation. Length of run, 1,200 feet.	Apr. 9 May 15 June 4, 19 July 10, 21 Aug. 16 Sept. 20	Apr. 15 June 4 Aug. 3 Sept. 9 Oct. 12	March 15 - Nov. 1	175	Mills Orchard
Redding 6SE	1955	Reddish clay loam interspersed with cobble.	One gravimetric sampling station. Total sampling depth, 4 feet.	Sprinkler	Apr. 5 May 17, 30 June 18 July 2, 14, 28 Aug. 13, 23 Sept. 3, 27	May 18 June 26 Aug. 5 Sept. 19	April 1 - Nov. 1	515	Redding 6SE
TULARE LAKE BASIN VALLEY FLOOR									
GRASS									
Arvin (CE)	1959 1960	Hesperia fine sandy loam. Fairly uniform. 0-12 feet overlying stratified layers varying in texture from sand to clay loam.	Neutron scattering	Border irrigation. Length of run, 440 feet.	Shown in Table 8	Mowed every two weeks.	Jan. 1 - Dec. 31	437	Arvin-Frick
ALFALFA									
Arvin Jewett	1957-58	Hesperia fine sandy loam, fairly uniform throughout 0-9 feet.	Ten gravimetric sampling stations. Total sampling depth, 9 feet.	Border irrigation. Length of run, 1,300 feet.	Feb. 7 May 20, 30	Mar. 28 May 25	Feb. 1 - Nov. 30	448	Arvin Jewett #1
Arvin Jewett #2	1957-58	Hesperia fine sandy loam, fairly uniform throughout 0-9 feet.	Ten gravimetric sampling stations. Total sampling depth, 9 feet.	Border irrigation. Length of run, 1,300 feet.	Feb. 7 May 20, 30	Mar. 28 May 25	Feb. 1 - Nov. 30	448	Arvin Jewett #1
Arvin Jewett #3	1958	Hesperia fine sandy loam, fairly uniform throughout 0-9 feet.	Ten gravimetric sampling stations. Total sampling depth	Border irrigation. Length of run, 1,300 feet.	Feb. 7 May 20, 30	Mar. 28 May 25	Feb. 1 - Nov. 30	448	Arvin Jewett #3

TABLE A-5 (continued)

GENERAL INFORMATION RELATIVE TO EVAPOTRANSPIRATION MEASURING STATIONS

Area, crop, and station name	Year of measurement	Soil profile characteristics	Moisture measurement techniques	Method of irrigation	Dates of irrigation	Dates of cutting or harvesting	Approximate growing season	Elevation	Correlative agroclimatic station
CENTRAL VALLEY (continued)									
TULARE LAKE BASIN VALLEY FLOOR (continued)									
ALFALFA (continued)									
Arvin (CC)	1959	Hesperia fine sandy loam 0-12 feet overlying stratified layers varying in texture from sand to clay loam.	Neutron scattering.	Border irrigation. Length of run, 440 feet.	Shown in Table 8	Mar. 12 Apr. 10 May 16 June 15 July 11 Aug. 8 Sept. 5 Oct. 17	Feb. 15 - Dec. 15	437	Arvin Jevett #2 and Arvin Frick
Arvin (CC)	1960	Hesperia fine sandy loam 0-12 feet overlying stratified layers varying in texture from sand to clay loam.	Neutron scattering.	Border irrigation. Length of run, 440 feet.	Shown in Table 8	Mar. 21 Apr. 20 May 23 July 24 Aug. 25 Sept.26	Feb. 15 - Dec. 15	437	Arvin Frick
PLUMS									
Arvin (CB)	1959	Hesperia fine sandy loam 0-18 feet overlying sand.	Neutron scattering.	Furrow irrigation. Length of run, 325 feet.	Shown in Table 8	June 8	Mar. 1 - Nov. 30	470	Arvin Jevett #2 and Arvin Frick
Arvin (CB)	1960	Hesperia fine sandy loam 0-18 feet overlying sand.	Neutron scattering.	Furrow irrigation. Length of run, 325 feet.	Shown in Table 8	June 14	Mar. 1 - Nov. 30	470	Arvin Frick
COTTON									
Arvin (CD)	1959	Hesperia fine sandy loam, fairly uniform 0-10 feet overlying sandy loam stratified with sand and clay layers.	Neutron scattering.	Furrow irrigation. Length of run, 440 feet.	Shown in Table 8	Nov. 5 Dec. 12	Apr. 1 - Oct. 31	440	Arvin Jevett #2 and Arvin Frick
Arvin (CE)	1960	Hesperia fine sandy loam, fairly uniform 0-10 feet overlying sandy loam stratified with sand and clay layers.	Neutron scattering.	Furrow irrigation. Length of run, 440 feet.	Shown in Table 8	Nov. 30, 1960 Jan. 12, 1961	Apr. 1 - Oct. 31	435	Arvin Frick

TABLE A-5 (continued)

GENERAL INFORMATION RELATIVE TO EVAPOTRANSPIRATION MEASURING STATIONS

Area, crop, and station name	Year of measurement	Soil profile characteristics	Moisture measurement techniques	Method of irrigation	Dates of irrigation	Dates of cutting or harvesting	Approximate growing season	Elevation	Correlative agroclimatic station
				LAHONTON					
LASSEN-ALPINE MOUNTAIN VALLEYS									
PASTURE									
Colevilla ZW	1957	Peat 0-1½ feet, underlain by sandy loam.	Evapotranspirometer	Continuous sub-irrigation with variable high water table levels.	Continuous		April 15 - Sept. 15	5,100	Coleville ZW
ALFALFA Leavitt Lake	1955	Loam 0-9', silty clay loam 9-13'. Compact silt 13-16'. Sand 16-18'. Water table 11-16'.	Four gravimetric sampling stations. Total sampling depth, 6-8 feet.	Border irrigation. Length of run, 1,200 feet.	May 1 July 26 Aug. 15, 27	Aug. 1 Sept. 27	May 15 - Sept. 15	4,112	Leavitt Lake

NEUTRON PROBE MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA FOR SEVERAL IRRIGATED CROPS,
1959 AND 1960

Area, crop, station: name, and period of ending	Depth of applied water: days	Date	Inches	Soil moisture determination: Number of access tubes	Moisture depletion in feet: Mean	Soil moisture change, in inches: error	Twice standard error	Precipitation, in inches	Evapotranspiration (ET), in inches: Measured	Estimated daily ET	Pan evaporation (Ep), in inches: Measured	Estimated daily Ep	Pan coefficient	Black minus white atmosphere evaporation, in milliliters: Mean reading	Atmometer coefficient	Crop development: Estimated percent ground cover	Height, inches	Available soil moisture: Root zone, feet	Soil moisture, inches
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS																			
										CENTRAL VALLEY									
Alfalfa																			
Pittville (AA), 1959									3/17/59					1/ 5/15/59					
3/17	--			--	--	----	----	----	----	0.00	----	----	----	----	---	------	20	3	0-12	16.37
4/8	22			12	18	1.92	0.44	0.00	1.92	----	1.92	0.09	----	----	---	------	35	10	0-12	14.4[illegible]
4/23	15			12	18	3.60	0.26	0.26	3.86	----	5.78	0.26	----	----	---	------	75	18	0-12	10.8[illegible]
4/29	6	4/25-29	NR	--	--	----	----	0.00	----	1.20	6.98	----	----	----	---	------	--	--	----	-----
5/6	7			--	--	----	----	0.00	----	1.47	8.45	----	----	----	---	------	90	22	0-12	16.22
5/12	6			12	11	0.79	0.24	0.04	0.83	----	9.28	0.14	----	----	---	------	95	28	0-12	15.43
5/28	16			12	10	3.04	0.32	0.37	3.41	----	12.69	0.21	----	----	---	288	100	30	0-12	18.39
6/10	13			12	10	4.29	0.42	0.00	4.29	----	16.98	0.33	----	----	---	249	537	0.01/2	100	30	0-12	8.10
6/17	7			12	16	0.93	0.40	0.00	0.93	----	17.91	0.13	----	----	---	152	689	0.0061	5	3	0-12	[illegible].17
6/24	7			12	16	1.65	0.58	0.00	1.65	----	19.56	0.24	----	----	---	157	846	0.0105	20	7	0-12	5.[illegible]2
7/2	8			12	17	1.26	0.58	0.35	1.61	----	21.17	0.20	----	----	---	157	1,003	0.0103	40	10	0-12	4.2[illegible]
7/5	3	7/1-5	NR	--	--	----	----	0.00	----	0.92	22.13	----	----	----	---	64	1,067	------	--	--	----	-----
7/6	1			--	--	----	----	0.00	----	0.31	22.44	----	----	----	---	22	1,089	------	50	12	0-12	9.63
7/15	9			12	16	2.77	0.54	0.00	2.77	----	25.21	0.31	----	----	---	195	1,284	0.0142	100	25	0-12	6.86
7/27	12			12	16	3.64	0.90	0.00	3.64	----	28.85	0.30	----	----	---	268	1,552	0.0136	100	30	0-12	3.22
7/31	4	7/27-31	NR	--	--	----	----	0.00	----	0.95	29.80	----	----	----	---	70	1,622	------	--	--	----	-----
8/3	3			--	--	----	----	0.00	----	0.86	30.66	----	----	----	---	59	1,681	------	10	3	0-12	8.62
8/14	11			12	16	1.81	0.34	0.00	1.81	----	32.47	0.16	----	----	---	232	1,913	0.0078	30	8	0-12	6.81
8/27	13	8/27	NR	--	--	----	----	0.00	----	2.40	34.87	----	----	----	---	271	2,184	------	--	--	----	-----
9/3	7			--	--	----	----	0.00	----	2.10	36.97	----	----	----	---	149	2,333	------	60	14	0-12	10.29
9/10	7			8	12	1.64	0.46	0.00	1.64	----	38.61	0.23	----	----	---	132	2,465	0.0124	100	26	0-12	8.[illegible]
9/15	5			8	12	1.85	0.16	0.00	1.85	----	40.46	0.37	----	----	---	75	2,540	0.0247	100	30	0-12	6.80
9/30	15			--	--	----	----	0.00	----	2.51	42.97	----	----	----	---	209	2,749	------	--	--	----	-----
TOTALS	197					29.19		1.02	30.21	12.76	42.97					2,461						
Pittville (AA), 1960									3/10/60				1/25/60		1/ 6/7/60					
3/10	--			--	--	----	----	----	----	0.00	----	----	2.68	----	---	------	20	5	0-12	12.31
4/19	39			8	12	3.05	0.48	0.66	3.71	----	3.71	0.10	5.91	8.59	0.63	------	80	10	0-12	9.26
4/28	9			9	12	0.48	0.26	0.19	0.67	----	4.38	0.07	1.23	9.82	0.54	------	80	12	0-12	8.76
5/11	13			9	12	1.31	0.36	0.41	1.72	----	6.10	0.13	2.59	12.41	0.66	------	95	14	0-12	7.47
5/16	5	5/16	NR	--	--	----	----	0.00	----	1.47	7.57	----	1.44	13.85	----	------	NR	NR	----	-----
5/19	3			--	--	----	----	0.00	----	0.90	8.47	----	0.81	14.66	----	------	95	19	0-12	8.77
6/3	15			9	12	2.00	0.80	0.75	3.31	----	11.78	0.22	2.91	17.57	1.14	------	100	27	0-12	6.21
6/10	7			9	12	1.98	0.32	0.10	2.08	----	13.86	0.30	2.08	19.65	1.00	50	50	------	10	3	0-12	4.23
6/24	14			9	12	1.21	0.30	0.00	1.21	----	15.07	0.09	4.12	23.77	0.29	275	325	0.0044	20	5	0-12	3.02
6/26	2	6/26	NR	--	--	----	----	0.00	----	0.30	15.37	----	0.55	24.32	----	------	----	----	--	--	----	-----
6/30	4			--	--	----	----	0.00	----	0.98	16.35	----	1.09	25.41	----	121	446	------	40	12	0-12	9.62
7/9	10			8	12	3.45	0.48	0.00	3.45	----	19.80	0.35	2.80	28.21	1.23	195	641	0.0177	90	20	0-12	6.1[illegible]
7/18	9			8	12	3.41	0.60	0.00	3.41	----	23.21	0.38	3.17	31.38	1.08	160	801	0.0213	100	28	0-12	2.1[illegible]
7/25	7			8	12	0.99	0.28	0.00	0.99	----	24.20	0.14	2.64	34.02	0.38	137	938	0.0072	10	3	0-12	1.[illegible]
8/1	7	8/1	NR	--	--	----	----	0.00	----	0.92	25.16	----	2.09	36.11	----	------	----	----	--	--	----	-----
8/5	4			--	--	----	----	0.00	----	1.06	26.18	----	1.33	37.44	----	194	1,132	------	20	10	0-12	7.47
8/12	7			13	12	1.54	0.44	0.00	1.54	----	27.72	0.22	2.28	39.72	0.68	129	1,261	0.0119	60	16	0-12	7.92
8/19	7			13	12	2.85	0.50	0.00	2.85	----	30.57	0.41	2.10	41.82	1.36	132	1,393	0.0216	90	24	0-12	[illegible]
8/26	7			9	12	1.91	0.46	0.00	1.91	----	32.48	0.27	20.3	43.85	0.94	114	1,507	0.0168	NR	NR	0-12	[illegible]
8/28	2	8/28	NR	--	--	----	----	0.00	----	0.18	32.66	----	0.17	44.02	----	------	----	----	--	--	----	-----
9/1	4			--	--	----	----	0.00	----	1.34	34.00	----	1.29	45.47	----	9[illegible]	1,604	------	95	24	0-12	[illegible]
9/16	15			9	12	3.12	0.22	0.00	3.12	----	37.12	0.21	3.62	48.93	0.86	247	1,9[illegible]	0.0126	10	3	0-12	[illegible]
9/28	12			9	12	1.43	0.22	0.00	1.43	----	38.55	0.12	1.79	50.72	0.80	1[illegible]	2,0[illegible]	0.0080	20	[illegible]	0-[illegible]	[illegible]
10/11	13			9	12	2.37	0.34	0.20	2.57	----	41.12	0.20	2.01	52.73	1.28	---	---	------	30	12	0-[illegible]	[illegible]
11/8	28			9	12	1.89	0.64	0.36	2.25	----	43.37	0.08	3.04	[illegible].77	0.74	---	---	------	60	[illegible]	[illegible]	[illegible]
TOTALS	243					33.55		2.67	36.22	7.15	43.37		53.09			2,029						

TABLE A-6 (continued)

NEUTRON PROBE MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA FOR SEVERAL IRRIGATED CROPS,
1959 AND 1960

Area, crop, station: name, and period of ending:		Date	Depth of applied water: Inches	Soil moisture determination: Number of access tubes	Moisture depletion, depth, in feet	Soil moisture change, in inches: Mean	Standard error	Precipitation, in inches	Evapotranspiration (ET), in inches: Measured	Estimated	Accumulated	Mean daily: For period: from	Pan evaporation (Ep), in inches: Measured	Pan coefficient, rate	Accumulated	Mean from	Black minus white atmometer evaporation, in milliliters: Mean atmometer	Accumulated	Mean from	Crop development: Estimated percent	Plant height, ground cover	Root zone, in inches	Available soil moisture: Soil ture, in feet	Soil moisture, in inches
TULARE LAKE BASIN (continued)																								
Grass																								
Arvin (CE), 1959											7/24/59		2/	12/31/58		3/	3/1/59							
7/24	--			--	--	----	----	----	----	----	0.00	----	----	41.15	----	----	2,392	------	90	9	0-3	4.89		
7/31	7			5	3	2.19	0.24	0.00	2.19	----	2.19	0.31	2.44	43.59	0.90	136	2,528	0.0161	90	11	0-3	2.70		
8/3	3	8/3	NR	--	--	----	----	0.00	----	0.78	2.97	----	0.87	44.46	----	40	2,568	------	NR	NR	----	-----		
8/11	8	8/11	NR	--	--	----	----	0.00	----	2.10	5.07	----	2.46	46.92	----	154	2,722	------	NR	NR	----	-----		
8/19	8			--	--	----	----	0.00	----	1.90	6.97	----	2.22	49.14	----	145	2,867	------	85	9	0-3	4.21		
8/26	7			5	3	1.45	0.22	0.00	1.45	----	8.42	0.21	1.76	50.90	0.82	111	2,978	0.0131	85	12	0-3	2.76		
8/28	2	8/28	NR	--	--	----	----	0.00	----	0.51	8.93	----	0.62	51.52	----	37	3,015	------	NR	NR	----	-----		
8/31	3			--	--	----	----	0.00	----	0.60	9.53	----	0.73	52.25	----	52	3,067	------	75	8	0-3	6.46		
9/16	16			5	3	1.95	0.22	0.34	2.29	----	11.82	0.14	3.24	55.49	0.71	255	3,322	0.0090	95	15	0-3	4.17		
9/28	12			5	3	1.68	0.34	0.00	1.68	----	13.50	0.14	2.40	57.89	0.70	191	3,513	0.0088	70	4	0-3	2.49		
TOTALS	66					7.27		0.34	7.61	5.89	13.50		16.74			1,121								
Arvin (CE), 1960											8/8/60		2/	1/1/60		3/	3/23/60							
1/4	--	1/4	4.58	--	--	----	----	----	----	----	------	----	----	0.15	----	----	-----	------	--	--	----	-----		
2/24	49	2/24	3.86	--	--	----	----	2.62	----	----	------	----	----	3.68	----	----	-----	------	--	--	----	-----		
3/9	13			--	--	----	----	0.64	----	----	------	----	----	5.02	----	----	-----	------	70	7	----	-----		
3/28	19			4	4	1.02	0.40	1.16	2.18	----	------	0.11	2.86	7.88	0.76	----	59	------	--	--	----	-----		
4/8	11	4/8	3.00	--	--	----	----	----	----	----	------	----	----	9.95	----	----	227	------	--	--	----	-----		
5/17	39	5/17	4.72	--	--	----	----	0.55	----	----	------	----	----	18.67	----	----	843	------	--	--	----	-----		
5/25	8			--	--	----	----	----	----	----	------	----	----	21.04	----	----	986	------	85	7	----	-----		
6/2	8			4	9b/	2.07	0.22	----	2.07	----	------	0.26	2.36	23.40	0.88	157	1,143	0.0132	85	8	----	-----		
6/3	1	6/3	3.80	--	--	----	----	----	----	----	------	----	----	23.77	----	----	1,165	------	--	--	----	-----		
6/7	4			--	--	----	----	----	----	----	------	----	----	25.17	----	----	1,252	------	90	8	----	-----		
6/21	14	6/21	4.03	4	4	3.32	0.85	----	3.32	----	------	0.24	4.76	29.93	0.70	316	1,568	0.0105	90	10	----	-----		
6/30	9	6/30	3.22	--	--	----	----	----	----	----	------	----	----	32.87	----	----	1,782	------	90	10	----	-----		
7/12	12	7/12	4.37	--	--	----	----	----	----	----	------	----	----	36.65	----	----	2,032	------	--	--	----	-----		
7/22	10	7/22	3.43	--	--	----	----	----	----	----	------	----	----	39.65	----	----	2,247	------	--	--	----	-----		
7/27	6			--	--	----	----	----	----	----	------	----	----	40.89	----	----	----	------	90	12	----	-----		
8/8	12	8/8	3.64	--	--	----	----	----	----	----	0.00	----	----	44.36	----	----	2,568	------	--	--	----	-----		
8/11	3			--	--	----	----	----	----	0.86	0.86	----	0.86	45.22	----	58	2,626	------	95	7	----	-----		
8/18	7			4	5	1.75	0.20	----	1.75	----	2.61	0.25	1.81	47.03	0.97	142	2,768	0.0123	95	10	----	-----		
8/29	11	8/29	8.35	4	4	1.89	0.80	----	1.89	----	4.50	0.17	2.81	49.84	0.67	193	2,961	0.0098	--	--	----	-----		
9/1	3			--	--	----	----	----	----	0.63	5.13	----	0.68	50.52	----	53	3,014	------	95	7	----	-----		
9/7	6			4	8b/	1.17	0.22	----	1.17	----	6.30	----	1.33	51.85	0.88	107	3,121	0.0109	95	18	----	-----		
9/8	1	9/8	4.28	--	--	----	----	----	----	0.20	6.50	----	0.23	52.08	----	18	3,139	------	--	--	----	-----		
9/12	4			--	--	----	----	----	----	0.54	7.04	----	0.79	52.87	----	65	3,204	------	95	20	----	-----		
9/28	16			3	9b/	2.12	0.56	----	2.12	----	9.16	0.13	3.25	56.12	0.65	245	3,449	0.0086	100	23	----	-----		
9/29	1	9/29	3.82	--	--	----	----	----	----	0.14	9.30	----	0.22	56.34	----	22	3,471	------	--	--	----	-----		
10/11	12			--	--	----	----	T	----	2.39	11.69	----	1.87	56.21	----	143	3,614	------	100	12	----	-----		
10/25	14	10/25	4.01	4	8b/	2.29	0.26	----	2.29	----	13.98	0.16	1.79	60.00	1.28	178	3,792	0.0129	--	--	----	-----		
11/1	7			--	--	----	----	----	----	0.58	14.56	----	0.72	60.72	----	75	3,867	------	100	14	----	-----		
11/29	28			4	10b/	-1.30a/	0.96	2.75	1.45	----	16.01	0.05	1.78	62.50	0.81	207	4,074	0.0070	100	4-10	----	-----		
12/8	10			4	4	0.30	0.14	0.02	0.32	----	16.33	0.03	0.58	63.08	0.55	----	-----	------	100	12	----	-----		
1/10/61	33			4	13b/	0.77	0.10	0.04	0.81	----	17.14	0.02	0.76	63.84	1.06	----	-----	------	100	8	----	-----		
TOTALS	156		24.10			8.99		2.81	11.80	5.34			19.48			1,506								
(8/8/60 1/10/61)																								
Alfalfa																								
Arvin (CC), 1959											3/13/59		2/	12/31/58		3/	3/1/59							
2/21		2/21	NR	--	--	----	----	----	----	----	------	----	----	------	----	----	-----	------	--	--	----	-----		
3/13	--			--	--	----	----	----	----	----	0.00	----	----	5.86	----	----	147	------	5	2	0-12	21.80		
3/27	14			6	4.5	1.07	0.12	T	1.07	----	1.07	0.08	2.28	8.14	0.47	186	333	0.0058	--	--	0-12	20.73		
[illegible]	[illegible]	[illegible]	NR	[illegible]	[illegible]	[illegible]	[illegible]	0.00	[illegible]	0.10	1.17	[illegible]	0.21	8.35	[illegible]	14	347	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

CENTRAL VALLEY (continued)

NEUTRON PROBE MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA FOR SEVERAL IRRIGATED CROPS,
1959 AND 1960

Area, crop, station: name, and period of ending	Depth of applied water: Date	Depth of applied water: Inches	Soil moisture determination: Number of access tubes	Soil moisture determination: Moisture depletion in depth, feet: Mean	Soil moisture determination: Soil moisture change, in inches: Twice standard error	Soil moisture determination: Precipitation, in inches	Evapotranspiration (ET), in inches: Measured from	Evapotranspiration (ET), in inches: Estimated from	Evapotranspiration (ET), in inches: Measured mean rate	Evapotranspiration (ET), in inches: Accumulated daily: For period	Pan evaporation (Ep), in inches: Pan coefficient, Ep/Ep-w: Mean	Pan evaporation (Ep), in inches: Accumulated from	Black minus white atmometer evaporation, in milliliters: Mean	Black minus white atmometer evaporation, in milliliters: Accumulated	Crop development: Estimated percent ground cover	Crop development: Plant height, inches	Available soil moisture: Root zone, feet	Available soil moisture: Soil moisture, inches
TULARE LAKE BASIN (continued)																		
Alfalfa (continued)																		
Arvin (CC), 1959 (continued)									3/13/59		2/	12/31/58		3/	3/1/59			
4/3 6			--	--	----	----	0.00	----	0.96	2.13	----	1.14	9.49	----	92	439	------	80	16	0-12	22.60
4/15 12			12	5.5	1.81	0.20	0.00	1.81	----	3.94	0.15	2.48	11.97	0.73	199	638	0.0091	20	5	0-12	20.79
4/21 6			12	5.5	0.73	0.20	0.00	0.73	----	4.67	0.12	1.68	13.65	0.43	94	732	0.0078	--	--	0-12	20.06
4/24 3	4/24	NR	--	--	----	----	0.00	----	0.30	4.97	----	0.71	14.36	----	41	773	------	--	--	----	-----
4/28 4			--	--	----	----	0.42	----	0.86	5.83	----	1.06	15.42	----	59	832	------	70	14	----	-----
5/7 9	5/7	NR	--	--	----	----	0.00	----	1.13	6.96	----	1.88	17.30	----	125	957	------	80	--	----	-----
5/14 7			--	--	----	----	T	----	1.21	8.17	----	1.94	19.24	----	119	1,076	------	90	20	0-12	23.41
5/19 5			12	5.5	0.77	0.12	0.00	0.77	----	8.94	0.15	1.28	20.52	0.60	74	1,150	0.0104	10	3	0-12	22.64
5/25 6			12	5.5	0.54	0.08	0.00	0.54	----	9.48	0.09	1.68	22.20	0.32	98	1,248	0.0055	50	9	0-12	22.10
5/29 4	5/29	NR	--	--	----	----	0.00	----	0.58	10.06	----	1.80	24.00	----	66	1,314	------	--	--	----	-----
6/1 3			--	--	----	----	0.00	----	0.76	10.82	----	0.78	24.78	----	57	1,371	------	--	--	0-12	23.91
6/9 8			12	5.5	2.06	0.42	0.00	2.06	----	12.88	0.26	2.45	27.23	0.84	148	1,519	0.0139	95	23	0-12	21.85
6/10 1	6/10	NR	--	--	----	----	0.00	----	0.18	13.06	----	0.22	27.45	----	17	1,536	------	--	--	----	-----
6/15 5			--	--	----	----	0.00	----	0.75	13.81	----	1.59	29.04	----	95	1,631	------	5	3	0-12	23.16
6/22 7			12	4.5	1.00	0.16	0.00	1.00	----	14.81	0.14	2.13	31.17	0.47	142	1,773	0.0070	40	8	0-12	22.16
6/25 3	6/25	3.2	--	--	----	----	0.00	----	0.48	15.29	----	1.03	32.20	----	65	1,838	------	--	--	----	-----
6/29 4			--	--	----	----	0.00	----	0.97	16.26	----	1.19	33.39	----	67	1,905	------	75	15	0-12	25.07
7/3 4			11	4.5	1.09	0.16	0.00	1.09	----	17.35	0.27	1.58	34.97	0.69	88	1,993	0.0124	85	19	0-12	23.98
7/4 1	7/4	2.9	--	--	----	----	0.00	----	0.04	17.39	----	0.06	35.03	----	9	2,002	------	85	19	----	-----
7/8 4			--	--	----	----	0.00	----	0.86	18.25	----	1.48	36.51	----	93	2,095	------	95	24	0-12	24.23
7/13 5			11	3	0.81	0.06	0.00	0.81	----	19.06	0.16	1.46	37.97	0.55	90	2,185	0.0090	10	4	0-12	23.42
7/17 4			11	4	0.39	0.08	0.00	0.39	----	19.45	0.10	1.25	39.22	0.31	80	2,265	0.0049	20	5	0-12	23.03
7/19 2	7/19	2.2	--	--	----	----	0.00	----	0.16	19.61	----	0.53	39.75	----	34	2,299	------	--	--	----	-----
7/22 3			--	--	----	----	0.00	----	0.94	20.55	----	0.84	40.59	----	50	2,349	------	40	8	0-12	25.66
7/29 7			13	4	1.70	0.16	0.00	1.70	----	22.25	0.24	2.30	42.89	0.74	126	2,475	0.0134	--	--	0-12	23.96
7/30 1	7/30	3.4	--	--	----	----	0.00	----	0.19	22.44	----	0.26	43.15	----	17	2,492	------	--	--	----	-----
8/8 9			--	--	----	----	0.00	----	2.19	24.63	----	2.83	45.98	----	168	2,660	------	--	--	0-12	23.65
8/13 5			6	3	0.39	----	0.00	0.39	----	25.02	0.08	1.67	47.65	0.23	102	2,762	0.0038	--	--	0-12	23.26
8/17 4	8/17	NR	--	--	----	----	0.00	----	0.19	25.21	----	0.34	48.49	----	56	2,818	------	--	--	----	-----
8/20 3			--	--	----	----	0.00	----	0.69	25.90	----	0.88	49.37	----	54	2,872	------	35	7	----	-----
8/24 4	8/24	NR	--	--	----	----	0.00	----	0.56	26.46	----	0.80	50.17	----	56	2,928	------	--	--	----	-----
8/27 3			--	--	----	----	0.00	----	1.12	27.58	----	0.98	51.15	----	54	2,982	------	70	14	0-12	26.04
9/4 8			20	5	2.24	0.22	0.00	2.24	----	29.82	0.28	1.96	53.11	1.14	142	3,124	0.0158	80	17	0-12	23.50
9/15 11			20	7	1.28	0.26	0.34	1.62	----	31.44	0.15	2.00	55.11	0.81	170	3,294	0.0095	10	4	0-12	22.52
9/17 2	9/17	NR	--	--	----	----	0.00	----	0.42	31.86	----	0.52	55.63	----	32	3,326	------	--	--	----	-----
9/22 5			--	--	----	----	0.00	----	0.88	32.74	----	0.88	56.51	----	74	3,400	------	55	10	0-12	24.88
10/2 10			20	6	1.74	0.22	0.00	1.74	----	34.48	0.17	2.11	58.62	0.82	158	3,558	0.0110	75	15	0-12	23.1[illegible]
10/3 1	10/3	NR	--	--	----	----	0.00	----	0.12	34.60	----	0.14	58.76	----	14	3,572	------	--	--	----	-----
10/9 6			--	--	----	----	0.00	----	0.78	35.38	----	0.90	59.66	----	82	3,654	------	80	16	0-12	25.13
10/21 12			20	4	1.29	0.12	0.00	1.29	----	36.67	0.11	1.72	61.38	0.75	172	3,826	0.0075	10	3	0-12	23.34
10/29 8	10/29	NR	--	--	----	----	0.00	----	0.40	37.07	----	1.01	62.39	----	90	3,916	------	--	--	----	-----
11/3 5			--	--	----	----	0.00	----	0.64	37.71	----	0.64	63.03	----	45	3,961	------	35	7	0-12	25.[illegible]
12/2 29			20	7	2.52	0.40	0.00	2.52	----	40.23	0.09	2.49	65.52	1.01	----	------	------	60	12	0-12	22.80
1/5/60 34			20	11	1.67	0.30	0.34	2.01	----	42.24	0.06	1.76	67.28	1.14	---	------	------	--	--	0-12	21.13
TOTALS 298			--	--	23.10	----	1.50	23.78	18.46	42.24		61.42			3,814						
Arvin (CC), 1960										5/12/60		2/	1/1/60		3/	3/23/60					
4/11 4/11		NR	--	--	----	----	----	----	----	----	----	----	----	----	---	----	------	--	--	----	-----
5/12 31			--	--	----	----	0.55	----	----	0.00	----	----	17.30	----	---	759	------	10	15	0-12	22.[illegible]
5/24 12			20	12	2.71	0.24	----	2.71	----	2.71	0.23	3.54	20.84	0.76	206	965	0.0132	15	4	0-12	19.5[illegible]
5/31 7			20	5	0.27	0.12	----	0.27	----	2.98	0.04	2.04	22.88	0.13	148	1,113	0.0018	50	5	0-12	19.29

TABLE A-6 (continued)

NEUTRON PROBE MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA FOR SEVERAL IRRIGATED CROPS,
1959 AND 1960

Area, crop, station: name, and period of ending	Depth of applied water: Date	Depth of applied water: Inches	Soil moisture determination: Number of access tubes	Soil moisture determination: Depth, in feet	Soil moisture determination: Soil moisture change, in inches: Mean	Soil moisture determination: Soil moisture change, in inches: Twice standard error	Precipitation, in inches	Evapotranspiration (ET), in inches: Accumulated ET from Mar 1	Evapotranspiration (ET), in inches: Estimated ET from Mar 1	Pan evaporation (Ep), in inches: Mean daily pan evaporation rate	Pan evaporation (Ep), in inches: Accumulated pan evaporation from Mar 1	Black minus white atmometer evaporation, in milliliters: Mean coefficient	Black minus white atmometer evaporation, in milliliters: Accumulated atmometer evaporation from Mar 1	Crop development: Estimated percentage of ground cover	Crop development: Plant height, inches	Crop development: Root zone, inches	Available soil moisture: Soil moisture, inches	Available soil moisture: Soil moisture, inches
TULARE LAKE BASIN (continued)																		
Alfalfa (continued)																		
Arvin (CD), 1960 (continued)																		
6/1	1	6/1	3.60	--	--	----	----	----	----	0.03	3.01	----	0.20	23.08	----	9	1,122	------	--	--	----	----
6/17	16	6/17	3.76	--	--	----	----	----	----	4.13	7.14	----	5.51	28.59	----	262	1,844	------	--	--	----	----
6/24	7			--	--	----	----	----	----	2.53	9.67	----	2.32	31.12	----	180	1,654	------	20	4	0-12	19.66
7/1	7			7	9	1.01	0.20	----	1.01	----	10.68	0.14	1.03	33.07	0.02	138	1,792	0.0073	45	5	0-12	18.95
7/2	1	7/2	3.33	--	--	----	----	----	----	0.16	10.84	----	0.30	33.32	----	22	1,814	------	--	--	----	----
7/8	6			--	--	----	----	----	----	1.28	12.12	----	1.97	35.29	----	129	1,943	------	60	12	0-12	20.02
7/21	13			20	6	3.53	0.20	----	3.53	----	15.65	0.27	4.04	39.36	0.87	281	2,224	0.0126	100	3	0-12	16.49
8/1	11			8	5	1.03	0.20	----	1.03	----	16.68	0.09	3.09	42.45	0.33	207	2,431	0.0050	20	4	0-12	15.46
8/3	2	8/3	3.95	--	--	----	----	----	----	0.05	16.93	----	0.51	42.96	----	36	2,467	------	--	--	----	----
8/10	7			--	--	----	----	----	----	1.11	18.04	----	2.02	44.98	----	144	2,611	------	40	14	0-12	17.80
9/1	22			20	14	5.27	----	----	5.27	----	23.31	0.24	5.56	50.54	0.92	402	3,013	0.0131	20	4	0-12	12.53
9/2	1	9/2	4.38	--	--	----	----	----	----	0.12	23.43	----	0.29	50.83	----	26	3,039	------	--	--	----	----
9/12	10	9/12	NR	--	--	----	----	----	----	1.13	24.56	----	2.06	52.89	----	164	3,203	------	30	6	----	----
9/16	4			--	--	----	----	----	----	0.42	24.98	----	0.84	53.73	----	61	3,264	------	50	18	0-12	20.27
9/22	6			8	5	1.58	0.16	----	1.58		26.56	0.26	1.19	54.92	1.33	98	3,362	0.0161	75	18	0-12	18.69
9/29	7			--	--	----	----	----	----	0.72	27.28	----	1.44	56.36	----	108	3,470	------	20	4	0-12	17.97
10/7	8			15	12	0.59	0.20	----	0.59	----	27.87	0.07	1.32	57.68	0.45	110	3,580	0.0054	30	6	0-12	17.38
10/27	20			16	8	1.83	0.16	----	1.83	----	29.70	0.09	2.53	60.21	0.72	231	3,811	0.0079	50	13	0-12	15.55
11/18	22			19	10	-1.153/	0.14	2.02	0.87	----	30.57	0.04	1.60	61.81	0.54	179	3,990	0.0049	10	4	0-12	16.76
TOTALS	221					16.67		2.57	18.69	11.88	30.57		44.51			3,231						
CENTRAL VALLEY (continued)																		
Cotton											4/30/59		3/	12/31/58		3/	3/1/59	
Arvin (CD), 1959																		
2/10	8	2/10	12	--	--	----	----	----	----	----	----	----	----	----	----	----	----	----
Planted		4/1-4																
4/30				--	--	----	----	----	----	----	0.00	----	----	15.89	----	----	863	------
5/8	8			--	--	----	----	----	----	0.13	0.13	----	1.68	17.57	----	117	980	------
5/21	13			23	2	0.32	0.05	----	0.32	----	0.45	0.02	3.88	21.45	0.08	217	1,197	0.0015
5/26	5	5/26	4.1	--	--	----	----	0.00	----	0.12	0.57	----	1.52	22.97	----	70	1,267	------
6/3	8			--	--	----	----	0.00	----	1.42	1.99	----	2.24	25.21	----	140	1,407	------
6/11	8			22	3	1.12	0.19	0.00	1.12	----	3.11	0.14	2.66	27.87	0.42	165	1,572	0.0068
6/16	5			22	3	0.76	0.10	0.00	0.76	----	3.87	0.15	1.53	29.40	0.50	87	1,659	0.0087
6/17	1	6/17	3.8	--	--	----	----	0.00	----	0.14	4.01	----	0.28	29.68	----	20	1,679	------
6/23	6			--	--	----	----	0.00	----	2.37	6.38	----	1.88	31.56	----	133	1,812	------
6/30	7			22	5	2.67	0.12	0.00	2.67	----	9.05	0.38	2.11	33.67	1.26	126	1,938	0.0212
7/7	7			22	5	2.41	0.18	0.00	2.41	----	11.46	0.34	2.43	36.10	0.99	138	2,076	0.0175
7/11	4	7/11	3.8	--	--	----	----	0.00	----	1.34	12.80	----	1.35	37.45	----	84	2,160	------
7/15	4			--	--	----	----	0.00	----	1.45	14.25	----	1.21	38.66	----	75	2,235	------
7/21	6			21	6	2.15	0.20	0.00	2.15	----	16.40	0.36	1.79	40.45	1.20	116	2,351	0.0185
7/21																		
7/28	7			21	7	2.40	0.22	0.00	2.40	----	18.80	0.34	2.23	42.68	1.08	120	2,471	0.0200
7/28																		
8/4	7			21	8	2.31	0.24	0.00	2.31	----	21.11	0.33	2.23	44.91	1.04	126	2,597	0.0183
8/7	3	8/7	3.6	--	--	----	----	0.00	----	0.85	21.96	----	0.82	45.73	----	55	2,652	------
8/11	4			--	--	----	----	0.00	----	1.01	22.97	----	1.33	47.06	----	76	2,728	------
8/18	7			22	8	1.38	0.24	0.00	1.38	----	24.35	0.20	1.91	48.97	0.72	125	2,853	0.0110
8/20	2	8/20	3.4	--	--	----	----	0.00	----	0.34	24.69	----	0.47	49.44	----	28	2,881	------
8/25				--	--	----	----	0.00	----	1.16	25.85	----	1.16	50.60	----	78	2,959	------
9/2	8			22	9	2.22	0.24	0.00	2.22	----	28.07	0.23	2.23	52.83	1.00	146	3,105	0.0152
9/10	8			22	9	1.[illegible]2	0.24	0.00	1.[illegible]	----	29.58	0.19	1.73	54.56	0.88	138	3,243	0.0110
9/24	14			22	11	1.99	0.24	0.34	2.	----	31.92	0.17	2.45	57.01	0.9[illegible]	200	3,443	0.011[illegible]
9/24																		

Area, crop, station: name, and period of ending	Crop development: Estimated percent ground cover	Crop development: Plant height, inches	Crop development: Root zone, inches	Available soil moisture: Soil moisture, inches	Available soil moisture: Soil moisture, inches
TULARE LAKE BASIN (continued)					
Alfalfa (continued)					
Arvin (CD), 1960 (continued)					
6/1	--	--	----	----	
6/17	--	--	----	----	
6/24	20	4	0-12	19.66	
7/1	45	5	0-12	18.95	
7/2	--	--	----	----	
7/8	60	12	0-12	20.02	
7/21	100	3	0-12	16.49	
8/1	20	4	0-12	15.46	
8/3	--	--	----	----	
8/10	40	14	0-12	17.80	
9/1	20	4	0-12	12.53	
9/2	--	--	----	----	
9/12	30	6	----	----	
9/16	50	18	0-12	20.27	
9/22	75	18	0-12	18.69	
9/29	20	4	0-12	17.97	
10/7	30	6	0-12	17.38	
10/27	50	13	0-12	15.55	
11/18	10	4	0-12	16.76	
CENTRAL VALLEY (continued)					
Cotton					
Arvin (CD), 1959					
2/10	--	--	----	----	
Planted					
4/30	NR	NR	----	----	
5/8	1	4	0-2	1.58	
5/21	2	5½	0-2	1.23	
5/26	NR	NR	----	----	
6/3	5	9	0-3	2.75	
6/11	NR	14	0-3	1.66	
6/16	15	3	0-3	0.90	
6/17	NR	NR	----	----	
6/23	30	NR	0-5	8.38	
6/30	NR	34	0-9	[illegible]	
7/7	NR	NR	0-5	3.28	
7/11	NR	NR	----	----	
7/15	80	38	[illegible]	[illegible]	
7/21	80	39	[illegible]	[illegible]	
7/21			0-7	7.[illegible]	
7/28	85	42	0-7	[illegible]	
7/28			0-[illegible]	[illegible]	
8/4	90	42	0-8	[illegible]	
8/7	NR	NR	----	----	
8/11	90	[illegible]	0-[illegible]	[illegible]	
8/18	90	47	0-8	[illegible]	
8/20	NR	NR	----	----	
8/25	100	[illegible]	0-9	[illegible]	
9/2	[illegible]	49	0-9	[illegible]	
9/10	65	NR	0-9	[illegible]	
9/24	0	NR	0-11	[illegible]	
9/24			0-[illegible]	[illegible]	

NEUTRON PROBE MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA FOR SEVERAL IRRIGATED CROPS,
1959 AND 1960

Area, crop, station: name, number and period of ending	Date	Depth of applied water	Inches	Soil moisture determination: Number of access tubes	Moisture depletion depth, feet	Soil moisture change, in inches: Mean	Twice standard error	Precipitation, in inches	Evapotranspiration (ET), in inches: Measured	Estimated	Accumulated mean daily rate	Accumulated from period	Pan evaporation (Ep), in inches: Pan coefficient, Ep/Ep	Accumulated from	Black minus white atmometer evaporation, in milliliters: Mean	Atmometer coefficient, E/Ep-W	Estimated from	Crop development: percent ground cover	Plant height, inches	Root zone, feet	Available soil moisture: Soil moisture, inches
TULARE LAKE BASIN (continued)																					
Cotton (continued)																					
Arvin (CD), 1959 (continued)																					
10/19	25			22	12	3.68	0.20	0.00	3.68	----	32.60	0.14	4.21	61.22	0.88	372	3,815	0.0099	75	NR	0-12	3.44
Defoliated--- 10/19																					
11/4	16			21	12	0.36	0.12	0.00	0.36	----	35.96	0.02	2.01	63.23	0.18	163	3,978	0.0022	NR	NR	0-12	3.08
12/17	43			21	12	0.33	0.14	T	0.33	----	36.29	0.01	3.21	66.44	0.10	---	-----	------	NR	NR		
12/31	14			--	--	----	----	----	----	0.03	36.32	----	0.68	67.12	----	---	-----	------	NR	NR		
TOTALS	245		30.7			25.62		0.34	25.96	10.36	36.32		51.23			3,115					
Arvin (CP), 1960											3/18/60		2/	1/1/60		3/	3/23/60					
3/18		3/18	6.20	--	--	----	----	----	----	----	0.00	----	----	6.19	----	---	-----	------	--	--	----	-----
3/23	5			--	--	----	----	----	----	0.50	0.50	----	0.85	7.04	----	----	000	------	0	0	0-1	1.53
Planted -----4/7																					
5/6	44			10	2	-0.08 3/		1.52	1.46	----	1.96	0.03	8.40	15.44	0.17	634	634	0.0023	1	--	0-1	1.52
5/26	20			23	10 b/	0.20	0.48	----	0.20	----	2.16	0.01	5.86	21.30	0.03	369	1,003	0.0005	2	4	0-1	1.39
5/26																					0-2	2.61
6/9	14			23	10 b/	0.17	----	----	0.17	----	2.33	0.01	4.53	25.83	0.04	297	1,300	0.0006	2	8	0-2	2.44
6/9																					0-3	3.24
6/15	6	6/15	3.44	7	3	0.84	0.56	----	0.84	----	3.17	0.14	2.03	27.86	0.41	131	1,431	0.0064	4	10	0-3	2.40
6/20	5			--	--	----	----	----	----	1.81	4.98	----	1.82	29.68	----	124	1,555	------	10	12	0-4	5.72
6/30	10			22	4	2.41	0.20	----	2.41	----	7.39	0.24	3.20	32.88	0.75	226	1,781	0.0107	30	16	0-4	3.31
6/30																					0-5	4.87
7/7	7			22	5	1.94	0.14	----	1.94	----	9.33	0.28	2.13	35.01	0.91	138	1,919	0.0140	40	24	0-5	2.93
7/8	1	7/8	4.01	--	--	----	----	----	----	0.25	9.58	----	0.31	35.32	----	24	1,943	------	--	24	----	-----
7/15	7			--	--	----	----	----	----	2.38	11.96	----	2.23	37.55	----	155	2,098	------	60	28	0-7	5.09
7/22	7			13	7	2.20	0.30	----	2.20	----	14.22	0.32	2.12	39.67	1.07	148	2,246	0.0153	55	32	0-7	2.83
7/22																					0-9	4.06
7/28	6			13	9	1.80	0.20	----	1.80	----	16.11	0.32	1.47	41.14	1.28	101	2,347	0.0187	--	36	0-9	2.17
7/29	1	7/29	2.78	--	--	----	----	----	----	0.29	16.40	----	0.27	41.41	----	19	2,366	------	--	36	----	-----
8/9	11			--	--	----	----	----	----	3.96	20.36	----	3.17	44.58	----	215	2,581	------	80	40	0-9	4.69
8/19	10			23	9	3.26	0.46	----	3.28	----	23.64	0.33	2.62	47.20	1.25	198	2,779	0.0166	80	40	0-9	1.41
8/20	1	8/20	8.94	--	--	----	----	----	----	0.49	24.13	----	0.39	47.59	----	29	2,808	------	--	44	----	-----
8/23	3			--	--	----	----	----	----	2.98	26.67	----	0.95	48.54	----	57	2,865	------	5	44	0-9	8.27
8/31	8			23	7	1.29	0.14	----	1.29	----	28.37	0.16	1.71	50.25	0.75	127	2,992	0.0102	60	40	0-9	6.98
9/8	8			23	5	1.0	0.12	----	1.00	----	29.04	0.20	1.79	52.04	0.89	141	3,133	0.0113	60	40	0-9	5.36
9/21	13			23	9	2.7	0.1	----	2.7	----	30.71	0.21	2.62	54.66	1.05	205	3,338	0.0134	--	40	0-9	2.63
10/14	23			23	9	1.9	0.22	----	1.9	----	32.60	0.08	3.96	58.62	0.45	318	3,656	0.0056	60	40	0-9	0.84
Defoliated---10/19																					
11/22	39			23	10	-1.10 3/	0.30	2.04	0.94	----	33.44	0.02	3.45	62.07	0.27	364	4,021	0.0026	--	40	0-9	1.94
1/16/61	55			22	7	-0.20 3/	0.22	0.77	0.57	----	34.01	0.01	2.06	64.13	0.28	NR	-----	------	--	30	----	-----
3/10/61	53			22	8	1.40	0.26	0.75	2.20	----	36.27	0.04	4.20	68.33	0.54	NR	-----	------	--	--	----	-----
TOTALS	357		25.34			20.74		.11	2.65	10.62	36.27		62.14			4,021					
Plums																					
Arvin (CB), 1959											3/31/59		2/	12/31/[illegible]		3/	3/1/59					
3/27		3/27	NR	--	--	----	----	----	----	----	----	----	----	----	----	---	-----	------	--	--	----	-----
3/31	--			--	--	----	----	0.00	----	----	0.00	----	----	3.08	----	---	390	------	NR	--	----	-----
4/8	2			--	--	----	----	0.00	----	0.18	0.19	----	0.35	9.23	----	30	420	------	NR	--	----	-----
4/18	16			5	7.6	1.40	1.20	0.00	1.[illegible]	----	2.07	0.12	3.42	12.6[illegible]	0.5[illegible]	262	682	0.0072	NR	--	----	-----
5/6	18			5	7.6	1.70	0.04	0.00	2.1[illegible]	----	4.2[illegible]	0.12	4.39	17.04	0.50	2[illegible]	940	0.0084	45	--	----	-----
5/7	1	5/7	NR	--	--	----	----	0.00	----	0.13	4.33	----	0.26	17.30	----	22	962	------	NR	--	----	-----
5/11	4			--	--	----	----	0.00	----	0.97	5.3[illegible]	----	1.04	18.34	----	62	1,024	------	NR	--	----	-----
5/25	14	5/25	NR	--	--	----	----	0.00	----	2.2[illegible]	7.17	----	4.2[illegible]	22.[illegible]	----	220	1,244	------	NR	--	----	-----
5/31	[illegible]			--	--	----	----	0.20	----	1.[illegible]	8.72	----	1.42	24.[illegible]	----	115	1,359	------	NR	--	----	-----
6/8	8			6	16.[illegible]	1.4[illegible]	0.[illegible]0	0.00	1.4[illegible]	----	11.17	0.1[illegible]	2.21	26.7[illegible]	0.86	136	1,495	0.0107	NR	--	----	-----

TABLE A-6 (continued)

NEUTRON PROBE MEASUREMENTS OF EVAPOTRANSPIRATION
AND RELATED DATA FOR SEVERAL IRRIGATED CROPS,
1959 AND 1960

Area, crop, station name, and period of ending	Number of days	Date	Depth of applied water Inches	Soil moisture determination: Number of access tubes	Moisture depletion depth, feet	Soil moisture change, in inches: Mean	Soil moisture change, in inches: Twice standard error	Precipitation, inches	Evapotranspiration (ET), in inches: Measured	Evapotranspiration (ET), in inches: Estimated	Evapotranspiration (ET), in inches: Accumulated from	Pan evaporation (Ep), in inches: Measured daily rate	Pan evaporation (Ep), in inches: Estimated for period	Pan evaporation (Ep), in inches: Accumulated from	Pan coefficient, Ep	Black minus white atmometer evaporation, in milliliters: Mean	Black minus white atmometer evaporation, in milliliters: Accumulated from	Black minus white atmometer evaporation, in milliliters: Estimated coefficient, ET/Eb-w	Crop development: Percent ground cover	Crop development: Plant height, inches	Available soil moisture: Estimated Root zone, feet	Available soil moisture: Soil moisture, inches
TULARE LAKE BASIN (continued)																						
Plums (continued)																						
Arvin (CB), 1959 (continued)																						
6/24	16			6	16.5	3.54	1.18	0.00	3.54	----	14.71	0.22	5.07	31.82	0.70	328	1,823	0.0108	NR	--	----	----
7/4	10	7/4	NR	--	--	----	----	0.00	----	2.28	16.99	----	3.26	35.08	----	184	2,007	------	NR	--	----	----
7/9	5			--	--	----	----	0.00	----	1.63	18.62	----	1.73	36.81	----	101	2,108	------	50	--	----	----
7/27	18			6	16.0	4.25	0.82	0.00	4.25	----	22.87	0.24	5.47	42.28	0.78	339	2,447	0.0125	NR	--	----	----
8/3	7			6	16.0	2.15	0.26	0.00	2.15	----	25.02	0.31	2.18	44.46	0.99	112	2,559	0.0192	NR	--	----	----
8/10	7	8/10	NR	--	--	----	----	0.00	----	2.15	27.17	----	2.17	46.63	----	139	2,698	------	NR	--	----	----
8/17	7			--	--	----	----	0.00	----	1.41	28.58	----	1.92	48.55	----	126	2,824	------	60	--	----	----
9/17	31			6	16.0	3.09	1.58	0.34	4.23	----	32.81	0.14	7.13	55.68	0.59	508	3,332	0.0083	NR	--	----	----
11/5	49			6	16.0	1.73	0.40	0.00	1.73	----	34.54	0.04	7.60	63.28	0.23	763	4,095	0.0023	40	--	----	----
11/20	15			6	16.0(-)	0.26a/	0.12	0.00	0.00	----	34.54	0.00	1.36	64.64	0.00	44	4,139	0.0000	10	--	----	----
11/30	10	--		--	--	----	----	0.00	----	0.00	34.54	----	0.76	65.40	----	102	4,241	------	NR	--	----	----
TOTALS	244					20.63		0.78	21.41	13.13	34.54		56.52			3,851						
Arvin (CB), 1960											6/1/60		2/	1/1/60		3/	3/23/60					
6/1		6/1	NR	--	--	----	----	----	----	----	0.00	----	----	23.05	----	---	1,108	------	--	--	----	----
6/6	6			--	--	----	----	----	----	2.04	2.04	----	1.83	24.88	----	125	1,233	------	40	--	----	----
6/14	7			6	d/	2.48	1.16	----	2.48	----	4.52	0.35	2.61	27.49	0.95	178	1,411	0.0139	60	--	----	----
6/27	13			6	d/	2.89	0.74	----	2.89	----	7.41	0.22	4.37	31.86	0.66	294	1,705	0.0098	45	--	----	----
7/7	10	7/7	NR	--	--	----	----	----	2.07	9.48	----	3.14	35.00	----	215	1,920	------	--	--	----	----
7/12	7			6	--	----	----	----	----	1.83	11.31	----	1.65	36.65	----	112	2,032	------	50	--	----	----
7/27	15			6	d/	4.08	2.04	----	4.08	----	15.39	0.27	4.24	40.89	0.96	298	2,330	0.0137	50	--	----	----
8/9	13	8/9	NR	--	--	----	----	----	----	3.62	19.01	----	3.78	44.67	----	261	2,591	------	--	--	----	----
8/11	2			6	--	----	----	----	----	0.40	19.41	----	0.55	45.22	----	34	2,625	------	--	--	----	----
9/2	22			6	d/	4.06	2.39	----	4.06	----	23.47	0.18	5.59	50.81	0.73	413	3,038	0.0098	45	--	----	----
9/23	21	9/23	NR	--	--	----	----	----	----	3.14	26.61	----	4.30	55.11	----	334	3,372	------	--	--	----	----
9/28	6			6	--	----	----	----	----	1.01	27.62	----	1.01	56.12	----	76	3,448	------	45	--	----	----
10/12	14			6	d/	1.18	1.33	T	1.18	----	28.80	0.08	2.22	58.34	0.53	180	3,628	0.0066	45	--	----	----
11/29	48			6	d/	-1.83a/	0.81	2.75	0.94	----	29.74	0.02	4.16	62.50	0.22	445	4,073	0.0021	01	--	----	----
TOTALS	184					12.86		2.75	15.63	14.11	29.74		39.45			2,965						

1/ Mean of three pairs of Livingston black and white spherical atmometers.

2/ Mean of three U. S. Weather Bureau standard evaporation pans.

3/ Mean of four pairs of Livingston black and white spherical atmometers.

a/ Minus value indicates soil moisture accretion.

b/ Depletion depths selected to recover unsaturated moisture flow into drier soil.

c/ Soil moisture measurements on 3/23 based on 10 soil tube cores; soil moisture measurements on 5/6 based on neutron probe.

d/ Used 13 feet for tubes 2, 3, 4, and 6; 14 feet for tube 1; and 20 feet for tube 5.

TABLE A-7

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/ /Eb-w	Pan evaporation Ep, in inches	ET/ /Ep
						CENTRAL VALLEY							
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS													
Pasture	1959												
Alturas-Dorris Ranch a/b/	Apr. 7	-	----	----	----	----	----	---	---	---	----	----	----
	Apr. 14	7	1.21	1.27	----	1.24	0.18	---	---	---	----	1.34	0.93
	Apr. 21	7	1.49	1.28	----	1.39	0.20	---	---	---	----	1.34	1.04
	Apr. 30	9	1.32	1.49	----	1.40	0.16	---	---	---	----	1.67	0.84
	May 5	5	0.66	0.89	----	0.77	0.15	---	---	---	----	1.29	0.60
	May 12	7	1.49	1.30	----	1.39	0.20	---	---	---	----	1.34	1.04
	May 19	7	1.37	1.46	----	1.42	0.20	---	---	---	----	1.27	1.12
	May 26	7	1.81	1.49	----	1.65	0.24	---	---	---	----	1.36	1.21
	May 31	5	0.68	0.83	----	0.76	0.15	---	---	---	----	0.83	0.92
	June 2	2	0.58	0.67	----	0.62	0.31	---	---	---	----	0.48	1.29
	June 9	7	2.18	2.20	----	2.19	0.31	425	311	114	0.0192	1.74	1.26
	June 16	7	2.23	2.04	----	2.14	0.31	524	383	141	0.0151	2.01	1.06
	June 23	7	2.51	2.26	----	2.38	0.34	516	363	153	0.0156	2.12	1.12
	June 30	7	1.54	1.70	----	1.62	0.23	350	248	102	0.0160	1.59	1.02
	July 7	7	2.48	2.39	----	2.44	0.35	552	401	151	0.0161	2.57	0.95
	July 14	7	2.41	2.40	----	2.41	0.34	556	383	153	0.0157	2.00	1.20
	July 21	7	2.64	2.80	----	2.72	0.39	536	394	142	0.0191	1.99	1.37
	July 28	7	2.05	2.06	----	2.06	0.29	c/	c/	c/	c/	2.38	0.87
	July 31	3	0.79	0.85	----	0.82	0.27	876	677	199	0.0145	0.89	0.92
	Aug. 4	4	1.30	1.39	----	1.34	0.34	460	346	114	0.0118	1.46	0.92
	Aug. 11	7	2.21	1.98	----	2.10	0.30	428	336	92	0.0255	1.97	1.07
	Aug. 18	7	1.99	2.48	----	2.24	0.32	548	413	135	0.0166	1.99	1.12
	Aug. 25	7	1.49	1.58	----	1.54	0.22	372	265	107	0.0144	1.47	1.05
	Aug. 31	6	1.84	1.31	----	1.57	0.26	423	324	99	0.0159	1.76	0.89

TABLE A-7 (continued)

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/ /Eb-w	Pan evaporation Ep, in inches	ET/ /Ep
CENTRAL VALLEY (continued)													
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)													
Pasture (continued)	1959												
Alturas Dorris Ranch a/b/ (continued)	Sept. 1	1	0.23	0.24	----	0.23	0.23	57	39	18	0.0130	0.07	3.29
	Sept. 8	7	1.43	1.37	----	1.40	0.20	446	319	127	0.0110	1.70	0.82
	Sept. 15	7	1.42	1.34	----	1.38	0.20	497	401	96	0.0144	1.74	0.79
	Sept. 22	7	0.85	0.68	----	0.77	0.11	231	157	74	0.0104	0.84	0.92
	Sept. 30	8	1.33	0.91	----	1.12	0.14	---	---	---	----	1.06	1.06
	Oct. 6	6	0.85	0.77	----	0.81	0.14	---	---	---	----	0.95	0.85
	Oct. 13	7	0.25	0.29	----	0.27	0.04	---	---	---	----	0.68	0.40
	Oct. 20	7	0.66	0.50	----	0.58	0.08	---	---	---	----	0.94	0.62
	Oct. 27	7	0.41	0.59	----	0.50	0.07	---	---	---	----	0.61	0.82
	Oct. 31	4	0.94	0.04	----	0.49	0.12	---	---	---	----	c/	c/
	Nov. 2	2	0.70	0.04	----	0.37	0.18	---	---	---	----	0.62	1.39
	1960												
	Apr. 8	-	----	----	----	----	----	---	---	---	----	----	----
	Apr. 11	3	0.46	----	----	----	0.15	---	---	---	----	0.59	0.78
	Apr. 18	7	0.61	0.79	----	0.70	0.10	---	---	---	----	0.95	0.74
	Apr. 25	7	0.47	0.60	----	0.54	0.08	---	---	---	----	0.89	0.61
	May 1	6	0.61	0.65	----	0.63	0.10	---	---	---	----	1.07	0.59
	May 9	8	0.62	----	----	----	0.08	---	---	---	----	1.20	0.52
	May 16	7	1.53	----	----	----	0.22	---	---	---	----	1.88	0.81
	May 23	7	----	1.14	----	----	0.16	---	---	---	----	1.21	0.94
	May 25	2	0.32	0.30	----	0.31	0.16	---	---	---	----	0.25	1.24
	May 31	6	1.01	----	----	----	0.17	---	---	---	----	1.17	0.86

TABLE A-7 (continued)

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/Eb-w	Pan evaporation Ep, in inches	ET/Ep
CENTRAL VALLEY (continued)													
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)													
Pasture (continued)	1960												
Alturas Dorris Ranch a/b/ (continued)	June 7	7	----	----	----	1.96 d/	0.28	500 f/	360 f/	140 f/	----	1.96	----
	June 14	7	1.41	----	----	----	0.20	437	308	129	0.0109	1.73	0.82
	June 21	7	----	----	----	1.96 d/	0.28	459	343	116	----	1.96	----
	June 22	1	----	----	----	0.26 e/	0.26	c/	c/	c/	----	c/	----
	June 28	6	1.36	----	----	----	0.23	459	319	140	0.0116 g/	1.98	0.82 g/
	July 5	7	1.94	1.92	----	1.93	0.28	466	331	135	0.0143	1.82	1.06
	July 12	7	2.21	2.39	----	2.30	0.33	536	410	126	0.0183	2.11	1.09
	July 19	7	2.42	2.32	----	2.37	0.34	524	385	139	0.0170	1.95	1.21
	July 26	7	----	2.24	----	----	0.32	592	469	123	0.0182	2.18	1.03
	Aug. 1	6	----	1.49	----	----	0.20	347	262	85	0.0175	1.39	1.07
	Aug. 3	2	----	0.62	----	----	0.31	c/	c/	c/	----	0.55	1.13
	Aug. 8	5	----	1.47	----	----	0.29	495	370	125	0.0118	1.32	1.11
	Aug. 16	8	----	2.46	----	----	0.31	540	430	110	0.0224	2.27	1.08
	Aug. 22	6	----	1.97	----	----	0.33	546	433	113	0.0174	1.82	1.08
	Aug. 29	7	----	1.88	----	----	0.27	387	282	105	0.0179	1.55	1.21
	Aug. 31	2	0.59	----	----	----	0.30	133	106	27	0.0218	0.51	1.16
	Sept. 5	5	1.25	----	----	----	0.25	358	285	73	0.0171	1.31	0.95
	Sept. 12	7	1.44	----	----	----	0.21	371	272	99	0.0145	1.32	1.09
	Sept. 19	7	1.37	----	----	----	0.20	406	300	106	0.0129	1.44	0.95
	Sept. 26	7	1.37	1.21	----	1.29	0.18	371	272	99	0.0130	1.24	1.04
	Sept. 30	4	0.63	0.69	----	0.66	0.16	188	144	44	0.0150	0.60	1.10
	Oct. 3	3	0.49	0.45	----	0.47	0.16	159	116	43	0.0109	0.50	0.94
	Oct. 10	7	0.86	0.94	----	0.90	0.13	---	---	---	----	0.94	0.96
	Oct. 16	6	0.64	----	----	----	0.11	---	---	---	----	0.61	1.05

TABLE A-7 (continued)

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/Eb-w	Pan evaporation Ep, in inches	ET/Ep
						CENTRAL VALLEY (continued)							
SACRAMENTO RIVER BASIN MOUNTAIN VALLEYS (continued)													
Pasture (continued)	1960												
Alturas Dorris Ranch a/b/ (continued)	Oct. 22	6	0.64	0.66	----	0.65	0.11	---	---	---	----	0.76	0.86
	Oct. 28	6	0.60	0.72	----	0.66	0.11	---	---	---	----	0.74	0.89
	Oct. 31	3	0.21	0.26	----	0.24	0.08	---	---	---	----	0.26	0.92
	Nov. 7	7	----	----	----	0.55 d/	0.08	---	---	---	----	0.59	----
	Nov. 14	7	----	----	----	0.13 d/	0.02	---	---	---	----	0.14	----
	Nov. 21	7	----	----	----	0.03 d/	0.00	---	---	---	----	0.03	----
	Dec. 1	10	0.23	0.11	----	0.17	0.02	---	---	---	----	0.38	0.45
	Dec. 9	8	0.12	0.46	----	0.29	0.04	---	---	---	----	0.16	1.81
	Dec. 14	5	0.02	0.18	----	0.10	0.02	---	---	---	----	0.09	1.11
	Dec. 20	6	0.13	0.21	----	0.17	0.03	---	---	---	----	0.12	1.42
	Dec. 28	8	0.11	0.19	----	0.15	0.02	---	---	---	----	0.23	0.65
	Dec. 31	3	0.07	0.01	----	0.04	0.01	---	---	---	----	0.02	0.20
SACRAMENTO RIVER BASIN VALLEY FLOOR													
Ryegrass	1958												
Davis Campbell h/i/	Sept. 6	-	----	----	----	----	----	---	---	---	----	----	----
	Sept. 10	4	1.22	0.80	1.04	1.02	0.26	344	270	74 b/	0.0138	1.28	0.80
	Sept. 13	3	----	----	----	----	----	189	133	56 b/	----	0.75	----
	Sept. 18	5	1.10	0.98	0.98	1.02	0.20	469	369	100 b/	0.0102	1.62	0.63
	Sept. 25	7	1.70	1.03	1.03	1.25	0.18	673	539	134 b/	0.0093	2.22	0.57
	Sept. 29	4	----	----	----	----	----	298	222	76 b/	----	0.89	----
	Oct. 6	7	1.96	1.53	1.47	1.65	0.24	565	470	95 j/	0.0174	1.81	0.91
	Oct. 15	9	2.02	1.96	1.59	1.86	0.21	681	572	109 j/	0.0171	2.10	0.89
	Oct. 22	7	1.13	1.13	1.19	1.15	0.16	486	421	65 j/	0.0177	1.43	0.81
	Oct. 29	7	0.80	0.86	0.98	0.88	0.13	297	246	51 j/	0.0172	0.92	0.96

TABLE A-7 (continued)

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/Eb-w	Pan evaporation Ep, in inches	ET/Ep
			CENTRAL VALLEY (continued)										
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)													
Ryegrass (continued)	1958												
Davis Campbell h/i/ (continued)	Nov. 4	6	----	----	----	----	----	231	189	42 j/	----	0.64	----
	Nov. 13	9	0.99	0.93	1.12	1.01	0.11	377	316	61 j/	0.0166	1.26	0.80
	Nov. 18	5	0.48	0.60	0.48	0.52	0.10	---	---	---	----	0.50	1.04
	Nov. 26	8	0.43	0.31	0.37	0.37	0.05	---	---	---	----	0.46	0.80
	Dec. 2	6	0.55	0.49	0.31	0.45	0.08	---	---	---	----	----	----
	Dec. 15	13	0.06	0.37	0.18	0.20	0.02	---	---	---	----	----	----
	Dec. 31	16	0.60	0.53	0.60	0.58	0.04	---	---	---	----	----	----
	1959												
	Dec. 31	-	----	----	----	----	----	---	---	---	----	----	----
	Feb. 2	33	1.22	1.40	1.65	1.42	0.04	---	---	---	----	2.03	0.70
	Feb. 19	17	1.53	2.08	1.71	1.77	0.10	---	---	---	----	1.46	1.21
	Feb. 27	8	0.42	0.60	0.48	0.50	0.06	---	---	---	----	0.72	0.69
	Mar. 17	18	2.20	2.45	3.43	2.69	0.15	---	---	---	----	4.31	0.62
	Apr. 1	15	1.47	1.84	1.96	1.76	0.13	---	---	---	----	2.26	0.78
	Apr. 16	15	2.69	3.24	1.59	2.51	0.17	---	---	---	----	4.26	0.59
	Apr. 20	4	----	----	----	0.54 k/	0.14	---	---	---	----	0.93	----
	Apr. 23	3	----	----	----	0.35 k/	0.12	---	---	---	----	0.61	----
	Apr. 30	7	----	----	----	0.93 k/	0.13	---	---	---	----	1.59	----
	May 7	7	1.41	1.10	0.92	1.14	0.16	---	---	---	----	1.99	0.57
	May 14	7	1.84	1.65	1.71	1.73	0.25	---	---	---	----	2.35	0.74
	May 21	7	----	----	----	1.56 k/	0.22	---	---	---	----	2.56	----
	May 28	7	0.98	1.10	I.10	1.06	0.15	---	---	---	----	1.91	0.56

TABLE A-7 (continued)

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/Eb-w	Pan evaporation Ep, in inches	ET/Ep
CENTRAL VALLEY (continued)													
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)													
Ryegrass (continued)	1959												
Davis Campbell	June 4	7	----	----	----	1.34 k/	0.19	---	---	---	----	2.23	----
h/i/ (continued)	June 8	4	----	----	----	0.85 k/	0.21	---	---	---	----	1.44	----
	June 15	7	1.35	2.14	1.53	1.67	0.24	---	---	---	----	2.23	0.75
	June 22	7	----	----	----	1.86 k/	0.26	---	---	j/	----	2.63	----
	June 30	8	----	----	----	2.22 k/	0.28	787	584	j/	----	3.09	----
	July 7	7	2.09	2.15	2.02	2.09	0.30	654	490	164 j/	0.0127	2.69	0.78
	July 13	6	1.71	1.64	1.38	1.58	0.26	580	464	116 j/	0.0136	2.10	0.75
	July 23	10	2.57	2.69	2.94	2.73	0.27	879	685	182 j/	0.0140	3.46	0.79
	July 29	6	1.90	1.87	1.35	1.71	0.28	537	416	121 j/	0.0141	2.49	0.69
	Aug. 3	5	1.67	1.51	1.16	1.45	0.29	427	337	j/	0.0161	1.73	0.84
	Aug. 10	7	1.71	1.77	1.74	1.74	0.25	---	---	j/	----	1.89	0.92
	Aug. 12	2	0.43	0.44	0.58	0.48	0.24	---	---	j/	----	0.63	0.76
	Aug. 18	6	1.44	1.28	1.41	1.38	0.23	---	---	j/	----	1.93	0.72
	Aug. 22	4	0.74	0.66	0.41	0.60	0.15	---	---	j/	----	1.10	0.54
	Aug. 28	6	1.13	1.35	1.28	1.25	0.21	---	---	j/	----	1.61	0.78
	Aug. 31	3	0.83	0.67	0.76	0.75	0.25	201	139	j/	0.0121	0.99	0.76
	Sept. 3	3	----	----	----	0.76 k/	0.25	225	165	j/	----	0.59	----
	Sept. 11	8	1.71	1.84	1.84	1.80	0.22	586	423	163 j/	0.0110	2.45	0.73
	Sept. 14	3	----	0.46	0.49	0.48	0.16	229	172	57 j/	0.0084	0.84	0.57
	Sept. 21	7	1.12	0.87	0.96	0.98	0.14	249	164	105 j/	0.0115	1.07	0.92
	Sept. 23	2	0.28	0.21	0.43	0.31	0.16	146	108	38 j/	0.0082	0.50	0.62
	Oct. 2	9	2.63 l/	2.08	2.02	2.06	0.23	963	803	160 j/	0.0129	3.37	0.61
	Oct. 7	5	0.57 l/	0.60	0.53	0.56	0.11	261	192	69 j/	0.0081	0.87	0.64
	Oct. 16	9	1.94 l/	1.61	1.46	1.54	0.17	634	496	138 j/	0.0112	2.00	0.77
	Oct. 24	8	1.16 l/	0.73	0.80	0.76	0.10	416	310	105 j/	0.0072	1.12	0.68

TABLE A-7 (continued)

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/ /Eb-w	Pan evaporation Ep, in inches	ET/ /Ep
					CENTRAL VALLEY (continued)								
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)													
Ryegrass (continued)	1959												
Davis Campbell	Nov. 2	9	1.38[l]	1.43	1.37	1.40	0.16	752	634	113[j]	0.0143	2.67	0.52
h/i/ (continued)	Nov. 12	10	0.84[l]	0.67	----	0.67	0.07	472	360	112[j]	0.0060	1.23	0.54
	Nov. 20	8	0.49	0.55	----	0.52	0.06	---	---	---	----	0.58	0.90
	Dec. 5	15	0.83	0.92	1.04	0.93	0.06	---	---	---	----	2.38	0.41
	Dec. 15	10	0.28	0.31	0.34	0.31	0.31	---	---	---	----	1.04	0.30
	Dec. 22	7	0.24	0.12	0.21	0.19	0.03	---	---	---	----	0.31	0.61
	Dec. 31	9	0.48	0.39	0.27	0.38	0.04	---	---	---	----	0.33	1.15
	1960												
	Dec. 31	-	----	----	----	----	----	---	---	---	----	----	----
	Jan. 12	12	0.22	0.34	0.34	0.30	0.02	---	---	---	----	0.73	0.41
	Jan. 19	7	0.21	0.28	0.09	0.19	0.03	---	---	---	----	0.37	0.51
	Jan. 26	7	0.57	0.11	0.24	0.31	0.04	---	---	---	----	0.28	1.11
	Jan. 30	4	0.03	0.00	0.09	0.04	0.01	---	---	---	----	0.10	0.40
	Feb. 8	9	---	----	m/	0.16[n]	0.02	---	---	---	----	0.60	0.27
	Feb. 15	7	----	----	m/	0.53[n]	0.08	---	---	---	----	0.68	0.78
	Feb. 26	11	0.80	0.86	0.86	0.84	0.08	---	---	---	----	1.60	0.52
	Mar. 8	11	0.54	0.79	0.54	0.62	0.06	---	---	---	----	0.75	0.83
	Mar. 18	10	0.94	1.18	1.47	1.20	0.12	---	---	---	----	1.65	0.73
	Mar. 31	13	1.81	1.32	1.45	1.53	0.12	---	---	---	----	1.81	0.85
	Apr. 12	12	1.92	2.04	1.98	1.98	0.16	---	---	---	----	2.43	0.81
	Apr. 18	6	1.04	1.22	1.16	1.14	0.19	---	---	---	----	1.62	0.70
	Apr. 29	11	1.68	1.72	1.78	1.73	0.16	446	308	138	0.0125	1.60	1.08

TABLE A-7 (continued)

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches: Tank 1	Tank 2	Tank 3	Mean	Mean daily	Atmometer evaporation, in milliliters: Black	White	Eb-w	ET/ /Eb-w	Pan evaporation Ep, in inches	ET/ /Ep
CENTRAL VALLEY (continued)													
SACRAMENTO RIVER BASIN VALLEY FLOOR (continued)													
Ryegrass (continued) 1960													
Davis Campbell h/i/ (continued)	May 10	11	2.35	2.19	2.23	2.26	0.21	604	421	183	0.0123	2.50	0.90
	May 26	16	3.69	3.71	3.62	3.67	0.23	1169	899	270	0.0136	4.95	0.74
	June 1	6	1.65	1.47	1.59	1.57	0.26	509	392	117	0.0135	1.75	0.91
	June 9	8	1.42	1.29	1.30	1.34	0.17	788	634	154	0.0087	3.60	0.37
	June 13	4	0.95	0.89	1.29	1.04	0.26	335	250	85	0.0122	1.34	0.78
	June 22	9	1.50	1.29	1.12	1.30	0.14	1047	864	183	0.0071	3.95	0.33
	July 1	9	2.05	2.40	2.11	2.19	0.24	717	532	185	0.0117	3.13	0.70
	July 6	5	1.29	1.22	1.35	1.29	0.26	423	318	105	0.0123	1.78	0.72
	July 8	2	0.61	0.55	0.61	0.59	0.30	163	123	40	0.0148	0.72	0.82
	July 12	4	0.74	0.80	0.61	0.72	0.18	338	250	88	0.0082	1.46	0.49
	July 19	7	1.64	1.64	1.67	1.65	0.24	633	476	157	0.0105	2.48	0.67
LAHONTAN													
LASSEN-ALPINE MOUNTAIN VALLEYS													
Pasture 1957													
Coleville 2W g/h/	May 27	-	----	----	----	----	----	---	---	---	----	----	----
	June 3	7	1.34	----	----	----	0.19	---	---	---	----	1.38	0.97
	June 6	3	0.73	----	----	----	0.24	---	---	---	----	0.79	0.92
	June 10	4	0.95	----	----	----	0.24	---	---	---	----	0.75	1.27
	June 17	7	1.34	----	----	----	0.19	502	365	137	0.0098	1.63	0.82
	June 24	7	1.93	----	----	----	0.28	569	415	154	0.0125	2.29	0.84
	June 30	6	1.96	----	----	----	0.33	542	399	143	0.0137	1.85	1.06
	July 8	8	2.27	----	----	----	0.28	639	491	148	0.0153	2.22	1.02
	July 16	8	2.50	----	----	----	0.31	693	527	166	0.0151	2.46	1.02
	July 29	13	3.58	----	----	----	0.28	995	760	235	0.0152	3.70	0.97
	Aug. 1	3	0.77	----	----	----	0.26	277	225	52	0.0148	0.95	0.81

EVAPOTRANSPIROMETER MEASUREMENTS AND RELATED DATA
FOR HIGH WATER TABLE PASTURE AND IRRIGATED RYEGRASS

Area, crop, and station name	Period ending	Number of days	Evapotranspiration (ET) for period of measurement, in inches					Atmometer evaporation, in milliliters			ET/ /Eb-w	Pan evaporation Ep, in inches	ET/ /Ep
			Tank 1	Tank 2	Tank 3	Mean	Mean daily	Black	White	Eb-w			
						LAHONTAN							
LASSEN-ALPINE MOUNTAIN VALLEYS													
Pasture (continued)	1957												
Coleville 2W 9/4/ (continued)	Aug. 5	4	1.25	----	----	----	0.31	437	346	91	0.0136	1.51	0.83
	Aug. 12	7	1.88	----	----	----	0.27	532	392	140	0.0134	1.94	0.97
	Aug. 19	7	1.78	----	----	----	0.25	587	453	134	0.0133	2.11	0.84
	Aug. 26	7	1.75	----	----	----	0.25	635	499	136	0.0129	2.22	0.79
	Aug. 31	5	1.10	----	----	----	0.22	388	306	82	0.0134	1.31	0.84
	Sept. 2	2	0.21	----	----	----	0.10	118	86	32	0.0066	0.41	0.51
	Sept. 9	7	1.09	----	----	----	0.16	512	386	126	0.0086	1.72	0.63
	Sept. 13	4	0.71	----	----	----	0.18	202	152	50	0.0142	0.70	1.01
	Sept. 16	3	0.50	----	----	----	0.17	187	140	47	0.0106	0.64	0.78
	Sept. 23	7	0.88	----	----	----	0.13	345	241	104	0.0085	1.16	0.76

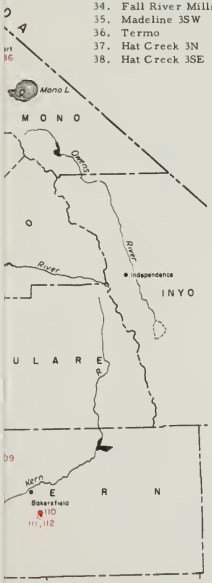
a - Ground cover 100 percent May through September, 40 - 100 percent during April, and 0 - 40 percent November and December.
b - High water table evapotranspirometer with water stage recorders on supply and outflow tanks. Elevation of water table in tanks 6 - 8 inches below ground surface.
c - Included in following measurement.
d - Estimated value. Estimate based on U. S. Weather Bureau pan evaporation.
e - Interpolated value from mean daily rate.
f - Atmometer values accumulated from May 23.
g - Coefficients derived from a measured period plus a short period of estimated evapotranspiration.
h - Ground cover 100 percent for all periods of measurement.
i - Weighing tanks.
j - Atmometer values obtained from U. C. Campbell Tract Climatic Station.
k - Estimated value based on U. S. Weather Bureau pan evaporation. Evapotranspiration for these periods were estimated because reliable measurements were not available on the amount of water that entered each evapotranspirometer from sprinkler irrigations.
l - Tank 1 values were not used in calculating the mean. The grass in this evapotranspirometer was allowed to grow to a considerable height to determine effect thereof on evapotranspiration rate.
m Heavy rainfall caused overflow of tanks.
n - Evapotranspiration value of the 20-foot Davis evapotranspirometer was used because heavy rainfall during this period overflowed from the evapotranspirometers and the amount of rainfall that remained in the evapotranspirometers could not be determined.
o - ET measured as water supply to one evapotranspirometer tank. Water level in tank automatically adjusted to reflect a one- to three-foot variable water table elevation of surrounding area.

AGROCLIMATIC STATIONS

ACTIVE-1960

ACTIVE-PRE 1960

1. Macdoel F. S.
2. Montague 3NE
3. Yreka 1NE
4. Davis Creek 4WNW
5. Grenada 6E
6. Fort Jones R. S.
7. Gazelle 1NNE
8. Gazelle 3NNW
9. Big Sage Reservoir
10. Cedarville Chevron
11. Cedarville 2E
12. Cedarville 1E
13. Alturas Park Avenue
14. Alturas Dorris Ranch
15. Canby Ohm
16. Canby R. S.
17. Canby 11SW
18. Callahan Towne Ranch
19. Mt. Shasta City W.B.
20. Likely Williams Ranch
21. Likely 4N
22. Adin Harper
23. Adin R.S.
24. West Valley Reservoir
25. Lookout 1S
26. Lookout Hunt
27. Bieber 4E
28. Bieber S.C.S.
29. McArthur 2E
30. Pittville 1S
31. Glenburn DWR
32. Fall River Mills 4NW
33. Fall River Mills R.S.
34. Fall River Mills Intake
35. Madeline 3SW
36. Termo
37. Hat Creek 3N
38. Hat Creek 3SE
39. Bella Vista 4NE
40. Eagle Lake Stone Ranch
41. Hayfork R. S.
42. Redding R. S.
43. Redding Stayer
44. Redding 6SE
45. Redding A. P.
46. Anderson 2E
47. Anderson 3E
48. Anderson 4E
49. Leavitt Lake
50. Standish 4NW
51. Standish 1NW
52. Red Bluff 3E
53. Red Bluff Cone Ranch
54. Corning 3NW
55. Corning 3NE
56. Corning Jobe
57. Vina Beck
58. Quincy R. S.
59. Newville
60. Loyalton 5W
61. Loyalton 7N
62. Hamilton City
63. Mills Orchard
64. Oroville Agric. Comm.
65. Richvale 1E
66. Sacramento Refuge
67. Palermo 3SW
68. Pennington 3NW
69. Live Oak 3SE
70. Loma Rica
71. Browns Valley 3NE
72. Penn Valley
73. Tahoe
74. Yuba City
75. Yuba City 9W
76. Arbuckle 1S
77. Lincoln Vineyard
78. Auburn Mt. Vernon
79. Gold Hill Doty Flat
80. Rocklin Igarashi
81. Woodfords
82. Davis Campbell #1
83. Davis Campbell #2
84. Coleville 2W
85. Elk Grove 4NW
86. Bridgeport DWR
87. Thornton 2S
88. Twitchell Island
89. Lodi 3SW
90. Lodi 3S
91. Stockton 8S
92. Stockton 9S
93. El Solyo Ranch
94. Vernalis 3SE
95. Ceres 3E
96. Atwater 1N
97. Newman 1SE
98. Merced 5SE
99. Berenda 2N
100. Los Banos 3S
101. Los Banos Equipment Yard
102. Los Banos 8SE
103. Kerman 2ESE
104. Fresno Kearney Pa.k
105. Mendota Murietta Ranch
106. Panoche Junction
107. Kingsburg 5S #1
108. Kingsburg 5S #2
109. Shafter 2NW
110. Arvin Frick
111. Arvin Jewett #1
112. Arvin Jewett #2



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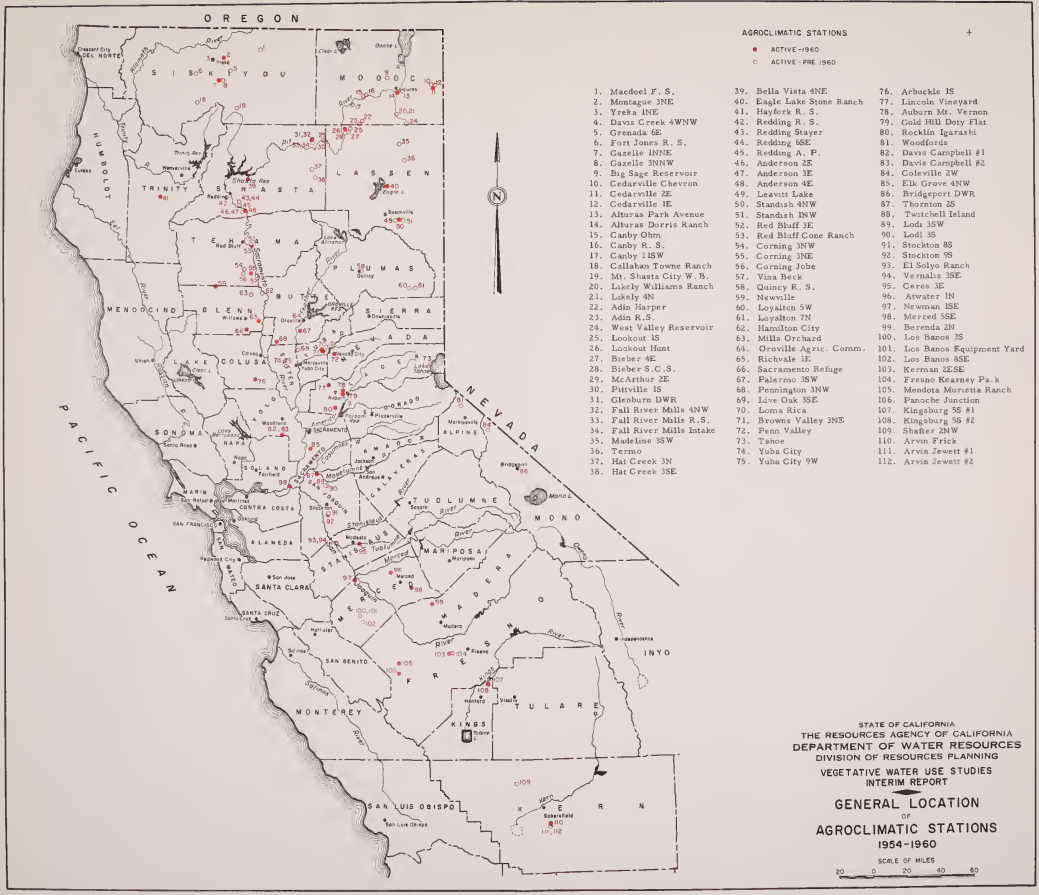
DIVISION OF RESOURCES PLANNING

VEGETATIVE WATER USE STUDIES
INTERIM REPORT

GENERAL LOCATION
OF
AGROCLIMATIC STATIONS
1954-1960

SCALE OF MILES
20 0 20 40 60



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VEGETATIVE WATER USE STUDIES
INTERIM REPORT

GENERAL LOCATION OF AGROCLIMATIC STATIONS 1954-1960

SCALE OF MILES
20 0 20 40 60

EVAPOTRANSPIRATION STATIONS

- ● EVAPOTRANSPEROMETER - ACTIVE IN 1960
- ○ EVAPOTRANSPEROMETER - ACTIVE PRE 1960
- ▲ NEUTRON PROBE - ACTIVE IN 1960
- △ NEUTRON PROBE - ACTIVE PRE 1960
- ☐ GRAVIMETRIC - ACTIVE PRE 1960

1. Gazelle Dougherty #1
2. Gazelle Dougherty #2
3. Gazelle Dougherty #3
4. Canby Bushey
5. Alturas Dorris Ranch
6. Bieber 3E
7. Bieber Leonard
8. Pittville (AA)
9. McArthur (AB)
10. McArthur 1NE
11. McArthur Albaugh #1
12. McArthur Albaugh #2
13. Pittville 1S
14. Hat Creek Kern
15. Hat Creek Opdyke
16. Redding 6SE
17. Anderson 2N
18. Anderson 3E
19. Anderson Trisdale
20. Leavitt Lake
21. Mills Orchard
22. Coleville 2W
23. Davis Campbell
24. Arvin (CE)
25. Arvin (CC)
26. Arvin (CB)
27. Arvin (CF)
28. Arvin (CD)
29. Arvin Jewett
30. Arvin Jewett #2
31. Arvin Jewett #3

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VEGETATIVE WATER USE STUDIES
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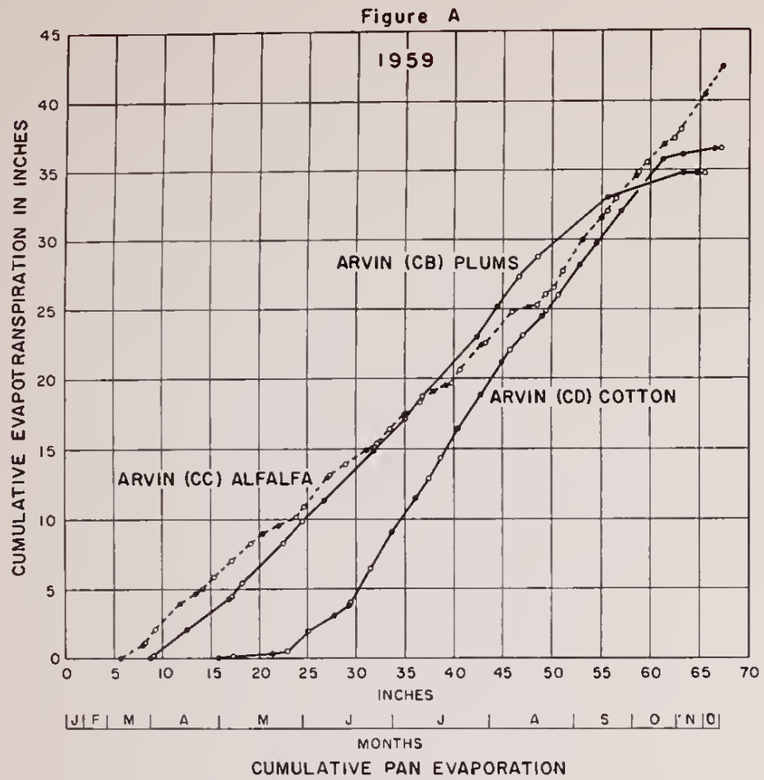
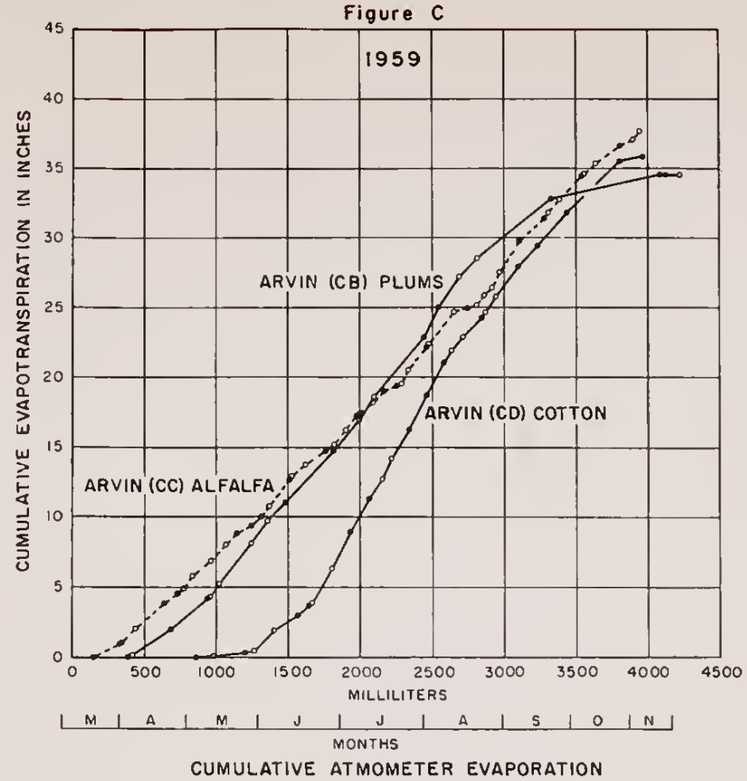
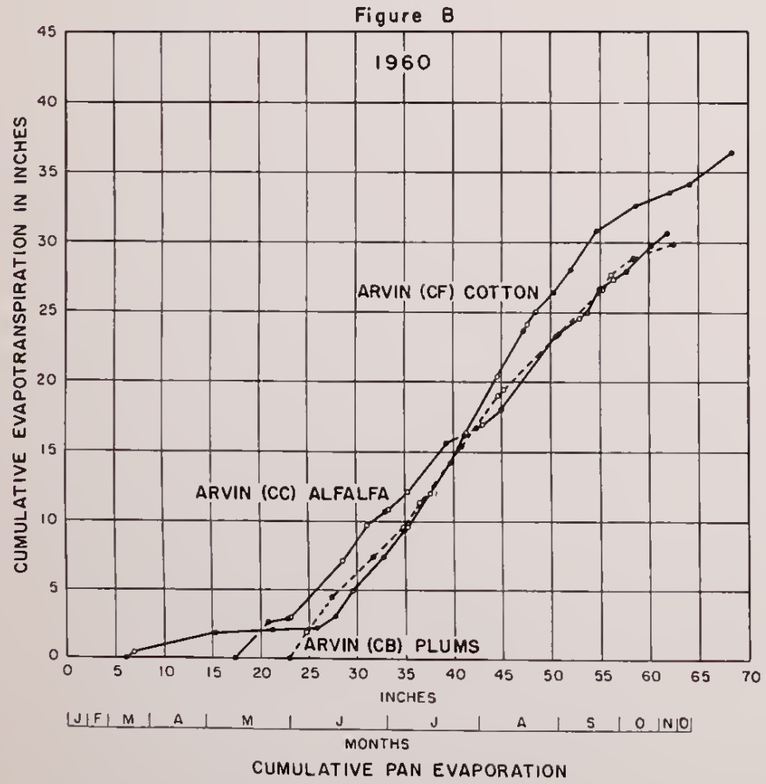
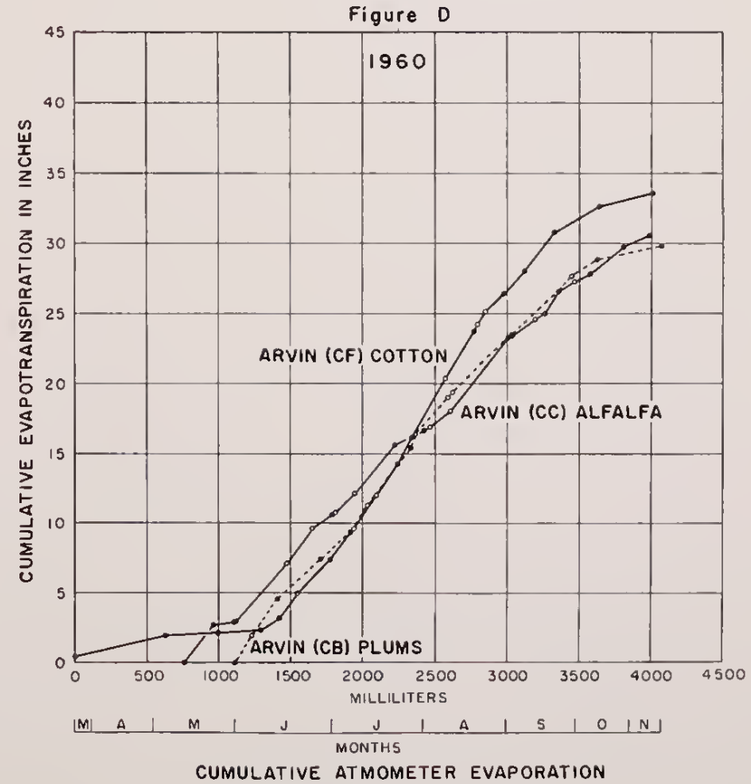
GENERAL LOCATION
OF
EVAPOTRANSPIRATION STATIONS
1955-1960

SCALE OF MILES
20 0 20 40 60









NOTE: SLOPE DIFFERENCES ARE DUE TO PLANT CONDITIONS, SOIL MOISTURE AVAILABILITY, AND OTHER FACTORS
CODE: • EVAPOTRANSPIRATION MEASURED
○ EVAPOTRANSPIRATION ESTIMATED

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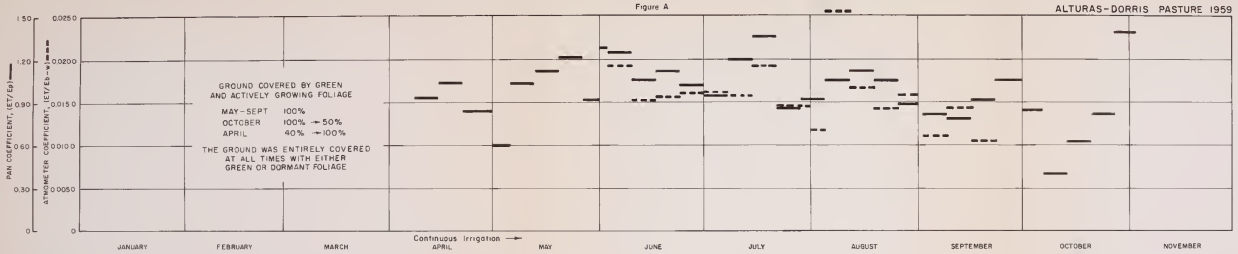
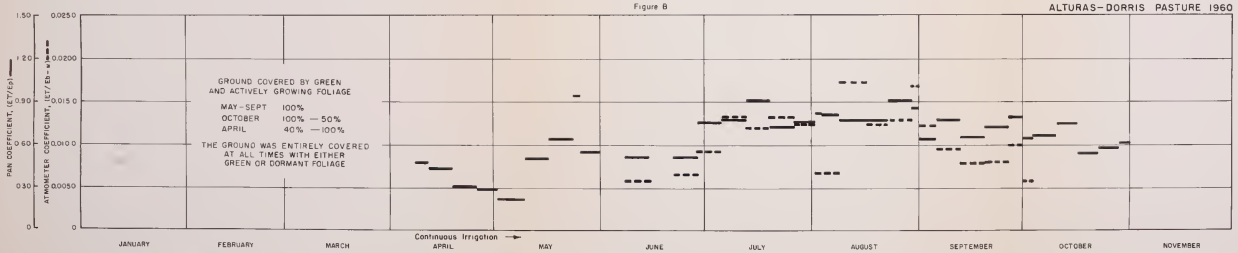
VEGETATIVE WATER USE STUDIES
INTERIM REPORT

COMPARISON OF EVAPOTRANSPIRATION CURVES OF DIFFERENT CROPS GROWN AT THE SAME LOCATION ON THE SAME SOIL SERIES

OCTOBER 1962





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VEGETATIVE WATER USE STUDIES
INTERIM REPORT

VARIATION OF PAN AND ATMOMETER COEFFICIENTS
FOR
INDIVIDUAL PERIODS OF MEASUREMENTS
WITH RESPECT TO
CROP GROUND COVER, AVAILABLE SOIL MOISTURE AND OTHER PLANT CONDITIONS
OCTOBER 1962

Figure C

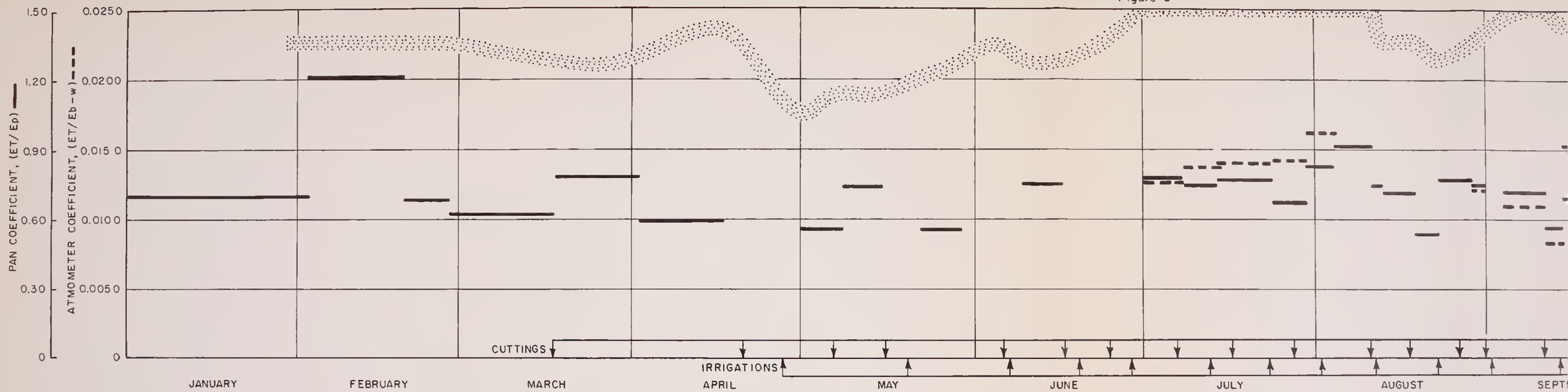
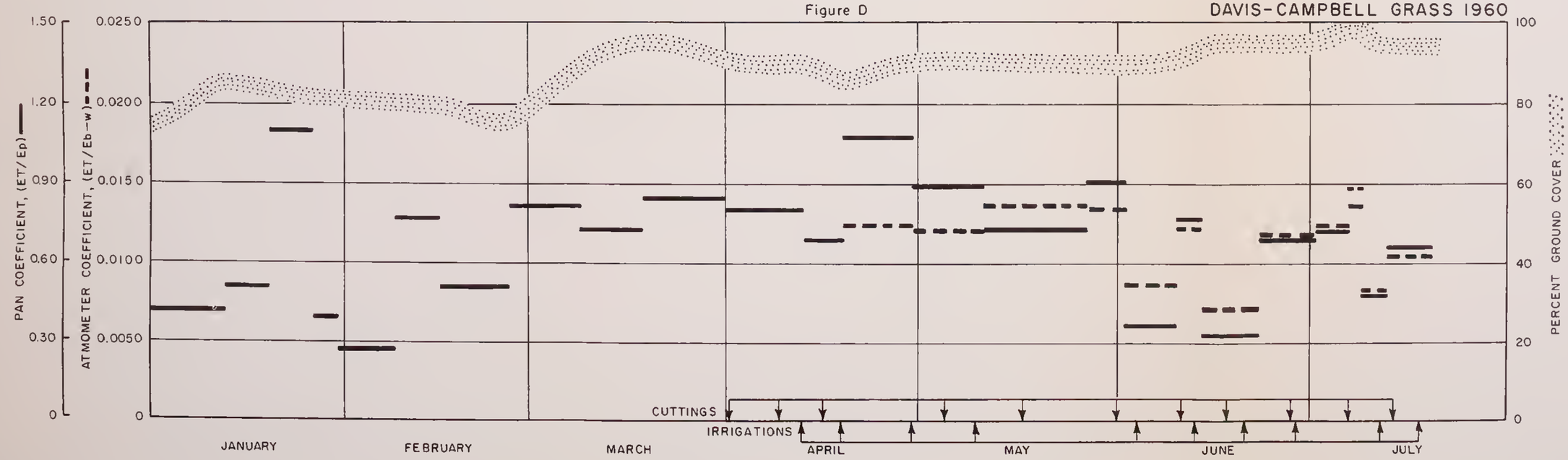


Figure D

DAVIS-CAMPBELL GRASS 1960



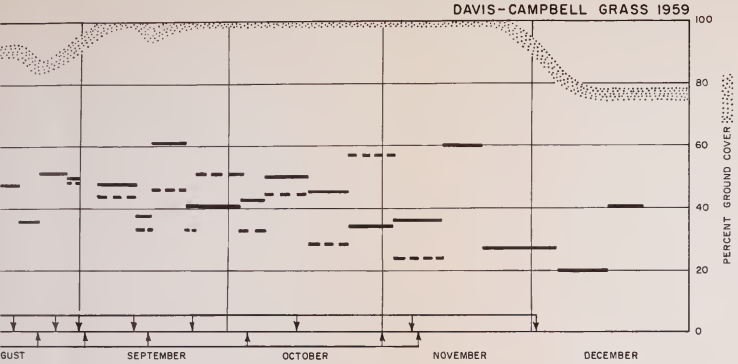
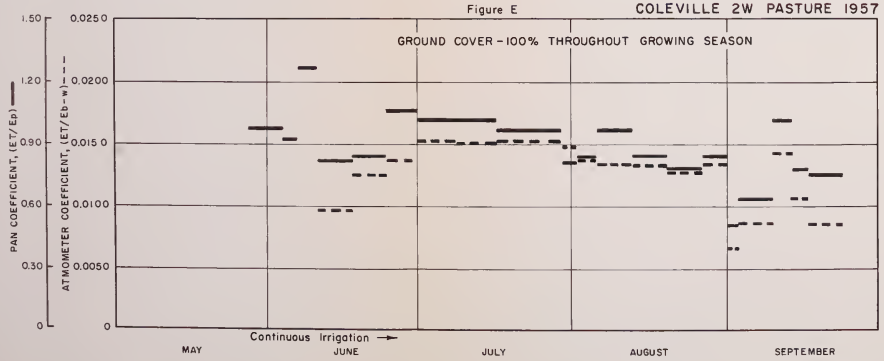


Figure E



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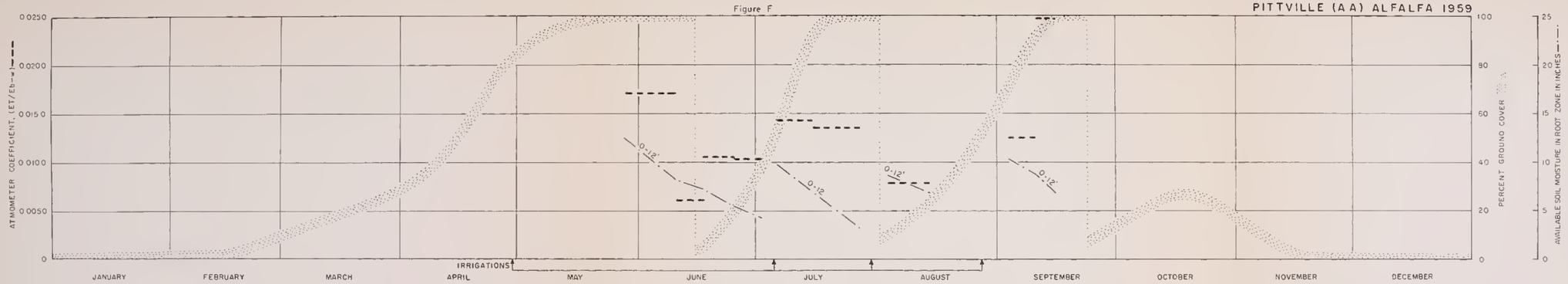
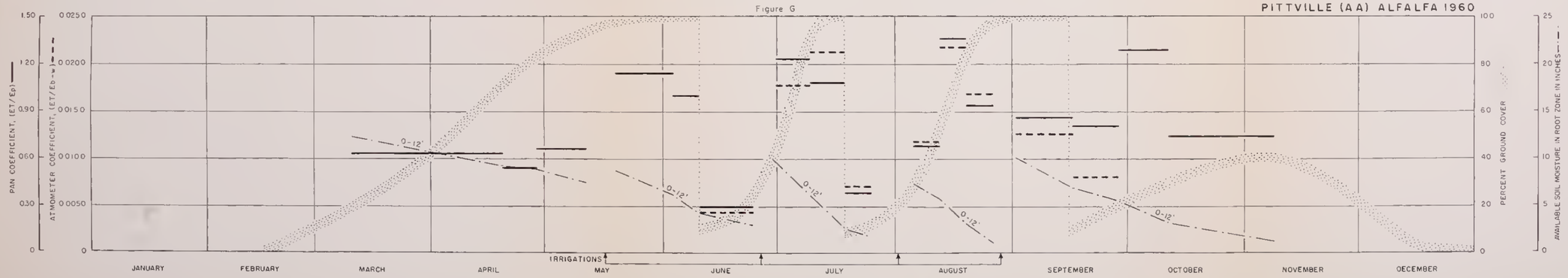
OCTOBER 1962





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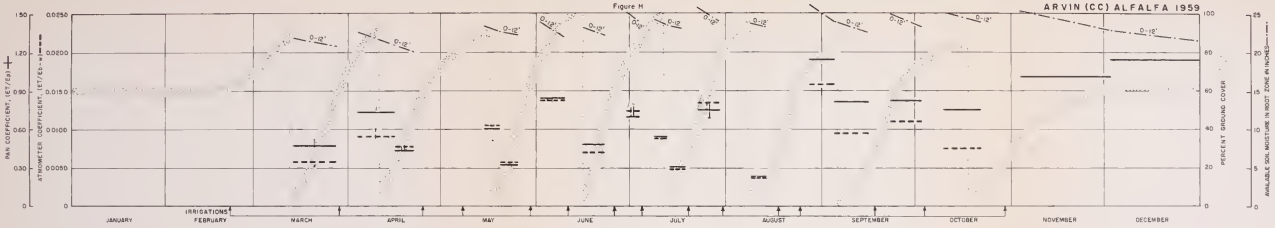

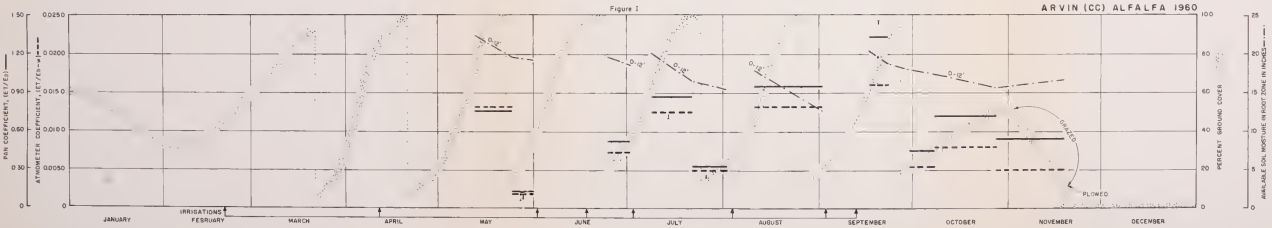

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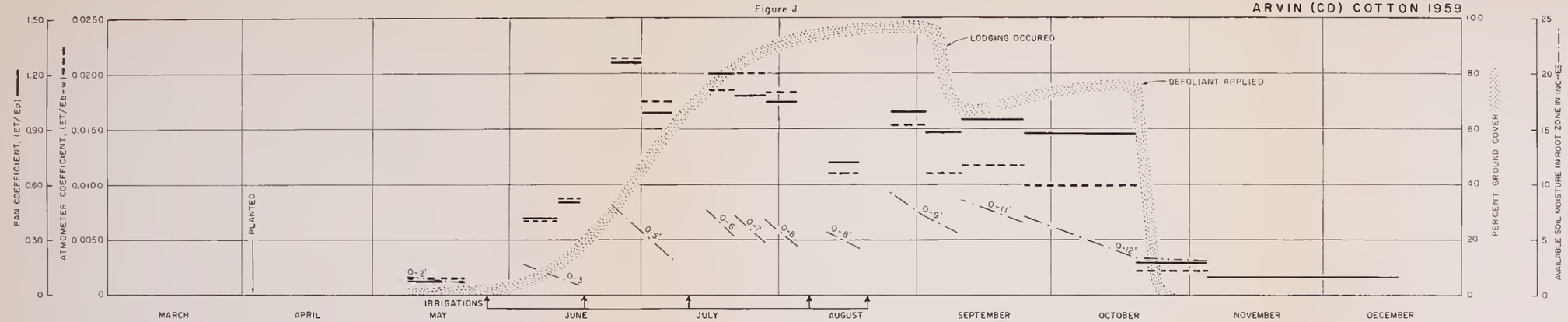

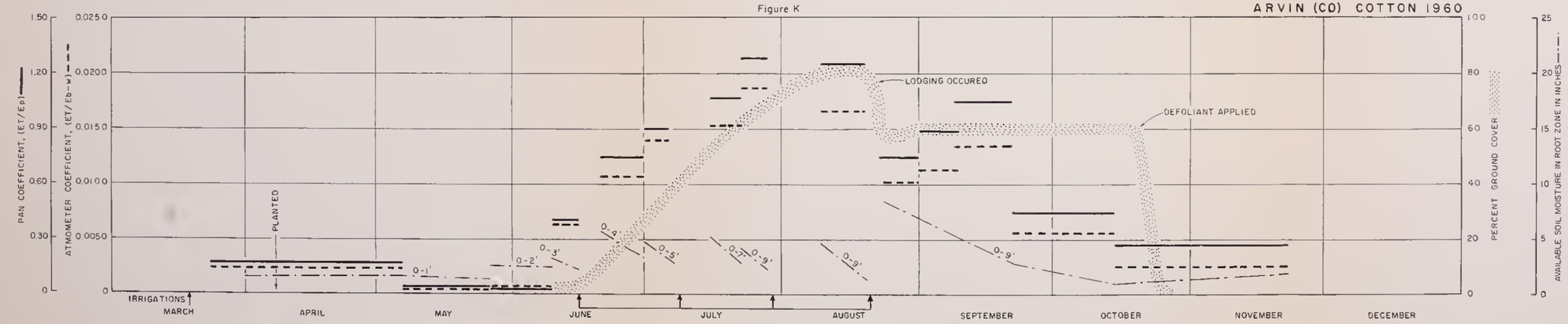

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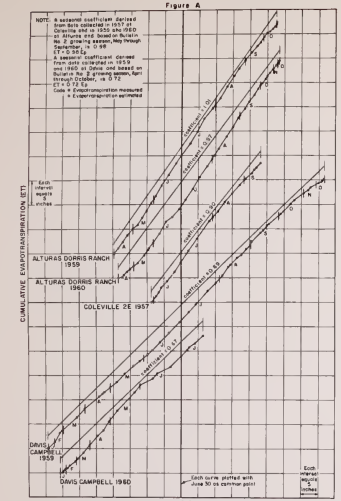
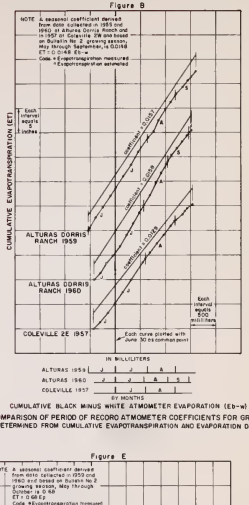
Figure A



CUMULATIVE EVAPORATION FROM CLASS A PANS (Ep)

COMPARISON OF PERIOD OF RECORD PAN COEFFICIENTS FOR GRASS
DETERMINED FROM CUMULATIVE EVAPOTRANSPIRATION AND EVAPORATION DATA

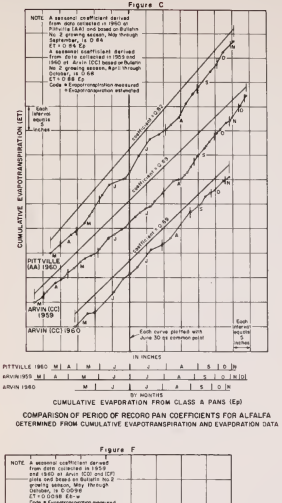
Figure B



CUMULATIVE BLACK MINUS WHITE ATMOMETER EVAPORATION (Eb-w)

COMPARISON OF PERIOD OF RECORD ATMOMETER COEFFICIENTS FOR GRASS
DETERMINED FROM CUMULATIVE EVAPOTRANSPIRATION AND EVAPORATION DATA

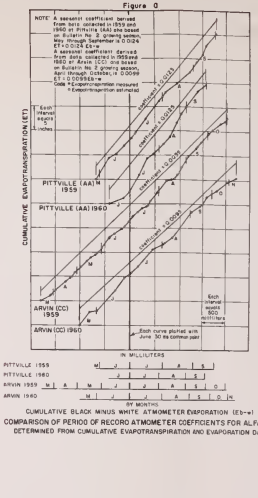
Figure C



CUMULATIVE EVAPORATION FROM CLASS A PANS (Ep)

COMPARISON OF PERIOD OF RECORD PAN COEFFICIENTS FOR ALFALFA
DETERMINED FROM CUMULATIVE EVAPOTRANSPIRATION AND EVAPORATION DATA

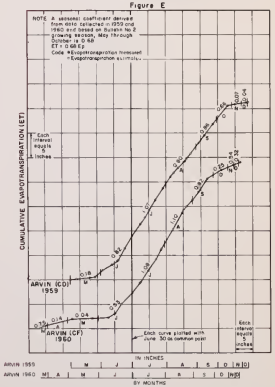
Figure D



CUMULATIVE BLACK MINUS WHITE ATMOMETER EVAPORATION (Eb-w)

COMPARISON OF PERIOD OF RECORD ATMOMETER COEFFICIENTS FOR ALFALFA
DETERMINED FROM CUMULATIVE EVAPOTRANSPIRATION AND EVAPORATION DATA

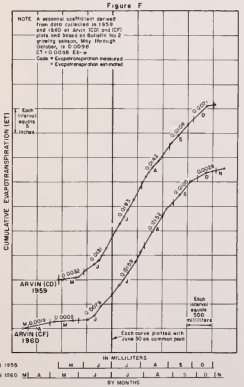
Figure E



CUMULATIVE EVAPORATION FROM CLASS A PANS (Ep)

COMPARISON OF MONTHLY PAN COEFFICIENTS FOR COTTON
DETERMINED FROM CUMULATIVE EVAPOTRANSPIRATION AND EVAPORATION DATA

Figure F



CUMULATIVE BLACK MINUS WHITE ATMOMETER EVAPORATION (Eb-w)

COMPARISON OF MONTHLY ATMOMETER COEFFICIENTS FOR COTTON
DETERMINED FROM CUMULATIVE EVAPOTRANSPIRATION AND EVAPORATION DATA

NOTE SLOPE DIFFERENCES ARE DUE TO PLANT CONDITIONS, SOIL MOISTURE AVAILABILITY, AND OTHER FACTORS

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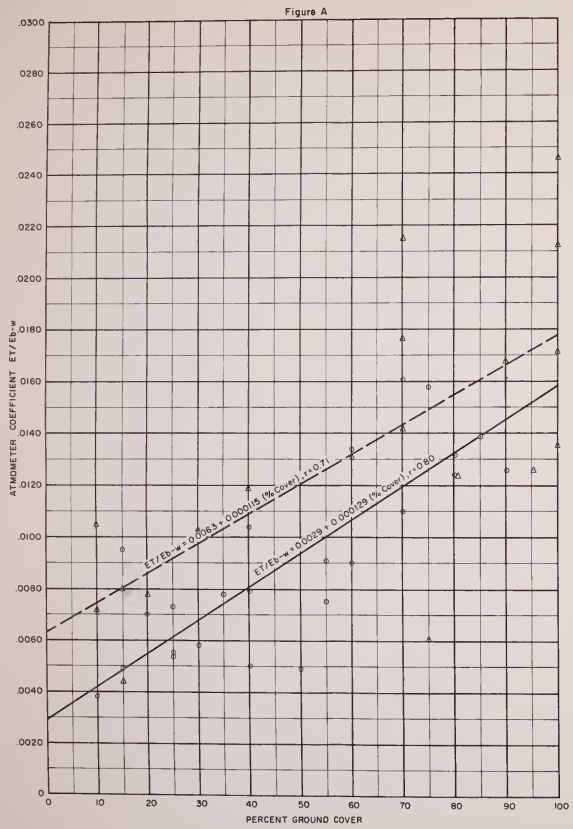

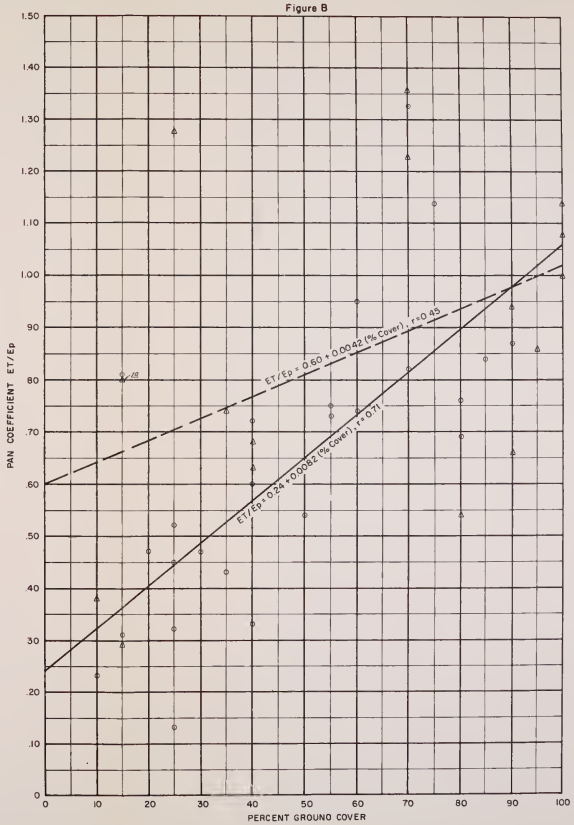

LEGEND

ARVIN (CC) ALFALFA

PITTVILLE (AA) ALFALFA

SOMEWHAT HIGHER THAN WOULD BE EXPECTED DUE TO EVAPORATION OF pan

NOTE:
PERCENT GROUND COVER DATA TAKEN FROM TABULATION BASED ON CURVES DRAWN USING DATA IN APPENDIX TABLE OF NEUTRON DATA

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RELATIONSHIP BETWEEN PAN AND ATMOMETER COEFFICIENTS FOR ALFALFA AND GROUND COVER

DATA ARE FOR 1959 AND 1960

EVAPOTRANSPIRATION STATIONS

- ● EVAPOTRANSPEROMETER - ACTIVE IN 1960
- ⊂ EVAPOTRANSPEROMETER - ACTIVE PRE 1960
- ▲ NEUTRON PROBE - ACTIVE IN 1960
- △ NEUTRON PROBE - ACTIVE PRE 1960
- ▭ GRAVIMETRIC - ACTIVE PRE 1960

1. Gazelle Dougherty #1
2. Gazelle Dougherty #2
3. Gazelle Dougherty #3
4. Canby Bushey
5. Alturas Dorris Ranch
6. Bieber 3E
7. Bieber Leonard
8. Pittville (AA)
9. McArthur (AB)
10. McArthur 1NE
11. McArthur Albaugh #1
12. McArthur Albaugh #2
13. Pittville 1S
14. Hat Creek Kern
15. Hat Creek Opdyke
16. Redding 6SE
17. Anderson 2N
18. Anderson 3E
19. Anderson Trisdale
20. Leavitt Lake
21. Mills Orchard
22. Coleville 2W
23. Davis Campbell
24. Arvin (CE)
25. Arvin (CC)
26. Arvin (CB)
27. Arvin (CF)
28. Arvin (CD)
29. Arvin Jewett
30. Arvin Jewett #2
31. Arvin Jewett #3

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GENERAL LOCATION OF EVAPOTRANSPIRATION STATIONS 1955-1960

SCALE OF MILES
20 0 20 40 60